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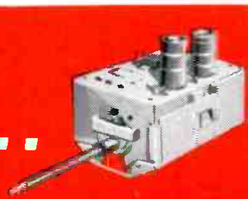

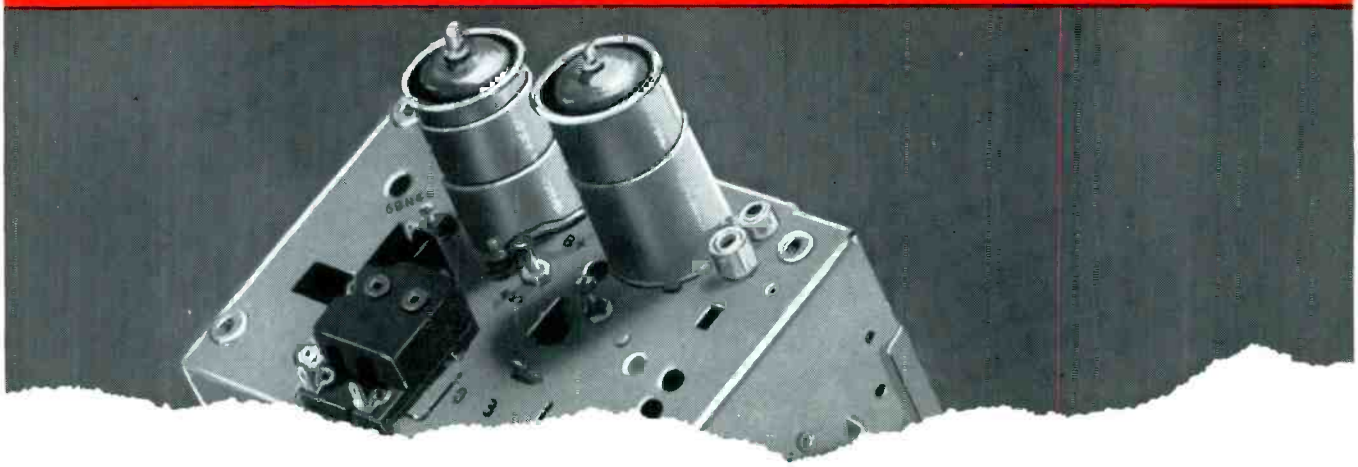

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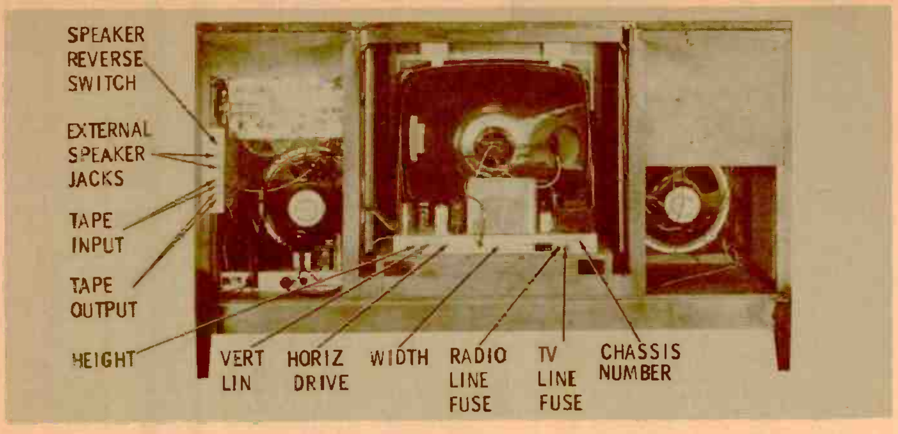
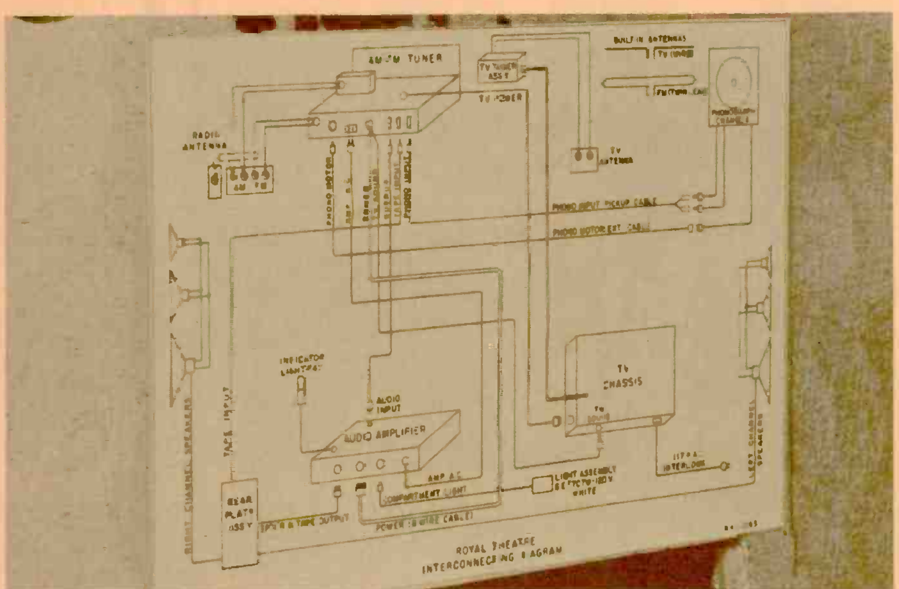
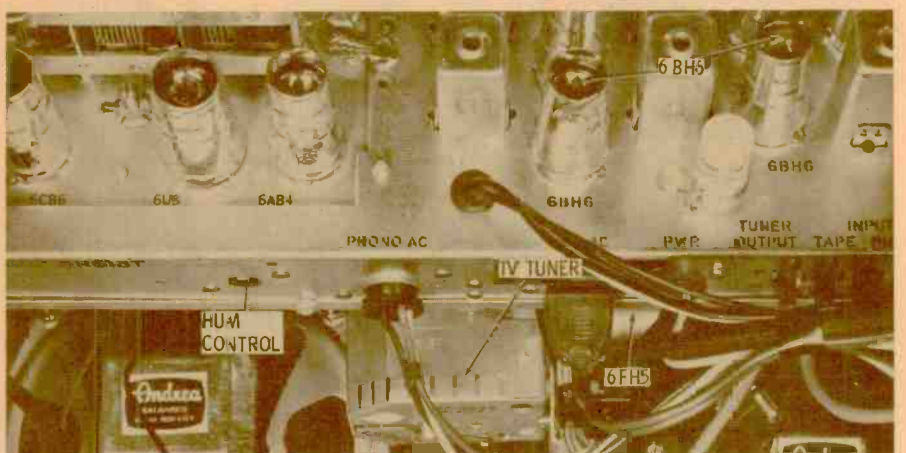
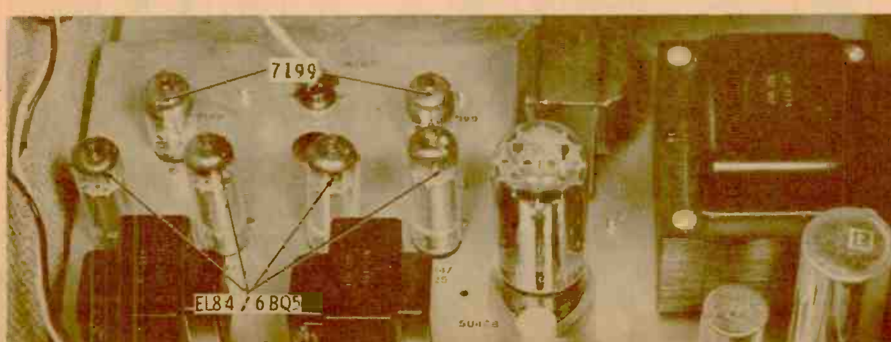








Andrea Model WFCO-VS 323-5 Chassis VS 323-5

The Andrea *Royal Theater* is a complete home entertainment center featuring a 23" TV, AM-FM radio (with provisions to receive simulcast transmissions), and four-speed stereo phono. A Garrard Model 210 changer is housed in the phono compartment at the left, and all operational controls are located under the right lid. Sliding doors cover the 23HP4 CRT, a 110° tube with a bonded safety shield.

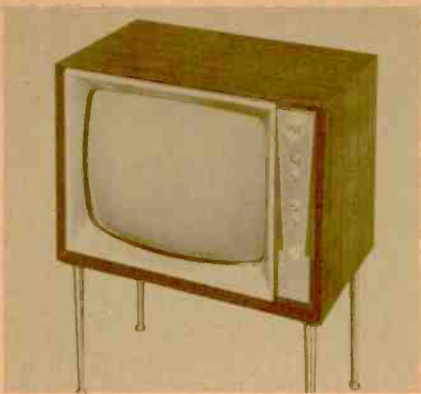
The four-section, hand-wired chassis incorporates a total of 38 tubes—17 of which are used in the TV circuits. The television sound signal is demodulated by a ratio detector using two diode sections of a 6T8, amplified by the triode section of the same tube, fed from there to both channels of the sound section in the AM-FM tuner, and finally applied to the audio power amplifier chassis. The AM-FM tuner also contains the off-on switch that controls the power relay for the TV, but if you jumper pins 2 and 3 of the tuner power plug, you can operate the TV chassis independently of the other sections.

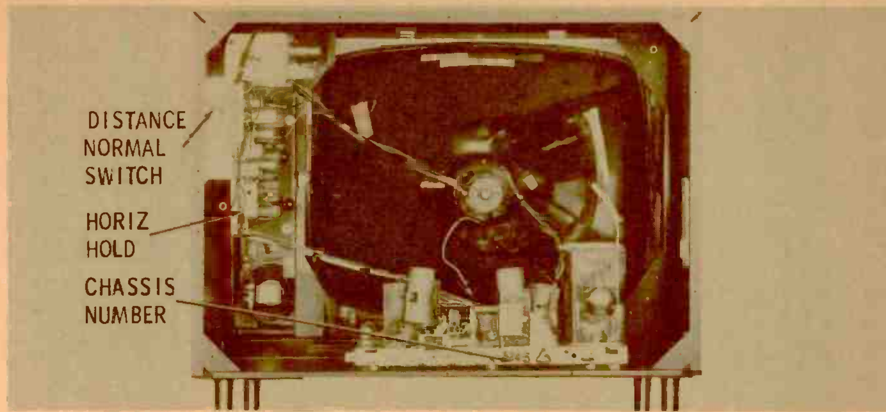
The AM-FM tuner obtains its power from the amplifier chassis. However, a 2½-amp slow-blow fuse on the rear apron of the TV chassis protects both the amplifier and AM-FM tuner. Another 2½-amp, slow-blow fuse is in series with the primary of the TV power transformer. In addition the sweep circuits are protected by a ¼-amp, slow-blow fuse located inside the high-voltage cage.

Although the interchassis wiring is rather complex, a diagram located on the left panel of the TV compartment makes it easy to trace the connections.

All sockets are identified by stamped labels to further simplify tracing cable connections. Notice that the TV tuner is fastened to the cabinet in front of the AM-FM tuner. Thus, the 6FH5 RF amplifier and 6CG8A mixer-oscillator tubes are rather difficult to reach. Although the tubes used in the TV are common types, the AM-FM tuner uses five 6BH6's in different RF and IF stages—an unfamiliar sight these days.

The 40-watt power amplifier incorporates a Type 7199 triode-pentode, driving a push-pull pair of EL84/6BQ5 output tubes in each sound channel.





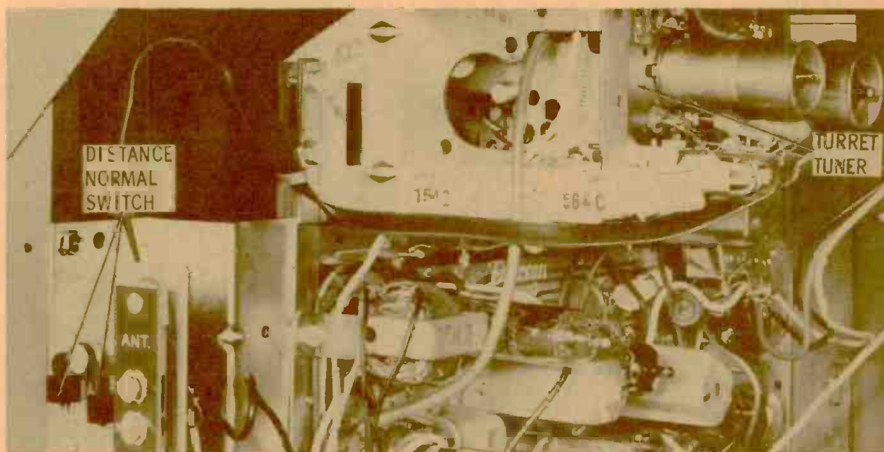
Emerson Model 1542 Chassis 120564C

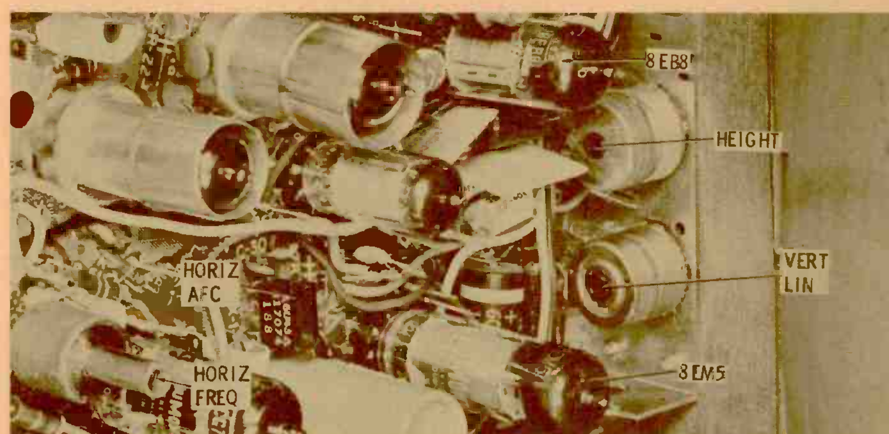
Although a table-model installation is shown, this type of chassis is also found in consoles and combinations. All models are equipped with a 92°, 23YP4 picture tube having a bonded safety shield. Operational controls are mounted in a row at the right side of the front panel, above the speaker. Just below the channel selector is the *Magic Memory* volume control—a conventional 1-megohm control with a push-push off-on switch.

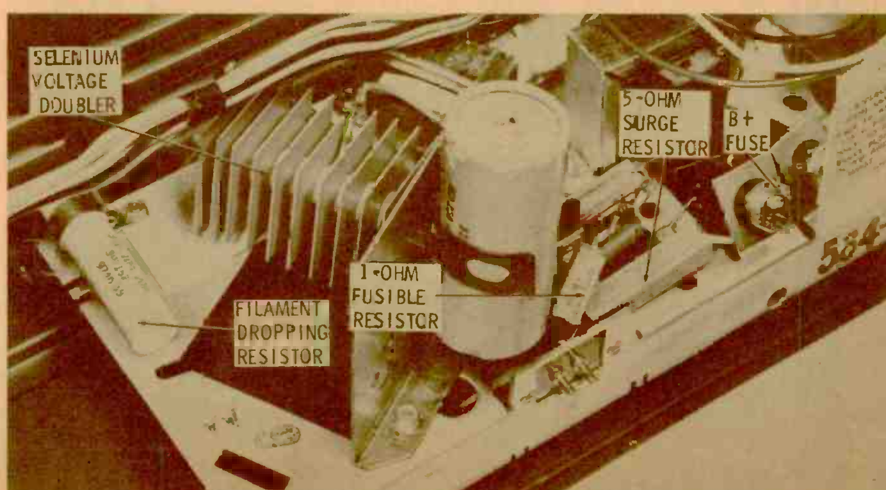
The chassis is made up of two separate lightweight pieces, with long interconnecting leads. The horizontal section, all hand-wired, contains the power-supply and horizontal-deflection circuits. The vertical section consists of a single printed board containing the remaining stages. A phenolic shaft extends through the back to provide adjustment of the horizontal hold.

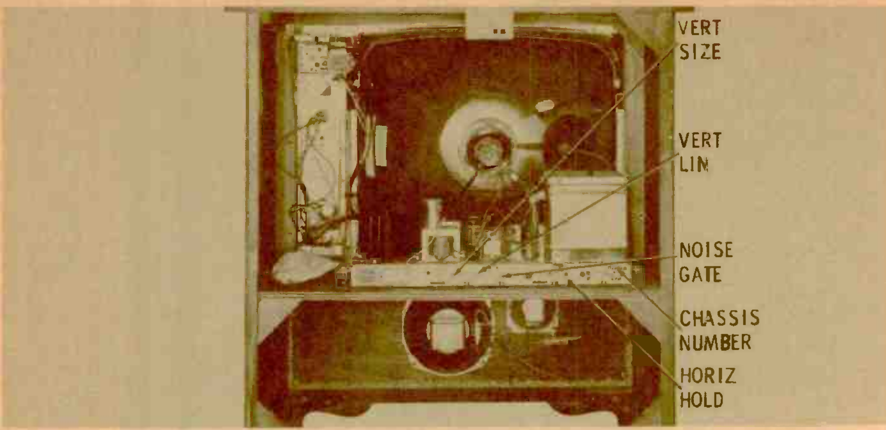
A pair of slide switches, "ganged" by means of a plastic rocker arm, function as a *distance-normal* switch to control the tuner-input signal and RF-AGC bias. The tuner is a small turret type. Individual-channel oscillator slugs are accessible from the front after removal of the channel-selector and fine-tuning knobs. However, a 1/8" alignment tool ground to only 3/32" wide must be used for making the adjustments, to prevent damage to the coil forms. The height and vertical linearity potentiometers are mounted behind the brightness and vertical hold controls. These screwdriver adjustments are accessible either from the front (through the hollow shafts of the operating controls) or from the back. Two relatively new tube types are used on this part of the chassis. They are the 8EB8 video output and vertical multivibrator, and the 8EM5 serving the output section of the combined vertical circuit. The dual selenium horizontal AFC diode, a common-cathode type, is soldered into place with long enough leads to permit attachment of a scope probe.

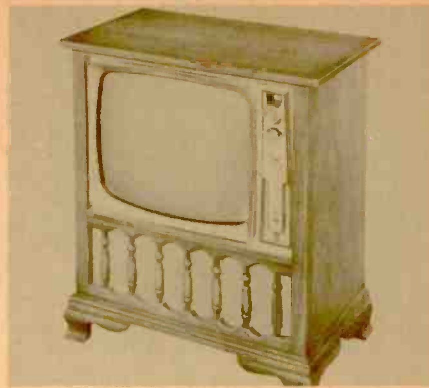
The voltage-doubler power supply of this series-string set is among the few now using a selenium rectifier stack. The B+ circuit is protected by both a 5-ohm, 10-watt surge resistor and a 1 6/10-amp, type-N fuse. A 1-ohm fusible resistor guards the series filament circuit and brings the voltage down to 95V AC as required by the tube complement of this set.

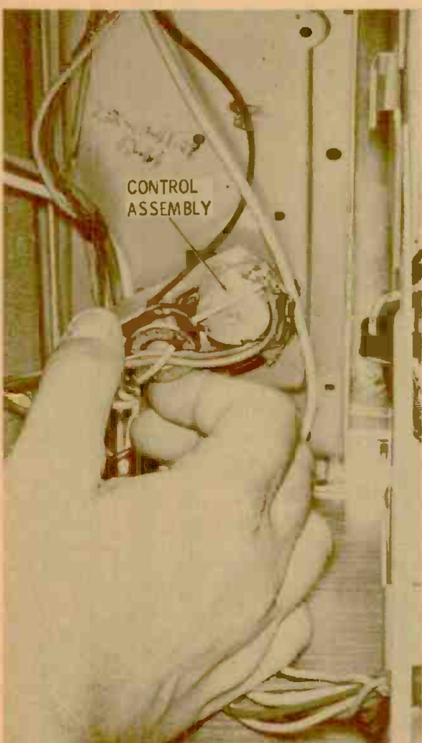


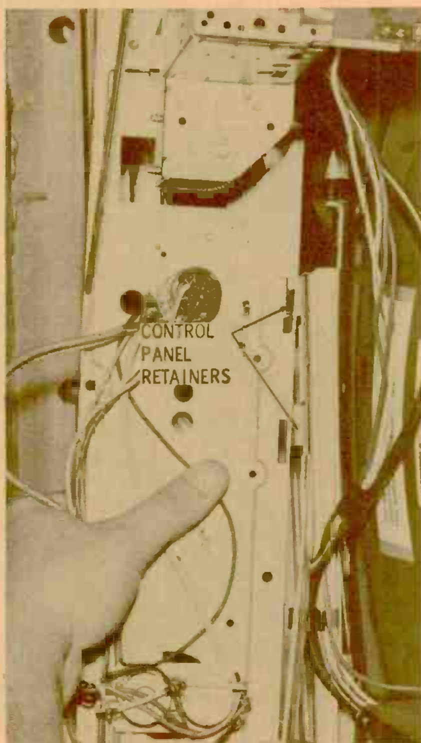


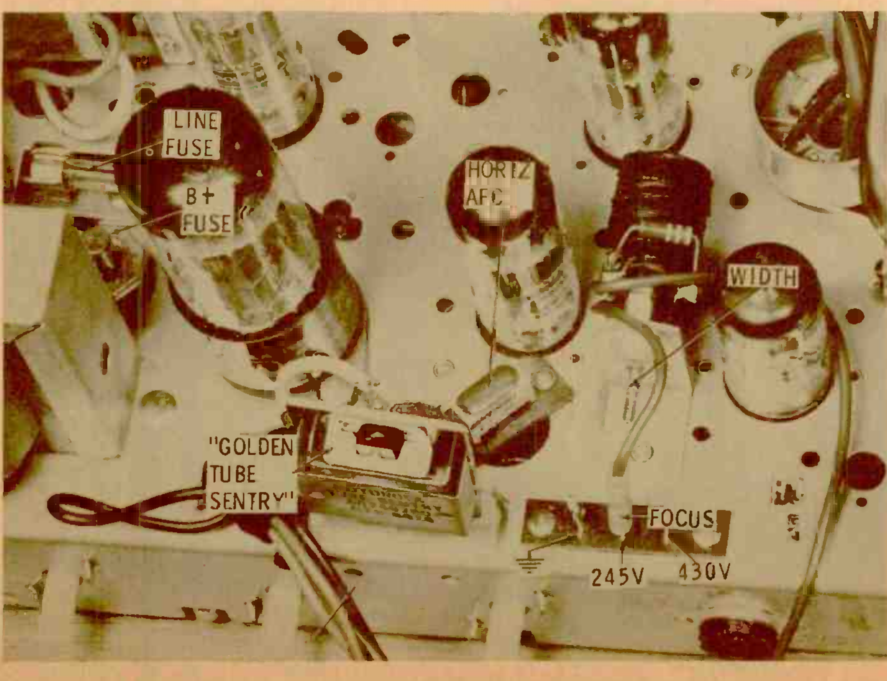












Motorola Model 23K40CW Chassis VTS-569

This is the *Dutchess County* from the *Drexel* line by Motorola. A 110°, 23GP4 picture tube with bonded safety shield is featured in the series. The control panel includes a preset fine-tuning adjustment, push-push off-on switch and volume control, brightness and vertical hold thumbwheel knobs, and a tone control.

Hand wiring is employed in the 19-tube horizontal chassis. Although the receiver is transformer-powered, it incorporates two pairs of 3-volt tubes—the first and second video IF, and the sync separator-AGC keyer and sound IF—with each pair series-connected across the filament transformer. A tube-placement chart glued on the back of the high-voltage cage points out these unusual filament connections. Both the CRT and the chassis can be pulled out as a single unit after four bolts have been removed from beneath the cabinet.

Before removing the chassis, the control panel must be unplugged or removed from the front of the cabinet. Four ¼" metal screws hold it in place. Once they are removed, the brightness and vertical hold control assembly must be rotated 90° counterclockwise so the thumbwheel knobs will clear the escutcheon.

After the control panel has been removed, it can be hooked onto two retainer ears on the side frame of the chassis for convenience in transport.

Circuit-protecting devices are extensively employed in this chassis. Two fuses are used; one is a 5-amp snap-in unit in series with the transformer primary, and the other is a ½-amp, type-N in series with B+. The *Golden Tube Sentry* is a thermal switch that keeps the B+ circuit open until the tube filaments have heated. In addition, a 1½" length of #26 copper wire is connected in series with the filament supply. A series-connected dual AFC diode sits immediately in front of the *Tube Sentry*. To the right of it is the width coil and focus terminal board. Three potentials are provided to obtain the best focus. A special ringing circuit connected to the focus lead develops a sine-wave voltage in the proper phase to apply maximum voltage to the focusing anode when the beam is at the sides of the screen.

RCA Victor Model 211CB412 Chassis CTC11A

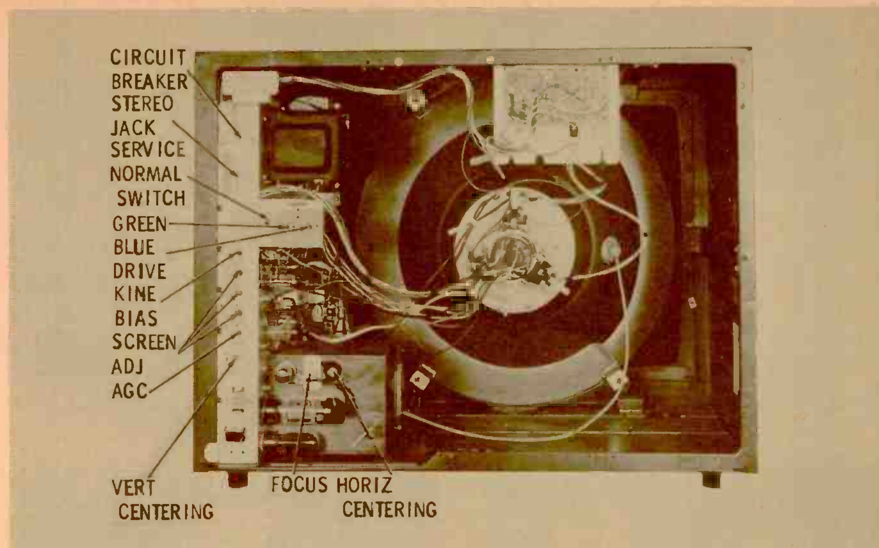
The nameplate *New Vista Color* identifies the latest RCA line of color receivers. Although all 48 models use a 6CW4 nuvistor as an RF amplifier, this isn't the biggest news concerning these sets. Their most significant new feature is an improved type of tricolor picture tube, the 21FBP22. Higher-efficiency phosphors give a brighter picture; furthermore, the three new phosphors are approximately equal in efficiency. (In earlier tubes, the red phosphor was noticeably less efficient than the other two.)

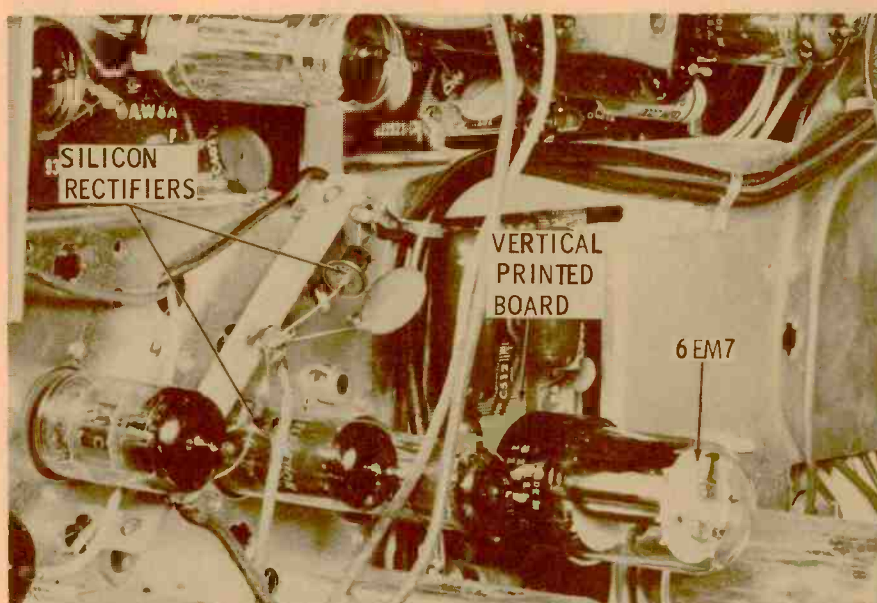
Front-panel controls and safety-glass mounting are the same as in earlier models, and the chassis itself differs only slightly from the CTC10. Rear-apron mounted setup adjustments are the same as outlined in the February, 1961 *Previews of New Sets,* and carry identical labels. However, there is something new on the rear apron—a circuit breaker that takes the place of the 3½-amp fuse protecting the B+ supply.

