

JUNE, 1959 35 CENTS



RF REPORTER[®]

PHOTOFACT

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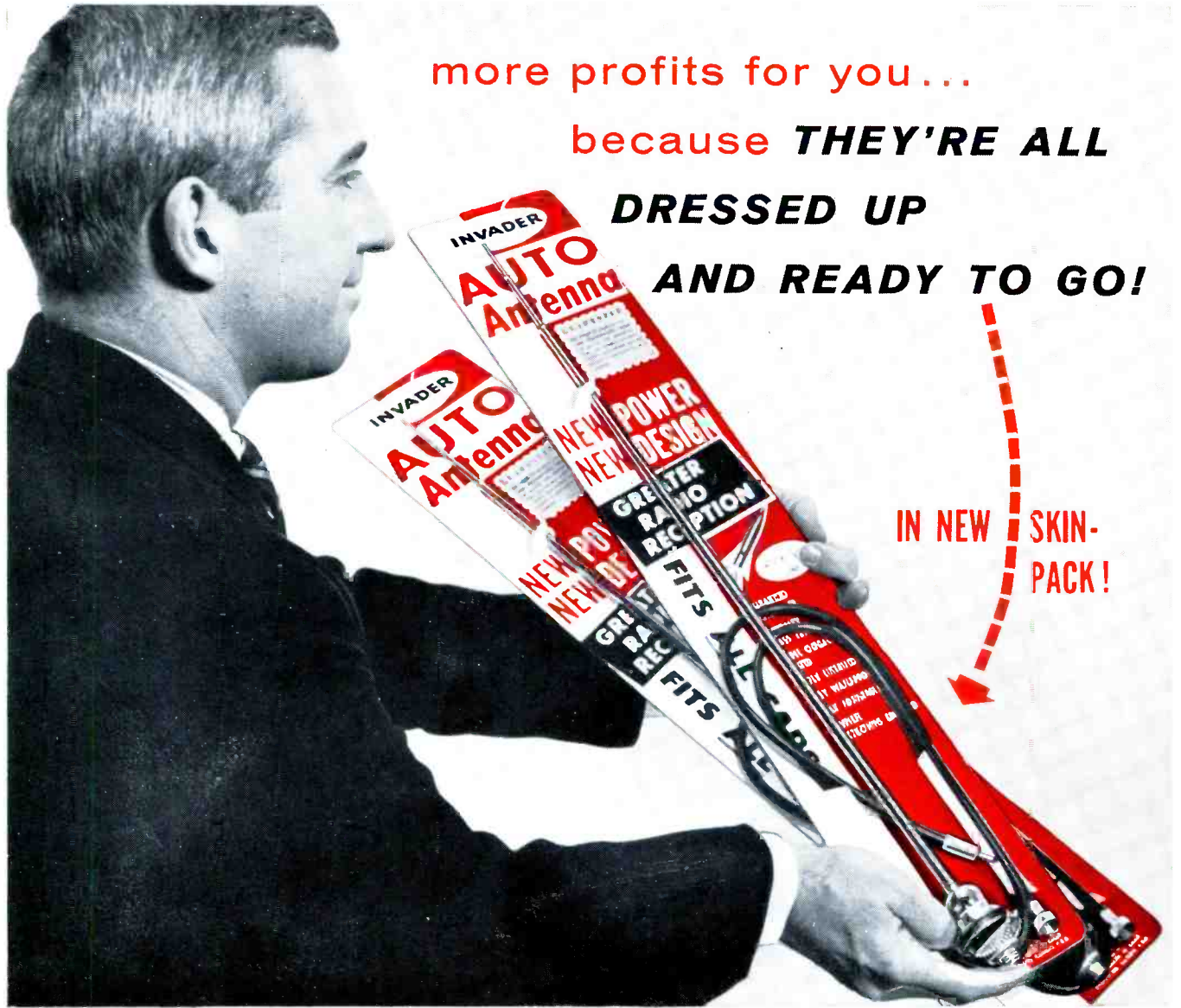


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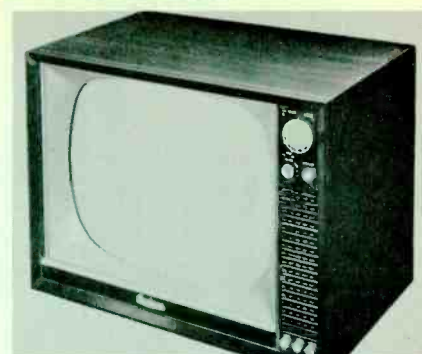
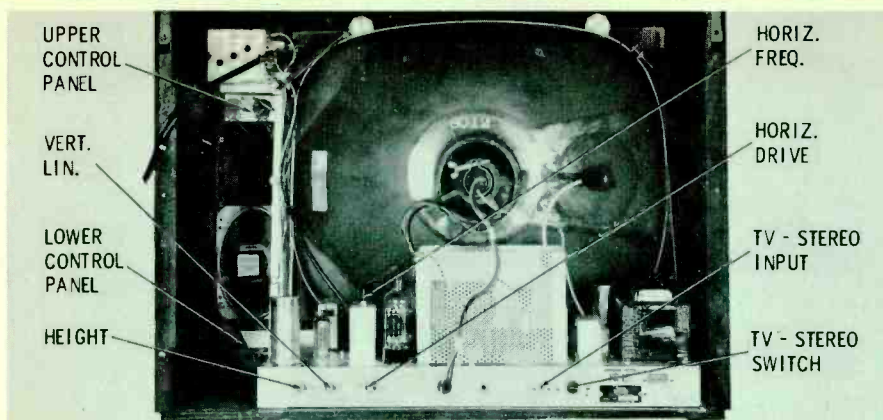
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**Andrea Model T-VR 121
 Chassis VR-121**

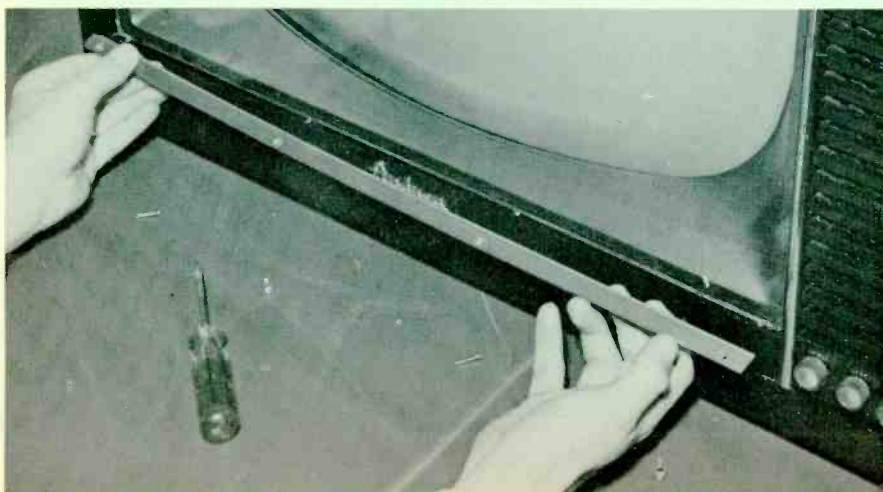
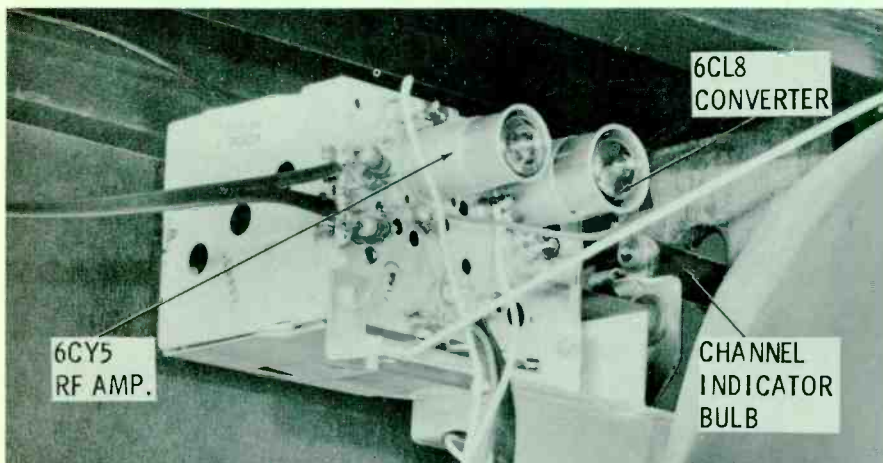
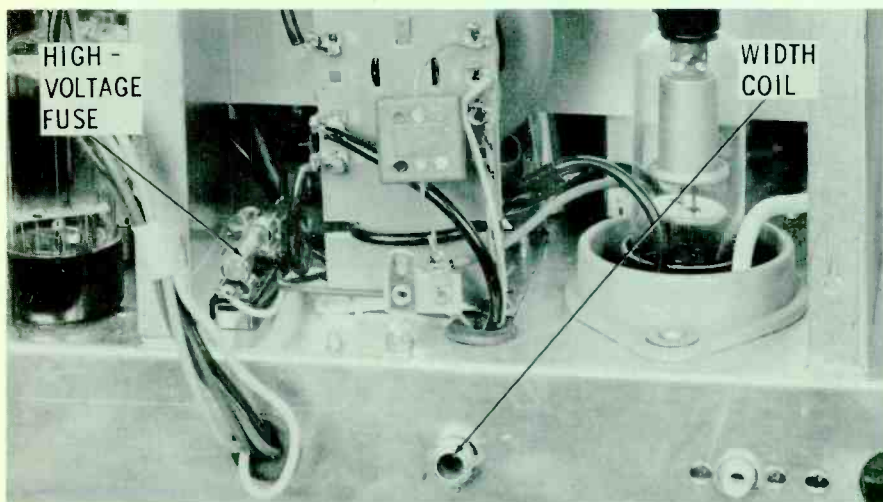
With 21" 110° picture tube, this chassis is housed in a table model wood cabinet. All operating controls are on the front; the top group consists of channel selector, fine tuning, contrast, and volume with push-type on/off switch. The three lower controls are horizontal hold, vertical hold, and brightness.