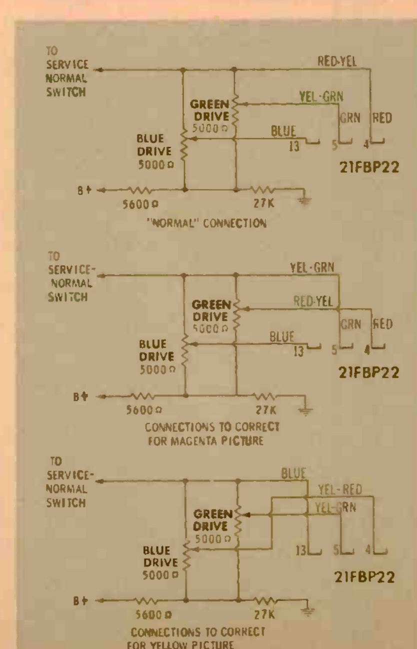
A pair of silicon rectifiers are used in a full-wave voltage doubler to supply 390 volts B+ at 430 ma. Although the 6EM7 combined vertical multivibrator and output circuit contains only minor electrical variations from the corresponding section of the CTC10, this circuit has been changed back to printed wiring.

One of the most obvious differences between this and previous models is the absence of the plastic boot covering the CRT bell. Instead of using the old-style high-voltage connector and series resistor, the new CRT has a button-type anode connector, like a black-and-white tube.

The CRT cathode circuitry is also affected by the change in picture-tube type. In earlier tubes, the red phosphor was always the weakest; in the 21FBP22, however, the phosphor efficiencies are so nearly identical that normal production variations among individual tubes can alter the *relative* strength of the three phosphors. As a result, a certain number of the new tubes are not able to reproduce a perfectly white background when used in the "normal" circuit (shown at the top of the accompanying schematic). Instead, the background will have a magenta or yellow tint. To take care of these cases, the cathode circuit can be altered as shown in the other two sections of the schematic.







See PHOTOFACT Set 497, Folder 1

Mfr: Magnavox **Chassis No. 32 Series**

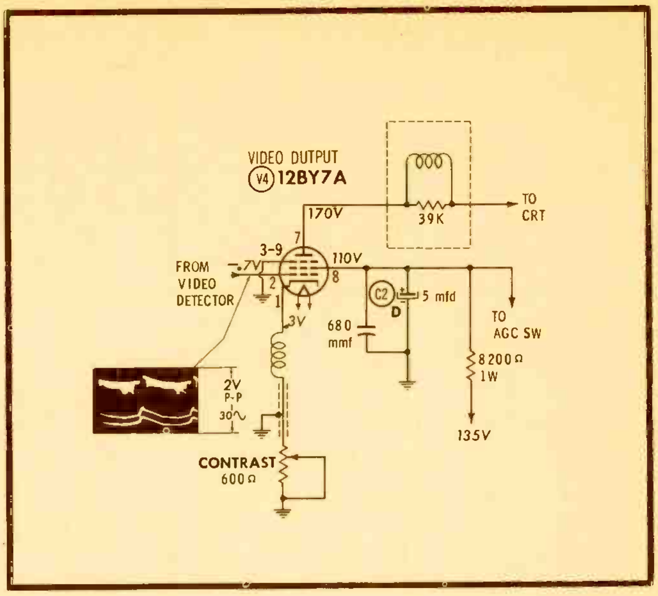
Card No: MA 32-1

Section Affected: Pix.

Symptoms: Insufficient picture contrast.

Cause: Video amplifier screen-bypass capacitor leaky.

What To Do: Replace C2D with 5-mfd, 350V unit.



Mfr: Magnavox **Chassis No. 32 Series**

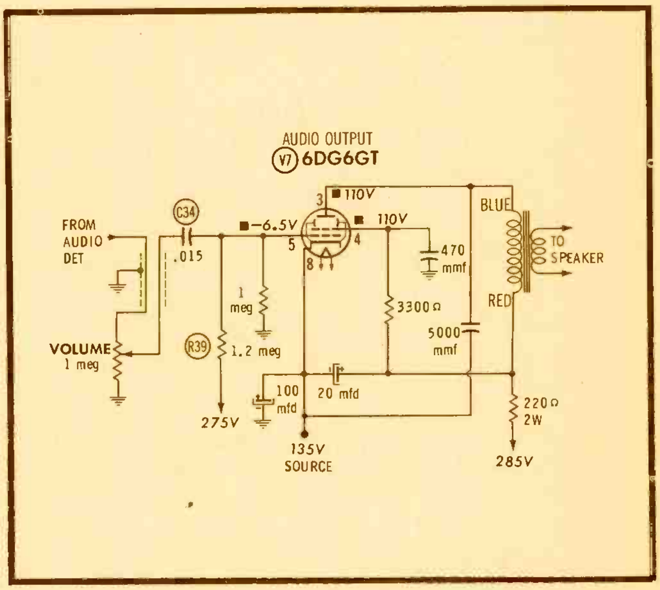
Card No: MA 32-2

Section Affected: Pix.

Symptoms: Adjustment of volume control changes picture contrast. Bias on grid (pin 5) of V7 varies as control is rotated.

Cause: Shorted capacitor in audio circuit.

What To Do: Replace C34 (.015 mfd); also check value of R39 (1.2 meg).



Mfr: Magnavox **Chassis No. 32 Series**

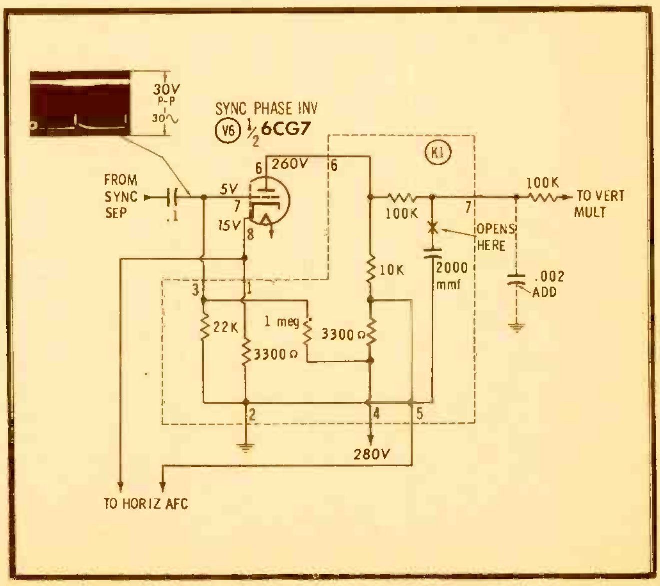
Card No: MA 32-3

Section Affected: Sync.

Symptoms: Unstable vertical sync.

Cause: Open capacitor section in printed integrator network K1.

What To Do: Add a .022-mfd, 400V capacitor from terminal 7 of K1 to ground.



See PHOTOFACT Set 497, Folder 1

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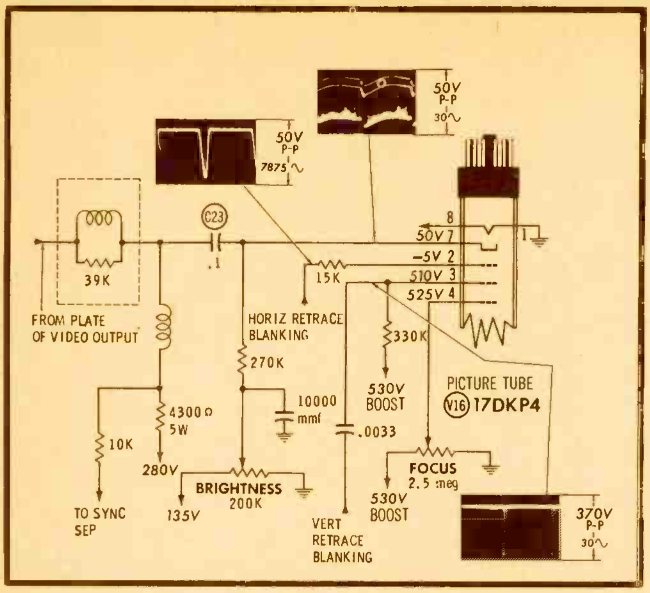
See PHOTOFACT Set 497, Folder 1



See PHOTOFACT Set 497, Folder 1

Mfr: Magnavox **Chassis No. 32 Series**

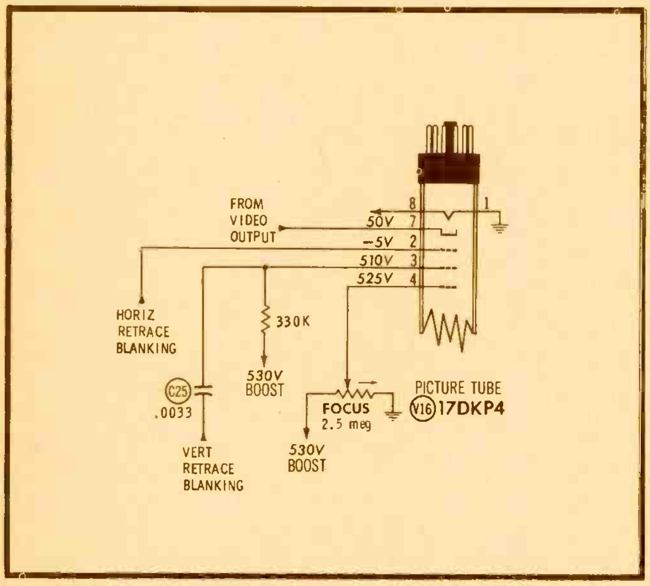
Card No: MA 32-4

Section Affected: Pix.

Symptoms: Insufficient brightness.

Cause: Leaky coupling capacitor in video amplifier circuit.

What To Do: Replace C23 (.1 mfd—400V).



Mfr: Magnavox **Chassis No. 32 Series**

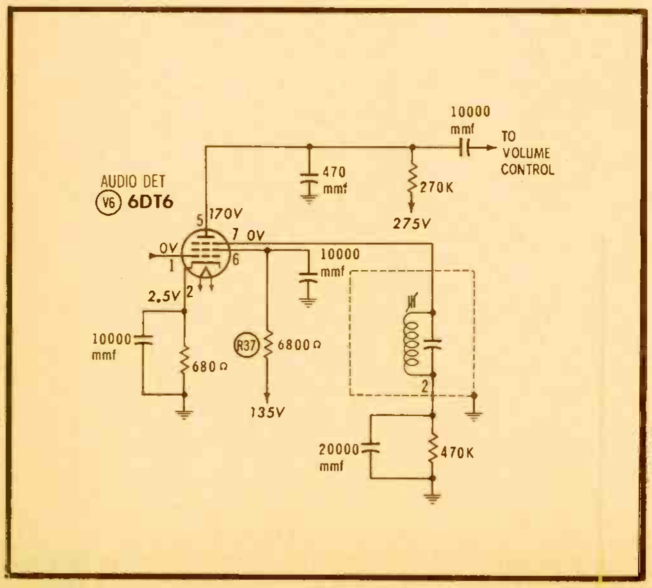
Card No: MA 32-5

Section Affected: Pix.

Symptoms: Vertical retrace lines visible in picture.

Cause: Vertical blanking capacitor open.

What To Do: Replace C25 (.0033 mfd — 600V).



Mfr: Magnavox **Chassis No. 32 Series**

Card No: MA 32-6

Section Affected: Sound.

Symptoms: No sound. Low voltage on screen grid (pin 6) of V6.

Cause: Open screen resistor in audio detector circuit.

What To Do: Replace R37 (6800 ohms).

See PHOTOFACT Set 500, Folder 2

See PHOTOFACT Set 500, Folder 2

Mfr: Sylvania **Chassis No. 547-1**

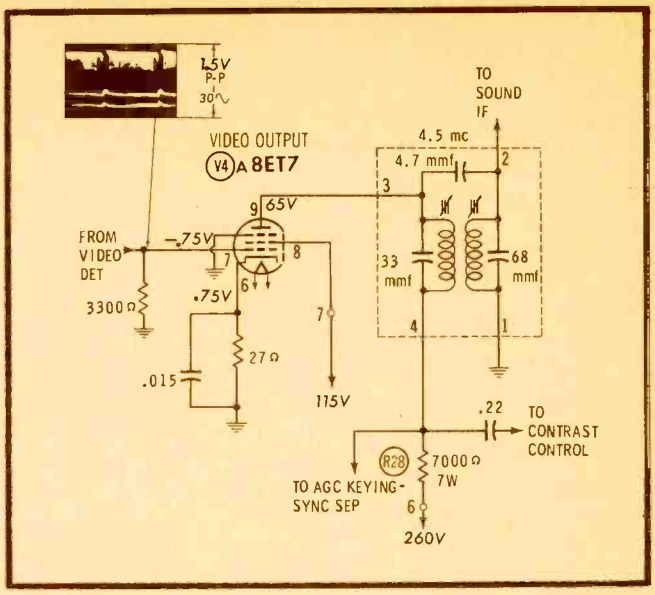
Card No: SY 547-1-1

Section Affected: Pix.

Symptoms: Weak picture. Low voltage on plate (pin 9) of V4, 8ET7 video output.

Cause: Resistor in video output plate circuit increased in value.

What To Do: Replace R28 (7000 ohms — 7W).



Mfr: Sylvania **Chassis No. 547-1**

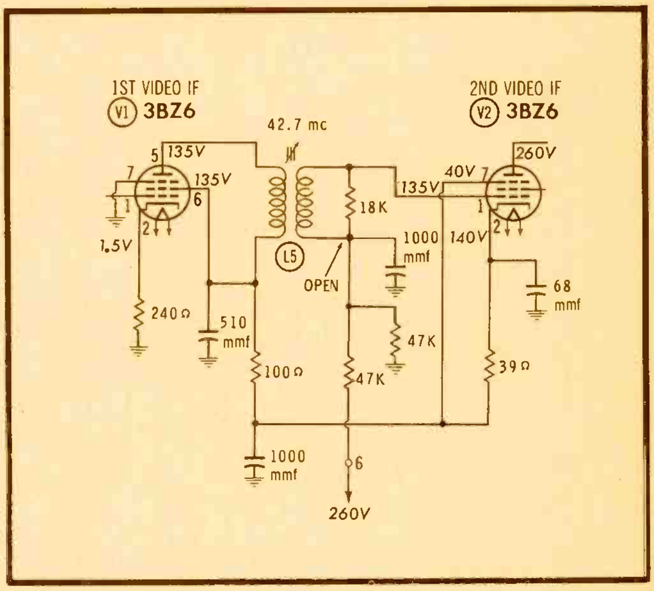
Card No: SY 547-1-2

Section Affected: Pix.

Symptoms: Weak video.

Cause: Open pigtail on grid section of video IF transformer.

What To Do: Resolder pigtail of L5.



Mfr: Sylvania **Chassis No. 547-1**

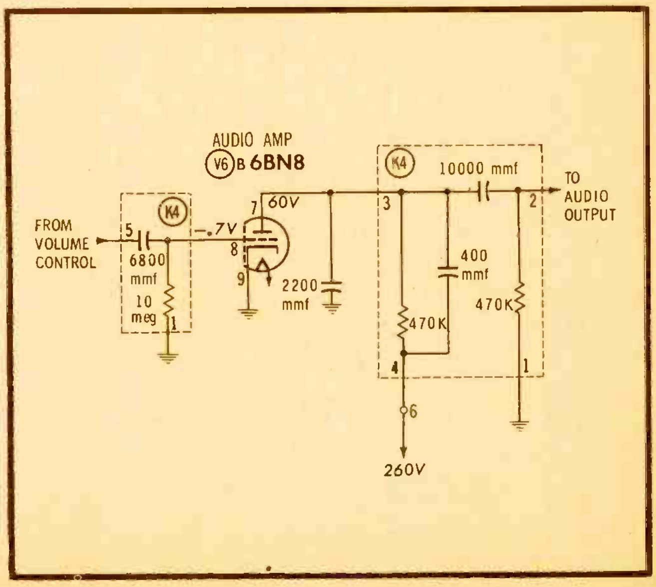
Card No: SY 547-1-3

Section Affected: Sound.

Symptoms: Distorted and weak sound. Low voltage on plate (pin 7) of V6B, 6BN8 audio amplifier.

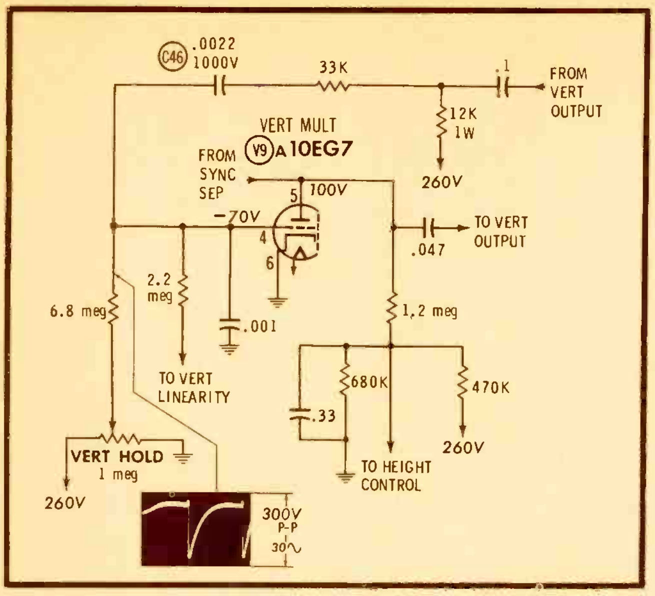
Cause: Plate-load resistor of AF amplifier increased in value.

What To Do: Replace K4 printed circuit, containing 470K-ohm plate-load resistor.



See PHOTOFACT Set 500, Folder 2

See PHOTOFACT Set 500, Folder 2



Mfr: Sylvania **Chassis No. 547-1**

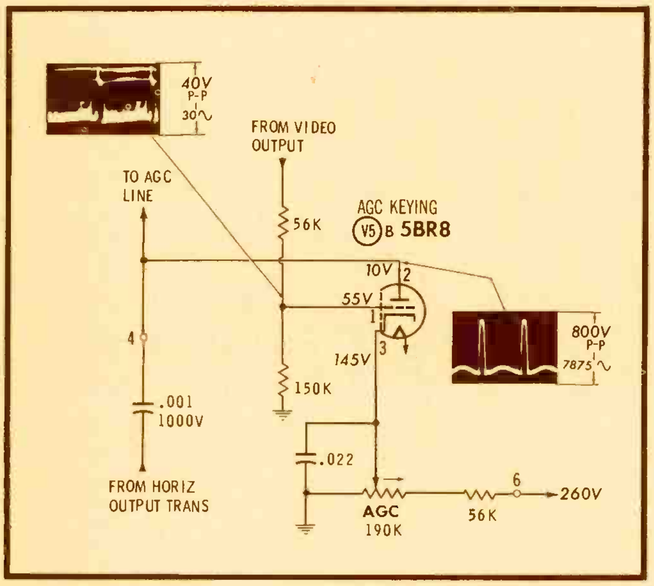
Card No: SY 547-1-4

Section Affected: Raster.

Symptoms: No vertical sweep. Positive voltage on grid (pin 4) of V8A, 10EG7 vertical multivibrator.

Cause: Feedback capacitor shorted.

What To Do: Replace C46 (.0022 mfd — 1000V, 10%).



Mfr: Sylvania **Chassis No. 547-1**

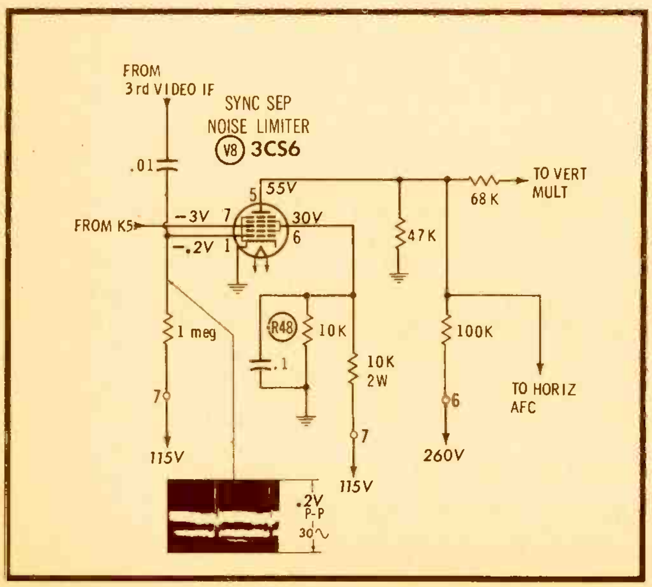
Card No: SY 547-1-5

Section Affected: Pix.

Symptoms: No picture; incorrect bias voltage on cathode (pin 3) of V5B, 5BR8 AGC keying tube.

Cause: Open AGC control.

What To Do: Replace R8 (190K).



Mfr: Sylvania **Chassis No. 547-1**

Card No: SY 547-1-6

Section Affected: Sync.

Symptoms: Poor horizontal and vertical hold. Low voltage at screen (pin 6) of V8, 3CS6 sync separator.

Cause: Screen grid voltage-divider resistor burned and reduced in value.

What To Do: Replace R48 (10K—1W).

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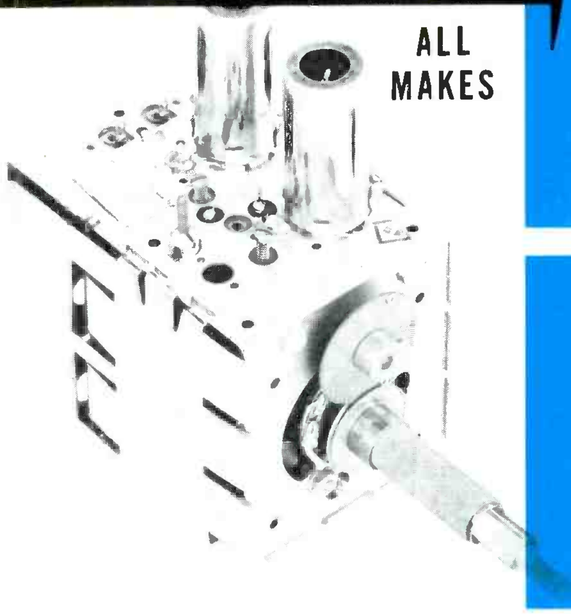

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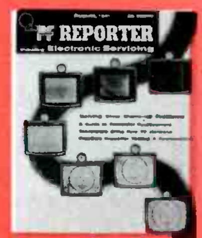
CONTENTS

ABOUT THE COVER

Many years ago, the Stanley Steamer lost out to its competitors because people didn't have the patience to wait while it warmed up. The sets you service can avoid a similar fate, if you make it a point to correct slow warm-up troubles. "Shop Talk," starting on page 22, suggests cures for unreasonably long warm-up time.



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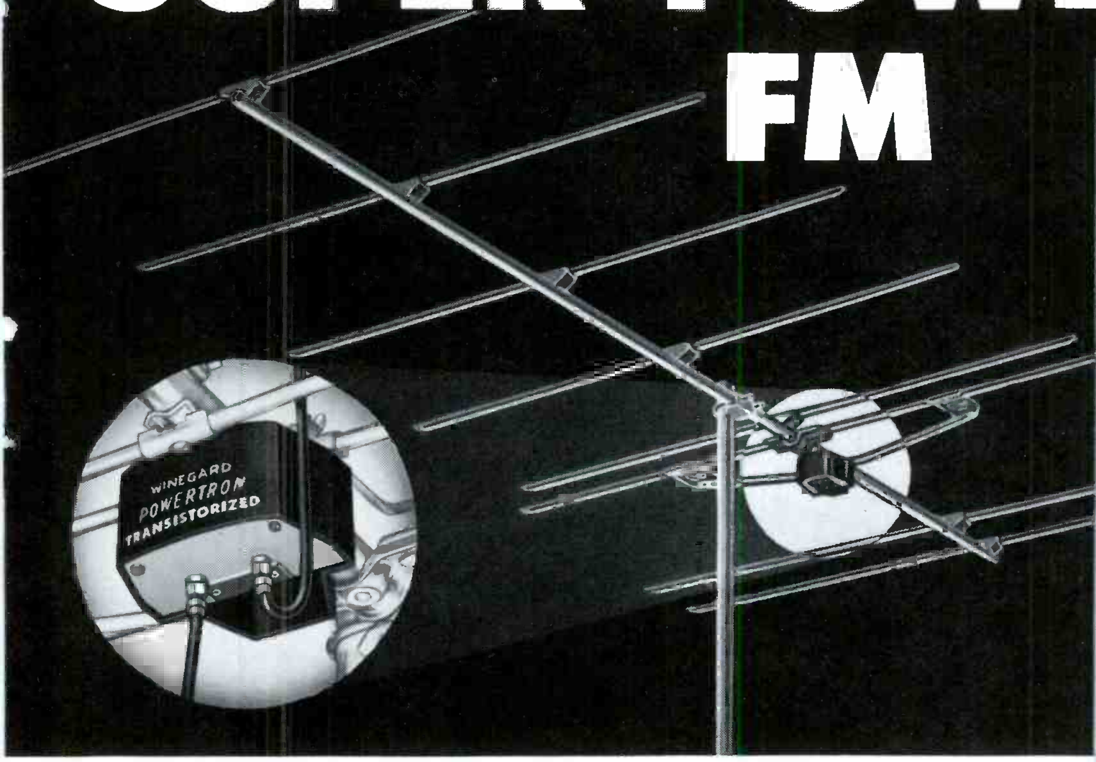


MODEL PF-8 FM STEREO-TRON YAGI — GOLD ANODIZED

This is the world's most powerful FM antenna. Because Multiplex requires an antenna with greater sensitivity and gain to offset the power loss of the carrier and sub-carrier, Winegard's PF-8 is the best antenna you can install for Multiplex. When you hook up a PF-8, weak signals come in like "locals".

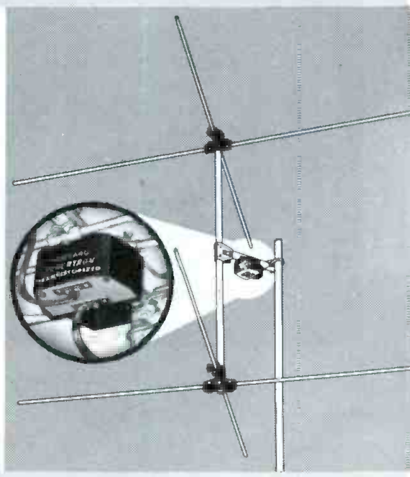
The PF-8 has a minimum gain of 26 DB over a folded dipole with a flat frequency response of ± ¼ DB from 88 to 108 m.c. It features a built-in TV-FM coupler and has eight elements with EXCLUSIVE "TAPERED T" driven element engineered perfectly to match the powerful transistorized, direct coupled, *built-in* amplifier. It is *available two ways* — Model PF-8 for 300 ohm twin lead or Model PF-8C for 75 ohm coax.

2 NEW TRANSISTORIZED WINEGARD ELECTRONIC FM ANTENNAS FOR LONG DISTANCE FM AND MULTIPLEX

Now WINEGARD brings you super-powerful FM antennas with *BUILT-IN* transistorized amplifiers for L-O-N-G range FM and multiplex reception. You can offer your customers the PF-8 FM STEREO-TRON Yagi (directional) or the PF-4 FM ELECTRONIC Turnstile (omni-directional). Both models deliver unexcelled performance far beyond ordinary FM antennas—open a new field of opportunity in the fast growing FM and Multiplex market.

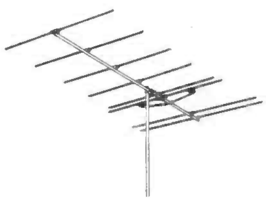
Here Are Some Important Features of Winegard Electronic FM Antennas

1. Transistorized amplifier is designed as *part of* the "Tapered T" driven element (model PF-8) for unprecedented efficiency and signal-to-noise ratio.
2. Built-In FM-TV coupler allows you to use one power supply and down lead when used with a WINEGARD POWERTRON TV antenna.
3. Gold anodized finish—100% corrosion-proofed—all hardware irridized. This is the finest finish of any antenna—meets U.S. Navy specifications.
4. The quality of craftsmanship and materials in these antennas tell their own story—perfect mechanical balance—100 m.p.h. wind tested.

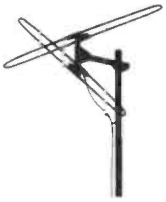


MODEL PF-4 FM ELECTRONIC TURNSTILE — GOLD ANODIZED

Most powerful non-directional FM antenna with 16 DB gain in all directions over a folded dipole. Has Winegard offset mount and transistorized amplifier with TV-FM coupler. Model PF-4 has 300 ohm output.



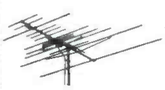
MODEL FM-8—Non-Electronic Yagi — Gold Anodized. The FM-8 is the finest non-electronic FM antenna available. It features the same Winegard "Tapered T" driven element and construction as our super-powerful PF-8.



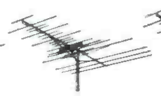
MODEL FM-3T — Non-Electronic FM Turnstile — Gold Anodized. Very popular WINEGARD omni-directional FM antenna. Has WINEGARD'S offset mount and is gold anodized. Easy to install — can be mounted on same mast as TV antenna.

WORLD'S MOST POWERFUL TV AND FM ELECTRONIC ANTENNAS, WINEGARD "TRON" SERIES, TELETRONS — POWERTRONS — COLORTRONS — STEREO-TRONS

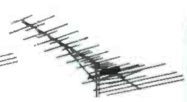
Watch Winegard go in '61 National Consumer Advertising this Fall in LIFE, LOOK, SUCCESSFUL FARMING, FIELD AND STREAM, SUNSET.



POWERTRON MODEL P-55 14 Elements



POWERTRON MODEL P-55X 21 Elements



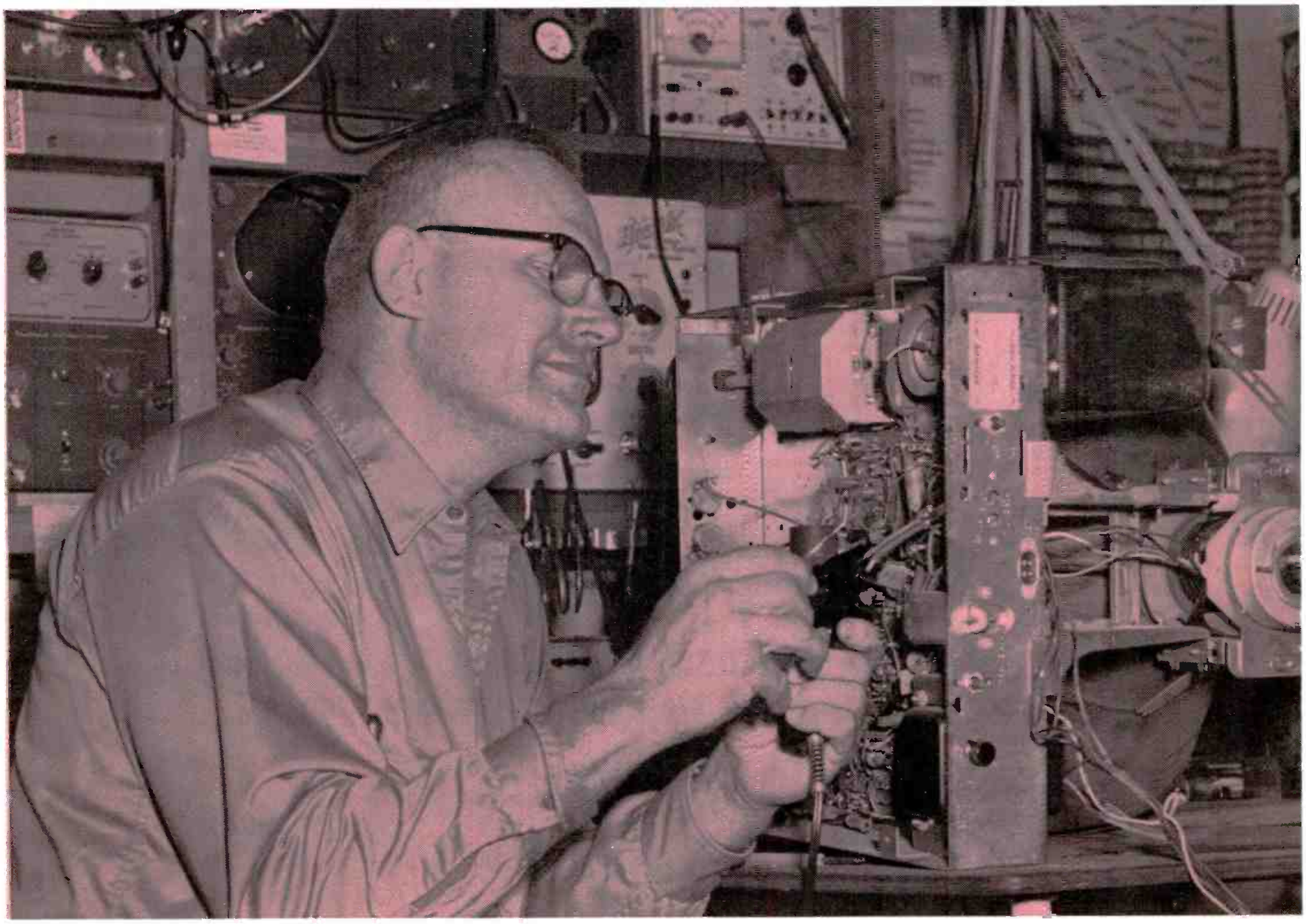
SUPER POWERTRON MODEL SP-55X 30 Elements

Write for Technical Bulletins or Ask Your Distributor

Winegard

ANTENNA SYSTEMS

3009-8 Scotten Blvd., Burlington, Iowa



LETTERS TO THE EDITOR

Dear Editor:

For some time now, I have been receiving your valuable publication here in Australia. Although not yet in a TV area, I have been intensively engaged in practical study of TV for over two years. I have to rely on freak long-distance signal pickup, but this has been considerably successful. Four TV stations on our Australian channel 2 (63-70 mc) have come in over distances from 700 to 1700 miles via midsummer sporadic "E"-layer propagation. Besides this "local" reception, I have also been fortunate in picking up signals via the trans-equatorial path from stations around 5000 miles away. The most regular among these have been KONA, Hawaii (American channel 2); a U.S. Army station on channel 3 in South Korea; and a Russian station in Vladivostok. The latter is the most consistent.

I cannot speak too highly of your magazine. The articles last year on "Tough-Dog Sync Problems" were of especially great assistance, since there is much room for investigation and improvement of sync circuits to obtain greater stability on the extremely weak and erratic TV signals available here.

George Petersen
Ayr, Australia

Dear Editor:

I would like to express my appreciation of your magazine, as I have found it to be a wonderful aid in my work of TV servicing. Keep up the splendid work.

L. Lane
Melbourne, Australia

Which serves to prove the other side of the world isn't so far away—or so different—after all!—Ed.

Dear Editor:

I failed to receive my copy of the June PF Reporter. Perhaps the reason is because I moved to a new address. Your magazine is very important to me, and I do not want to miss a single issue—so would you please rush me my copy?

R. J. Cottingham
Charlotte, N.C.

Glad to oblige. The reason you missed an issue is that we didn't receive your address-change notice in time. Anyone planning to move can make sure of uninterrupted service by letting our Circulation Dept. know both the new and old address (as well as the subscription code line) by the 15th of the month preceding publication of the first issue to be mailed to the new address.—Ed.

Dear Editor:

On page 64 of your June issue, you had a picture of a portable, high-powered megaphone which appears to be exactly what one of my customers has been asking for. Can you tell me who makes this unit?

George K. Hansen
Chicago, Ill.

Sure can — it's the University Model PP-1T. Also, the items on page 65, in the order of their appearance, are the Jensen Model RT-20 (three units), Challenger Model CHM, Masco "Custom Ten," Bogen Model TQ, Multitone "Personal Call," and Stromberg-Carlson "Pagemaster."—Ed.

Dear Editor:

I'd like to find some way of getting detailed data on new pieces of test equipment as soon as they are introduced—even before you have a chance to report on them in your "Notes" column.

L. Denby
Minneapolis, Minn.

Try our monthly Free Catalog and Literature Service. It regularly carries manufacturers' offers of catalog sheets and brochures on the latest test instruments, as well as on other parts, services, and equipment. All you do is check the desired items on the card inside the back cover, and drop it in the mail; your information will be forwarded free of charge.—Ed.

Dear Editor:

I would appreciate an early coverage of the Sencore Model SM112 VTVM-VOM (advertised in your May issue) in "Notes on Test Equipment."

Raymond D. Konkle
Konk's Radio and TV Service
Madison, Ind.

You have only one more month to wait; this unit will be discussed in the September column.—Ed.

Dear Editor:

As a "whodunit" fan, I find your tough dogs and *The Troubleshooter* more suspense-filled than Perry Mason. Keep up the good work.

O. E. ("Oz") Austin
Tampa, Fla.

We assume this is a compliment—but thinking it over, we're not so sure.—Ed.

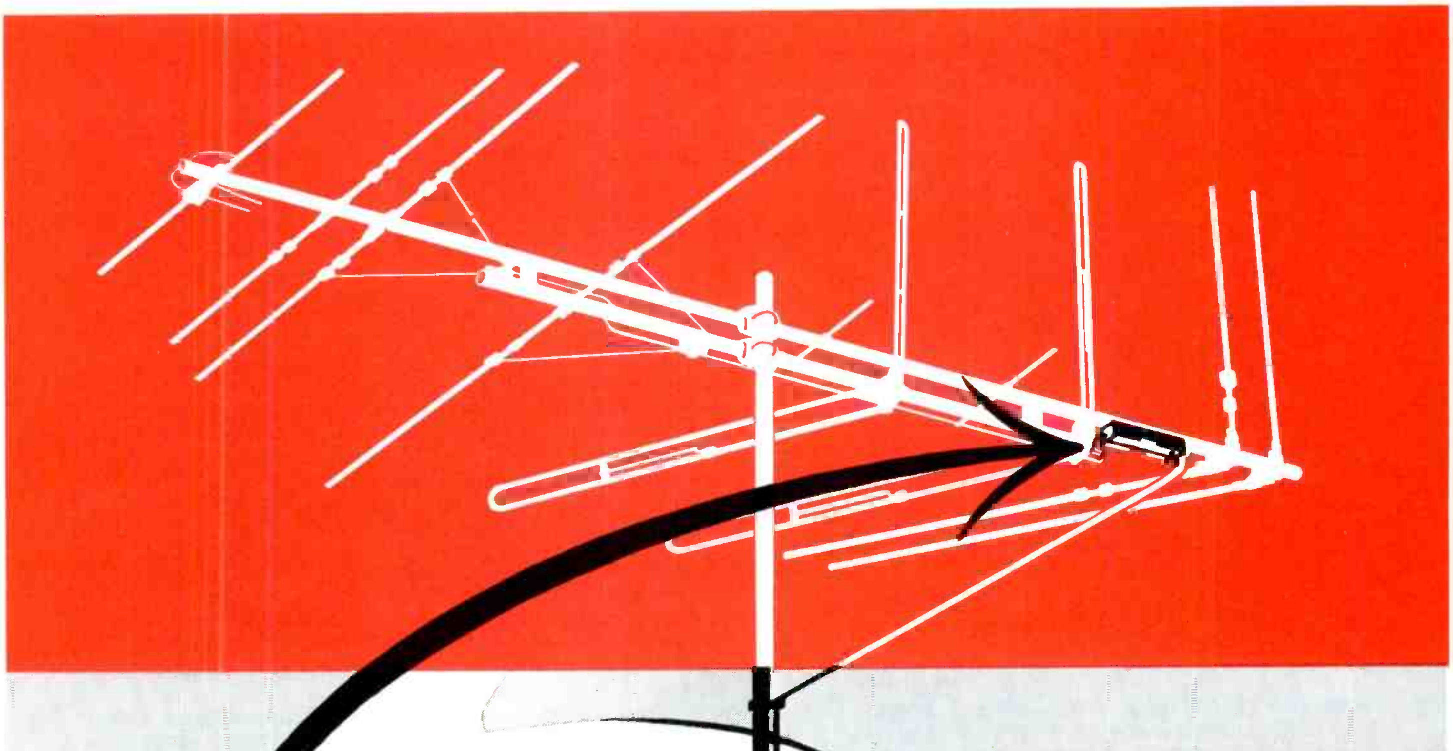
Dear Editor:

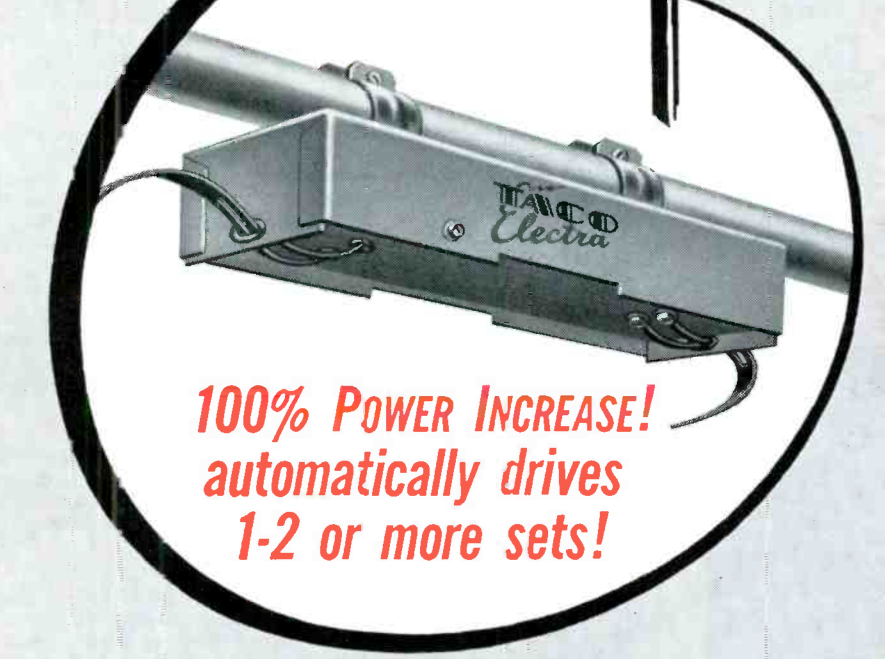
Congratulations for a real curve ball in your April article, "Do You *Really* Have the Test Equipment You Need?" I'd certainly go along with the idea that a scope and VTVM are the basic test instruments for television but I'd add capacitor test equipment right there—and I wouldn't even discuss tube checkers without mentioning a CRT rejuvenator. How could you list a sweep and marker generator as basic equipment while listing a tube checker and capacitance bridge as "nice to have"? Except for my VTVM, I wouldn't do without my capacitor tester for all the other test equipment you could stack in my shop, *including* oscilloscopes.

Why don't you have technicians instead of English majors or engineers write your stuff?

Bob Hill
Bob Hill Car Radio-TV
Long Beach, Calif.

We still contend that capacitor and tube testers are "nice to have," which simply means they can save much time and effort—but they aren't absolute *necessities! On the other hand, how could you possibly align RF and IF circuits without a sweep and marker generator? If you're* really *professional, you'll have* all *the instruments discussed in the article. Incidentally, there's not a man on our staff who hasn't been a practicing, professional radio-TV technician.—Ed.*

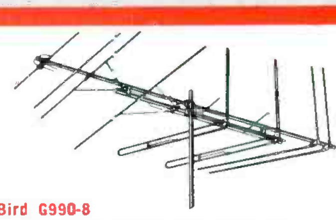




Streamlined—light weight unit—no burden for rotor operation. Built-in two set connection. And if you need to feed more—three, five, ten, or more sets can receive the finest pictures obtainable through use of standard distribution systems.

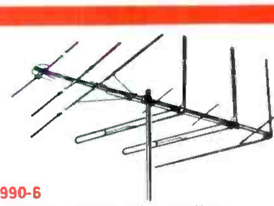
But let your customer convince you. Install an Electra in a poor location—and then receive the compliments. IT'S GOT TO WORK. The Electra has been tried, tested, checked and double-checked and never failed. If there's a picture to be gotten—the TACO T-Bird Electra will get it!

TACO T-Bird Antennas — the only 100% rust-proofed antennas . . . Anodized gold with iridited hardware!



T-Bird G990-8

The ultimate for tough long distance reception areas. Can range up to 175 miles from TV transmitter and still pull in the picture! The finest antenna —at any price—in any location.



T-Bird G990-6

Pulls in distant signals without lines, snow or blur. Range up to 125 miles with maximum power gain on all channels from 2-13. Anodized and iridized for complete protection against rust and corrosion.

T-Bird G990-5

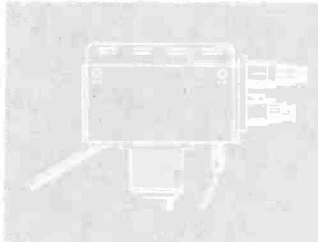
Ideal for near-fringe areas. Selected directivity pattern kills co-channel interference, minimizes snow and fade. Exceptionally flat frequency response produces superb black and white or color pictures.

Get In On It Right Now

Write or wire for complete money-making details **TODAY.**

TACO

TECHNICAL APPLIANCE CORPORATION
SHERBURNE, NEW YORK.



The Electronic Scanner

Philco Will Continue Marketing Tubes

A rumor that "**Philco** has quit the receiving-tube business" needs clarification. While it is true that the Lansdale Division will gradually discontinue making receiving tubes and swing more of its facilities to producing transistors, they will continue to make picture tubes. Also, the **Philco** Accessory-Service Division will continue to supply a full line of receiving tubes for the replacement market.

Sylvania to Cut Tube Production

The increasing use of semiconductor devices in electronic equipment has led **Sylvania Electric Products, Inc.** to announce plans to discontinue operations at its Shawnee, Okla. tube plant. Matthew D. Burns, Senior Vice President in charge of **Sylvania's** Electronic Tube Division, said the shut-down will be accomplished over the next six months. The division will continue to operate plants at Emporium, Brookville, and Altoona, Pa., and in Burlington, Iowa.

Taps for a Great Name in Electronics

On June 30, **Dr. Lee DeForest** quietly passed away at the age of 87. Much credit is due **Dr. DeForest** for his great contributions to the development of the science of electronics. His invention of the triode in 1906, above all his other achievements, permanently established his fame as a genius and an electronics pioneer.

License Agreement on Antennas

Two manufacturers of TV antennas have reached a licensing arrangement, under which **Channel Master Corp.** will produce certain antenna designs covered by a **Winegard Co.** patent. Specific **Channel Master** models covered by this agreement include the Model 334 "Skyblazer," Model 335 "Trailblazer," Models 355 and 356 "Color King," and "Color King Booster Kit" Model 355-7.

Battery Merchandiser Has a Change Tray

A new display rack for batteries used in transistorized equipment has a tray for returning change from over-the-counter sales. It's one of the sales aids in the **RCA** "Blueprint For Profit" battery promotion available through authorized **RCA** distributors.

CRT Test Chart Service

A $1.00 cash-in-advance yearly subscription will keep **B & K** "CRT Cathode Rejuvenator Tester" owners supplied with up-to-date information on all picture tubes. Completely new charts will be mailed in May and November to those subscribing to the service.

Upswing in Color Activity

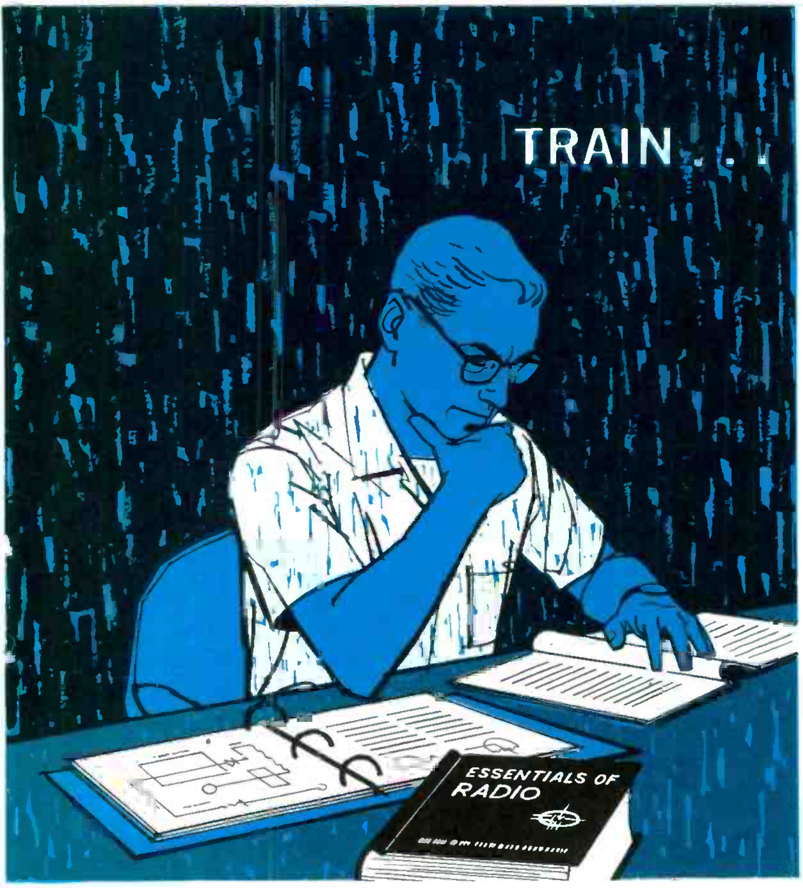
The new stir of interest in color TV which began last spring is accelerating its pace. Zenith, General Electric, Silvertone, Philco, and possibly other new brands of color sets are slated to join RCA, Admiral, Magnavox, Packard-Bell, Emerson, DuMont, and Olympic on the sales floor. All will use a conventional round, three-gun 21" picture tube. Motorola has previewed a model with a 23", 90° rectangular tube, but has no immediate plans for regular production. Programming has been gradually increasing, and now averages 4½ hours daily on the NBC network. Tying in with the expanding opportunities in color, standing-order subscribers to PHOTOFACT Folders will be receiving an up-to-date color TV course this fall as a bonus. A 12- to 16-page lesson will be included with each of 16 consecutive Sets, starting with No. 541.

Service Industry Loses a Leader

Karl W. Heinzman, board member and past president of **Television Service Association of Michigan,** suffered a fatal heart attack in Detroit on June 24 at the age of 52. **Karl** was nationally known for his tireless, unselfish efforts to improve the status of independent service dealers and combat problems within the television industry.

Component Warranty Period Extended

A two-year warranty is now in effect on capacitors and resistors sold by all divisions of **Aerovox Corp.,** superseding the former one-year warranty period. There will be no immediate across-the board price increase on either resistors or capacitors as a result of this new policy.


TRAIN . . .
ESSENTIALS OF RADIO


THEN SHARE THE PROFITS
CERTIFIED SERVICE STATION
RAYTHEON

Shop Talk

SOLVING SLOW WARM-UP PROBLEMS!

by Allan F. Kinckiner

Considering the large number of circuits in a television receiver, and the demand placed on all of them to reach normal operation from a "cold start" in a matter of seconds, it is surprising that complaints of slow warm-up are not more common. More often than not, however, the set owner endures slow warm-up until he calls in a serviceman to correct another more serious (or at least more annoying) defect. The tolerance of delay depends largely on the symptoms produced. For example, a raster which requires a couple of minutes to reach full size might not annoy the customer enough to seek service, whereas slowness in "snapping into sync" may be bothersome enough to put in a call for repair.

The patience (or lack of it) on the part of the set owner is an added aspect of handling slow warm-up problems. Some persons are willing to wait several minutes for the receiver to reach normal operation. (Members of one household actually turned their receiver on ten minutes before using it, knowing it took that long before the sound could be received clearly.) Some less patient people complain if warm-up requires as long as a minute. Usually they make it a habit to turn on the receiver and wait until the program appears. Such waiting exaggerates warm-up time and makes a 40-second delay seem insufferably long. Still other customers complain because their set takes longer to warm up in comparison with other sets. This can be an awkward problem if they are comparing a two- or three-year-old series-heater receiver with a newer power-transformer model. Having the set owner time the actual warm-up, and explaining that some receiver designs require slightly longer warm-up times, will often placate these impatient customers. This procedure is useful in dealing with complaints that have no valid basis. However, the rest of this article is concerned with slow warm-ups that result in justifiable complaints.

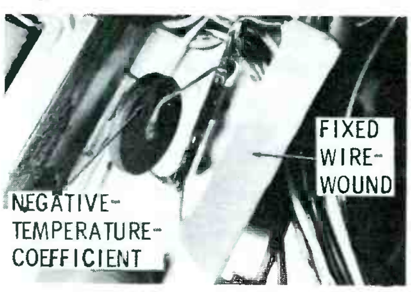


Fig. 1. Combination of two resistors protecting a series filament circuit.

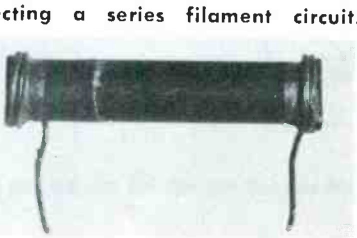


Fig. 2. Cracks, chips, or white spots indicate defect in protective resistor.

Filament-Circuit Faults

Certain defects in filament circuits—especially in the series-string type—are the chief cause of unduly long warm-up time. To recognize such conditions, it is important to be familiar with the normal variations in the time taken by different circuits to become fully stabilized after the receiver is turned on.

Many receivers use either a fixed wire-wound resistor, a negative-temperature-coefficient type, or a series combination of the two (Fig. 1) to limit the initial current surge through a series filament string. Average warm-up times among these three circuits vary slightly, as shown in Chart I. These figures were obtained by checking all sets serviced in a shop over a three-month period, and recording the interval from turn-on time until the receiver operated normally. The shortest time (15 seconds) was observed on only one late-model portable; no other sets warmed up in less than 20 seconds. For receivers using a temperature-compensating resistor, it was found that the hot resistance of this unit considerably affected the results; the higher the hot resistance, the slower the warm-up.

As compensation for the slightly longer delay produced by this type of resistor, it provides a greater degree of protection than a wire-wound unit. Its high resistance when cold minimizes physical distortion of tube heaters when voltage is first applied (a major cause of heater-cathode shorts). Also, it has been noted that tubes protected by a temperature-compensating resistor seem to have a lower failure rate from gas and grid emission.