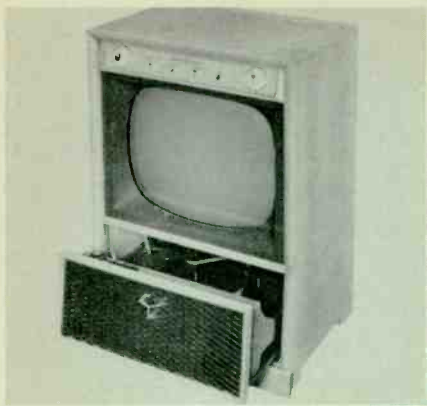
The transformer-powered chassis is a fairly narrow horizontal style with conventional wiring. A bracket attachment suspends the VHF tuner at the top of the cabinet. Rear service adjustments are shown in the photograph; the TV-STEREO switch is a two-position slide-type which permits the audio section of the receiver to operate as one channel of a stereo hookup or as a phono amplifier. With the double-throw switch in stereo position, the TV is automatically disabled by opening of the filaments for the CRT, vertical-sweep, and horizontal-output tubes.

The back panel of the high-voltage cage comes off after removal of four 1/4" metal screws. The clip-in type fuse inside the cage is a 1/4-amp slow-blow unit which protects both vertical and horizontal output circuits. When the back of the set is removed, all tubes are accessible with the exception of two or three behind the high-voltage cage. The most recent tube types include a 6CZ5 in the vertical-sweep section and a 6AS8 video IF and detector.

Both tubes of the VHF tuner are positioned in a horizontal plane and have telescoping type shields. To touch up the RF oscillator adjustments, remove the two front knobs and use a hex-shaped tool that will fit the two 1/8" diameter cores. The top adjustment is made on channel 13 and affects alignment of all high channels. The lower adjustment is set up on channel 6 and affects channels 2 through 6, inclusive. The bulb in front of the tuner is a #44 pilot that remains on for both TV and phono operation. The main chassis, tuner, and picture tube are one complete assembly and may be removed from the cabinet as such. When removing the chassis, slide it back as far as possible and then tilt it forward to clear the top edge of the cabinet.

In order to clean the screen of the picture tube without removing the chassis, take out the four Phillips-head screws holding the lower trim and remove the strip as shown. The safety glass can then be lifted up and out.





**Setchell Carlson Model
21C159
Chassis 159 or (Z159)**

This new 21" console combination has control knobs across the top and a record-changer drawer at the bottom. Aside from TV, the instrument features an AM-FM radio and provisions for stereo operation of the phonograph. The back of the set need not be removed for general service in the home. The top of the wood cabinet is hinged and opens like a lid from the front after three metal bolts located under the front top molding are removed. The horizontal chassis, powered with a transformer and a pair of silicon rectifiers, is mounted above the picture tube.

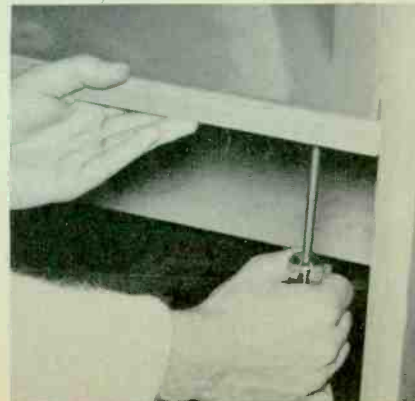
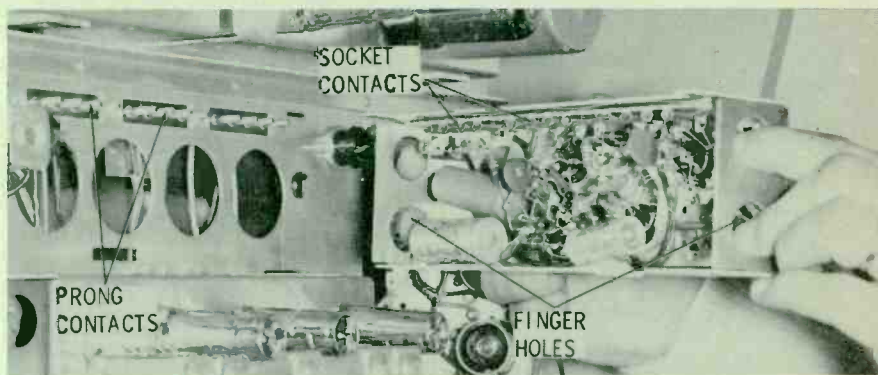
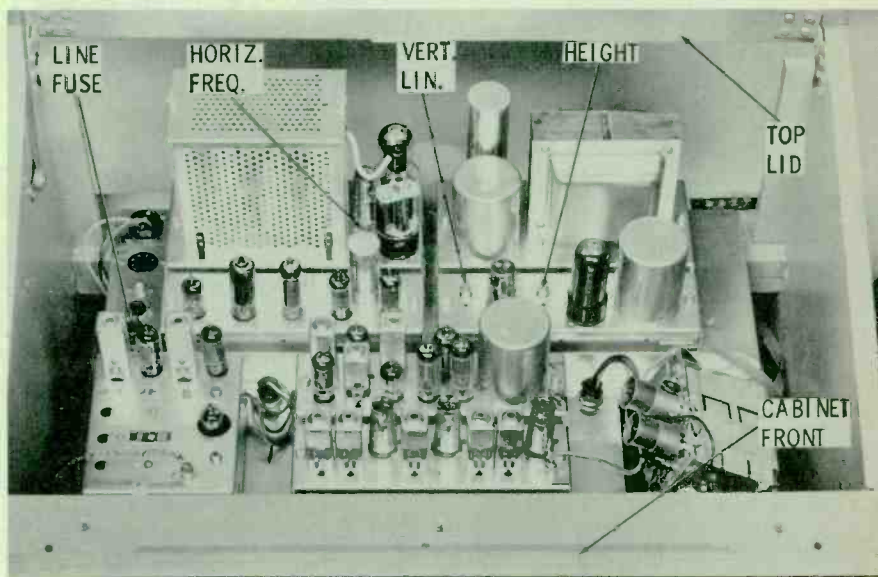
There's a small trap door on the back of the set to provide access to yoke and centering adjustments. Service controls, including vertical hold, brightness, horizontal hold, and focus, are also found on the rear, as well as a tube-saver jack, audio-reverse switch, and a speaker socket for stereo output. If the picture tube becomes weak, a shorting plug can be inserted into the saver jack. This causes CRT heater voltage, and thus tube emission, to be increased. The audio-reverse switch is used for reversing the speaker systems during stereo operation.

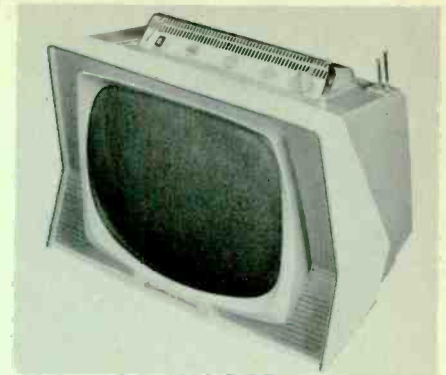
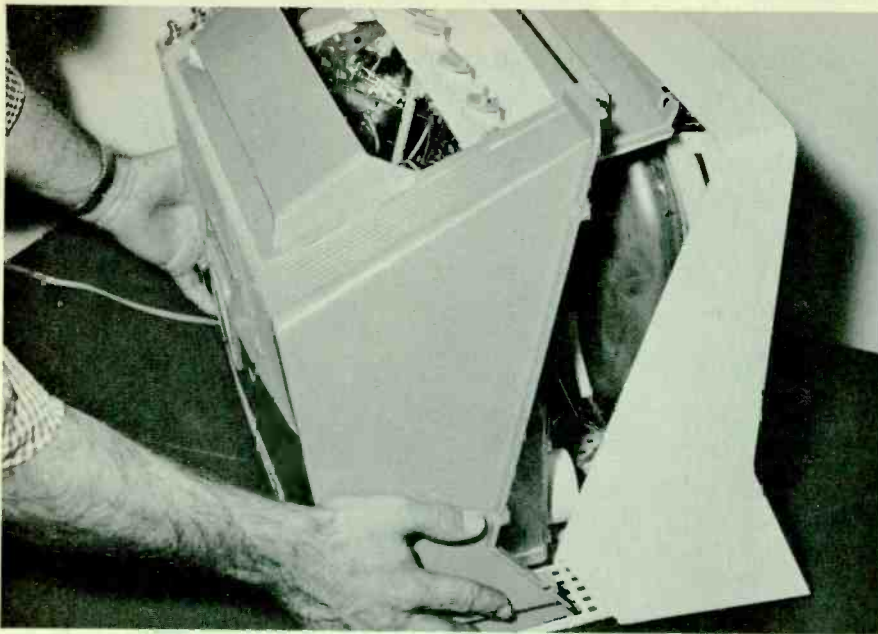
Looking at the top of the chassis from the front of the set, note the locations of the 3-amp line fuse as well as the remaining service adjustments. Tubes are of a conventional variety and within easy reach with the lid open. 23 are employed in the TV, 4 in the FM radio, 3 in the AM radio, and 3 in the stereo amp unit. Filaments for all tubes are connected in a parallel arrangement.

The "unit-ized" chassis is made up of a number of plug-in sections. A section is removed by taking out the two Phillips-head screws at each end and pulling straight up. Finger holes, which also aid in ventilation, are provided at the ends of each unit.

The record-changer drawer, which houses the FM radio and stereo chassis, can be removed by lifting the front about 6" and pulling the entire drawer forward. Don't forget, of course, to unplug the cables leading to the main TV chassis.

By removing two Phillips screws holding the bottom trim strip, the safety glass and tube can be cleaned from the front. Since the strip supports the glass, be sure to hold the assembly firmly when removing it.





**Sylvania Model 17D203Q
Chassis 1-543-1**

This "Dualette" model is a dual-purpose set designed for both table and portable use. You'll recognize it by its 17" screen centered in an open fish-mouth design on the front of an all-plastic cabinet. Channel selector, volume, contrast, brightness, and push-type on/off knobs are in line across a protruding section on top. A telescoping "V" antenna is also located on top of the cabinet in one back corner. It can be rotated in any direction when extended, and folded out of sight when not in use.

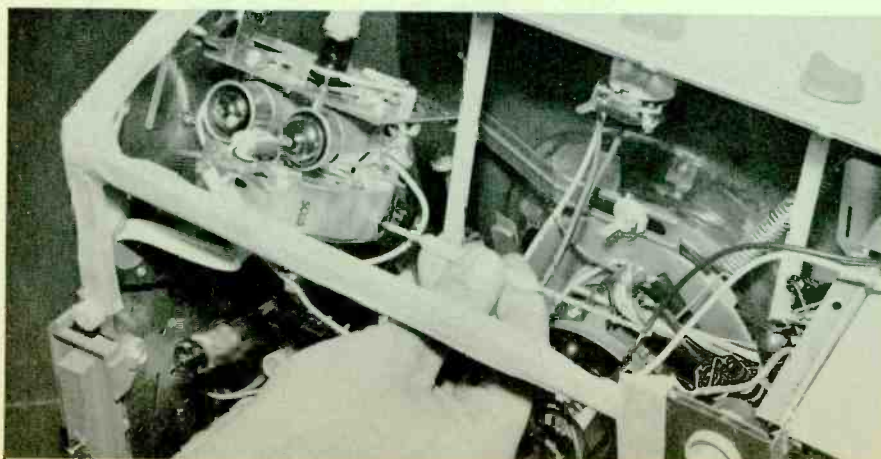
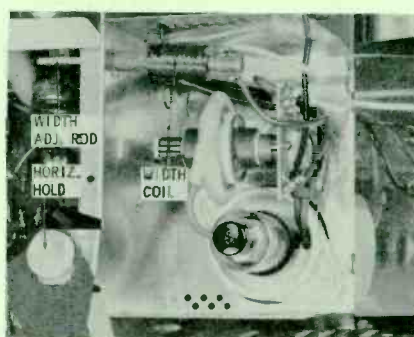
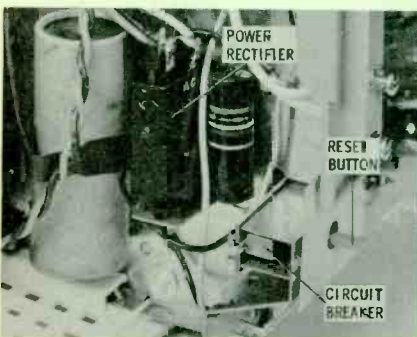
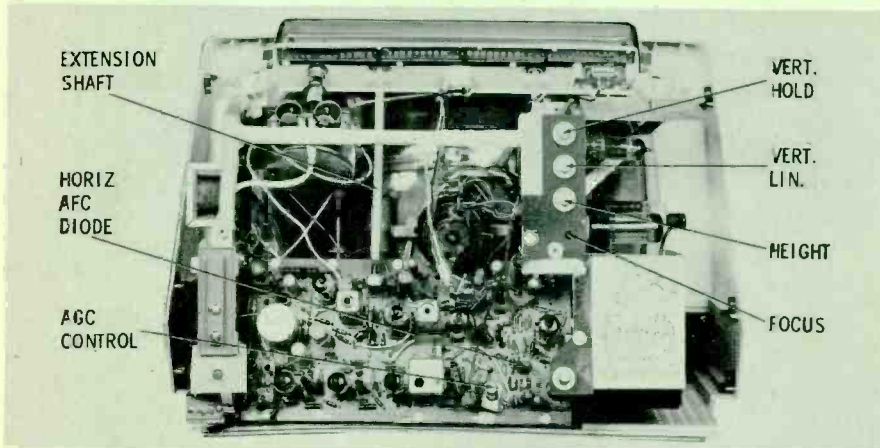
To open up the instrument for servicing, remove eight screws holding the rear section and pull back as shown. It is not necessary to remove any of the control knobs, even when pulling out the entire chassis. The picture tube and yoke are mounted on the front section and stay in place when the chassis is pulled.

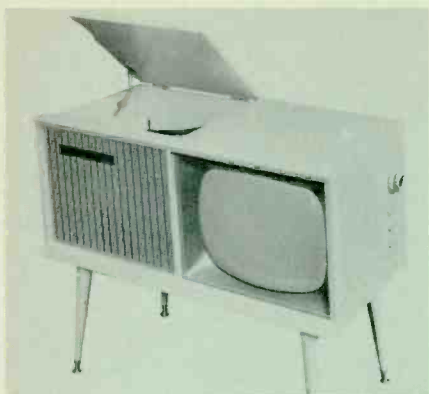
Major service adjustments are shown in the rear cabinet photo. The chassis is laid out in a frame around the CRT, with most of its circuitry confined to the single-section printed board at the bottom. Since the brightness and volume controls are attached directly to the board, two long plastic extension shafts are employed. Among the series-string tubes, you'll find a 5BR8 in the sound and AGC circuits, a 10DE7 vertical oscillator-output, and a 6DQ6A in the horizontal-amplifier stage.

The "hot" chassis features a circuit breaker with manual reset button in the AC-input circuit. This thermal unit protects all circuits except the one for the tube filaments. The power supply contains two silicon diodes in a voltage-doubler network. The rectifiers are part of a clip-in unit mounted on the side of the chassis as shown.

You'll find the high-voltage cage in the lower-right section of the chassis. As shown, the width coil mounts inside the cage with a white nylon rod extending out one side for adjustment purposes. The horizontal-hold control, which is also a coil adjustment, is positioned directly below this width rod.

With the rear cover of the set removed, oscillator adjustments on the *Fireball* tuner can be made as shown. Incidentally, the tuner employs a 2BN4 amplifier and a 5CG8 mixer and oscillator. To clean the screen on this model, both the chassis and picture tube must be removed. Don't try any short cuts!