In most filament-circuit troubles that cause slow warm-up, the filament voltage to one or more tubes is lowered. A deficiency which produces no other symptoms is likely to be slight; therefore, these faults can be difficult to find. Sometimes you can spot an obvious defect such as a damaged filament resistor (Fig. 2); other times, no faults can be found by inspection, and the outward ac-

• *Please turn to page 52*

Chart I—Typical Warm-Up of Series Heater Strings

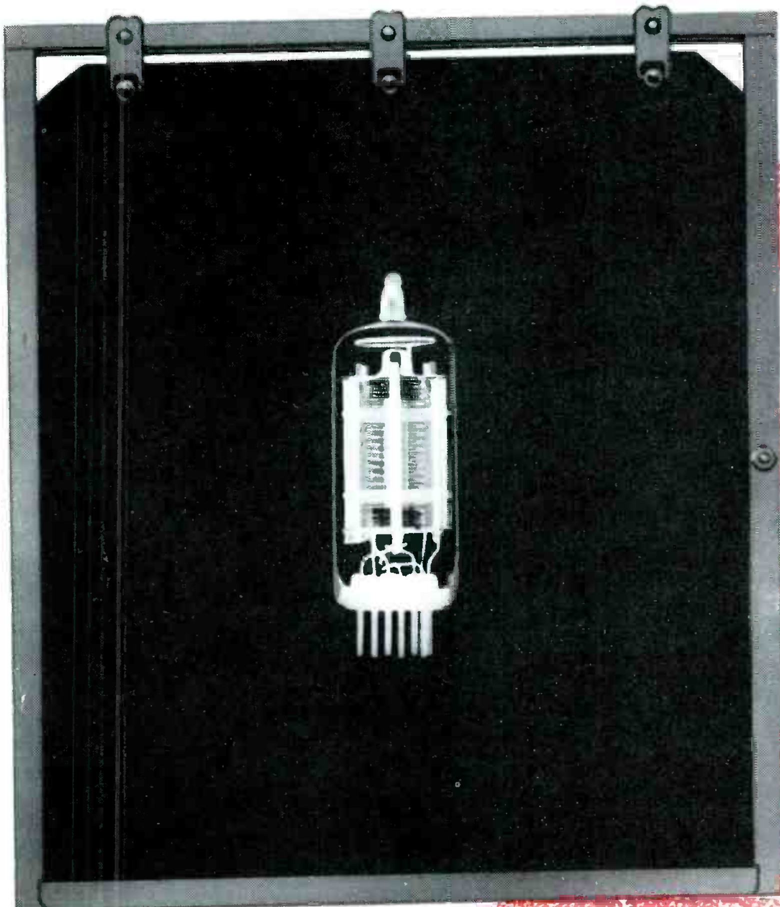
TYPE OF SERIES RESISTOR	WARM-UP TIMES (SEC.)		
	LONGEST	SHORTEST	AVERAGE
NEGATIVE TEMP COEFFICIENT	55	25	35
COMBINATION NTC & FIXED WIRE-WOUND	45	20	30
FIXED WIRE-WOUND ONLY	40	20	25+

ABSENCE OF "GRID EMISSION" AND GAS DEMONSTRATES GOOD HEALTH OF TUNG-SOL IF AMPLIFIER TUBES

Radio and TV doctors know that IF amplifier tubes must be physically sound in order to enjoy a healthy long life. Because they operate in a high impedance circuit, internal cleanliness is vital to avoid gas distress. Grid emission, which displays identical symptoms, likewise must be carefully avoided. Tung-Sol's exacting engineering standards and rigid quality control in every step of manufacture assure vigorous long life. Tung-Sol IF amplifier tubes are made in a humidity-controlled, dust-free atmosphere. The operator's hands never touch the cathode coating. Gas evacuation and metal heating are done with critical precision by means of the most advanced equipment. As a result, Tung-Sol IF amplifier tubes possess unusual stamina and help you to maintain enviable standards in your service business.

GOOD MEDICINE FOR PROFITS

One of the most highly recommended medicines for profits in radio and TV service business is the prescribing of tubes that are reliable. Cuts radio and TV set hospital visits. You can rely on Tung-Sol tubes.



HERE ARE SOME OF THE MORE POPULAR TUNG-SOL IF AMPLIFIERS:

1U4; 6AG5; 3AU6; 4AU6; 6AU6A; 12AU6; 3BA6; 4BA6; 6BA6; 12BA6; 3BC5; 4BC5; 6BC5; 6BH6; 6BJ6; 3CB6; 4CB6; 6CB6; 3BZ6; 4BZ6; 6BZ6; 12BZ6; 3DK6; 4DK6; 6DK6; 12AC6; 12BL6; 12AF6; 12EK6; 12EZ6; 18GD6A; 18FW6A

the first name | to ask for when ordering

TUNG-SOL®

IF AMPLIFIER TUBES

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

CHARTING THE WAY FOR

A GUIDE FOR SELECTING

Hundreds of different types of transistors are now on the market, and servicemen are understandably confused about which types they are likely to need in their work. For this reason, many service-shop owners are not attempting to keep a stock of transistors on hand. But transistor failures are occurring often enough that a serviceman can't afford to run to the distributor each time he suspects transistor trouble.

A replacement stock is highly desirable, not only to reduce trip mileage, but also to make servicing easier. Whenever preliminary tests indicate a faulty transistor, a serviceman may hesitate to buy a special replacement until he has made additional checks to confirm his diagnosis. These procedures waste time which can be saved by simply installing a substitute type. Furthermore, if the replacement results in receiver performance which is as good as it was originally, the new transistor can be permanently left in the equipment.

The serviceman today is thus caught in a dilemma between the advantages of having a replacement stock and the apparent difficulties of selecting the types of transistors he needs most. It would seem logical to base his selection on the most "popular" types. However, this approach is not very practical in working with transistors, since few (if any) stand out as being much more frequently used than others.

Fortunately, the very nature of transistors makes it possible to take a different slant on the replacement problem—one that would not be practical with tubes. Most of the differences which prevent the interchange of tube types involve the base connections, filament voltages, and number of elements. Transistors are not generally limited by these considerations, since nearly all are three-element units, and since most replacement types have long, flexible leads that can be connected in any required pattern. The differences among transistors, aside from the basic division between PNP and NPN classes, are mostly a matter of variations in voltage ratings, power dissipation, current gain, and frequency characteristics.

In fact, transistors which reach the market bearing different type numbers often originate in a single production run! Transistor-manufacturing processes typically result in a fairly wide range of characteristics among the units produced. Thus, it is common practice to divide transistors into groups according to certain specified characteristics determined by testing. The result may be a series of similar types with consecutive numbers, or even a group of types with no apparent family resemblance to each other. Two types from different manufacturers, produced by similar but not identical processes, may have specifications closely parallel to each other—but usually not close enough to permit using the same type number for both.

This last statement suggests that different transistor types might be interchanged rather freely, provided the associated circuits are not so critical that performance is noticeably affected by substitution. In actual practice, service technicians are finding that most circuits in portable radios and similar equipment are sufficiently *non*critical—and also sufficiently standardized—to permit rather liberal substitution. This happy situation leads to a realistic and economical solution to the problem of selecting a useful replacement stock.

A modest-sized stock of transistors, based on one PNP and one NPN type for each stage commonly found in portable radios, can meet practically all substitution and replacement needs. There are exceptions to this rule, of course, but the substitutions will work in as many as 9 out of 10 cases.

Several companies have already developed this idea to the point of marketing general-substitution kits (containing 4 to 11 transistors) for replacement use. Others have not designated any particular types as being especially suited as standard replacements, but offer an extensive line from which general-substitute types can be chosen. To help service shops assemble a minimum stock, we have prepared a cross-reference chart which lists suitable types available from different manufacturers for use in each stage of a portable radio.

How to Use the Chart

First of all, determine which stage you suspect of having a defective transistor. Even without looking at service data, you can generally recognize the stage from such clues as output-transformer leads or IF cans.

Next, find out if the original transistor is a PNP or an NPN type. You can look it up in a reference book, or the voltages supplied to the element leads can furnish the clues you need. Consider the collector voltage, which is considerably different from the other two element voltages unless there is a short in the transistor. If this voltage is more negative than the other two (or less positive), the transistor is PNP; otherwise, it is NPN.

You now have sufficient information to go ahead and select a replacement from the chart. Find the column containing the needed class of transistor (PNP or NPN) for the appropriate stage; then read down to locate the type number listed for the manufacturer whose transistors are most readily available to you.

If the replacement transistor seems to take care of the trouble, you may be able to leave it in the radio. However, before considering the repair fully completed, you should let the radio play awhile—say, about an hour—to make sure

TRANSISTOR REPLACEMENTS

A SUITABLE STOCK

no further trouble develops.

Suppose the transistor substitution doesn't bring the performance of the radio up to par. This is to be expected in a certain number of cases where an exact replacement is not being used; therefore, here are a few things to check before concluding that the substitution doesn't work.

If an RF or IF unit was replaced, touch up the alignment of the radio. This step is necessary even when an original-type replacement is installed.

If the substitute transistor breaks down, make sure the radio doesn't have an exceptionally high battery voltage or heavy current demand which exceeds the ratings of most conventional transistors.

If an RF or IF circuit breaks into oscillation, or if gain seems abnormally low, the circuit may have been designed for a transistor which has unusually high or low power-gain characteristics compared to an average replacement type. Refer to specifications for the original type of transistor, and note whether it is an "end member" of a series of consecutively-numbered types which differ only in power gain. If so, a different substitute type may serve the purpose.

Another possible cause of oscillation or poor gain is a difference in impedance or capacitance between the original and substitute types. This condition, which occasionally gives trouble in RF-IF applications, is traceable to differences in manufacturing method (as between alloy-junction and grown-junction types), which lead to built-in electrical differences. If in doubt, check published specifications.

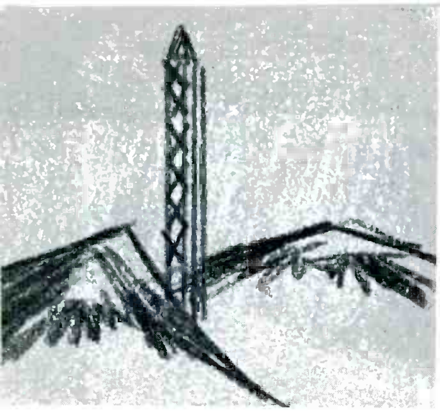
Audio types are generally much more noncritical than RF-IF transistors. However, types with higher power-gain ratings are normally used in output stages. Just about the only problem is an occasional need for a matched pair for use in a push-pull output stage. Investigate this angle if you are troubled with distortion or an obvious unbalance between halves of this circuit.

These hints are given as a starting point for solving occasional difficulties—not to detract from the basic fact that transistor substitution is a widely successful practice. Select your stock, and you'll be agreeably surprised to find out how much it helps to relieve your radio-service problems. ▲

Replacement Transistors for Specific Stages in Portable Radios

APPLICATION P = PNP N = NPN	RF PNP	RF NPN	MIX-OSC-CONVERTER PNP	MIX-OSC-CONVERTER NPN	IF PNP	IF NPN	DRIVER PNP	DRIVER NPN	OUTPUT PNP	OUTPUT NPN
AMPEREX	2N1517	—	2N1516	—	2N1515	—	2N280	—	2N284	—
DELCO	DS25	—	DS25	—	DS25	—	DS26	—	DS26	—
G-E	2N394	2N293	2N394	2N1086	2N394	2N293	2N188A	2N169A	2N241A	2N292
GENERAL INSTRUMENT CO.	2N605	GT-792R	2N520	GT-792R	2N520	GT-792R	GT-109	GT-948R	GT-109	GT-948R
MOTOROLA	2N544 +	2N1086	2N1108 +	2N1086 +	2N1110 +	2N169 +	2SB54 +	—	2N1274 +	—
PHILCO	2N344	—	T1306	—	T1233	—	T1001	—	T1005	—
RCA	2N1632	—	2N412 +	—	2N410 +	—	2N406 +	2N1010	2N408 +	2N649
RAYTHEON	2N416	—	2N486	—	2N483	2N1367	2N362	—	2N632	—
SEMITRONICS	HF20	NR10 +	HF12 +	NR10 +	HF6 +	NR5 +	AT20 +	NA20 +	AT30 +	NA30 +
SPRAGUE	2N344	—	2N344	—	2N344	—	—	—	—	—
SYLVANIA	2N544	2N377	SYL 105 +	SYL 101 +	SYL 106 +	SYL 102 +	SYL 107 +	SYL 103 +	SYL 108 +	SYL 104 +
TEXAS INSTRUMENTS	2N1107	2N172	2N1108	2N172	2N1110	2N253	2N238	—	2N185	—
TUNG-SOL	ET-1 +	ET-8 +	ET-1 +	ET-8 +	ET-2 +	ET-9 +	ET-5 +	ET-10	ET-4 +	ET-11
U. S. TRANSISTOR	2N416	—	TO-101 +	—	TO-102 +	—	TO-103 +	—	TO-104 +	—
WESTINGHOUSE	2N616	—	2N617	—	2N615	—	2N403	—	2N60	—
WORKMAN	BA6A	SA7	BE5A	SK7	BA6A	—	AT6A	SC7	B5A	L6

NOTE: Several manufacturers supply kits of replacement transistors. Types included in these kits are marked +.



TRANSLATORS

WHAT NEW TRANSLATOR STATIONS MEAN TO THE SERVICEMAN

by George M. Frese

Fig. 1. Complete VHF translator located on mesa top—Mexican Hat, Utah.

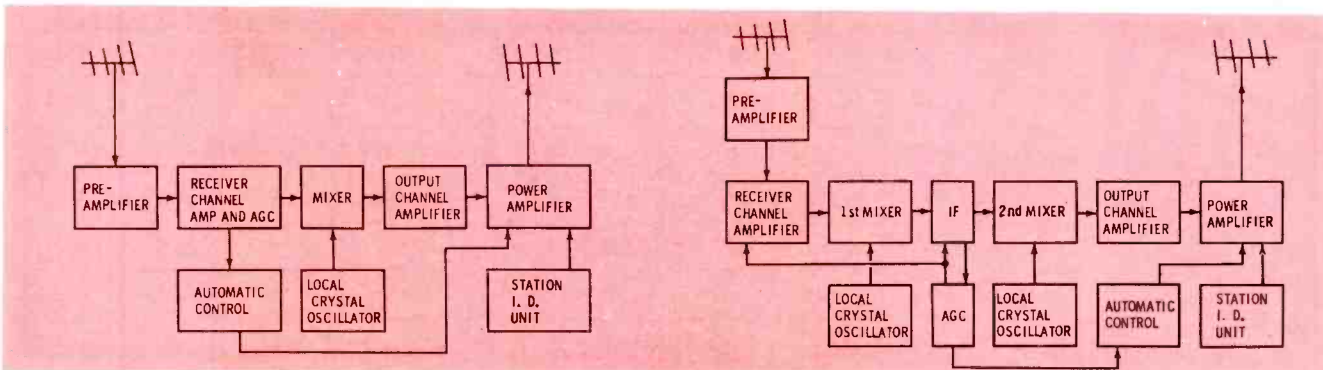
A translator is a low-powered transmitter which receives an on-the-air signal from a regular TV station, converts it to a different frequency, amplifies it, and reradiates it into an area beyond the range of the primary station. This type of signal-distribution device has grown considerably in importance during the past year, since the FCC has legalized the use of VHF translators and has established rules for their operation. Developments in this field are of special interest to TV technicians in far-fringe areas, who are not only in a natural position to take the lead in establishing and maintaining translator stations, but stand to benefit from the increased sale and repair of receivers.

TV-signal repeaters have a long history, especially in mountainous areas of the Far West—where many valleys are signal-starved but reception is dependable on nearby mountaintops. The craving for TV was satisfied in many localities with on-channel boosters, which consisted simply of a receiving antenna in a favorable location, coupled to a retransmitting antenna through a VHF amplifier. Since the original and reradiated signals were on the same frequency, these installations often had difficulty avoiding trouble with feedback, ghosts, and other detriments to good reception. Boosters thus have never gained legal status. To provide a technically satisfactory service, the FCC in 1956 adopted standards for translators which would rebroadcast on any of the top 14 UHF channels (70-83). Local groups were invited to file for these, just as for any regular broadcast station. Although they are more expensive than boosters, and require UHF conversion on all receivers, well

Fig. 2. Many reception areas are long and narrow, like this Colorado valley.

over 300 of these translators have been built to date. However, their potential usefulness has barely been touched upon.

Insistent pressure for legal VHF translator service caused the FCC to amend its rules last September, clearing the way for such service in addition to UHF, and establishing the necessary technical rules. Since then, a boom has occurred. Illegal-booster operators—nearly a thousand strong—have been in a scramble to modify or convert their equipment to meet the new requirements, as well as to file for "legaliz-



(A) Single-conversion type.

(B) Double-conversion type.

Fig. 3. Block diagrams of translators.

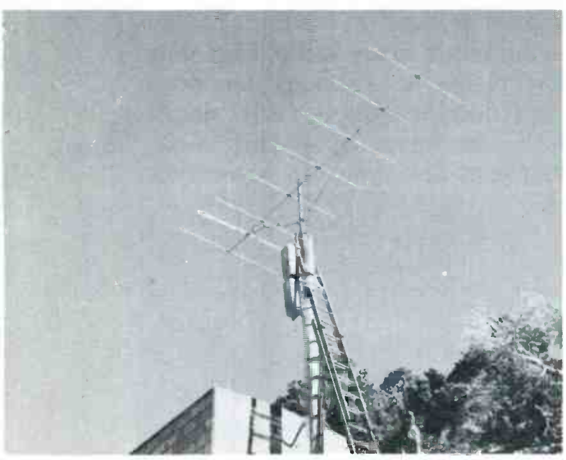
BRING NEW TV HORIZONS!

ing" construction permits. In addition, interest in translators has been stirred in many new areas where TV reception is still nonexistent or extremely poor. As a result, manufacturers are engaged in meeting an unprecedented demand for translator equipment.

Facts About Translators

Translators are "made to order" for the type of location shown in Fig. 1, on a mountain with access to a good input signal and a line-of-sight coverage of the area to be served. Some translators are also being used in locations where the terrain is relatively flat; these use exceptionally tall towers (some 300′ high) and can pull in signals which are too weak to be received with a conventional home TV installation.

Maximum permissible RF power output for translators is only 1 watt on VHF or 100 watts on UHF, but the effective radiated power is usually higher because a directional transmitting antenna is commonly used. As shown in Fig. 2, the most desirable transmitter site is likely to be at one end of a long, narrow coverage area, and it is best to concentrate the radiation into a lobe resembling the directivity pattern of an ordinary Yagi receiving antenna. With this arrangement, a 500-microvolt signal can be delivered across a pair of 300-ohm receiving-antenna terminals at distances of up to 30 miles on Channel 2, or 8 miles on Channel 13. Putting it another way, Grade A field strength for a typical Channel 10 translator, with antenna gain of 10, is obtainable as far as 3 miles straight ahead of the antenna, and a Grade B field (requiring a high-gain receiving antenna) about 10 miles. Even greater range can be obtained with vertically-stacked antennas. However, signal strength remains high only within a narrow beam—in this example, only 30° each side of the straight-ahead position. A lower-gain antenna would provide a shorter, broader range. UHF coverage areas are comparable to VHF, or greater, because of the higher RF input power permitted.



Compact installation has UHF transmitting antennas (in weatherproof housing) mounted on same mast as VHF receiving antenna. Note concrete-block shelter.

Use of different input and output frequencies permits the receiving and transmitting antennas to be mounted close together; this increases efficiency by minimizing the length of transmission line required. The translator unit may be mounted in a weatherproof housing on the mast, but it is more customary to provide a small, heated shack where testing and servicing can be performed more conveniently. The equipment consists of the sections indicated in Fig. 3. In the single-conversion unit, the input signal is picked up on a high-gain antenna array and coupled to a low-noise preamplifier (generally of the single-channel strip type). Any interference which may be present is removed at the output of the preamp by filters or traps. The amplifier is required to be controlled by AGC—not only to reduce fluctuation of output-signal strength, but also to ensure that output power will not exceed the prescribed limit. A crystal-type local oscillator is used in order to maintain the necessary frequency tolerance of .02%; its output, when mixed with the primary-station input, directly yields the band of frequencies to be retransmitted. The resulting signal is amplified to the proper level and fed to the transmitting antenna. An automatic identification circuit meets FCC requirements by generating the station call letters in Morse code every half hour and superimposing them on the RF signal. This 4-kc signal appears as slender sound bars in the picture, and also as an audible tone at the receiver.

Two transmitting antennas, facing in slightly different directions, broaden coverage pattern of this UHF translator.

A somewhat more elaborate type of translator uses double conversion, reducing the incoming signal to a lower intermediate frequency before converting it to the retransmitting frequency. This system has the advantage of increasing the number of different frequency conversions

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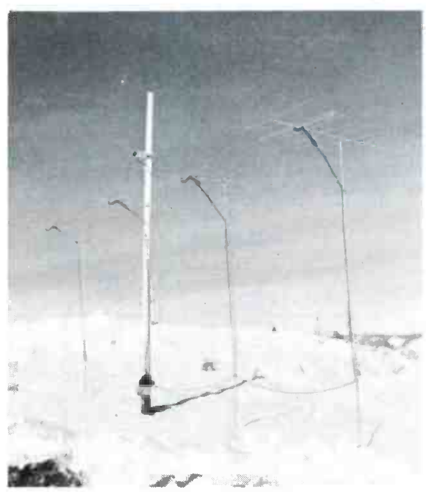

Horizontally-stacked receiving Yagis increase signal input to translator and improve consistency of reception.

PRACTICAL CAPACITOR TESTING AND REPLACEMENT

DOWN-TO-EARTH BENCH PROCEDURES YOU SHOULD KNOW.

Capacitors, like other electrical components, can and do become defective. They may change in value, open, short, become excessively leaky, or drift from their designated value as operating temperatures vary. Trouble symptoms likewise cover a broad range—loss of signal, B+ shorts, hum, video or audio distortion, detuning, motorboating, frequency drift, etc. A shorted unit is also likely to damage other parts in the same circuit.

Meter Tests

It's usually advisable to analyze capacitor troubles with in-circuit measurements as far as possible, especially when printed boards and/or miniaturized components are involved. There's no sense in unsoldering or removing components from the circuit unless or until it is really necessary. Suppose, for example, you suspect a bad C8 in Fig. 1. If +25 volts is present at the grid of V2, it is reasonable to assume that the capacitor could be leaky. But before carrying this assumption further, why not obtain additional proof? After all, a shorted or gassy tube could be responsible for the positive grid voltage. So remove the tube from the socket and measure the grid voltage again. If you note the same symptom, and there seems to be no other contributing factor, it's then worth your trouble to disconnect the grid end of the capacitor from the circuit.

Editor's Note: This article has been adapted from the new Howard W. Sams book, "Understanding Capacitors and Their Uses," by William F. Mullin.

Using nothing more than a VOM or VTVM, there are two methods of testing for leakage. (See Fig. 2.) With the set turned on and no signal coming through, connect the meter leads between the open end of the capacitor and ground, and check either voltage or current. Passable readings for a coupling capacitor like C8 should not exceed two or three volts or 5 to 10 ma. A word of caution in making these voltage and current measurements: A badly shorted capacitor will permit high current to flow through the ground-return path provided by the meter, so be sure to start out on a scale high enough to prevent damage to the instrument.

The ohmmeter scale of a VTVM or VOM can also be used, *with the equipment turned off,* to make an in-circuit test for a shorted capacitor. However, this test has a couple of serious drawbacks. First, parallel paths (including hard-to-find "sneak circuits") make it difficult to interpret the resistance readings. A low-resistance shunt, such as a coil, can make a capacitor appear shorted. Even a high-resistance parallel circuit can prevent you from detecting capacitor leakage severe enough to cause noticeable trouble symptoms.

The second drawback of ohmmeter checks is the low applied voltage, generally 30 volts or less, delivered by the internal battery of the ohmmeter. This potential is not sufficient to reveal intermittent leakage paths and shorts which show up only under the stress of normal circuit voltages. Oddly enough, the exact opposite of this disadvantage is encountered in some miniaturized transistor circuitry, where the ohmmeter voltage may exceed the rating of the capacitors.

Although many technicians may not realize it, checking for open capacitors is also a fairly simple task. But again, by making in-circuit tests first, you can save much

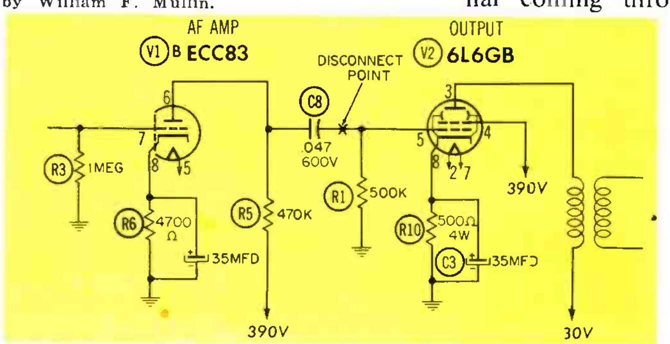

Fig. 1. Typical audio-amplifier circuit. Note grid-coupling capacitor C8.

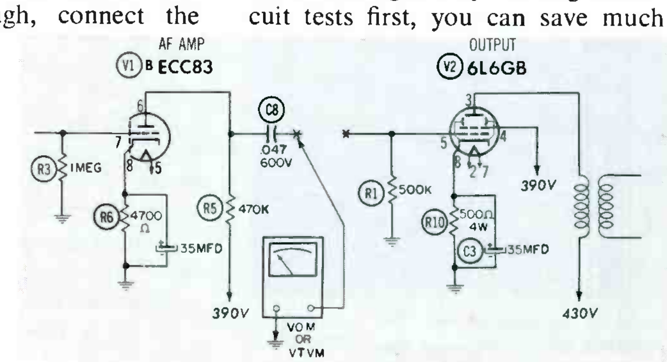

Fig. 2. Test procedure for leakage. Only ground return is through meter.

CAPACITOR TESTERS

MANUFACTURER	MODEL NO.	TESTS PERFORMED						CAPACITANCE RANGE	LEAKAGE DC-TEST POTENTIAL
		VALUE	SHORTS	OPEN	LKG.	POWER FACTOR	IN-CKT.		
AEROVOX	97 *	✔	✔	✔	✔		✔	200 mmf-3.5 mfd	150V
ARKAY	CA-40	✔	✔	✔				1 mmf-1 mfd	—
B & K	360 †	✔	✔	✔				100 mmf-4 mfd	—
CORNELL-DUBILIER	BF-70 *	✔	✔	✔	✔	✔		10 mmf-2000 mfd	0-600V
EICO	950B *	✔	✔	✔	✔	✔		10 mmf-5000 mfd	0-500V
EMC	801 *	✔	✔	✔	✔	✔	✔	10 mmf-5000 mfd	0-500V
HICKOK	209A ‡	✔	✔	✔				1 mmf-1000 mfd	—
JACKSON	591	✔	✔	✔	✔	✔		10 mmf-1000 mfd	6-500V
MERCURY	400 †	✔	✔	✔				.001-80 mfd	—
PACO	C-20 *	✔			✔	✔		10 mmf-2000 mfd	0-500V
PYRAMID	RC-1 *	✔	✔	✔	✔	✔		10 mmf-2000 mfd	0-500V
SENCORE	LC3 *		✔	✔	✔			100 mmf (minimum)	50V
SIMPSON	383A	✔	✔	✔	✔		✔	10 mmf-10 mfd	300V (WITH SERIES R)
SPRAGUE	TCA-1 ¶	✔	✔	✔	✔	✔		1 mmf-2000 mfd	0-150V

¶ SPECIAL LOW VOLTAGE PROVIDED TO CHECK VALUE OF LOW-VOLTAGE ELECTROLYTICS. * PROVIDES ADDITIONAL TESTS FOR OTHER COMPONENTS. † FUNCTION OF VOM ‡ FUNCTION OF VTVM

time and trouble. One procedure involves the use of an oscilloscope or AC voltmeter to check for the presence of signal where it should be absent, or vice versa. Of course, you must know what to expect in the way of waveform or voltage indications. For instance, you would expect a coupling capacitor such as C8 (Fig. 1) to pass practically all the available signal from the plate of V1 to the grid of V2; but in the circuit of Fig. 3, you would expect to find very little AC present at the screen grid (pin 8) of V1. Excessive signal at this point would indicate that the screen bypass unit (C4) was not doing its job.

In this case, substitution is often convenient; usually, however, an ohmmeter check can spot an open capacitor just as quickly. When a capacitor is removed from the circuit and fully discharged, connecting an ohmmeter across the capacitor should cause it to charge. The time this action takes is governed by the value of capacitance and the amount of series resistance in the circuit. The ohmmeter itself has at least several thousand ohms of resistance (depending on the range used); thus, if the capacitor is of fairly large value—say, .01 mfd or more—the time constant will be long enough to cause a noticeable change in the ohmmeter reading. On the x100K scale, for example, connecting the meter across a normal capacitor may cause the pointer to flick over as far as mid-scale, and then swing back—rapidly at first, and then more gradually—until the reading is near infinity.

Failure of the ohmmeter to react as described is a fairly good indication that the capacitor is open. Remember, however, that capacitor value must be sufficient to provide a measurable charging period. A value of 330 mmf might not produce more than a slight flicker of the ohmmeter needle, if that much.

Incidentally, if you have discharged a capacitor and then find that the ohmmeter needle "pegs" when the leads are connected across it, don't assume that you have found some weird circuit or that the meter is at fault. This is a natural phenomenon caused by a capacitor characteristic known as dielectric absorption. Certain types of capacitors exhibit this characteristic more than others. This is what happens: Even though you have shorted across the terminals of the capacitor, a small voltage will immediately start to build up across its plates when the short is

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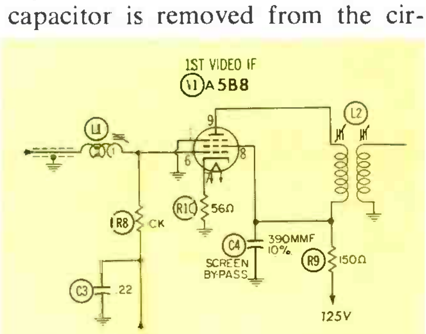


Fig. 3. Typical video-IF stage of a TV receiver. Note screen-bypass cap C4.

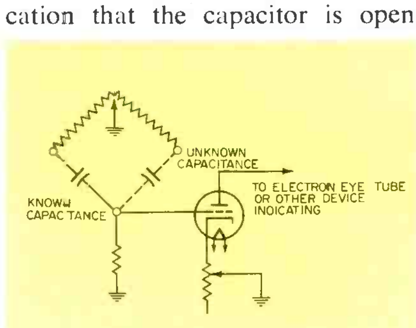


Fig. 4. Simplified bridge circuit employed to measure capacitance value.

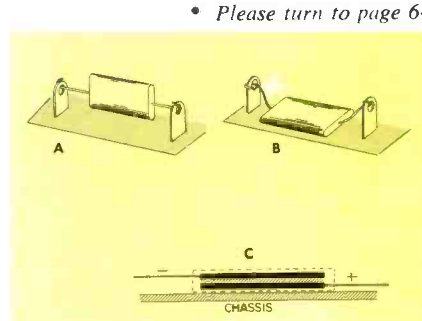
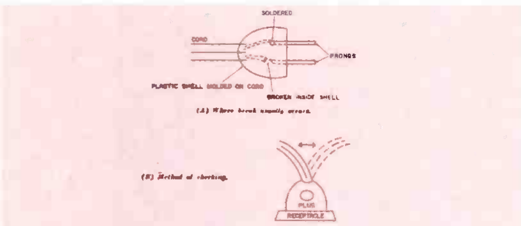


Fig. 5. Faulty installation of capacitor can easily introduce new troubles.

What trouble do you run into when servicing home appliances? Experts say most faults are traced to defective line cords, switches, thermostats, heating elements, or small motors. Here, then, are some tips on locating and correcting troubles caused by these specific components. Much of the work can be done with an ordinary VOM, but appliance testers, wattmeters, and temperature sensers are also useful.

Repairing

Line Cords

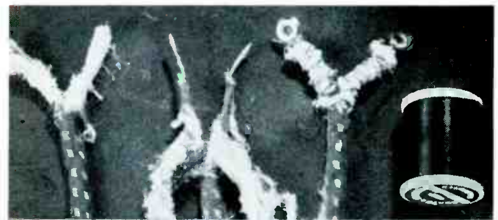


Due to constant flexing, aging, and abuse, line cords and plugs usually wear out before other parts. You can often detect an intermittent connection by simply moving the cord from side to side.

The quickest check on cord insulation is to bend it sharply. If the cord shows any signs of cracking or crumbling, replace it.

In replacing appliance wiring, use conductors that can safely handle high currents! Also see that insulation is equivalent to or better than the original. Knowing the wattage rating of the appliance, you can calculate the wire size needed by using the formula: $I = W/E$—where I is appliance current, W is wattage rating, and E is line voltage. After determining current, consult a wire table to select a size with roughly twice the required current capacity. The accompanying table can be your guide for most appliances.

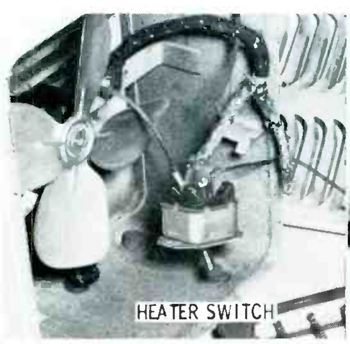
APPLIANCE RATING (MAX. WATTS)	WIRE SIZE TO USE (GAUGE NO.)
125	18
150	17
200	16
250	15
325	14
425	13
525	12
650	11
850	10

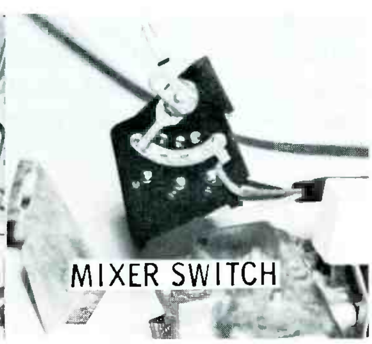


When replacing asbestos heavy-duty cord, remove about 3" of the outer coating, fold back the asbestos, strip the ends of the wire, and attach the connectors. Then, as a finishing touch, replace the asbestos and bind it with thread.

For heavy-duty service, always use a solderless connector. Shape the wire to fit the grooves, and then fold the two sections together. Crimp the shank over the insulation so that good contact results when the terminal nut is tightened.

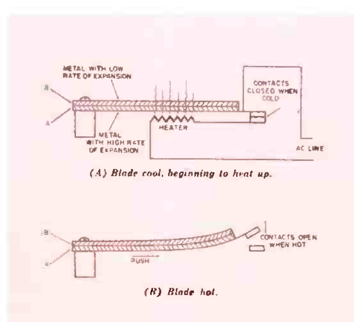
Switches and Thermostats





A faulty manual switch can cut off power to an appliance or cause intermittent operation. A continuity test with an ohmmeter will usually pinpoint this trouble. However, on heavy-duty switches, always check for high-resistance connections and signs of overheating.

On multiple-position switches (such as a speed control for a mixer), visually inspect the detent mechanism—if worn or loose, replace it to avoid future failure.



(A) Blade cool, beginning to heat up.

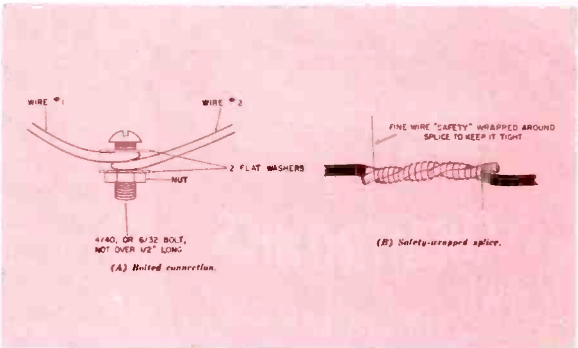
(B) Blade hot.

Irons, coffee makers, toasters, cookers, and other heat-producing appliances generally incorporate a small thermostat—a switch automatically activated by a heating element or by changes in ambient temperature. If you suspect thermostat trouble, inspect the switch contacts and look for corrosion or physical damage. Several adjustable types from electric irons are pictured here.

Small Appliances

Heating Elements

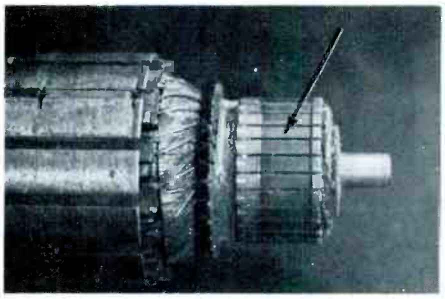
A heating element can carry enough current to produce usable heat energy without damage to the conductor. A continuity test or wattage measurement will quickly tell you its condition. Elements, if accessible, can be replaced by standard heating-element wire. Many appliances, however, employ a sealed unit. If open or shorted, this type must be replaced with an exact duplicate.

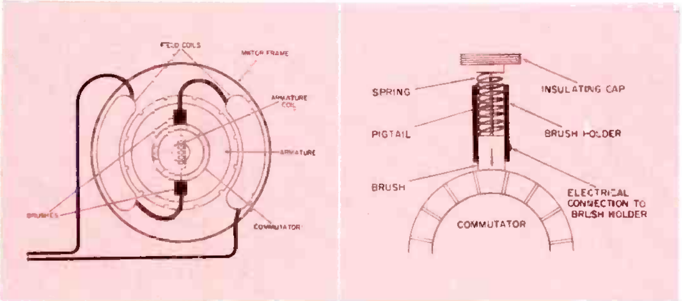


A wire splice in a high-current circuit must be capable of carrying the same current as the original wire; if loose or dirty, it will overheat and burn out. The drawing shows a couple of recommended types of splices. Incidentally, if you have trouble removing nut or screw connectors from heating elements, etc., try using penetrating oil or a rust remover.

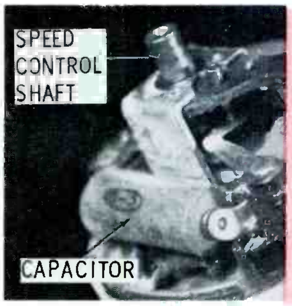
Small Motors

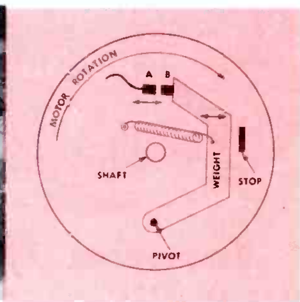
Food mixers, blenders, shavers, can openers, knife sharpeners, etc., generally have small commutator (brush-type) motors. These little workhorses all have about the same internal construction. Worn or broken brushes are one of the most frequent troubles. These are replaceable, and are easily removed for inspection. The ends should be smooth, and each should be long enough for the spring to keep a slight pressure on the commutator.





An appliance-motor commutator (arrow) should have a shiny ring all the way around. A rough, pitted surface usually indicates bad brushes or an open armature coil. To clean and smooth a commutator, use very fine sandpaper (not emery cloth!) Brushes may groove the commutator; however, if its surface is smooth, spacers are intact, and brush springs have enough tension, the motor should still work properly.





The speed of some motors is controlled by varying the applied voltage, while others use this centrifugal regulator. When the motor starts, the weighted arm moves away from the center axis; this, in turn, causes the motor-power contacts at A and B to break. The motor then slows down, but the spring soon pulls the arm in again and the contacts are closed. A capacitor (shown in photo) is usually placed across the contacts to reduce sparking. ▲

QUICKER SERVICING
by Jack Darr

where'd the BOOST go?

This is a question which has bothered a lot of us. It can be answered much easier by another question: "Where did it come from in the first place?" Boost isn't a gift of a couple of hundred volts from a well-insulated genie who lives inside the high-voltage cage. It's a perfectly natural result of the ingenious design of the damper circuit.

What is boost? It's the rectified voltage developed as a result of damper-tube conduction. Where does the current come from? Well, let's just disregard all the complicated theory about trace and retrace and simply say this: The yoke and flyback transformer form a resonant circuit which, when pulsed by current from the horizontal output tube, supplies the damper tube with a high-voltage AC signal. The purpose of the damper is to "damp" this AC oscillation and control the current through the yoke.

Is the circuit complicated? In its most fully-developed form (Fig. 1), it looks almost foreboding, so let's use the simplified version in Fig. 2. Doesn't look so bad now, does it? All we have is one transformer (the flyback) feeding another (the yoke), which is connected to a simple half-wave rectifier with a pi-type output filter. The DC output voltage appears at the cathode, and is actually developed across input filter capacitor C1. Because the lower end of the input filter capacitor returns to B+ instead of ground, we have a *biased diode;* any DC voltage developed across C1 will automatically be in series with the B+ voltage, so we get B++, or we have *boosted* the regular B+.

Because the output stage, flyback transformer, and yoke must be operating normally for proper development of boost voltage, its value is the best indicator of the condition of the horizontal sweep circuits—especially of those components which are difficult to test with conventional equipment. DC voltages, drive, current, and so on,

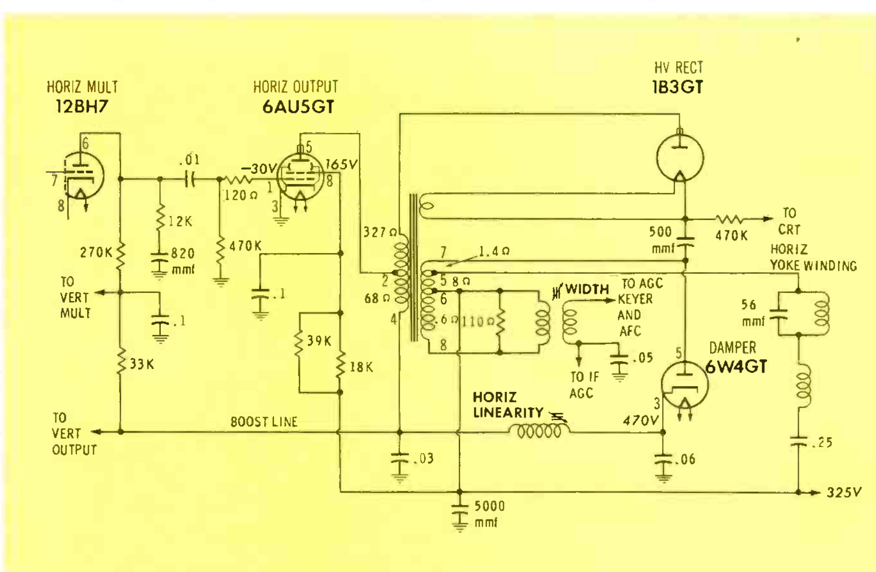


Fig. 1. Typical horizontal sweep section appears to be a complicated circuit.

Wake Up

A new day is dawning in electronics.

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

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

NEW SENCORE TRANSI-MASTER

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

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

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

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

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

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

DEALER NET. ONLY $49.50

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

Model TR110

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

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

NEW SENCORE TRANSISTOR AND DIODE CHECKER

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

Model TR115
Dealer Net
$19.95

SENCORE BATTERY ELIMINATOR AND TROUBLE SHOOTER

For replacing batteries during repair.

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

Model PS103
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can be checked with voltmeters and scopes, but shorted turns in yokes or flybacks require the use of special test instruments. While it's true that you may have use for these instruments in many cases, proper interpretation of the boost voltage can save you from unnecessarily making many special tests. So, let's outline a few simple tests that will lead us to the source of trouble without too much trouble or special equipment. First of all, we'll assume all standard tests have been made. This includes measurement of B+ voltage, replacement of tubes, a waveform check of horizontal drive, and tests for obvious short circuits. Only the boost voltage is missing, or lower than it should be.

If you were servicing a half-wave rectifier circuit, you'd make three tests: Replace the tube, measure the AC supply voltage on the plate, and check for a short or overload which could be pulling down the DC output voltage. All of these tests are equally valid in servicing damper circuits. Assuming we've checked the tube, how about the AC input voltage? The easiest way to check this is to place a scope probe close to, but not touching, the damper element connected to the flyback. The signal should contain high-amplitude spikes, as shown in Fig. 3. A little practice will give you a rough idea of what the amplitude should be. The absence of spikes should send you scurrying to the plate of the output tube for a similar test. If the spikes are low in amplitude (which would cause the boost voltage to be low), the trouble may be shorted turns in the yoke or flyback, or the high-voltage circuit might be harboring a short. Undamped oscillations, as shown in Fig. 4, usually mean the damper is not conducting or the boost capacitor is open.

Let's analyze one of the rougher ones, where everything else is OK, but it just doesn't work. Providing we didn't overlook anything, it's an "either/or" problem—it's either the flyback or the yoke. Disconnect the yoke and see if the pulses at the damper return to normal. Except in direct-drive circuits, where it is usually necessary for the yoke to be connected for the flyback circuit to operate, this test will immediately

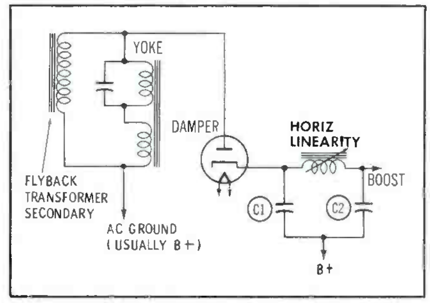

Fig. 2. Looking at only the boost circuit shows it to be a half-wave rectifier.

tell you whether or not to suspect the yoke. To make a more positive test, connect a substitute inductance across the flyback in place of the yoke. Several horizontal-sweep testers include an inductance which can be used for this purpose. If one of these isn't on hand, use a spare yoke with approximately the same inductance as the original. If the substitute is within 20% of the required inductance, boost voltage will be restored if the original yoke was defective. If nothing changes, the flyback is almost certain to have a shorted turn or turns. (Again, it is assumed that any capacitors in series with the yoke leads have been checked for shorts or leakage.)

There are three basic circuits used in yoke-flyback designs—one where the yoke is driven from a separate secondary winding (Fig. 2), the direct-drive type with the yoke and flyback in series (Fig. 5, left), and the modern type where the yoke is connected across a portion of an autotransformer-type flyback (Fig. 5, right).

The *action* of the damper tube is the same in all cases. However, in the direct-drive and autotransformer circuits, the damper cathode is connected to the high side of the yoke, whereas in the isolated-secondary type, the damper plate is attached to the high end. This is perfectly natural when we consider the standard phase reversal between the primary

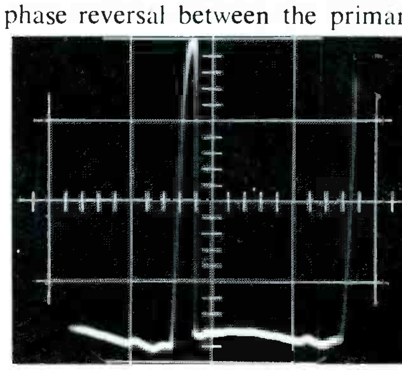

Fig. 3. As experience will show, this is normal signal at input side of damper.

It's taking the country by storm

THE MIGHTY MITE

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

- "It is the best tube tester I have ever owned." F.M., MONROE, LA., TV TECHNICIAN
- "It's a real asset to any serviceman." (35 years in servicing) C.H.W., EAST PRAIRIE, MO., TV TECHNICIAN
- "This is the best checker I have ever used." E.L.R., HASTINGS, MICH., TV TECHNICIAN
- "A must for every serviceman. A real Time Saver at a reasonable price." W.P., ERIE, PA., TV TECHNICIAN
- "The most complete and reliable instrument I ever bought for this price." H.P.R., QUEBEC, CANADA, TV TECHNICIAN
- "I already own one. This is my second Mighty Mite." PHILCO DISTRIBUTOR, ST. LOUIS, MO.
- "Mighty Mite has paid for itself the first month." W.C., UNIONTOWN, PA., TV REPAIR
- "I have found the Mighty Mite all that you say it is and more. It tests tubes that my other tester, costing twice as much, will not test." L.K.E., W9PWQ, CHICAGO, HAM

Don't be misled... there's only one Mighty Mite!

MAGAZINE TEST LABS SAY...

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

Les Deane

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

Sencore Sam says

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

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S E N C O R E

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Announcing...

NEW MIGHTY MITE II

Identical to TC109 Mighty Mite with addition of 4 sockets for testing compactrons, nuvistors, novars and 10 pin tubes.

Model TC114................Dealer Net **67**[50]

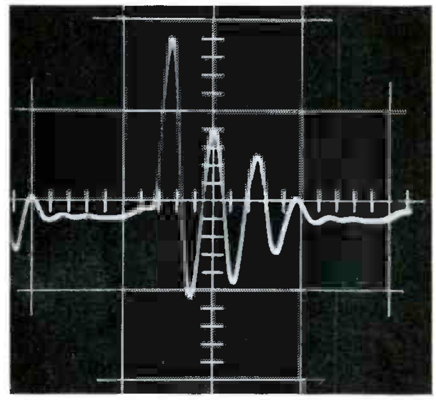

Fig. 4. Undamped oscillations at the damper are sure sign of boost trouble.

and secondary of an isolated-secondary transformer.

The second difference lies in the action of a capacitor sometimes connected across the damper tube. In transformer circuits, capacitance across the damper increases width —an advantage often used by designers and technicians to obtain that last half-inch of sweep. In direct-drive circuits, however, capacitance across the damper usually decreases sweep width. This capacitor also affects boost voltage. In transformer circuits, increasing sweep usually reduces boost voltage; for direct-drive circuits, the effect is just the opposite.

The horizontal linearity coil (Fig. 2) is an important part of many boost circuits. The entire circuit, including the coil and capacitors C1 and C2, is resonant at about 75 kc; when the coil is properly adjusted, the plate current of the horizontal output tube will dip. The bottom of the dip is the point of maximum RF (pulse) output and minimum plate current. Therefore, the coil is properly adjusted when the pulses applied to the damper plate are at maximum amplitude. At this same point, the boost voltage will also be maximum.

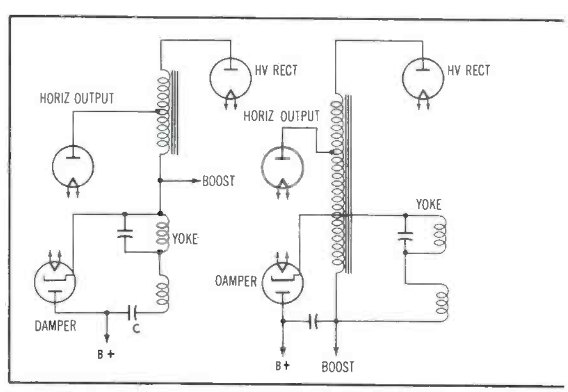

Fig. 5. Direct-drive and autotransformer flybacks have similar boost circuits.

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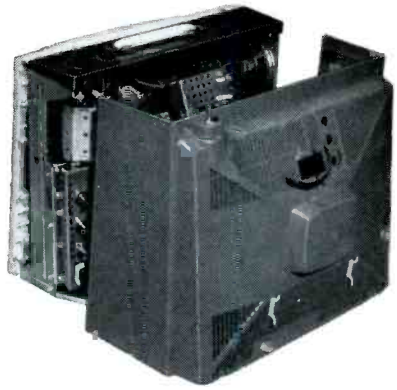
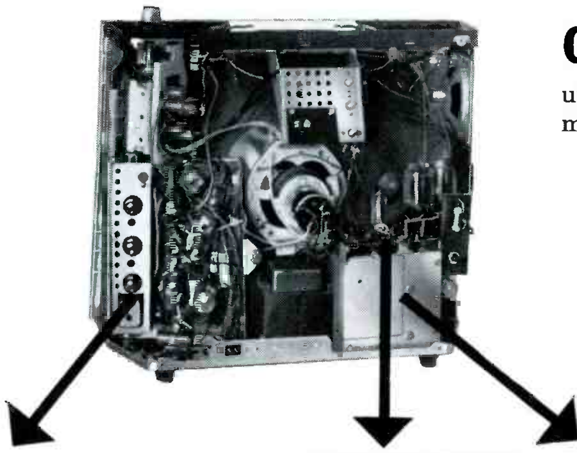
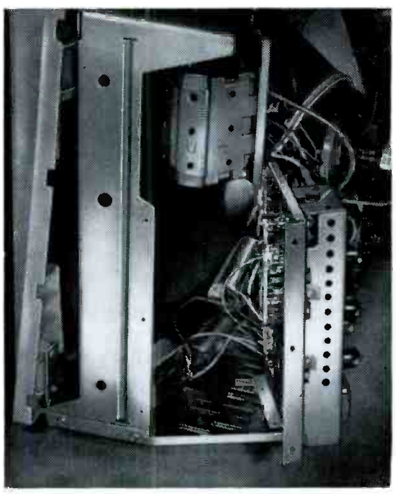
is the word for the new General Electric Celebrity Portable TV

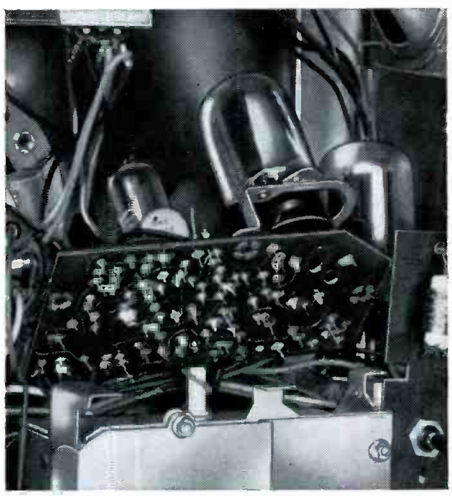


OFF The back *and the sides* of the cabinet come off as one unit, exposing the chassis for maximum accessibility.

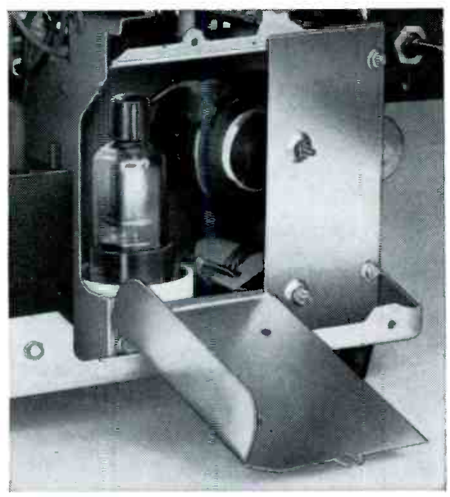




OPEN Precision-crafted IF circuit board swings open—components and connections are easy to *get at.*



UP Sweep circuit board lifts up, to make component replacement fast and easy. Full fillet solder connections for sure contact.



DOWN The high-voltage cage trap-door drops down for easy rectifier tube replacement. The whole panel is removable.

More time-saving features: Full power transformer • All fuses accessible • "Road maps" for easy circuit tracing • Color-coded leads • Plug-in video detector assembly • B+voltages marked, test points identified on circuit board.

The proof is in the picture! When the picture you see IN the Celebrity chassis is *this* clear—you need less time to clear the picture your customer sees ON the Celebrity.
Less time per call = more calls per day = PROFIT

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GENERAL ELECTRIC

General Electric Television Receiver Department, Syracuse, New York

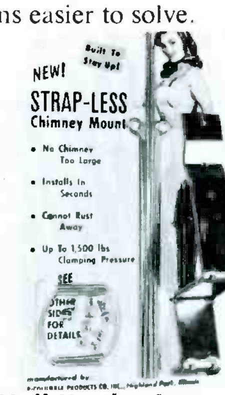
If adjusting the horizontal linearity coil fails to produce a change in boost voltage at any point, there is something wrong. Etiher the horizontal oscillator is far off frequency, there is a defective component in the linearity-coil circuit, or the flyback or yoke is bad—squelching the horizontal pulses so the linearity circuit can have no effect.