**Westinghouse Model
H-17C287
Chassis V-2365-11**

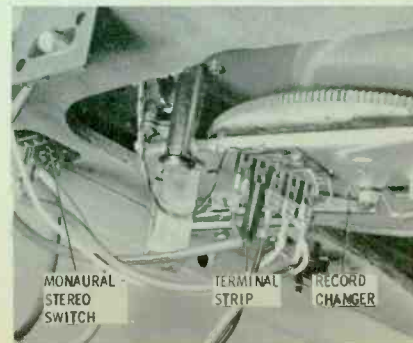
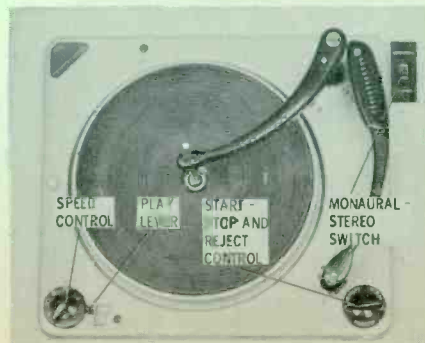
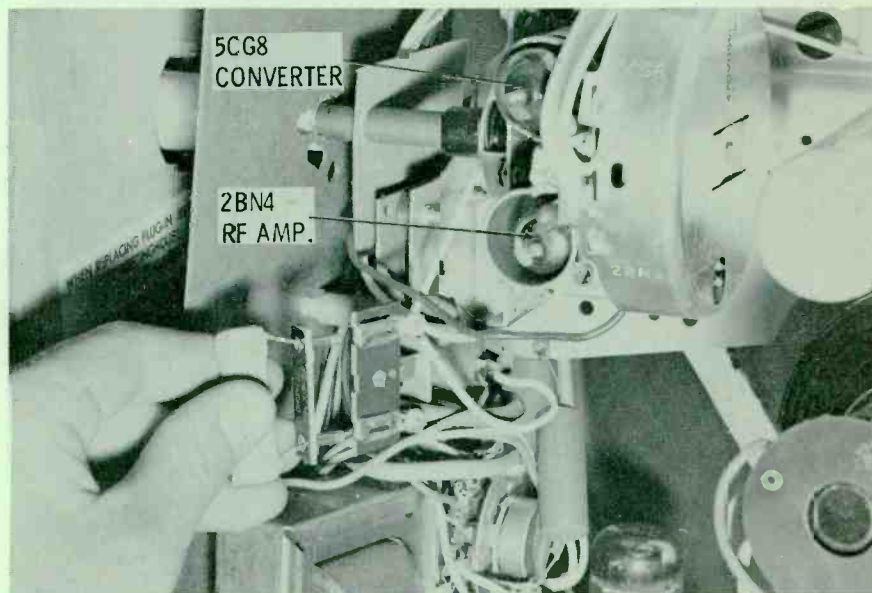
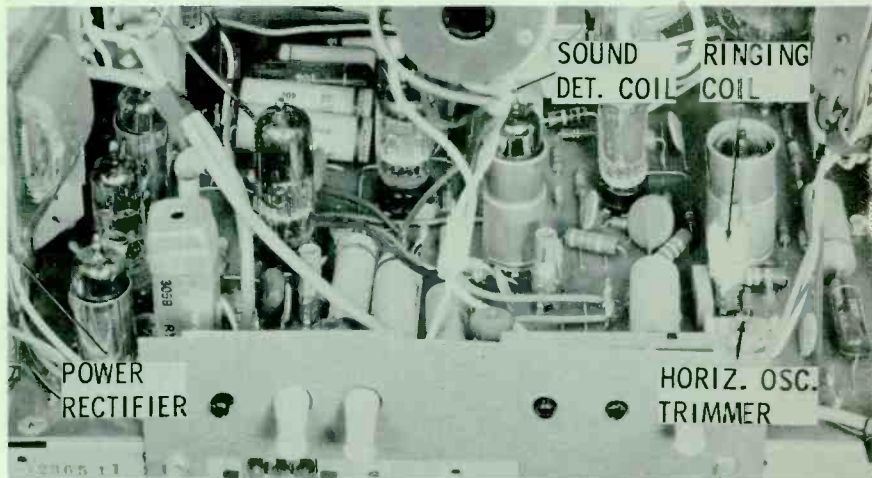
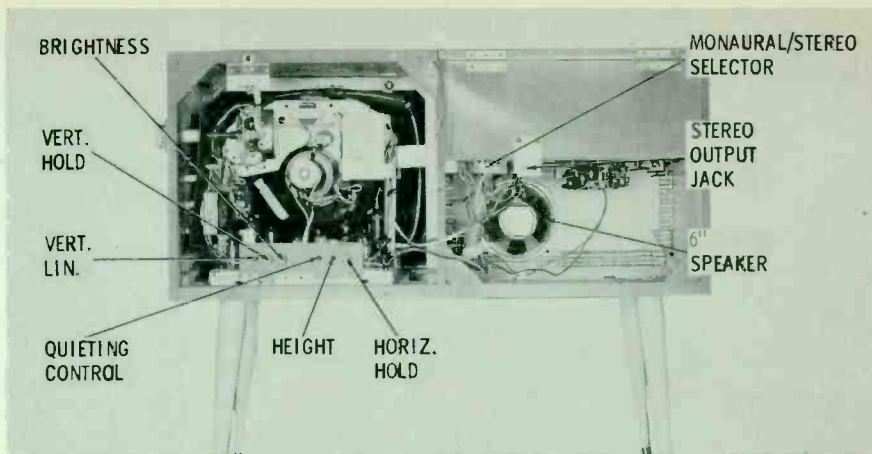
A little unusual for a modern console because of the 17" picture tube, this contemporary combination features a four-speed automatic record changer and provisions for converting to stereo. Unusual, too, is the phono amplifier system, which employs the video-amplifier tube as an audio driver. Circuit functions for this operation are automatically changed by the TV-PHONO switch located on the contrast control.

The chassis, powered with a single silicon rectifier, is a dual-section assembly built around the neck of a 90° CRT. The QUIETING control, shown as one of the rear service adjustments, is a 600-ohm pot located in the cathode circuit of the 3BN6 sound-detector tube. The MONAURAL/STEREO SELECTOR is a simple shorting link pivoted at the center of a three-terminal strip. In one position, the link completes the input circuit from the phono cartridge for monaural operation, and in the other, the input is split for the output of a dual-channel stereo cartridge.

The horizontal-oscillator trimmer, on top of the printed board, is a small variable capacitor with a range of 19 to 160 mmf. It parallels a 68-mmf unit connected from plate to grid in the horizontal multivibrator stage, and should be adjusted in conjunction with the ringing coil for best sync stability. If you can't find the plug-in silicon rectifier, try probing on the left side of the chassis directly beneath the tone control (with power off, of course).

Taking a look up near the *Fireball* tuner, you'll notice a plug-in fusible resistor positioned on the vertical side-rail. This is a 7.5-ohm unit to protect the power rectifier against surge and B+ shorts. To touch up oscillator adjustments of the VHF tuner, you'll find that a short alignment tool no longer than 2 3/4" is required. Latest series-string tubes used include a 3DK6 video IF, 12C5 audio output, and 6CN7 vertical multivibrator and horizontal AFC detector.

The record changer, which has a monaural-type cartridge in a stereo cartridge holder, is a Collaro "Conquest" model. Automatic or manual operation is selected by the lever marked PLAY. You might remember to check the video-amplifier tube should the phono output fail.

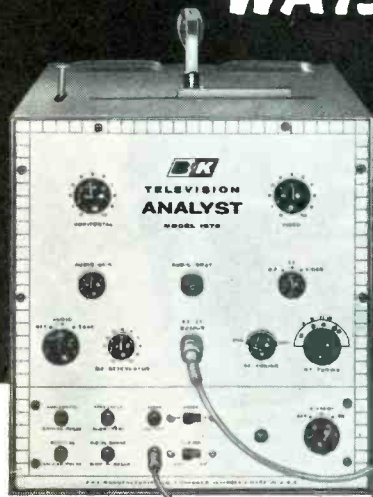


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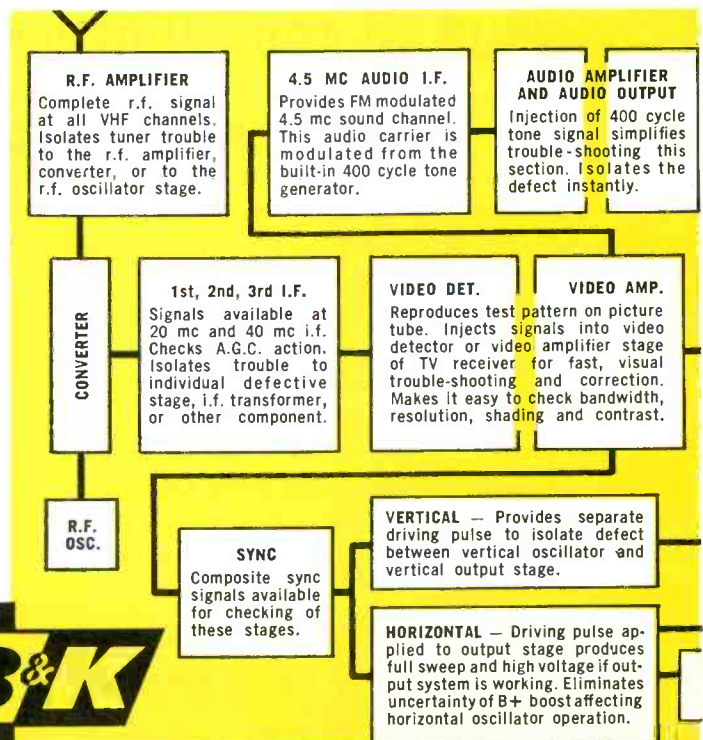
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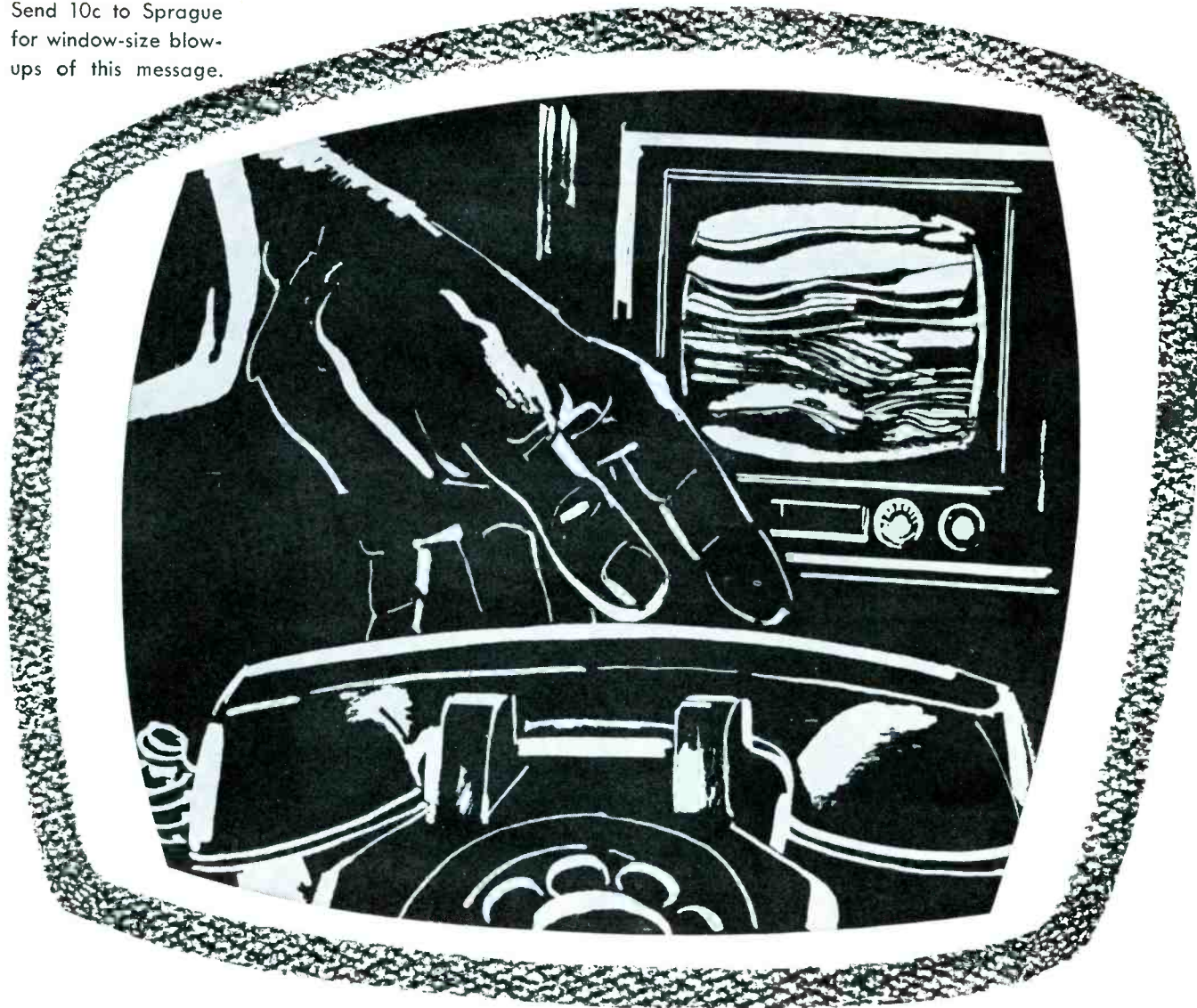
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MUrray Hill 8-6350

Western

The Maurice A. Kimball Co., Inc.
2550 Beverly Blvd., Los Angeles 57, Calif.
Dunkirk 8-6178; and 681 Market Street,
San Francisco 5, Calif. Exbrook 2-3365

Address all correspondence relating to circulation and editorial to PF REPORTER, 2201 East 46th Street, Indianapolis 6, Indiana



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NEXT MONTH

P's and Q's of Transistors

If you're looking for a simple explanation of basic transistor circuit operation, this is for you. Includes a cross-reference of portable-radio types.

Making Clock Radio Repairs

Several pointers on how to handle most of the minor problems associated with clock mechanisms used in today's radios.

Servicing Electronic Organs

By popular demand, here's one for the guys who are expected to service everything and anything electronic.



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Volume 9, No. 6

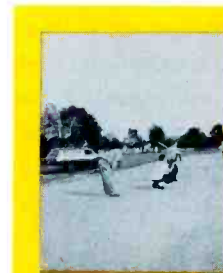
JUNE, 1959

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ABOUT THE COVER

Bases loaded, and here comes the last pitch of the game. We're betting that "big" little leaguer is having more fun than anyone. Sad part of it is, his lunch hour's nearly over. The rest of the afternoon will be spent "watching" a televised game from behind his customer's TV sets.



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Letters to the

EDITOR

Dear Editor:

There may be more of the "weaker sex" in this business than we think! (See letter from Mrs. Ruby D. Scragg in the March issue.) I took the enclosed photo of a radio which was recently brought in for repair. The bent gimmick holding the ends of the dial cord under tension is a bobby pin with a hook bent into each end. It works just as well as the regular spring!

V. W. HODGE

Claremont, N. H.



We're impressed with the resourcefulness of this unknown person, whether "she" is really a woman or just a man who's been raiding his wife's dressing table. Generally, we don't hold with makeshift repairs, but this one sure looks like it fills the bill—just hope the next one you find isn't used as a fuse!—Ed.

Dear Editor:

I have just finished reading your article "Bench Servicing New Sets" in which you feature the Philco 9L37 chassis. You have done a very fine job in presenting the procedure of servicing this set, and I know it will be very helpful to those servicemen who may not ordinarily receive your service manuals.

I would like to add one thing. You comment that the picture tube will rotate 45°. Actually, there is a set screw in the base of the CRT assembly which can be backed out to allow the tube to rotate 180° either way. This is very handy when you are working on the chassis "live," as you are able to see symptoms as you progress.

F. D. WHITTEN

Philco Corp.
Philadelphia, Pa.

Here's an excellent idea which we overlooked.—Ed.

Dear Editor:

I have noticed letters in your column mentioning bad effects of X-ray radiation in connection with TV work. For an extended period, we secured Picker reports on whatever radiation effects there were in our shop. Danger indicated by these reports was negligible.

ALHART ELECTRICAL CO., INC.
Rochester, N. Y.

As mentioned here last July, you have little to fear regarding X-rays. Concentrate instead on the danger of electrical shock — or the driving ability of the man behind the wheel of your service vehicle! —Ed.

• Please turn to page 20



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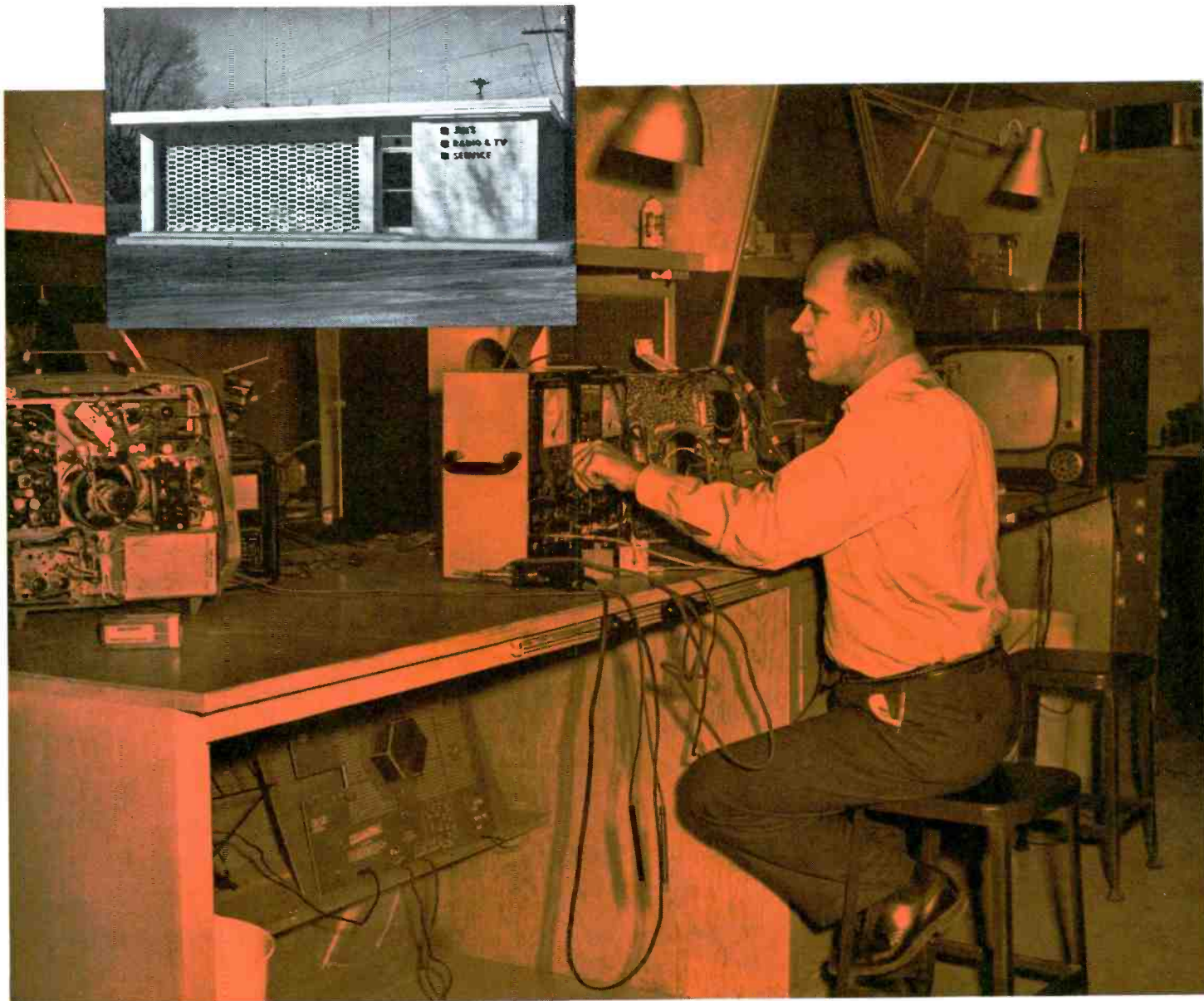
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Concentrating on dependable service gave

Jim a reputation which allowed business to grow quickly. Jim and his men handle radio and television service throughout their trade area.

Jim is a Major in the active Army Reserve. He carries a commercial card and is branching out into commercial mobile work.

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"When a shop concentrates on service, it can't afford to take chances with customer satisfaction. So we depend on Mallory components. They're always consistent in quality. And I always feel 'safe' about a job when I've used Mallory components . . . there's no worry about costly, time-consuming callbacks. Mallory has been giving me the same quality



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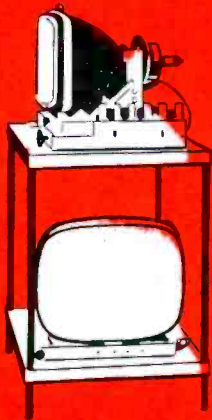
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SAVE LABOR! SAVE TIME! One of the most useful tools you've ever had in your shop, the RCA TV-Toter Table is constructed of 20 gauge reinforced steel with chrome-plated hardened-steel tubular legs, has a durable office grey hammer tone finish. Each table comes complete with four leg extensions and four casters to permit easy change-over from no-tilt table to handy roll-about unit. Measuring 24" x 24" x 33½" high, the RCA TV-Toter Table supports a TV chassis at convenient bench height.