Boost-Voltage Loading

Since boost voltage is "free," it is often used to advantage in supplying various circuits with higher-than-normal B+ voltage. Typical applications include the vertical and horizontal output stages, and in many cases the horizontal oscillator. The amount of current drawn from the boost circuit varies from 2 ma up to 30 or 40 ma. In the circuit shown in Fig. 1, all of the above loads draw quite a large current from boost without any trouble. By the way, in tracing the plate circuits for the horizontal oscillator and output tubes, you'll notice there is no direct connection to B+. For those of you who are perplexed by the perennial "merry-go-round"— oscillator drive is needed to produce boost, but the plate is supplied from boost—you'll find that B+ is supplied via the transformer secondary and the damper tube. Thus, the oscillator has enough voltage to start working, gradually building the boost supply up to normal.

If you suspect that boost-circuit loading is the cause of boost trouble, remove the load. Pull the vertical output tube, for instance, or disconnect the boost-voltage connections to the other circuits. In some cases you can connect a milliammeter in series with the circuit; figure out the normal current, by using the voltage drops across resistors in the circuit; and compare the two values.

By now it should be obvious that boost voltage holds a very useful clue for troubleshooting sweep and high-voltage troubles. Remember to check out the damper circuit just as you would any other half-wave rectifier, and you'll find a lot of your problems easier to solve.



Nail Up the Antenna

An innovation in chimney mounts overcomes the problem of mounting straps rusting in two—by doing away with them. It's the *Strap-Less Chimney Mount,* manufactured by R-Columbia Products Co., Inc., of Highland Park, Illinois.

Two pairs of 1/8″ rods take the place of conventional straps. They are threaded on one end to permit adjustment, and have eyes in the other end to accept either 1 ¼″ or 2″ masonry nails furnished as part of the kit. A hammer is all that is required to drive the nails into the mortar between bricks, stone, or blocks. It is best to insert the nails between the ends of adjacent bricks (not between rows) so that any leverage exerted will force the nail against a brick instead of mortar. The new mount is also supplied with lock screws to prevent the mast from turning. ▲

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When you insist on a Philco STAR BRIGHT 20/20 Picture Tube or Philco Receiving Tube, you're sure of unbeatably high quality. Type for type, there are many technical reasons why—but the most fundamental reason behind Philco's pledge of quality is the fact that Philco is here to stay . . . and the service-dealer is Philco's most important tube customer. The independent service-dealer has relied on the Philco name for over 30 years . . . and Philco constantly raises its standards to make its good name even more of an asset to you—the service-dealer, in the coming years.

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DOLLAR & SENSE *Servicing*

by JOE A. GROVES

PUTTING THE LID ON OVERHEAD

Every electronics service dealer should be aware that one way to increase profit is to reduce overhead. Unfortunately, far too few shop owners know how to keep their overhead expenses in line with their income. To make matters worse, there is relatively little information available to help those who want to find out *how* to control overhead. Here are some concrete steps you can take to overcome this problem.

First of all, you must realize that overhead will not take care of itself. Don't make the common mistake of thinking that as long as you're in business, and doing a certain volume of work, overhead is certain to maintain a specific level. This isn't true. It's doubtful if two shops out of thousand taking in $20,000 a year have the same expenses. Once you become aware of this fact, you'll have taken the first step toward improving your profit picture.

Next you must realize what overhead is — otherwise, how can you control it? Overhead is more than just your cost for rent, heat, lights, and truck operation. For a service operation, it takes in *all* of your expenses other than the costs of parts and money invested in real property such as buildings and equipment. Even then, depreciation on stock, equipment and business property must be classed as overhead.

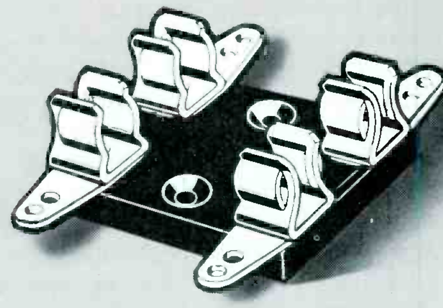
Take a look at the list of typical overhead expenses for an electronics service business. We've listed *only* 40! You undoubtedly have some other expenses that aren't shown. Also, you may find some that don't apply to your operation — but don't be too quick to cross them off.

Once you know what is costing you money, you must find out how much you're spending for each item. This calls for accurate records. If you don't like bookkeeping, you may want to hire someone to do it for you, or you can farm the job out to an independent accountant. You'll more than save the little bit it costs you. It may surprise you to learn that you can often save money, or at least wind up with a bigger percentage of profit, by *adding* another expense. But this is what happens when you invest in a record-keeping system, since paying attention to *where* your money goes is one of the secrets of operating a successful business.

When the end of the month comes and you find out what you spent your money for, don't stop there. It doesn't do any good to know you paid out $30 to buy gas and oil for your truck, unless you can determine whether or not this figure is in line with your operating budget. Keep a monthly record for each item, with expense figures entered side by side so you can compare current expenditures with those for previous months. A mere glance will tell you when one of the items is rising too

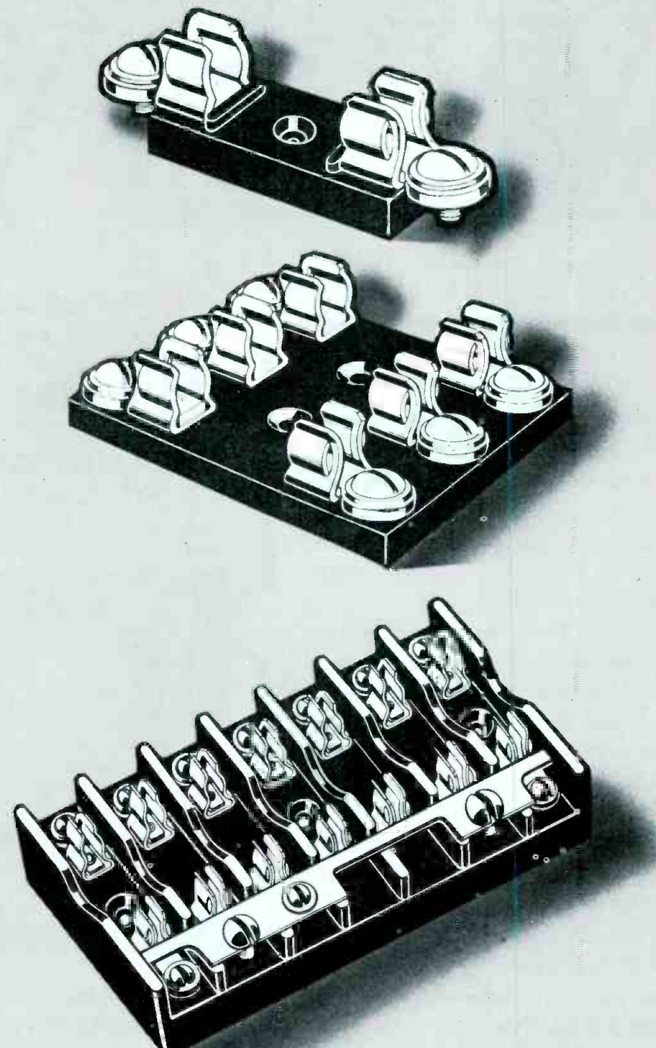
Chart I — Typical Overhead Expenses

1. Accounting Fees	21. Retirement Plan
2. Advertising	22. Service Information
3. Association Dues	23. Shipping Charges
4. Bad Debts	24. Social Security
5. Breakage	25. Telephone
6. Callbacks	26. Trade Magazines
7. Decorating	27. Truck Repairs
8. Gas & Oil	28. Vacation Pay
9. Hand Tools	29. Wages - Self
10. Heat	30. Wages - Office
11. Hospitalization Plans	31. Wages - Technicians
12. Insurance (All)	32. Wages - Misc.
13. Interest on Loans	33. Water
14. Inventory Shrinkage	34. State License & Tax
15. Legal Fees	35. Equipment Depreciation
16. Lights	36. Fixtures Depreciation
17. Lost-Time Wages	37. Furniture Depreciation
18. Office Supplies	38. Property Depreciation
19. Rent	39. Stock Depreciation
20. Repairs	40. Truck Depreciation



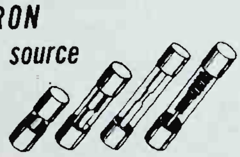
BLOCKS

for BUSS and FUSETRON FUSES



All types available for every application

BUSS and FUSETRON FUSES: One source for all your fuse needs.



Get full data for your files, write for BUSS bulletin, Form SFB—it gives a comprehensive picture of the complete line of fuses and fuse mountings of unquestioned high quality.

BUSSMANN MFG. DIVISION, *McGraw-Edison Co.,* **UNIVERSITY AT JEFFERSON, ST. LOUIS 7, MO.**

high or too fast. Then you can check to see if there is a valid reason for the increase, and if it's uncalled for, take steps to correct the situation.

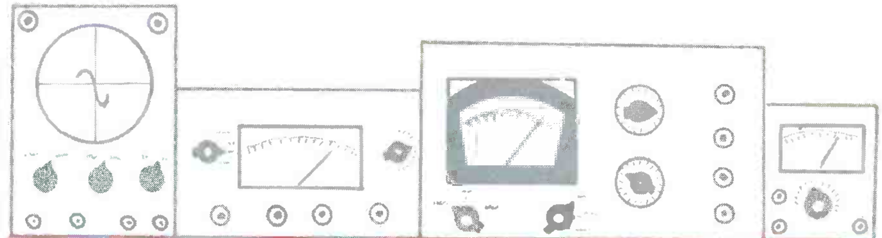
Even before you've recorded your second month's expenses, you may notice some item that seems unduly high. But don't be too hasty to conclude it is out of line and take drastic steps to correct it; first weigh all the facts. For example, a $25 telephone bill is no sign you should have the phone taken out. That would be committing business suicide in this field. It would be a good idea, though to find out *why* the bill was so high. Maybe it includes the cost of phone-book advertising, which should rightfully be a separate entry in your ledger. Maybe you made more than the usual number of long-distance calls. (You can take steps to correct *that.*) Maybe it includes a telephone-answering device — if so, is it paying off for you?

Carefully evaluate each and every expenditure on your list, because these expense figures provide cold, hard facts for you to use in guiding your business to success. Take rent, for example — an item of overhead which runs consistently the same month after month. Ask yourself, "Is my location giving me the most for my money? Could I be saving money if I signed a lease or moved to another location? Would a new location increase income enough to pay more rent? Would my income decrease if I moved to a less expensive spot?"

Carefully studying the implications of all other expenditures—not only at the start, but every month—will help you plan your best course of action. To illustrate how you might think through another overhead figure, let's consider bad debts. Any repair bill that's still due after 90 days is on its way to being lost forever. You can't laugh it off and say, "Well, I only had $1 in the tube." The job cost you *time*, and perhaps travel expense, as well as the price of the tube. Therefore, your penalty for not collecting may amount to several dollars. When unpaid bills begin to pile up, it's time to take some sort of action to recover at least some of the money due you. By rigid control of bad debts, you can go a long way toward improving your profit picture.

Still another item, of special interest to shop owners, is technicians' wages. During a lull in business, when wages paid for lost time loom large in the overhead-expense records, it's a great temptation to lay off hired technicians for immediate relief of the "profit pinch." But, once you let these men go, they're gone; and when business picks up again, you're stuck with the problem of finding and breaking in new help. Rather than inviting this delayed-action headache, why not get your brain working now, and think up ways to keep technicians busy so you can afford to keep them on the payroll? Maybe you need to *increase* advertising expenses to *reduce* lost-time wages — another good example of spending money to make money.

We could go on and on to show how careful planning helps keep expenses within bounds. However, we can summarize the whole subject in just a couple of sentences: If you're looking for a "lid" to hold down overhead, try a large record book. It works best when you keep it open and lean on it while you study the contents. ▲



NOTES ON TEST EQUIPMENT

by Les Deane

"Sines" of Power

Ever wish you could increase or decrease line voltage at will, have need of 60-cycle power at 24 volts, or desire a separate AC filament supply? The piece of equipment shown in Fig. 1 gives you all of this in one compact portable case. Manufactured by EICO, Inc., of Long Island City, New York, the Model 1073 Variable AC Supply not only offers an output of zero to 140-volts rms. but also provides built-in meters for monitoring load voltages and currents.

Designed for all kinds of AC-power jobs in the service shop, factory, laboratory, or home, the Model 1073 comes complete in either wired or kit form.

Specifications are:

1. *Power Requirements—120 volts, 60 cps; power consumption variable with load (360 watts max); unit convertible to 50-cps operation; 3-amp line fuse, switch and pilot light provided on front panel, supply nonisolated.*
2. *Output Voltage—continuously variable from 0 to 140VAC at 60 cps, and from 0 to 120VAC at 50 cps; undistorted line signal with insignificant voltage drop from no load to full load.*
3. *Output Current — two maximum ranges of one amp and three amps; AC output receptacle provided on panel.*
4. *Panel Meters—2⅜" rms units: AC voltmeter calibrated in divisions of 5 from 30 to 140 volts; AC ammeter calibrated in two scales of 0 to 1 amp and 0 to 3 amps; range selector and fuses provided on panel.*
5. *Size and Weight—8½" x 5¾" x 7", 9 lbs.*

Using a sample factory-wired version of this instrument, I ran several tests to check output voltages and currents, waveform reproduction, and accuracy of meter and dial calibrations. I found the meter readings to be well within 3% of full-scale values and the voltage dial reasonably exact using a line voltage of 120VAC. The output signal also matched that of the line—a pure 60-cycle sine wave. Using a number of dummy loads, I noted that the output voltage remained fairly constant within the designated current limits of the unit, and that it changed in only direct proportions

Fig. 1. Output from Eico's metered AC supply is variable from 0-140 volts.

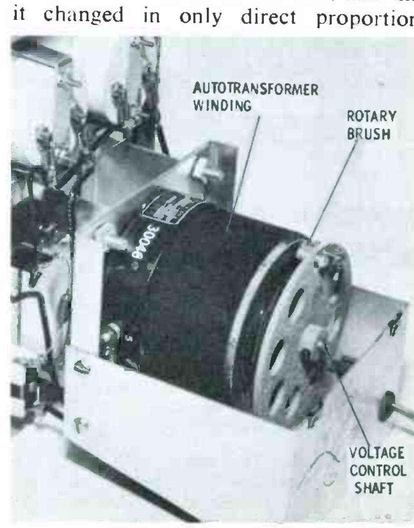


Fig. 2. Unusual transformer in the Model 1073 uses a rotary brush-type tap.

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MODEL 850 $79.50

FEATURES:

1 Now you can test low voltage applications. .5 VOLT full scale range on D.C. Extremely useful in low voltage transistor circuits.

2 BETTER STABILITY through improved current design.

3 LONG FULL VIEW SCALES. Scales 7" long at top arc for easy reading.

High Input Impedance (11 MEGOHMS) and wide Frequency Ranges give this extremely versatile Electronic Volt-Ohmmeter considerable advantage in the measurement of DC voltages, AC RMS and Peak-to-Peak voltages. It measures directly the Peak-to Peak values of high-frequency complex wave forms and RMS values of sine waves on separate scales.

ADDED PROTECTION. Meter is shorted out in OFF position for greater damping, meter safety during transit, electrically protected against accidental overload. ZERO CENTER mark for FM discriminator alignment, plus other galvanometer measurements.

New pencil thin test probe used for all functions: DC, AC, and ohms. No need to change cables. Beautifully styled case for professional appearance and functional utility, 7⅝" x 6⁷⁄₁₆" x 3¾".

Carrying handle can be used as a tester stand to place the tester at 25° angle for ease in reading.

Frequencies to 250 MC may be measured with auxiliary Diode Probe, **$7.50** extra. DC voltages to 50 KV may be measured with auxiliary High Voltage Probe. **$20.50** extra.

TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

CARRYING CASE

Case 859—OP—Black leather Padded Carrying Case **$19.50 Net**

RANGES

8 DC VOLTS RANGES	0-.5-1.5-5-15-50-150-500-1500
7 AC RMS VOLTS RANGES	0-1.5-5-15-50-150-500-1500
7 PEAK-TO-PEAK VOLTS RANGES	0-4-14-40-140-400-1400-4000
7 RESISTANCE RANGES	0-1000-10,000-100,000 OHMS; 1-10-100-1000 MEGOHMS.

FREQUENCY RANGE 15 CPS to 3MC; (Up to 250 MC with accessory diode probe available extra.)

INPUT IMPEDANCE DC Volts 11 Megohms; AC Volts minimum of .83 Megohms.

630 630-A 630-PL 630-APL 630-NA 630-T 631 310 666-HH 666-R

THE WORLD'S MOST COMPLETE LINE OF V-O-Ms. AVAILABLE FROM YOUR TRIPLETT DISTRIBUTOR'S STOCK with applied line voltage.

Construction of the Model 1073 centers around a variable line autoformer with toroidal-core design. Pictured in Fig. 2, this wire-wound component measures a little over 3½" in diameter and accounts for most of the instrument's weight. Line voltage is applied across a large winding of the autoformer, and a rotary brush mounted on a metal disc at the rear of the unit serves as a variable tap for the output voltage. Incidentally, the brush is replaceable, and detailed instructions for installing a new one are included in the Eico manual.

After working with the Model 1073 in the lab for only a short time, I realized that a variable AC supply has many applications in radio, TV, audio, and small-appliance servicing. Perhaps the most significant of these is simply being able to control applied line voltage. Thus, you can simulate conditions found in certain low line-voltage areas; or you can safely trace a short by applying only enough voltage to give you a needed indication.

By increasing line voltage, you can often accelerate the occurrence of intermittent troubles or check a doubtful component to make sure it will withstand normal line fluctuations. With the added meter features of the Model 1073, power consumption measurements offer an additional troubleshooting tool. Service data such as PHOTOFACT folders lists normal current requirements for all AC-powered equipment, and it's a simple procedure to check current by merely plugging a line cord into the panel of the Eico supply. Current ranges can be safely switched under load; and the double-pole power switch completely disconnects the instrument from both sides of the line when in the off position.

I found the 1073 of value as an AC source for calibrating or checking meter movements and other test equipment, and used it as a calibration standard for waveform amplitude measurements. The instrument provides a variable output sine wave from zero to approximately 400 volts peak to peak. Various levels of this 60-cycle signal can also be employed to signal-trace audio, sync, or vertical-sweep circuits. For these purposes, I used a test cord with clip-lead ends.

As a tube-filament supply, the unit is ideal for powering all series-string arrangements, and even 6- or 12-volt parallel systems up to a maximum current of 3 amps. To accurately monitor output voltages of less than 30 volts, an external voltmeter must be used. By adding a rectifier-filter network to the output of the instrument, it can also serve as a variable bias source or DC power supply. The above applications for this small power package represent just a few of its uses; its versatility is really limited only by the ingenuity of its operator.

CRT's Tested or Repaired

Designed for use in the home or shop, the portable instrument pictured in Fig. 3 checks all types of TV picture tubes, and can be used to restore many that have minor defects. Identified as Model 800 CRT Tester-Reactivator, produced by Mercury Electronics Corp. of Mineola, New York, it comes supplied with test-socket adapter and complete operating instructions.

Specifications are:

1. Power Requirements—110/125 volts, 60 cps; standby power consumption less than 5 watts; supply isolated from line; power switch and pilot

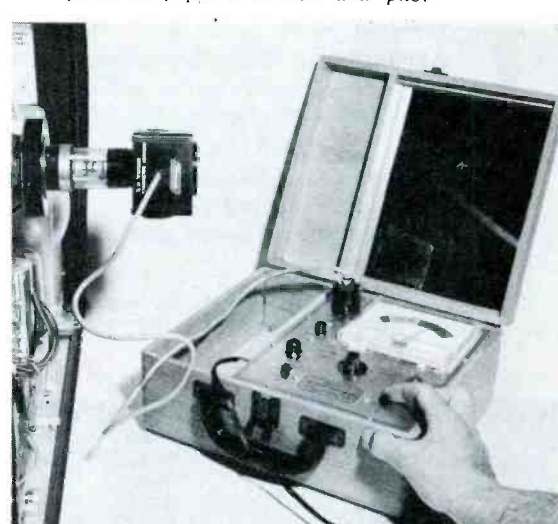


Fig. 3. Mercury's CRT tester restores emission and corrects other defects.

Fig. 4. Test head eliminates the need for additional test-socket adapters.

light provided on panel.

2. *Element Tests—filament continuity, shorts, and leakage shown on neon panel-indicator; grid, cathode, G2, and G4 element selector provided on panel.*
3. *Quality Test — CRT emission indicated on* GOOD-WEAK-BAD *scale of panel meter (relative 0-100 scale also provided).*
4. *Color Tubes — element and quality tests performed on individual guns; gun selector switch provided on test-socket adapter.*
5. *Life Test — relative life expectancy determined by declining rate of tube emission as filament voltage is removed; ratings of average time given in manual.*
6. *CRT Reactivation — provides both "boost" and "shot" methods of increasing emission for monochrome and color tubes, meter monitors results simultaneously; burns off shorts and re-welds open elements; single reactivation pushbutton on panel.*
7. *Other Features — adapter provides four different test sockets plus color-gun selector; panel switch offers 2-, 6-, and 8-volt heater potentials, with setup data for special tube types supplied in manual.*
8. *Size and Weight—case 4½" x 11⅛" x 9½", 7 lbs.*

One of the nice features of this unit is its large 4½" panel meter. The BAD, WEAK, GOOD areas of the meter scale are color-coded, and since the scale also has linear calibrations, it's a simple matter to compare the emission of different guns in a color tube and evaluate results of the life-expectancy test.

The only true way to test a tester is to use it in some practical applications. This I did with the Model 800 by coming up with some old picture-tube duds. After testing three of these, I found that the instrument detected each of their faults—all with low emission and one with a heater-to-cathdoe short.

I first tried to restore emission on two of the tubes by the "boost" method (increasing heater power). However, emission increased only slightly and, when the tubes were placed under normal operating conditions again, emission kept falling back to the original low level. Setting up the tester for the "shot" method of reactivation (high-voltage applied to the cathode coating), the emission readings for both tubes almost reached the good section of the scale.

I was unable to completely cure the tube with the interelement short, which was apparently caused by two elements in direct contact with each other. It's seldom possible to correct such a condition by any form of rejuvenation. Had the short been caused by foreign material lodged between the two elements, chances are the "shot" would have burned off the material and removed the short entirely.

Open elements are not indicated directly by the Model 800, but as outlined in the manual, they are determined by summing up results of the other tests or by visual inspection. CRT's calling for low (G2) screen voltages are tested in the same manner as conventional types, while quality readings for those with 2-volt filaments are a little different; a meter deflection above 20 on the linear scale indicates that this type of tube has satisfactory emission.

The test cable supplied with the Mercury unit features a single octal plug for connection to the instrument panel and a special *Multi-Head* adapter which provides test sockets for standard CRT's, color tubes, and 8- and 7-pin bases. As pictured in Fig. 4, the adapter box also includes a color-gun selector switch. ▲

THE TROUBLESHOOTER

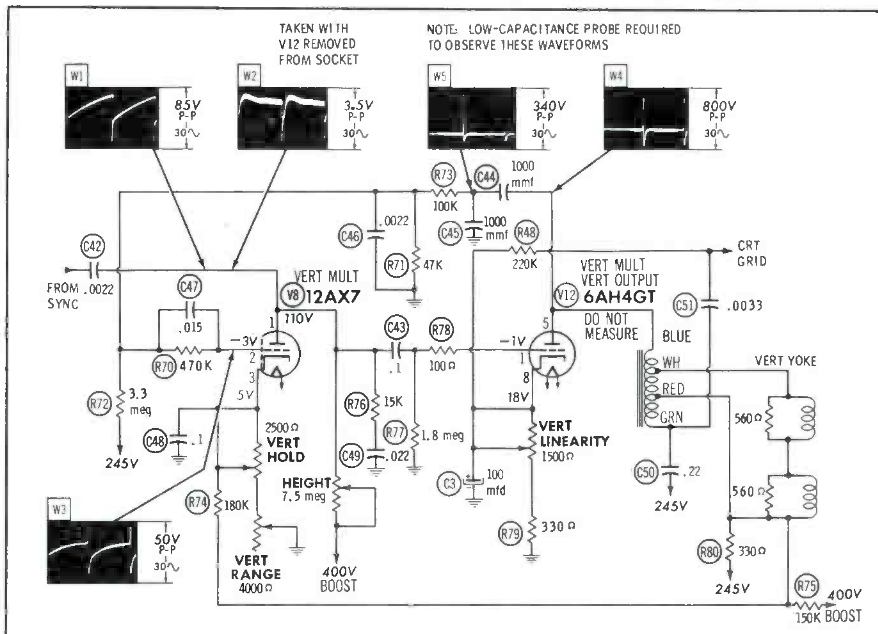
answers your service problems

Pulse Division

In the February article "Operation Vertical" you show the division of the feedback pulse. I'm wondering if there is a simplified method of determining what voltages should appear at different points in the circuit.

J. M. Lupold
Miami, Fla.

Generally speaking, mental arithmetic will provide "close-enough" voltage computations for tracing these circuits. Notice that C44 and C45 on the adjoining schematic are two 1000-mmf capacitors in series to ground. Therefore, you might logically expect the pulse to divide almost equally across both components. However, notice that R71 and R73 as well as C46 also go to ground from this junction. This automatically indicates that there will be more of a drop across C44, since the parallel paths to ground reduce the impedance across C45. Also, taking into account the approximately 2:1 resistance ratio between R73 and R71, plus the presence of C46 across the smaller resistor, you can see that considerably less than ⅓ of the pulse at the "high" end of R73 will be found at the "low" end of this resistor. The signal at the latter point, between 50 and 100 volts in amplitude, is fed to the grid coupling circuit of C47 and R70. Although C47 presents a fairly high impedance to the low-frequency (relatively level) portion of the waveform, it easily passes the pulses which trigger the multivibrator.



Meter Headache

I have a VTVM that sometimes misleads me to think I have oscillator troubles when servicing AC-DC radios. My latest experience was with an old Silvertone Model 5 that gave every indication of having a weak oscillator. Checking the voltage at the grid showed only –.5 volts instead of a healthy negative 5-15 volts. Further checks failed to reveal any defect that could be killing the oscillator, so I grabbed another VTVM from the TV bench to double-check my results. This time I found plenty of negative voltage on the grid. The first meter works in other applications, and is OK part of the time when checking oscillators. What could be causing the trouble? Incidentally, a shorted output IF transformer turned out to be the trouble.

SLIM'S TV
Tulsa, Okla.

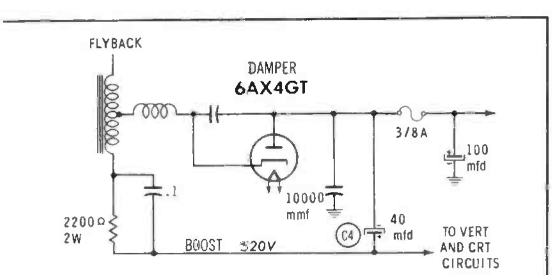
Sounds like the DC-voltage isolation resistor for the meter in question is inside the case rather than at the probe tip. Several old meters were wired in this manner. The additional capacitance of the meter lead probably loads the circuit enough to cause an erroneous indication. Try moving the isolating resistor to the probe end of the lead.

Hidden Resistance

I've often noticed that PHOTOFACT Folders show much lower resistance to ground from the cathode of the damper than the circuit seems to indicate. For example, the General Electric Chassis S covered in Folder 313-4 shows only 200K ohms from pin 3 to ground. In tracing the circuit, the only path is through the height and brightness controls with a combined resistance of 3.2 megohms. What have I overlooked?

GEORGE CHANAKA
Washington, D.C.