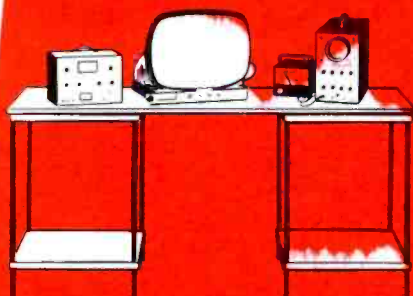
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Harrison, N. J.

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In addition to the items in your Service Sales Tape Pak, you receive the influential support of the consistent national advertising campaign reaching tape recorder owners in every important market including: the general consumer, the hi-fi bug, the clergy, the schools, professional musicians, etc.



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the rest is
up to you!



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- my check for \$44.40 is enclosed
 have your representative call
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CITY _____ ZONE _____ STATE _____

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Letters (Continued from page 12)

Dear Editor:

You are to be commended for introducing articles pertaining to communications receivers. With approximately 200,000 licensed radio amateurs and a growing number of short-wave listeners in this country, there is a definite need for qualified service technicians to handle the maintenance of this equipment.

Incidentally, "Getting Acquainted With Communications Receivers" in your March, 1959 issue made reference to a "40-mc ham FM band." No doubt this is a typographical error, because there is no 40-mc assignment at this time for the amateur radio service. In addition, Fig. 3 suggests connecting a TV antenna between terminals A1 and A2, with the shorting bar removed from terminal A2 and ground. This connection will work with a dipole cut to the proper frequency, but TV antennas are not suitable for communications frequencies. Connecting such an antenna directly across the input of the receiver in Fig. 3 will greatly attenuate the signal. If no other antenna is available, a TV antenna can be used temporarily by connecting one conductor of the twin lead to terminal A1 and leaving the shorting bar in place.

A. R. DAMBRAUSKAS

The Hallicrafters Co.
Chicago, Ill.

We trust that you also enjoyed Part 2 of Mr. Darr's series, which appeared in May. Thanks to excellent response from readers, we plan to continue to publish such coverages.

"40-mc ham band" was a typo; we meant to say 50-mc band—or, as most hams know it, the 6-meter band.

As for the antenna connection, we should have stuck to what we illustrated in Fig. 3. On a temporary basis, one side of a TV antenna can be utilized as a simple long-wire arrangement without any need for removing the shorting bar.
—Ed.

Dear Editor:

Your April issue had an interesting *Previews of New Sets* item dealing with the Magnavox Model 2MV147L, a TV receiver with remote control; however, a slight misstatement was made in the final paragraph of this article.

The statement in question is "The set control (nearest side of cabinet) selects channels for automatic tuning by pulling out or down on the knob. When this control is rotated clockwise in the *out* position, the associated channel is then set up for automatic shut-off."

Actually, the *set* control should be rotated *first*, then pulled out or down. Pulling down and then rotating will cause the control lever to bind on the program pin. In some cases, this has resulted in one or more pins being pulled completely out of the program wheel.

RAY S. GUICHARD

The Magnavox Co.
Fort Wayne, Ind.

Thanks.—Ed.

Dear Editor:

Regarding Mr. James L. Kirkwood's question about the old Thomas A. Edison disc phonograph (*Letters*, February issue), wouldn't it be feasible to use a stereo cartridge, which has vertical as well as horizontal compliance? Also, do the old cylindrical records have vertical modulation?

L. C. RODERICK

Alhambra, Calif.

A stereo cartridge might work if you use it in a modern, lightweight tone arm. Remember that good vertical compliance depends largely on the very light tracking pressure used in a stereo system. There may be some stylus problems, since the .7-mil stereo stylus would be all but lost in the big grooves of the old recordings; however, you might get a thicker stylus to work with the stereo cartridge.

Yes, the old-time cylindrical records are vertically modulated.—Ed.

Dear Editor:

I think I can help Messrs. DiGenaro and Glenn solve their problem of 12BY7's burning out repeatedly in the Westinghouse V-2342 and -43 chassis. Our trouble was traced to a minute crack in the printed wiring at pin 5.

LINDEN REESE

Flora, Ill.

Every case was traced to an open between either pin 4 or 5 of the 12BY7 socket and the printed board. With one half of the center-tapped filament open, excessive current flows through the remaining half and burns it out.

STANLEY LOCKWOOD

Omaha, Nebr.

Bridging pin connections 4 and 5 has proved to solve the problem for me, eliminating the thankless task of repairing the broken circuit board.

SCOTT R. COMMONS

Dallas, Texas

The break is usually so small that a magnifying glass and bright light are required to see it. A resistance check of the filament circuit often gives a normal indication.

CURT and ALTA BENTHAM

Willsboro, N. Y.

Using a jeweler's magnifying glass, we found a hairline crack in the solder connection of the 12BY7 socket at pin 5.

ROBERT E. BEAUVAIS

Grand Rapids, Mich.

In the *Troubleshooter* column, a question about frequent filament burnout of the 12BY7 tubes in our V-2342 chassis is answered by the advice to replace the tube socket, which is leaky. The cause of the burnout is more often a poor connection where pins 4 and 5 are soldered together, permitting all of the current to pass through one-half of the filament.

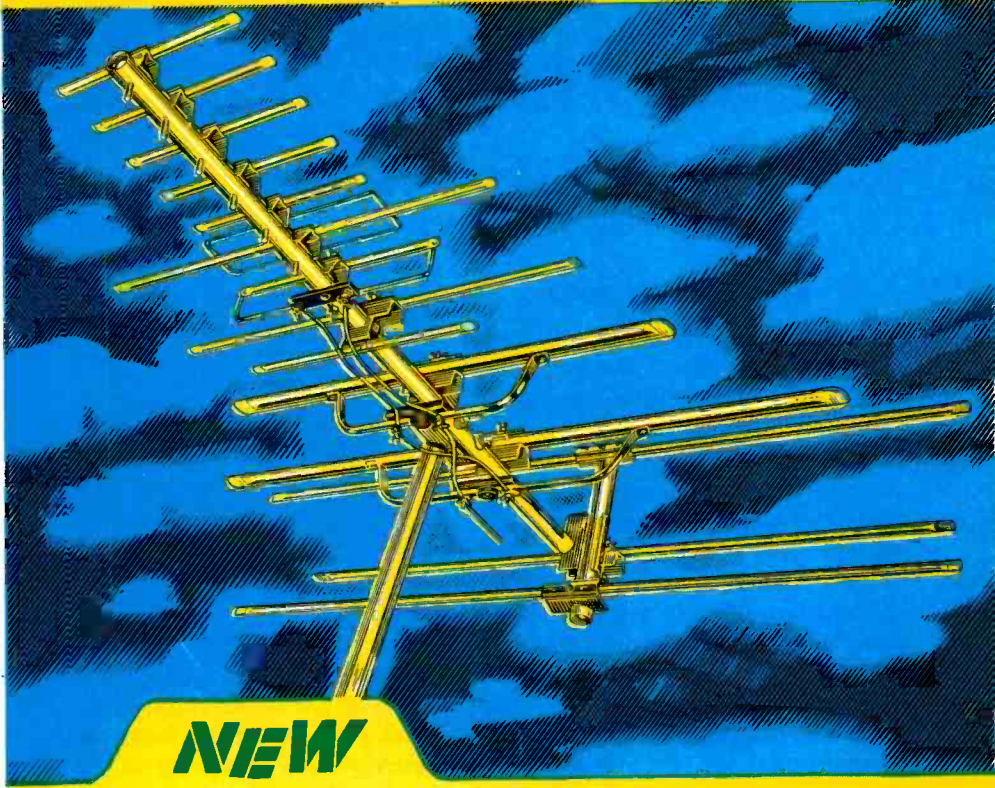
HARRY HORSTMANN

Westinghouse Electric Corp.

Metuchen, N. J.

OKAY, OKAY! Even the TROUBLESHOOTER misses once in a while, although he claims he does this just to see if his column is being read.—Ed.

THE GREATEST BREAK-THRU IN PICTURE RECEPTION SINCE THE INCEPTION OF THE FIRST YAGI ANTENNA!



MIRACLE TV ANTENNAS by TENNA Give you the exclusive and Vastly Superior **MIRACLE REFLECTOR SYSTEM**

It's new, it's different and decidedly better! In the Miracle System the reflectors are "tuned" to produce highest directive results, providing the finest possible front to back ratio across the maximum number of channels.

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As an example, the front to back ratio on channel 3 of the Miracle TM-78 is 40 to 1. No other antenna of any manufacturer has ever achieved such a high ratio.

The Miracle Reflector when installed on competitive antennas invariably increased the gain by at least 25% and more than doubled the front to back ratio on the channel being tested.

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across the

BENCH

by Stan Prentiss

Bendix Model 6003

This set employed only 17 tubes including high- and low-voltage rectifiers and picture tube. Interesting features include a stagger-tuned video IF system with two bifilar-wound transformers, a curiously-placed selenium rectifier in the horizontal yoke-return lead, and DC regulation via a self-stabilizing divider using tubes in a series-parallel combination. In case you aren't already familiar with it, the term bifilar means two windings interwound. Advantages of bifilar-wound transformers include a coupling coefficient that approaches unity, and single slug tuning. The high degree of coupling permits higher gain per stage and also the use of low-value RC time-constant circuits in IF-amplifier grid networks. A small RC value is desirable since it prevents noise signals from adding to the AGC bias—a condition that would affect IF-circuit response.

In addition to the adjustments provided by the two bifilar-wound coils, a series-tuned coil connects the output from the VHF mixer to

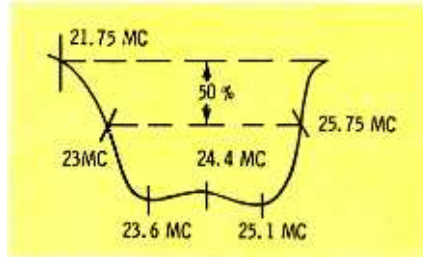


Fig. 1. IF response in Bendix 6003 shows 2.75-mc between 50% points.

the input of the 1st video IF tube. Besides being the third tuned circuit of the IF assembly, this series coil prevents excess local oscillator energy from appearing at the input of the video IF strip.

To digress a little, tuner design is such that at least 2.5 volts should be present at the mixer-grid test point on channel 12, due to the injection of local oscillator energy, and should vary between 2.5 volts on channel 12 and 5 volts on lower channels.

The three IF stages peak at 25.1, 23.6 and 24.4 to produce a video-IF response curve with about 2.75 mc between 6-db points (50% down on the curve). The typical

curve shown in Fig. 1 is adequate for the production of a reasonably sharp picture.

DC Stabilizing Circuit

The DC voltages applied to the various circuits are stabilized by operating the tubes in a series-parallel configuration as shown in Fig. 2. As you can readily see, the screen of V5, the cathodes of V6, V1, V2, V3, V4, V9, and the brightness control all connect to the cathode of V8. This, by the way, is the 150-volt source. V6 assists V8 in carrying the current demanded by the other tubes, even though it returns to the output side of the DC filter rather than to the input. The system is self-balancing since V8 is biased to draw a fixed amount of current, which happens to be the current required by the series-connected stages.

Another aspect of this type of circuit is that it eliminates the use of voltage-divider resistors. Don't try to replace the 6AS5 with a 6AQ5 or similar output tube, or you will unbalance the circuit. The result will be either poor audio (weak or distorted) or trouble in one of the stages supplied from the cathode of the audio-output tube.

Horizontal Output Circuit

The horizontal-output circuit employed in this receiver has several interesting features, any of which can give the technician a fit if he isn't aware of them. The screen-grid (Fig. 3) circuit first attracted my attention because I couldn't readily trace its DC supply path. At first, I assumed that DC reached the screen

• Please turn to page 58

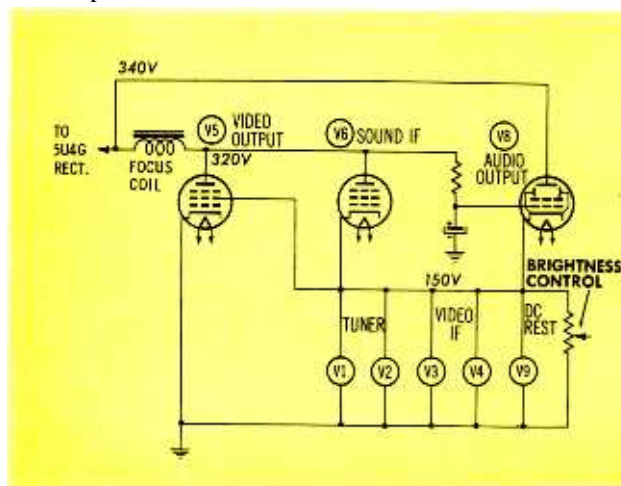


Fig. 2. B+ voltage regulation for RF, IF, and restorer stages is accomplished with series-parallel tube operation.

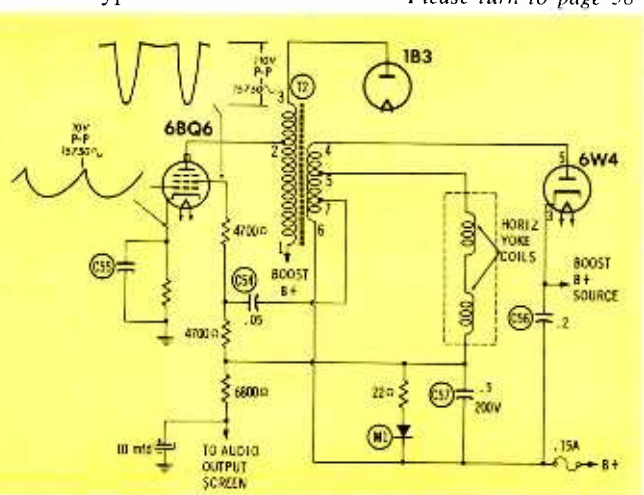


Fig. 3. Horizontal-output circuit employs selenium rectifier and feedback of the yoke signal to the screen grid.

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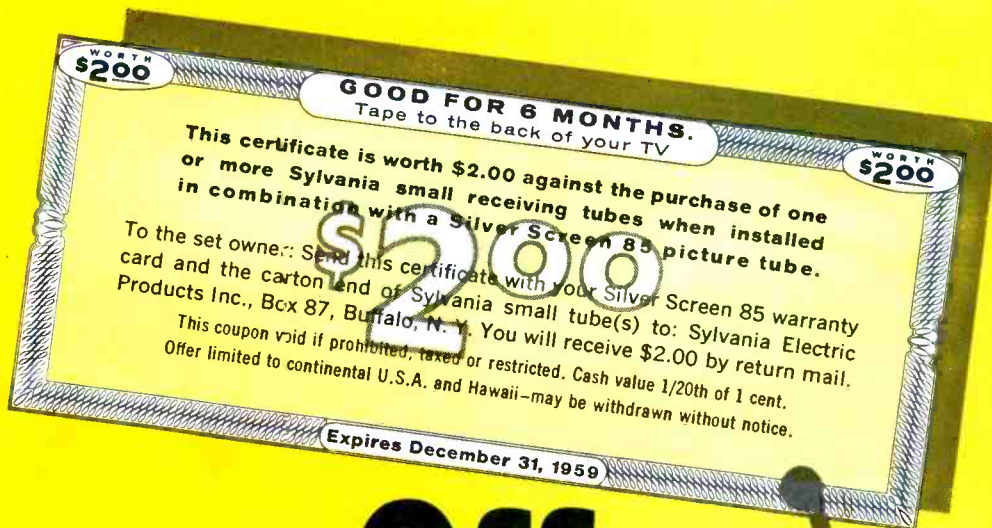
Your Service shares the spotlight with top-quality Sylvania picture tubes and receiving tubes in a three-point program to make your customer's old TV set *better than when it was new*.

Month after month, more set owners will be saving the \$2.00 coupon. Many will attach it to the back of their TV set so it's there for you to see.

You can identify yourself with this program by featuring Silver Screen 85 and Sylvania receiving tubes. Get behind the biggest, most practical, business-building offer ever made to the Service industry.



Look for this ad in these leading national magazines.



Coupon Offer

Sells your service and Sylvania receiving tubes in combination with every Silver Screen 85 you install

Here's an action-packed offer that can add an average of \$3.00 to \$6.00 in receiving tube business every time you install a Silver Screen 85 picture tube.

Sylvania urges your customers to have their receiving tubes checked to make sure they get full performance from their new Silver Screen 85. And, to emphasize the importance of replacing weak tubes, Sylvania offers to pay \$2.00 toward the cost of Sylvania receiving tubes installed in combination with a Silver Screen 85.

Your customers mail the \$2.00 certificate directly to Sylvania with the picture-tube warranty card and receiving-tube carton end. Nothing for you to sign or send.

Stock up on Sylvania. Be prepared for greater-than-ever consumer demand for America's Number One picture tube and receiving tubes.



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Fig. 1. Motorola Model 21K104M uses horizontally-mounted chassis with separate tuner-and-control panel.

BENCH SERVICING NEW SETS

by Thomas A. Lesh

Several TV set manufacturers have adopted a horizontal chassis layout for many of their latest models. This marks at least a partial reversal of the recent trend toward vertically-mounted chassis, but it doesn't mean a return to the design practices of ten years ago! Horizontal chassis in today's sets are a far cry from the bulky old "battleships" with their neat row of operating controls along the front apron. A typical modern unit has a compact, shallow design, and is usually mounted with its forward edge at some distance from the front wall of the cabinet. In addition, the tuner and operating controls have migrated to the top border of the front panel. The public has brought about this change in control location by showing a strong preference for sets with "no-stoop" tuning.

Top-mounted controls have been a source of much grumbling among servicemen because they complicate removal of the chassis from the cabinet. We might as well face it, though—the serviceman's wishes must bow to consumer demand in this case. A design with controls placed high on the set is considered such an important convenience feature that it can even mark the difference between success or failure of a manufacturer's TV line.

To satisfy modern standards, then, the "ideal" horizontal-chassis TV set should be equipped with high-up controls; but it should also be carefully designed to minimize the effort required in servicing. There are as many approaches to this problem as there are manufacturers. What may be the ultimate solution — applied to the larger Setchell-Carlson consoles for

the past several years — is to mount the entire chassis horizontally above the picture tube and make it accessible through a hinged cabinet top! In Westinghouse sets, the flat-mounted chassis frame usually has a slender superstructure to support the tuner and controls. (In some cases, this may also be used to fasten the CRT to the chassis assembly.) Certain other manufacturers such as General Electric and Muntz have been building an L-shaped chassis which mounts horizontally but has a vertical extension at one side to hold the tuner and various other components.