This set, like many others, has an electrolytic capacitor connected to the boost line. The leakage resistances of boost filter C4 and B+ filter C1 are in series to ground from the boost voltage line. Therefore, the resistance reading from pin 3 of the 6AX4 to ground will vary, depending on the amount of leakage in these components. Occasionally, you'll find a boost filter with a very high leakage resistance. These capacitors tend to retain a charge—even after you've used a jumper to discharge them. When you're measuring damper-cathode resistance in such cases, the meter needle will usually peg above the infinite reading. Rather than becoming disturbed about this effect, you can take it as a definite sign there's



very little leakage on the boost line, and immediately turn your attention elsewhere.

Feed-Through Replacements

In servicing tuners, can a feed-through capacitor be replaced with a ceramic capacitor of equal value?

CURTICE C. CAMPBELL
St. Charles, Minn.

Disc or tubular ceramic capacitors can be substituted for a feed-through type in filament-bypass circuits with little concern. However, in the RF- or mixer-oscillator stages, the additional stray capacitance created by the leads may seriously affect the tuning. See "Practical Capacitor Testing and Replacement" starting on page 28.

Universal Loop Antenna

Please let me know where I can buy, or how I can build, a universal test loop for radio service work. If this is an impossible request, what's the best way to meet the problem?

PAUL CAPITO
Erie, Pa.

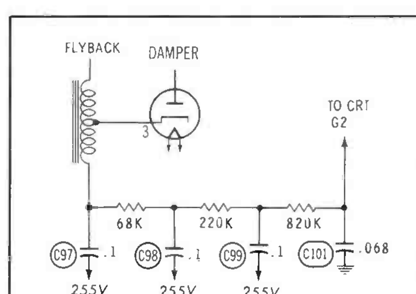
Loop antennas have such a wide range of inductances that it is impossible to have a standard loop that will match all radios. However almost any loop antenna will work satisfactorily for a bench test, and will allow you to align all but the antenna circuit. The latter adjustments should be made with the receiver installed in the cabinet so you can align the set to match the stray capacitance present during normal operation.

Crazy Symptom

An RCA Chassis KCS113A would lose the raster whenever the horizontal hold was adjusted to lock in a picture. On either side of lock in, normal sloping bars would appear. Quite by accident, I discovered a loose connection to G2 at the CRT base which proved to be causing the trouble. Do you have any explanation?

TRIANGLE
Durhamville, N.Y.

There was probably enough ripple on the boost line feeding G2 to arc over the poor connection whenever the oscillator was off frequency. Minimum ripple develops when the circuit is resonating at 15 570 cps; apparently, the resulting boost voltage was too "smooth" to span the gap. It would be wise to make sure the multiple boost filter capacitors are all up to par in this circuit.



SERVICE DEALER ADVERTISING PROGRAM

Now is the time to start your fall advertising campaign. You can add a lot of sparkle to your program by using a wide variety of ads to keep folks guessing about what you'll come up with next. If your promotional plans call for newspaper advertising, change ads every issue and repeat them every so often.

If you contemplate using direct mail, handbills, or posters with some special message, the largest ad from this month's selection should work in nicely with your plans.

Check with your printer to see if you should order newspaper mats ($1.75 per set of 5), reproduction proofs ($1 per set), or both ($2.50). Then, fill in the handy coupon on page 68 to order either this month's selection or the entire program of 60 ads. (With the latter, you receive a comb-bound book of proofs.) To be sure of getting your ads in time for your promotion, mail the request as early as possible.

ES-4 1⅞" x 4¼"

The "Doc" will make your business healthier by urging people to have their sets put in top shape before the fall rush.

ES-25 3⅜" x 6⅝"

Here you have lots of space to present your own special offer, surrounded by a border that people can't miss seeing.

ES-11 1⅞" x 5"

Dramatizing "service that satisfies," this ad stresses that your expert repairs make a TV set perform so well it's a pleasure to watch.

ES-45 1⅞" x 4¼"

The beaming face of this little sprite warms TV owners up to the idea of a clean-up and adjustment for a "bright-as-new," rock-steady picture.

ES-19 1⅞" x 7"

Cartoons poke sly fun at the do-it-yourselfer and warn him of possible danger, suggesting that it's safer and smarter to call you.

Solving Slow Warm-Up

(Continued from page 22)

tions of the set are rather misleading. For example, in a Motorola Chassis TS-518 I recently serviced, the picture and sound both appeared in about 50 seconds—but the raster was slightly small and somewhat dim. These defects disappeared after 10 minutes, when the size and brightness suddenly increased to normal.

The customer, a "do-it-yourselfer" who hadn't yet learned any better, had already replaced the damper, horizontal oscillator, and horizontal output tubes. I remembered that screen voltage to the output tube was supplied through a stacked B+ circuit involving the audio output tube, so I also tried a new 25L6 in the audio stage; but this maneuver had no effect. I ended up by taking the set into the shop.

After about one minute of warm-up time, with the raster still dim and narrow, B+ was about 240 volts—some 20 volts lower than normal. I didn't consider this low enough to explain the trouble, for I have seen the same type of set operate normally with B+ less than 230 volts. Screen voltage on the 25BQ6 horizontal output tube was normal, but the boost voltage measured only 330 volts instead of a normal 480. This last voltage was the greatest operating deficiency in the whole set, for boost was only 90 volts higher than B+. In these sets, the damper circuit normally develops a DC potential more than 200 volts above B+.

On the scope, the sawtooth signal at the 25BQ6 grid was just about perfect in both amplitude and shape. By means of a high voltage probe, I found that the pulses at the plate of the 25BQ6 and the cathode of the 12AX4 damper were only slightly below normal. These voltage and waveform readings took about five minutes. At this point I turned the set off, because I feared that it might require a long cooling period to return to its troubled state if I let it warm up thoroughly.

Reviewing my findings, I concluded that the trouble was definitely in the damper stage or on the boost line, since the boost voltage was much too low in proportion to the pulse that produced it. I could find no leakage or overload on the boost line, and tried a new 12AX4 without effect. As I turned the problem over in my mind, I concentrated further on the thought that a damper is a simple rectifier in terms of the DC voltage it recovers from the pulse it receives (usually 7% to 11% of the pulse amplitude). About all a rectifier tube needs in order to develop DC is an AC input and a hot cathode! Since the rectifying efficiency of the damper was evidently low, I pondered over the idea that the cathode was being insufficiently heated. The best way to get an indication of cathode tem-

"Well, you got his advice 'for what it is worth'—$3.50 to be exact!"

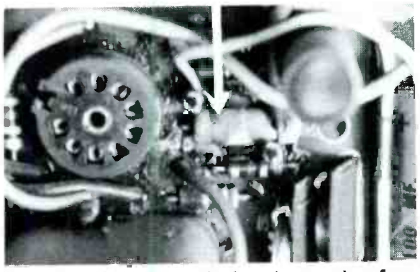


Fig. 3. Filament choke (arrow) often gives trouble in G-E "MM" TV receivers.

perature would be to read the heater voltage; however, because of the close quarters and high pulse voltages around the damper socket, I was hesitant to do any voltage probing right there.

Thus, I went searching for an indirect way to obtain my information, and this steered me to measuring the voltage across the temperature-compensating resistor in this series-string receiver. Even after the set had been allowed to warm up, this voltage reading seemed unusually high (30 volts). Considering the current through the filament string (.6 amp), and using Ohm's Law ($R = E/I$), I determined that the hot resistance of the temperature-compensating unit was 50 ohms. It normally should have been 19 ohms. A new resistor cured this slow warm-up trouble.

The behavior of this set cannot be called a "typical" result of either a filament-resistor defect or low damper-filament voltage. I have had experiences with several other sets that had similar defects, but which reacted quite differently.

Fixed Dropping Resistors

Wire-wound resistors used as filament-dropping units generally do not tend to increase in resistance with age, as do composition resistors. Theoretically, at least, they either open or maintain their resistance. I found one exception in a General Electric Chassis MM portable. Slowness in reaching full vertical size was a secondary defect in this set. A new 6CM7 vertical sweep tube had no effect. In desperation, I measured the voltage drop across the fixed filament resistor; from this, I was able to determine that its resistance was a trouble-making 71 ohms instead of the nominal 41-ohm value. Replacing the resistor completed that job. While on the subject of filament trouble in these MM receivers, I'd like to point out one more prone-to-fail component—the filament choke adjacent to the 6AU8 tube socket (Fig. 3). If these chokes simply opened, they would not present too difficult a service job; most often, however, they become intermittent or increase in resistance. I have personally run across six of these sets with defective chokes.

Another series-filament receiver once presented me with an unusual case of slow warm-up. It was a Crosley 426 which required well over a minute to develop normal picture contrast and sync. I could have blamed the slow increase in contrast on a defect in the picture tube, and let it go at that; however, I didn't, because this would have been ignoring the "slow sync" defect.

With the scope, I looked at the signal at the plate of the 6AN8 video output tube, and saw it expand in step with the increase in picture contrast. Full signal amplitude appeared quickly enough on the video output grid, so I figured a new 6AN8 was the answer. To my surprise, it wasn't.

In further checking, I discovered that the set uses the circuit in Fig. 4, in which resistors are shunted across

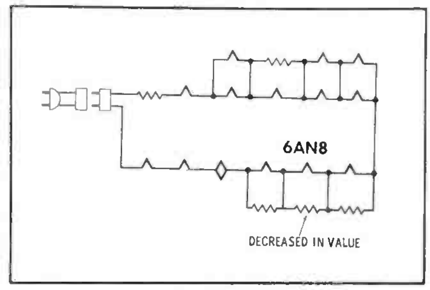


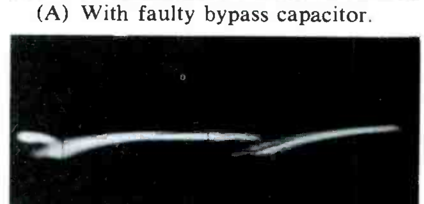
Fig. 4. Shunt resistor changed value, lowering filament voltage on one tube.

certain low-current tube heaters to permit their use in a higher-current series string. A resistor across the 6AN8 had decreased from its normal 40 ohms to less than 30 ohms; in so doing, it had dropped heater voltage on this tube to less than four volts. Finding this trouble also explained why the sync was affected, since the first sync stage is the triode section of the 6AN8.

Parallel Filaments

Slow warm-up troubles due to heater-circuit defects in series-wired sets are often mysterious. Considering the fact that *all* filament voltages are usually lowered, it isn't easy to understand why only one phase of receiver operation should suffer. In parallel-wired receivers, the same freakish condition is found when a low heater voltage is present on just one tube and affects only that circuit. Incidentally, a heater-voltage reading on any tube is more likely to be accurate if the voltmeter probes are applied directly to the tube pins. Checking the voltage across the socket connections fails to reveal any voltage drop caused by poor contact of a tube pin to the socket—a fairly common occurrence. Of course, the latter check *would* reveal a defective wiring connection to the socket, as in a case I saw recently.

(A) With faulty bypass capacitor.



(B) Operation restored to normal.

Fig. 5. At horizontal-output cathode.

Contrast was weak for the first five minutes of operation, and scope tracing showed that the signal amplitude was normal at the grid of the 12BY7 video output tube long before it became normal at the plate. Close inspection unearthed a cold-solder joint at pin 5 of the 12BY7, which allowed only half of the dual heater to receive normal voltage.

In octal-based and other hollow-pin tubes, low filament temperature can result from a high-resistance connection between the internal filament wires and the base pins. This trouble can easily be spotted by tube substitution, and it can be remedied by resoldering or crimping the affected pins. Depending on the way the bad connection reacts to temperature changes, this fault can cause fading or intermittent loss of operation as well as slow warm-up.

Faulty Electrolytics

Electrolytic filter capacitors are often the cause of slow warm-up, as in one Admiral 22A2 which took about two minutes to develop a raster. A drive signal appeared at the grid of the horizontal output tube in only 15 seconds, but the tube did not develop sufficient output to generate high voltage. Screen and cathode voltages on the 6CD6 were nearly normal, but the scope indicated a 10-volt signal (Fig. 5A) at the cathode. Replacing the 10-mfd cathode-bypass capacitor effectively killed this signal, as shown in Fig. 5B, and enabled the set to develop a raster after only 25 seconds of warm-up time. It is interesting to note that a serviceman could have changed tubes or checked voltages from now until doomsday without effecting a cure or finding the cause of the trouble, but one scope check immediately revealed the defect.

Occasionally, the warm-up lag is so long that the trouble seems permanent! I once bench-serviced a G-E receiver for no sound or picture. A defective electrolytic at the input of the first selenium rectifier checked "open" and was replaced. The result was restored B+ and a normally-operating receiver. Only after the customer came in for the set did I learn that it would operate if allowed to warm up for about 20 minutes.

Slow warm-up, like other troubles, can be intermittent; naturally, this greatly increases the difficulty of locating the defect. On one house call to service an Admiral 24 Series receiver, the customer's only complaint was that the raster was too slow in reaching full height. I turned the set on (it had been off since the previous night), timed its warm-up, and found that five minutes elapsed before full vertical sweep was obtained. Removing the back, I replaced the vertical output tube. Again timing the warm-up, I found that full deflection was attained in only 40 seconds. Collecting for my time and the tube, I went on my way feeling I had successfully taken care of that call.

The very next day I was jolted when the same customer called to lodge the very same complaint. This time I knew better than to attempt a cure in the home, so I brought the set in to the shop. With the help of the scope, I discovered a large pulse signal across the electrolytic filter capacitor connected to the B+ lead of the vertical output transformer. Replacing the filter solved the problem. Obviously, the old electrolytic was slow to form after lying idle for a period, but once formed, it reacted

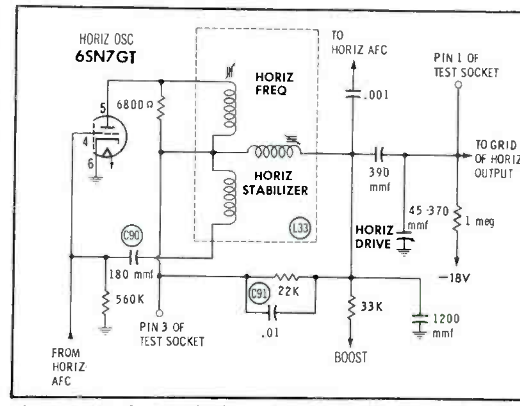


Fig. 6. A thermal defect disabled this circuit for 5 minutes after "turn-on."

normally for several hours.

Thermal Intermittents

Other cases of delayed operation quite similar to the preceding slow warm-up troubles are definitely the result of a thermally-induced make-and-break action in some connection. Unlike the usual slow warm-up trouble in which receiver operation gradually becomes normal, a thermal delay generally causes a sudden "pop-in" of normal operation.

In one Philco using a C-2 power supply, the raster did not appear until after the set had been on over five minutes. According to the set owner, it had been working this way for the previous six months. A scope probe connected to pin 3 of the horizontal-circuit test socket (see Fig. 6) indicated the oscillator was not operating, even after one minute of warm-up. The circuit was receiving B+ voltage through the damper stage, although boost was naturally not being developed. Other voltages on the tube were found to be as expected, in view of the fact that the oscillator was not working.

Quick resistance checks indicated no obvious defects in L33 and C90, the main components involved in producing oscillation. Since C91, across the stabilizing-coil portion of L33, is capable of killing oscillation if it is open, I bridged a wire across the capacitor to check this possibility. The oscillator started working! I thought at first that I had shocked the oscillator into action, but I soon found this was not so. When I removed the wire from across C91, the oscillator quit. Replacing C91 made the set develop high voltage and raster in a normal time (less than a minute).

Since C91 is mounted directly above the power transformer and fairly close to the hot-running 5U4 rectifier and 6BY5 damper, it is probable that the heat from these sources caused a poor connection in the capacitor to heal after several minutes of set operation.

One puzzling aspect of this case was the customer's claim that the trouble had been present for some six months. Normally, a 6CD6 repeatedly operated without drive would not last so long. However, the one in this set was supplied with 18 volts of fixed bias on the grid, which saved it from being badly overworked when there was no grid drive.

In another Philco (RF Chassis 37), the complaint was sound distortion for the first ten minutes after the set was turned on. I suspected that the distortion was occurring in or before the ratio detector. Knowing that a detuned secondary is the most probable cause of distortion in this circuit, I checked to see if tuning the secondary core would clear up the sound. With the barest amount of pressure on the core, the distortion disappeared. A poor connection in the transformer was plainly at fault. By merely replacing the transformer, I permanently cleared up the distortion.

A final example of a defect causing slow warm-up concerns a Motorola TS-221 which was troubled by horizontal tearout when first turned on. After about two minutes, horizontal sync would lock in, but not quite perfectly; sectional breaks, somewhat like those often seen in videotape transmissions, would remain for another few minutes. The picture would eventually fall into perfect sync, although the horizontal

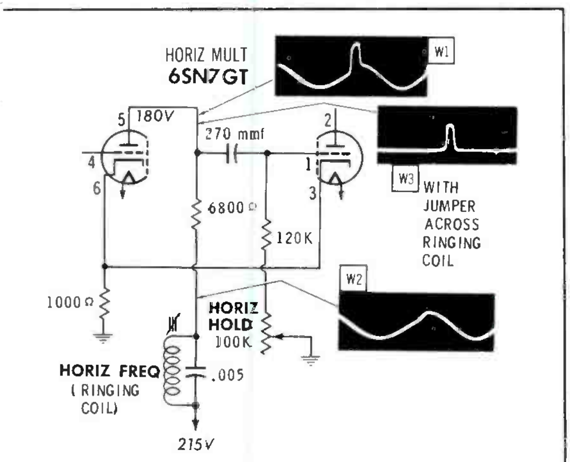


Fig. 7. Continuously-present fault in this stage behaved like warm-up problem.

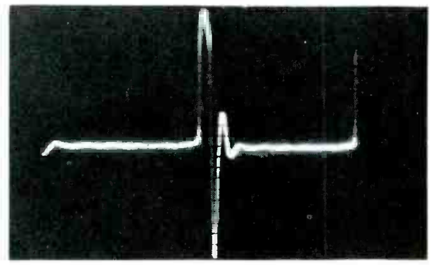


Fig. 8. Abnormal waveform at the plate (pin 5) of 6SN7GT in circuit of Fig. 7.

hold adjustment was more critical than normal.

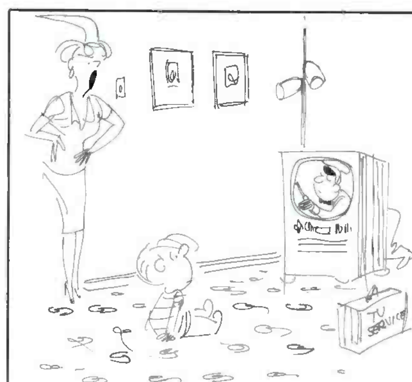
In the horizontal multivibrator circuit (Fig. 7), the oscilloscope revealed the abnormal waveform of Fig. 8 at the plate of the first section. The significance of this pattern can best be explained by analyzing the waveform normally found at this point, with the aid of the photos in Fig. 7.

This normal waveform (W1) has two distinct components—a sine wave (W2) produced across the ringing coil, and a pulse (W3) developed by multivibrator action. A slug in the ringing coil permits a phase adjustment of the sine wave for maximum stability of the multivibrator.

Since the abnormal waveform in Fig. 8 was almost a pure pulse signal, it was logical to assume that the sine wave was being damped by a short in the ringing coil or in its parallel capacitor. Substituting a new capacitor did not affect the symptom, but replacing the coil did restore normal synchronization.

Conclusion

As we have seen, insufficiently heated filaments, faulty filter capacitors, and thermal intermittent troubles all deserve consideration as causes of slow warm-up or delayed operation in television receivers—to say nothing of an old, weak picture tube! In addition to these effects,



I'll tell you whether he's one of the bad men or not when I see his bill! . . .

electronic equipment is prone to one other condition—grid blocking—which can give rise to similar symptoms. This trouble can also be puzzling, but it gives itself away by disappearing at the mere touch of a test probe on the affected grid. For this reason, it is not as difficult to troubleshoot as the other conditions enumerated in this article.

Because of the short duration of many warm-up troubles, it is often difficult to solve them by conventional troubleshooting methods. Probably the easiest way to overcome this situation is to let the receiver warm up thoroughly and then chill individual parts with a spray available for this purpose. When the defective part is treated, the sudden drop in temperature usually causes the symptom to recur.

Here's one more thought to keep in mind when you are looking for the answer to an apparent slow warm-up problem: The warm-up period is not over when full picture and sound appear. In reality, the operating temperature of the circuits continues to increase for perhaps 15 to 30 minutes, after which an equilibrium is reached. Until the temperature is completely stabilized, various components are subject to physical and electrical changes which can produce an abundance of annoying symptoms.

Although the case histories described in this article have referred to specific models or chassis, the same servicing procedures can be applied equally well to similar conditions in other receivers. ▲

Translators

(Continued from page 27)

which can be made without creating harmonic or beat interference.

In either type of unit, the only change introduced into the signal (other than frequency and amplitude) is a deliberate increase in the picture-to-sound ratio to prevent the appearance of sound bars during periods of selective fading which favors the sound signal.

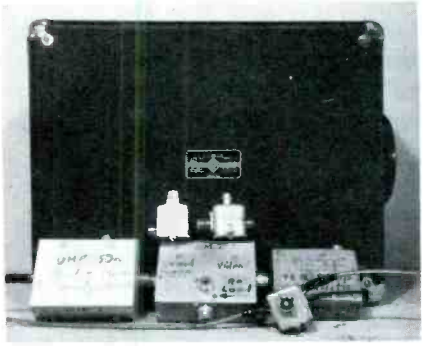
The cost of an average 1-watt VHF translator (excluding all auxiliary equipment) is in the \$1000-\$2000 range. UHF translators cost approximately \$3,000 for 10-watt models and \$8000 for 100-watt units. The cost margin between VHF and UHF installations is reduced to a slim percentage by the time the expenses for access roads, power lines, antennas, and accessories are figured in. Maintenance expenses can easily total \$500 to \$1000 a year for either type of translator.

Operating Regulations

Any individual, organized group, governmental unit, or broadcast-station licensee may be granted a license for a translator on FCC approval of plans for financing and operating the station. The general availability of translator equipment which has been type-accepted by the FCC simplifies the installation; anyone who can follow the manufacturer's assembly instructions correctly is authorized to install such equipment. A commercial radiotelephone license is required only for those adjustments which affect RF radiation or result in changes of frequency or power; therefore, much routine maintenance can be handled by a local technician even if he is unlicensed.

The unit can be operated unattended, as long as it can be turned off within 15 minutes' notice. (A remote switch is satisfactory for this purpose.) In addition, the translator must be equipped so that it automatically turns off when the primary station goes off the air.

Interference to or by UHF translators is avoided by following a frequency allocation plan specified by the FCC. As for the VHF type, no fixed allocations have been established; however, licensees are responsible for preventing their station



Demodulator units with coaxial fittings, an important part of test equipment for maintaining a translator.

emissions from interfering with *any* established service. If complaints of interference cannot be remedied, the translator is obliged to shut down or change frequency. In addition, interference between VHF translators must be mutually resolved by the parties concerned.

Planning an Installation

Community interest is the starting point of a new installation. The eagerness of residents to have local TV, and their willingness to finance it, are more important than the size of an area in determining the need for translator service; thus, communities and areas with populations ranging from 25 to 50,000 have installed translators. In a serviceman's home territory, he may take the initiative in planning, or he may be approached by a group of fellow citizens who are already interested and are seeking technical advice. Either way, he can be of great service to himself as well as his neighbors.

Once it has been decided that translator service is desirable, the next step is to determine if an installation is technically feasible. In mountainous country, a temporary Yagi antenna and a portable field-strength meter can be used to search for sites having satisfactory signal reception. The site finally chosen must also meet other requirements, as follows: Clear, obstruction-free signal paths to the area it will serve; ability to bring AC power to the site; and accessibility by vehicles for necessary maintenance. The most desirable sites should be monitored for at least four days to make sure a signal of 100 microvolts or more can be consistently received. Also, signal strength may be weaker during winter months, so it's not advisable to settle for a minimum signal. If possible, a TV receiver should be brought up to the site to see if a clear picture can be obtained.

Financing is another critical step in planning. Usually, a group of citizens determine whether or not they can expect to collect enough money through donations and pledges to build and maintain a translator. Oddly enough, the initial cost of the unit is fairly easy to obtain; nearly everybody is enthusiastic over the prospect of TV, and the first money-raising campaign usually meets its goals without great trouble. Invariably, however, money problems arise later, when more funds are needed for maintenance. By this time, many contributors feel they have done their bit. They know and resent the freeloaders in their midst, and are likely to decide not to pay any more themselves. Eventually, some non-profit "club" organizations run out of operating funds. When this happens, a public meeting is held; and the sponsoring group, in desperation, announces that the translator will be turned off until needed funds are obtained. After a few favorite programs are missed, more money comes in, and service is resumed.

This "pillar-to-post" operation has worked surprisingly well in many communities, due to the popularity of TV, but it leaves something to be desired. Other forms of financing—less subject to whim—are being tried or considered. A few examples are special local taxes assessed on all TV homes in a translator area, or support by local businessmen or civic organizations, resort owners, or other "angels" who consider local television a "good-will" expense worth a generous donation.

Once the general planning has been completed, a local service technician may well be called upon to select suitable equipment, arrange for its purchase, and perform or supervise the installation. This is an excellent chance for him to see to it that reliable, serviceable facilities are built.

Translator Maintenance

Proper maintenance is very important to good-quality translator operation, and quality must be upheld to meet the specifications of the license. Therefore, mere attention to breakdowns is not a sufficient degree of maintenance. A reasonably well-qualified person is needed in the local area to keep the translator on the air from week to week; his duties include replacing tubes and other necessary parts, checking output power (and perhaps also the modulation waveform), and making minor adjustments from time to time. In addition to this, a more extensive overhaul is desirable at intervals of several months—including a complete alignment check and other tests which require specialized knowledge and equipment.

The local TV serviceman who handles the routine maintenance can also take care of the major work, if he thoroughly understands the required procedures and has the necessary test equipment. A *minimum* would include a field-strength meter, a good sweep generator and scope, and a coaxial detector device, plus the usual assortment of other TV test gear.

At least a second-class radiotelephone license is recommended. Just as in CB servicing, many of the more advanced service procedures are likely to affect RF output power or frequency, and thus must be made by a licensed person.

It is advisable to draw up a specific contract between the translator licensee and the servicing organization so that everyone knows and understands the function of the latter. (Of course, this is unnecessary if the serviceman *is* the licensee.)

As an alternative to having major overhauls performed locally, the licensee can often arrange to have a traveling service engineer or regional organization take care of higher-order maintenance. It would also be feasible to install a standby unit, and periodically return the whole chassis to the manufacturer or a specialized service firm for a good working over.

The importance of preventive maintenance in avoiding unexpected failures is clearest to the man who answers emergency service calls. A trip up to a typical translator site is difficult and uncomfortable at many times, and often downright impossible in midwinter. If the translator is put in tip-top condition in the fall, it has a good chance of making it through the winter without failures; otherwise, a complaint of "snowy picture" may mean the serviceman has to travel on snowshoes!

A Word About Translators and the Receiver Market

In areas having practically no TV service, the availability of a translator signal creates eager buyers for receivers and antennas.

However, when one system is already established (be it VHF or UHF), there is considerable reluctance to accept another system. Thus, if a new translator is started in a locality where another is already operating, there is some reluctance to support the new service—even though it may be better or cheaper than the existing system. It has the best chance of success if it does not cause a major change at a typical viewer's set. Sales and service organizations can be very helpful in cooperating with new translator services by demonstrating reception of their signals, and advertising the new service along with their regular ads. However, if competing TV services are already present in the area, care should be taken not to "play favorites" and talk down the existing service. With proper promotion, translators can be instrumental in encouraging a healthy growth in television viewing. ▲

Capacitors

(Continued from page 29)

removed. In the matter of only a few seconds, this potential may represent anywhere from .2 to 3% of the voltage originally applied. Therefore, testing a capacitor with high dielectric absorption is almost like putting your ohmmeter leads across a weak portable-radio battery.

As far as capacitor value is concerned, a VOM equipped with an AC scale can be used to obtain an approximate reading. Specific instructions for this measurement are usually included in the operating manual for the instrument. Some instrument scales are calibrated directly in microfarads, making measurement of capacitance values a relatively simple matter.

Using the ordinary VOM as a capacitor checker has its limitations. In the first place, it really wasn't designed for the job; so it is useful primarily for providing preliminary information. Accurate measurements of value, leakage, power factor, etc., call for a regular capacitor-testing instrument.

Capacitor Checkers

There are two general types of capacitor checkers—the in-circuit and the out-of-circuit — and each has its particular applications and limitations.

The in-circuit capacitor checker will tell you at a glance if a capacitor is shorted or open, but it cannot tell you the exact value of a particular capacitor. It is, in essence, an all-or-nothing device. This will do when it's necessary to determine only whether a capacitor is working or not. If trouble is indicated in a circuit where a slight shift in capacitance can seriously affect performance, the capacitor must be removed from the circuit (or, at least one lead must be unsoldered) before it can be accurately checked.

All out-of-circuit capacitor checkers use some modification of a balanced-bridge circuit. The principle involved is simple—a known capacitance is balanced against the unknown by coupling an appropriate variable resistance to a calibrated dial. When the monitoring device shows that the circuit is balanced, the capacitance value can be read directly from the dial or meter scale. Other checkers may use variations of this circuit, but they accomplish the same results. A basic bridge circuit, used in many out-of-circuit testers, is shown in Fig. 4.

The leakage resistance (freedom from leakage) in capacitors varies from very high in micas and ceramics, to very low in electrolytics. A change in this characteristic can be detected only with an out-of-circuit tester or an appropriate bridge. Since values range up to 20,000 megohms, the correct test setup is required to insure accurate results.

DC leakage is common in capacitors. It is usually expressed in terms of the internal resistance, because leakage is low whenever resistance is high. In electrolytics the leakage is great enough that it can be compared directly with established standards. The test for DC or AC leakage must be performed with the capacitor out of the circuit. Manufacturers of both test equipment and capacitors supply charts indicating the correct amount for each type and value. These should be used in place of any rule of thumb, but even then, the person doing the testing will have to use judgment in interpreting the results.

Leakage measurements should be performed under typical operating voltages. Many instruments therefore offer a selection of test potentials. This voltage, of course, must not exceed the maximum limits of the capacitor under test—an especially important point in checking miniature electrolytics in transistorized equipment.

Leakage increases with temperature. AC leakage is expressed as so many milliamps at a particular frequency (usually 120 cycles per second) and temperature (such as +85°C).

Out-of-circuit testers are also useful for measuring the power factor of electrolytics. A bridge similar to the one in Fig. 4 is used. Here again, the test must be performed at rated temperatures only. (See Table I for capacitor test instruments and their specifications.)

Replacement Considerations

In order to choose a correct replacement, one must naturally be able to interpret the characteristic ratings of both the original and the replacement capacitor. In many cases, the component will be clearly marked as to value, working voltage, tolerance, and temperature coefficient; but on the other hand, only symbols or color codes may be used to identify the capacitor.

Color codes to indicate capacitor characteristics have long since been adopted by all major manufacturers. These are explained in almost any reference book or on capacitor charts available from manufacturers or their distributors.

The terms "microfarad" and "micromicrofarad" are, of course, familiar to all of us. However, be on the lookout for a couple of new terms—the "nano" and the "pico." The nano (abbreviated by the small letter "n") represents a multiplier of 10^{-9}, while the pico (small letter "p") indicates a multiplier of 10^{-12}. Instead of 250 mmf, you may see .25n or 250p.

The only exceptions to the standard-

"Another tower job?"

coding rules are found in certain transistor portables. Here, you're likely to see a capital letter P or M following a three-digit number code. You'll find that you can determine value by ignoring the letter and simply reading the numerical code. The last number represents the multiplier; a 103M or P, for example, means that the unit has a value of .01 mfd.

There are also certain precautions you must observe when replacing capacitors. The mere fact that the replacement unit has the correct value and voltage rating does not guarantee successful results.

Suppose you are called on to repair a defective TV and find that two mica capacitors have failed. You have no exact replacement micas with you, but you do have ceramics. Can they be used instead? The answer is a qualified yes—you can almost always replace a mica with a ceramic of equivalent value. One thing to watch, however, is tolerance. In addition, you will have to make certain the ceramic has the same electrical characteristics. In other words, you certainly wouldn't want to use a negative-temperature-coefficient type if it would upset the circuit. The safest thing to do would be to use an NPO type, which has a flat temperature curve.

Let's look at the other side of the coin for a moment. Suppose the capacitor to be replaced is a ceramic, and all you have are micas. If the bad ceramic is a general-purpose type, go right ahead and put in a mica, because the circuit requirements are probably not too critical. But if the ceramic is one of the temperature-compensating types, a mica won't do. Its temperature-vs.-capacitance characteristic just doesn't match that of the temperature-compensating ceramic.

You may occasionally run into a situation where a tubular ceramic needs replacement. There is no problem here—you can nearly always replace a tubular ceramic with an equivalent disc type. As a rule, the small difference in inductance will have no effect. However, this is not true if the tubular ceramic happens to be a feedthrough type such as those found in TV tuners. The presence of a feedthrough ceramic practically guarantees that an inductance problem exists. The only thing to do here is use an exact replacement.

***Mylar* vs. Paper**

Should a paper capacitor be replaced with one of an equivalent rating in a *Mylar* type? Yes, with one exception—paper types generally make better vibrator buffers than do *Mylars*. Paper types have superior surge-current characteristics and generally a much higher corona-starting voltage. However, this does not mean that paper capacitors are superior to *Mylar* types. Quite the contrary — *Mylars* are smaller and have operating characteristics (such as humidity protection) that make them superior to paper capacitors for most applications.

Many inexpensive radios, and even some television receivers, use wax or paraffin-filled paper capacitors. They are more subject to moisture infiltration than the molded-case types. For this reason, the latter should be used when replacement is required.

Electrolytics

Should an electrolytic be replaced with an equivalent paper type? How about vice versa? If the value of the electrolytic is low enough, you might be able to find a paper type that would fit the available space, although it's highly unlikely. Remember, the electrolytic was no doubt chosen in the first place because of its higher value-to-size ratio. Also, it may have some peculiar electrical characteristic. Replacing it with a paper unit—even of the same value—could be a serious error.

The reverse is even more true. Except in the case of pure energy storage (DC), a paper type should not be replaced with an electrolytic, even with one of equivalent value. Paper types were chosen originally because of their superior voltage characteristics, or because of polarity-reversal considerations. Remember, polarity is vitally important in an electrolytic; even a momentary reversal could ruin one. An example of where one might be damaged is in the replacement of a TV boost filter with a polarized electrolytic.

Voltage Ratings

As a rule, it is safe to substitute a capacitor of a higher voltage rating. But don't try to go the other way—if a circuit requires a 600 WVDC capacitor and you use 400, you can expect more than your share of trouble.

Another fairly simple problem is one where a certain capacitor is called for, but only smaller values are available. For example, suppose you need an 80 mfd @ 300 VDC—simply place two 40-mfd @ 300 VDC units (or any other reasonable combination) in parallel. The fact that the internal resistances are also paralleled, however, now results in a lower over-all resistance. This brings up the possibility of upsetting the RC time constant, which may cause trouble in critical applications. The only time you need be concerned is when replacing units in waveshaping networks or frequency-discriminating circuits. Although you can parallel capacitors to increase capacitance, don't forget that you cannot increase the voltage rating in this manner.

There is, however, a stop-gap method of increasing the voltage rating, and that is to place capacitors in series. Thus, two 40-mfd, 150-WVDC capacitors in parallel will be equal to a single 80-mfd, 150-WVDC unit, or they will be equivalent to a single 20-mfd, 300-WVDC unit if placed in series. Understand that in both cases the RC time constant may be upset, since the resistance is lower in the parallel circuit and higher in the series circuit than it would be in an equivalent single capacitor.

The shape of a capacitor is often an important consideration, because of space requirements. Substitution of one shape for another may radically change the distributed capacitance. For example, it may be perfectly satisfactory to substitute a disc for a tubular ceramic. Likewise, a molded *Mylar* capacitor that has axial leads might be replaced with another that has radial ones. Trouble might develop from this substitution in critical circuits, however, due to changes in the distributed capacitance.

Shape and size are also important in electrolytic replacement, especially in compact equipment where space occupied by the defective unit does not permit substitution of a differently-shaped capacitor. The two most common types of electrolytics are the cardboard-cased tubular and the metal can, and their performance and internal construction are identical. Hence, as long as their values are the same, they may be freely interchanged as far as electrical requirements are concerned.

Replacement Techniques

Removing the defective capacitor and inserting the replacement is seemingly a simple operation. Yet here is where many mistakes are made.

Faulty installation can affect circuit performance even though the new unit is a perfect twin. Take the mica capacitor in Fig. 5, for example. Originally it was installed at right angles to the chassis, as in Fig. 5A. The replacement has been installed parallel and too close to the chassis (Fig. 5B), causing a difference in the distributed capacitance (Fig. 5C) between the metal chassis and the plates inside the capacitor.

Another common error is failure to recognize the effect of lead length on the resonant frequency of capacitors and their circuits. For example, changing the length from 0.5" to 0.3" can raise the resonant frequency of a disc ceramic by as much as 10 mc. Other types may be affected even more. Disc ceramics are pointed out because they are so common in miniature circuitry, and when the components are tightly packed, there is always temptation to make the replacement the easy way. Thus, in a critical circuit, make certain the replacement unit has leads the same length as those of the original.

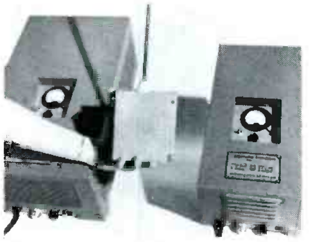
In summary, your best tool for capacitor testing and replacement is good judgment, born of knowledge and experience. Develop a sound testing technique, know the important characteristics of capacitors for various applications, learn capacitor coding as well as you know resistor color codes, and above all understand the limitations involved in choosing a *lasting* replacement. ▲

"I have to admit . . . the TV game has been good to me!"

PRODUCT report

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

Transmitter for Wireless Paging (36E)

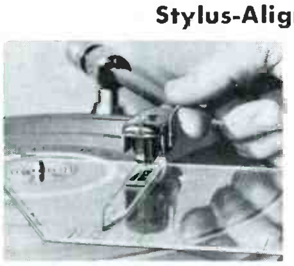


General Dynamics/Electronics has announced a new accessory for the **Stromberg-Carlson** "Pagemaster" wireless paging system. A transistorized, 100-mw transmitter is available either to supplement a conventional 5-watt transmitter, or for use in a separate small system. Operating in the 35- or 43-mc band, or in the 27-mc Citizens band, the low-power unit requires no FCC license. It is connected by two wires to an encoder, which modulates the RF output with different combinations of tones to trigger small "beep" receivers carried by users of the system.

Aids for Close Work (37E)

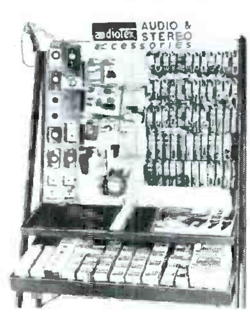
The **Moffatt** "Multi-Lamp" bench light and "Move-View" two-power magnifier are attached to flexible arms with dirt- and greaseproof polyvinyl jackets. Mounting is by means of small "snap-on" brackets, permanently fastened to bench tops, etc., wherever close work is often performed. This feature permits transferring a lamp or magnifier to a different location as needed. The units are supplied in various sizes and styles; prices range from $8.95 to $13.95 for lamps, and from $8.95 to $9.95 for magnifiers.

Stylus-Alignment Aid (38E)



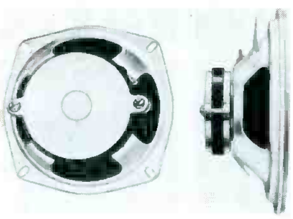
When a cartridge is installed in a tone arm, it must be properly aligned in three planes to assure the best possible performance. Eliminating tilt places the stylus perpendicular to the record groove; correct fore-and-aft positioning establishes the amount of overhang specified by the turntable manufacturer; and aligning the cartridge with its long axis parallel to the tone arm is important for good tracking. The "Stereo Stylusmaster," supplied by **Prestige Products, Inc.**, provides etched scales and a movable, mirror-topped pointer to assist in making these adjustments.

Display for Hi-Fi Stores (39E)



As a merchandising aid for high-fidelity dealers, **Audiotex** is offering a self-contained display rack (Deal #49-028) holding a full line of cables and connectors, speaker volume controls and selector switches, drawer slides, headphones, equipment for tape-recorder fans, and other audio accessories. An integral feature of the rack is an "Audio Demonstrator Unit" which lets customers try out various switches.

Speakers and Speaker Transformers (40E)



The shallow profile of the **Quam** 52C10 (left) and 8C10P4 (right) makes these speakers adaptable to many installations where space is limited. For example, the 8C10P4 can be mounted in between standard wall studding. Both speakers have 10-oz ceramic (barium ferrite) magnets. Also newly introduced are two 25-volt line transformers, the TCL25 and TDL25.

Sine-Square Wave Generator (41E)

The **Paco** Model G-34 generates both sinusoidal and square waves at any frequency between 6 cps and 750 kc. Maximum output obtained across a 600-ohm load is 10V rms for sine waves, or 18V p-p for square waves; amplitude is controlled by an attenuator switch and potentiometer. Rise time of square waves is less than .15 usec. Frequency accuracy is ±5%.

Horizontal AFC Diodes (42E)

Potted selenium dual-diode units of the **IRC** "NineL-R" series are applicable to TV horizontal AFC stages, as well as to bias power supplies, clamping circuits, etc. The 9LR2-2 voltage-doubler combination, 9LR2-3 common-cathode unit, and 9LR2-4 common-anode unit are respectively color-coded with green, yellow, and red markings on the top of the case. Maximum applied voltage rating at 25° C is 33 volts rms, while the peak inverse voltage rating is 47 volts. Units with two cells per section can be furnished if higher voltage ratings are needed.

Integrated Stereo Receiver (43E)

The **Monarch** Model 200A incorporates a stereo amplifier with total output of 32 watts, a transistorized preamp, independent AM, FM, and short-wave tuners, and a variety of inputs and control circuits—all on one chassis. Multiple-impedance output is provided, as well as a center-channel output to a third speaker and amplifier. Audiophile net is $179.95.

Flyback Insulation (44E)

To rebuild damaged insulation on flyback transformers or to stop arcing in or around the cage, **Colman** "High Voltage Putty" can be applied in a thick layer over the trouble spot and pressed into place. The TV set can be turned on immediately afterward. The putty does not harden, dry out, or crack with age. A 2-oz. roll, in a plastic box, costs 69c.

Portable Megaphone (45E)

One of a series of "Trumpet-line" megaphones from **ITT**, the Model 310A has a transistorized amplifier powered by four size-D flashlight cells. Power output is 8 watts. Other features include weatherproofing, a detachable arm sling, a pistol-grip handle with trigger-type on-off switch, and a detachable microphone with coiled cord.

Mast-Mounted Booster (46E)

A transistorized, all-channel VHF amplifier weighing 3½ oz. the **Blonder-Tongue** Model AB-4 "Signal Master," mounts on a TV or FM antenna mast. The device is powered by four flashlight cells housed in a remote power-supply chassis, which also contains a four-set antenna coupler with stripless lead terminals. Amplification figure ranges from 0 to 17 db, depending on the channel and number of sets connected; typical noise figure is 3 db on the low band and 6.5 db on the high band. List price is $29.95.

Portable Sound Unit (47E)

The **Perma-Power** "Roving Rostrum" is a compact public-address system powered by two standard lantern batteries. A transistorized push-pull amplifier with an output of 10 watts drives two 6" x 9" speakers. One of these is mounted in the main part of the 9¼" x 16¾" x 18" case (which doubles as a lectern); the other is in the cover. The low-impedance dynamic microphone supplied with the unit can be either mounted on a goose-neck stand or worn on a lavalier cord. Phono and radio inputs are also accepted by the amplifier. Weight is under 30 lbs; price, less batteries, is $124.50.

Plug Adapters (48E)

The problem of non-matching jacks and plugs, which often arises in service work when various pieces of equipment are being interconnected, can be remedied by the 11 assorted adapters in the **Switchcraft** No. 331A "Adapter Caddy Kit." In addition to several combinations of phono, coaxial, and phone-type connectors, the kit includes two stereo-to-mono "Y" plugs, and a 3' extension with phono tips at both ends.

Lubricating Contact Cleaner (49E)

Krylon "Spray Cleaner Lubricant" removes dirt and gummy deposits from contact surfaces in tuners, switches, and controls, and also leaves a non-drying film that lubricates the contacts and protects them against corrosion and oxidation. This chemical is sold in aerosol spray cans—16 oz for $1.95 or 6 oz for 98c. A plastic extension tube can be substituted for the regular nozzle to spray hard-to-reach spots.

Audio and Radio Controls (50E)

Although they have an audio power rating of 20 watts, **Centralab's** new line of L- and T-pad attenuators (in photo) are small enough to fit into a standard junction or switch box. Other new items: A shaft-coupling spring for converting "Fastatch" dual concentric controls into ganged stereo units which can be rotated together or separately, and a kit of the 24 most-frequently-needed exact-replacement controls for auto radios.

COMING NEXT MONTH

Track Down That Visible Hum
How to trace hum modulation to its source.

Radio-TV Component Stock Guide
Replacement parts that are handy to have at your fingertips.

Using a Tube Tester to Advantage
Suggestions on how you can get the most good from this basic test instrument.

Preparing for the 2nd-Class 'Phone Exam
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Address__________
City______ Zone__ State______

INDEX TO ADVERTISERS

August, 1961

Latest Jackson Tube Test Data

	MODEL 648				MODEL 598							
Tube Type	Fil.	D.	E.	Plate Test	A.	B.	C.	Fil. Cont.	D.	E.	F.	G.
6GW8	6.3	129	AB378	18 WZ	6.3	4Y		5	6	8	3	25
	"	125	AC46	36 WX	"	4Y			9	1Z		80
12GW6	12.6	123	AB569	17 W	12.6	2		7	0	5	4Y	19
15EA7	15.	A238	AC56	75 YZ	15.	7Z		8	5	4		65
	"	234	A17	13 WZ	"	7			2	1		18
25DK4	25.	234	5	14 W	25.	3	6	4	5			17
7233	6.3	127	AC56	36 Y	6.3	4Z	369	5	1	2		75

SUPPLEMENTS LATEST ROLL CHART 648-24 — SUPPLEMENTS LATEST ROLL CHART 598-3

MODEL 658

Tube Type	Sec.	Heater	Circuit H-K	Circuit P-G	Plate	Grid Test	Heater Current
6GW8	P	6.4J	129	ab378	30Q	30VY•	
	T	"	125	ac46	34Q	8XY•	
12GW6	P	13.6H	123	ab580	20R	70VY•	A22J Z600
15EA7	T	18.6E	238	ac56	60Q	10WY•	
	T	"	234	a17	18R	80VY•	A22J Z450
25DK4	D	22.P	124	5	9U	VW	
7233	T	6.4L	127	ac56	43T	40VY•	

SUPPLEMENTS LATEST ROLL CHART 658-4

"For further information, see Tube Test Data in PHOTOFACT Folder No. 540"

CATALOG AND LITERATURE SERVICE

ANTENNAS AND ACCESSORIES

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

2E. *R-COLUMBIA*—Complete literature on new, time-saving strapless chimney mount.

3E. *WINEGARD*—Information on transistorized Model AT-6 *Booster-Pak* home TV-signal amplifier. *See ad page 13.*

AUDIO AND HI-FI

4E. *EICO*—New 32-page catalog of kits and wired equipment for stereo and monophonic hi-fi, Citizens band transceivers, ham gear, transistor radios, and test equipment. Also, "Stereo Hi-Fi Guide," and "Short Course for Novice License." *See ad page 20.*

5E. *MUSI-PAK*—Full information about obtaining franchise to install and service background-music systems comprising tape-cartridge player, extensive taped music library, and built-in paging facilities. *See ad page 64.*

6E. *PERMA-POWER*—Literature describing the *Roving Rostrum,* a new high-volume sound system—completely portable and self-contained. *See ad page 38.*

7E. *SWITCHCRAFT*—New Reference Guide Wall Chart No. C-236 for selecting proper interconnecting cables. *MINI-MIX* two-input audio mixers, and *MIX-AMP* miniature amplifiers for all American-made tape recorders. *See ad page 62.*

BUSINESS AIDS

8E. *OELRICH*—New 32-page catalog of business forms and systems for radio-TV service dealers; pictures and describes specially-designed stock salesbooks, one-time carbon forms, file systems, job tickets, aluminum and vinyl form holders, and many other items.

COMMUNICATIONS RADIO

9E. *SECO*—New illustrated folder, Form 103, including data on latest test equipment and service aids for Citizens band and two-way radio. *See ad page 60.*

COMPONENTS

10E. *AEROVOX* — Pocket-size catalog of Type AFH twist-prong electrolytic capacitors, containing capacitance, voltage and size information with list prices for quick reference. *See ad page 61.*

11E. *ALPHA WIRE*—48-page Catalog No. 62, covering 6000 wire, cable, and tubing products.

12E. *BUSSMANN*—Form SFB, 24-page booklet giving detailed information on complete line of BUSS and FUSETRON *Small Dimension* fuses and fuse holders —the ones most used in protecting electronic equipment. *See ad page 41.*

13E. *MERIT*—Catalog sheet giving specifications and prices for new line of input, interstage, and output transformers for transistor circuits. *See ad page 36.*

14E. *J. W. MILLER*—Literature on RF, IF, and TV-sound transformers designed as exact replacements for popular original parts of eight major radio-TV manufacturers. *See ad page 44.*

15E. *SAMPSON — Transistor Battery Data and Reference Guide,* with size, price and cross-reference data on batteries used in all transistor radios; also information on "Point-of-Purchase Profit Pak," a counter display for *Samco* dry batteries. *See ad page 68.*

16E. *SPRAGUE*—New 44-page Catalog C-614, showing complete listings of all stock parts for TV and radio replacement use, as well as *Transfarad* and *Tel-Ohmike* capacitor analyzers. *See ads pages 11, 12.*

SEMICONDUCTORS

17E. *SEMITRONICS* — 16-page, pocket-size catalog describing line of American-made transistors, diodes, rectifiers, and service kits; includes four replacement-data cross-reference charts and supplementary circuit-application notes. *See ad page 58.*

SERVICE AIDS

18E. *BERNS*—Data on 3-in-1 picture-tube repair tool, on *Audio Pin-Plug Crimper* that lets you make pin-plug and ground connections for shielded cable without soldering, and on *ION* adjustable beam bender. *See ad page 64.*

19E. *CASTLE*—Leaflet describing fast overhauling service on television tuners of all makes and models. *See ad page 55.*

20E. *CHEMTRONICS* — Pamphlet describing *No-Arc High-Voltage Insulator,* a nonflammable, clear fluid for repairing damaged insulation on yokes and horizontal-output transformers, or for use as corona dope. *See ad page 32.*

21E. *MERCURY TUNER*—Information sheet describing immediate tuner-exchange service, 24- to 48-hour tuner repairs, and additional services; states prices and announces new seven-month warranty. *See ad page 48.*

22E. *MOFFATT* — Catalog and price sheets with full description of *Multi-Lamp* bench lights and *Move-View* magnifiers, illustrating a variety of applications for these snap-mounted units with long, flexible arms.

23E. *PRECISION TUNER* — Information on repair and alignment service available for any type of TV tuner. *See ad page 66.*

SPECIAL EQUIPMENT

24E. *ATR*—Descriptive literature on *Universal Inverters,* ideal for operating standard 110-volt AC PA systems and tape recorders in automobiles, buses, trucks, boats, and planes. *See ad page 16.*

25E. *EMCEE*—Literature on VHF translators for extending TV coverage into difficult reception areas; planning package to aid in establishing a translator station; reprint of FCC rules covering translators. *See ad page 58.*

TECHNICAL PUBLICATIONS

26E. *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics servicing. *See ads pages 40, 48, 49, 70.*

TEST EQUIPMENT

27E. *B & K*—Cataog AP18-R, giving data and information on *Dynamatic* 375 *Automatic VTVM, V O Matic* 360, *Dyna-Quik* tube testers, Model 1076 *Television Analyst,* Models 1070 and A107 *Dyna-Sweep Circuit Analyzers,* Model 610 *Test Panel,* Model 440 *CRT Cathode Rejuvenator Tester,* Model 160 Transistor tester, and Model 960 *Transistor Radio Analyst. See ads pages 17, 47.*

28E. *JACKSON* — Bulletin MK-61 on new Socket Modification Kit that enables Model 658 and 648R tube testers to check any of the newest types of tubes. *See ads pages 53, 72.*

29E. *METREX*—Serviceman's guide, "Cramful of Shortcuts," dealing with troubleshooting, alignment, and calibration of radio, TV, hi-fi, and related equipment; also manual for operation of new *Genie* pocket-size signal generator. *See ad page 66.*

30E. *PRECISION ELECTRONICS*—Specifications on Model 202 aural-visual signal tracer, *Television Clarifier* for rejecting interference, and Grommes *Little Genie* series of hi-fi kits.

31E. *SENCORE*—New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter,* plus brochure on complete line of *time-saver* instruments. *See ads pages 33, 35.*

TOOLS

32E. *CHAMPION DeARMENT*—New catalog No. 361, listing *Long Reach* pliers, *Little Champ* precision pliers, *HeatSorb Clamp* (heat sink), and other tools; also Form SA-1 brochure on sales aids and displays. *See ad page 60.*

33E. *XCELITE* — Current catalog describing complete line of hand tools for servicemen. *See ad page 34.*

TUBES

34E. *RAULAND*—20-page 8½" x 11" booklet describing tube-manufacturing facilities; also samples of consumer-handout pamphlets promoting Rauland receiving and picture tubes, plus complete pricing schedules.

35E. *SAMPSON*—*Hitachi* receiving-tube manual, giving extensive specifications, basing diagrams, and outlines for complete tube line; also catalog sheet with color photos and descriptions of *Hitachi* broadcast-band and two-band transistor radios. *See ad page 68.*

RCA STICKS TO ITS GUNS

The life of RCA Picture Tubes depends on it

The electron gun, heart of every TV picture tube, is a precision instrument. A speck of dust in the wrong place can mean the difference between poor and outstanding performance in a picture tube.

RCA assures outstanding performance in Silverama Picture Tubes by assembling every electron gun in the super-clean, dust-free atmosphere of the "White Room" at RCA's modern plant in Marion, Indiana.

Measured in terms of your business—this extra precaution helps to substantially reduce troublesome "in-warranty failures" and costly call-backs. Sell the finest name brand picture tube—RCA Silverama.

Silverama contains all-new electron gun, all-new parts and materials except for the envelope which is used. See your Authorized RCA Distributor today.

Workers wearing lint-free smocks, must enter "White Room" through an airlock. Room is kept under constant pressure to force any air-borne dust out when a door is opened.

Finished guns after ultrasonic cleaning in a super wetting agent are carried to the assembly line in these covered plastic cases —further protection against contamination.

Guns await final assembly in this pressurized plastic housing. Blower at top maintains pressure, prevents dust from entering housing.

RCA ELECTRON TUBE DIVISION, HARRISON, N. J.

RCA

The Most Trusted Name in Television

RADIO CORPORATION OF AMERICA