Motorola Chassis TS-552

Still other brands of sets have tuners and controls connected to the main mechanical differences between their '58 and '59 sets is in the method of mounting the tuner and operating controls. In last year's TS-542 and TS-544 chassis, the controls were on a small separate bracket, and the tuner was fastened to the main chassis frame at the upper left corner of the picture tube. On the other hand, this year's transformer-powered TS-552 and RTS-544 series have both the tuner and operating controls attached to a large subchassis panel which mounts on the front wall of the cabinet alongside the picture tube. Plug-in cables connect this

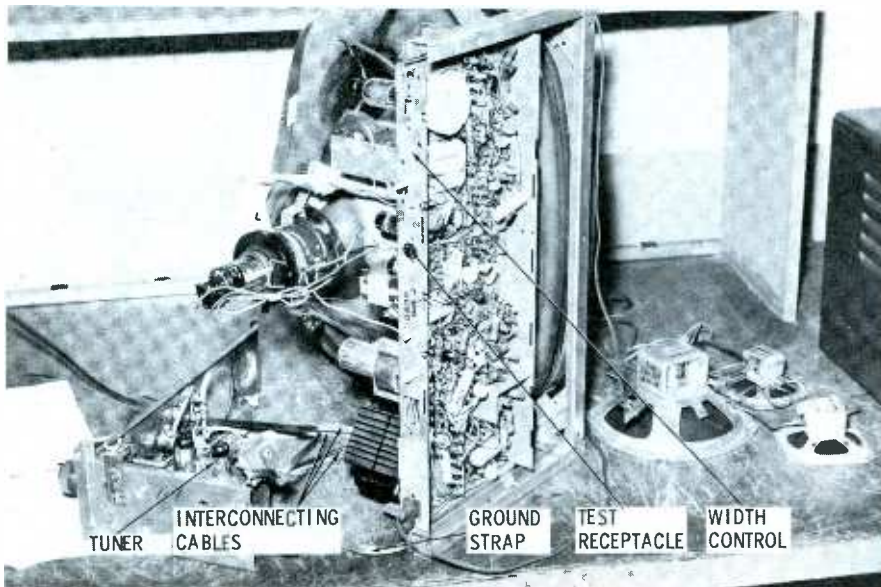


Fig. 2. Chassis can be operated in this position with no extension cables.

unit to the main chassis assembly. Either the main unit or the subchassis may be independently removed, but it's easiest to take out the main chassis *first* if you are disassembling the entire receiver.

The first step is to disconnect the two units. As viewed from the rear, the cable connections all terminate in the far left corner of the conventionally-wired main assembly. They consist of an 11-prong plug for control leads, a smaller 5-prong plug for tuner connections, a coaxial cable for IF signal input, and a braided ground strap with clips at both ends to connect the control panel to the main chassis.

The CRT and main chassis are held together by a solid framework of supporting members with angle braces. The chassis is fastened to this frame with only four screws; thus, for bench servicing, it might seem easier to separate the chassis from the CRT than to pull out the whole chassis-and-CRT assembly. However, we tried this and found no advantage to it. The chassis won't stand on its side without careful propping, and the cooling fins on the power transformer are easily bent in the process. Actually, the TS-552 is much easier to handle on the bench if the chassis and CRT are kept together. The whole assembly can be pulled out after the subchassis cables have been unplugged and four large chassis bolts removed. The angle braces at both sides make convenient carrying handles because of their location near the center-of-gravity point. Furthermore, the entire assembly is very stable when rested on its side (Fig. 2), thanks to the bracing provided by the frame members.

Once the chassis and CRT have been taken out of the cabinet, the tuner-and-control subchassis can be freed by removal of three screws — two at the bottom and another at the top right corner of the panel. There's no screw in the upper left corner; Motorola thoughtfully omitted it because it would have been hidden deep in a cranny between the tuner and the cabinet wall.

Before the subchassis can be removed, one little kink has to be straightened out. Like the RTS-544 chassis described in the January *Previews of New Sets*, the TS-552 has brightness and vertical hold controls

which must be retracted from their normal operating position before you can proceed with disassembly. To do this, find the actuating lever near these controls and push it upward.

You don't need to pull off the bass, treble, vertical hold, or brightness control knobs to permit chassis removal. But here's a small hint that will save time and temper: Avoid pushing these knobs inward on their shafts during a bench job. If they're not left in their original position, they won't properly clear the holes in the escutcheon when you reassemble the set.

Once the subchassis has been removed, it can be plugged into the main unit and operated on the bench. No extension cords are necessary if you arrange the receiver as shown in Fig. 2; merely undo one lead-retaining clip and change the position of the clip-on ground strap.

Circuit Features

If you're familiar with last year's transformer-powered Motorola chassis, the TS-544, you'll notice relatively few electrical differences between it and the newer TS-552. Most of the changes are additions rather than alterations, since the TS-552 is intended for use in deluxe models. The most striking difference is in the sound section, where the number of stages has been increased from three to five. (The current model has two sound IF's, a 3DT6 detector, an audio amplifier, and a single-ended output stage using a 6BQ5/EL84.) This expanded sound section includes separate bass and treble attenuator controls, mounted near the volume control below the tuner.

A schematic of the tone-control network is shown in Fig. 3. High-frequency components of the audio signal are coupled to the treble control through a 470-mmf capacitor. All the high-frequency signal voltage developed across this control is fed to the output when the control arm is in its topmost position, and moving the arm downward causes a gradual decrease in treble response.

Low-frequency portions of the signal are similarly regulated by the bass control. High-frequency information is bypassed across the latter by two 1000-mmf capacitors. The

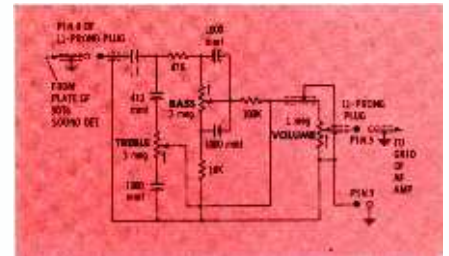


Fig. 3. Sound signal passes through the bass and treble controls in parallel.

outputs from the two controls are mixed and applied to the volume control for final selection of overall sound level.

Note in Fig. 3 that no direct connections are made to chassis ground within the tone-control network. The common reference point is the braided shielding on the input and output leads, isolated from the subchassis but grounded to the main chassis through pin 3 of the 11-prong interconnecting plug. This seemingly roundabout method of grounding is employed for the prevention of hum-producing ground loops, which would be created if multiple ground paths existed between the main chassis and the subchassis panel. This arrangement can be very puzzling to anyone who unthinkingly tries to take resistance measurements using the subchassis as a ground return. You'll get continuity if the 11-prong plug is in its socket and the braided ground strap is in place; otherwise, you'll be mighty confused.

Another distinctive feature of the TS-552 is a 5Y3GT rectifier tube wired in parallel with the regular 5U4GB rectifier to increase the current-delivering capability of the low-voltage supply. Additional new features, which the TS-552 shares with the RTS-544 (this year's "standard"

• Please turn to page 74

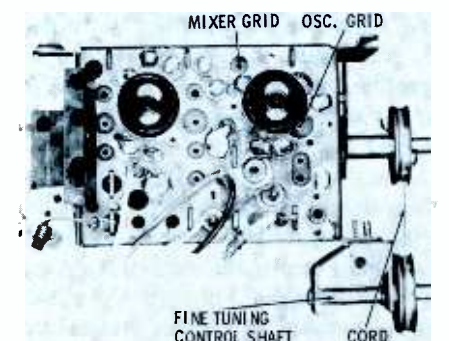
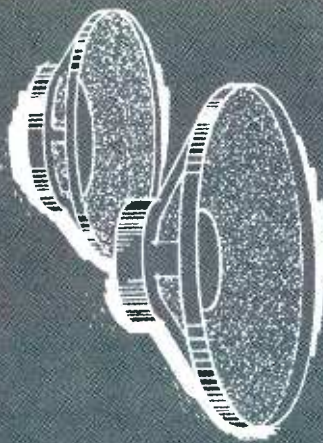


Fig. 4. Grid test point can be shorted to ground to disable the oscillator.



AUDIO FACTS

servicing

HIF

equipment part 5

The output signal from the pre-amplifier or "audio control center" is usually 1 or 2 volts in amplitude, and has been modified with regard to frequency response and other pertinent characteristics. In order to obtain a usable output (anywhere from 10 to 100 watts) at the speaker system, this previously shaped and amplified signal must be further processed. The main or power amplifier serves this function, and it is this unit with which we are concerned this month.

Usually, the main amplifier chassis contains no front-panel or operating controls. Its job is to increase the signal level sufficiently for proper speaker drive, but at the same time it must preserve frequency response and introduce as little hum, noise, and distortion as possible.

The amplifier chassis contains one or more stages of voltage amplification, a phase inverter, an output stage (which is virtually always connected push-pull), and a feedback network. Larger units may also use a driver stage, either single-ended or push-pull, ahead of the final stage. In most of our servicing procedures, we will be referring to Fig. 1, which is a more or less conventional 25-watt amplifier.

Section A of VI provides one stage of voltage amplification, while section B serves as a split-load phase inverter with equal cathode and plate loads. The two output signals from this stage are applied to the push-pull stage V2, which drives the push-pull output stage. The lower section of Fig. 1 shows the power supply; note the connector socket, which can be used to supply voltages to some other unit (preamp, etc.).

Balance

As compared to single-ended stages, push-pull circuits provide greater power output, less hum, and introduce less harmonic distortion. Also, they are less likely to motorboat or saturate the output transformer. However, these advantages occur only when the stage is balanced, i.e., when both halves of the circuit deliver equal output currents. The two stages should not differ by more than 5% in any respect; for best reproduction the difference should be less than 2%.

When the sections are not balanced, a number of things can occur. For instance, hum, harmonic distortion, and intermodulation distortion (IM) increase. If distortion is too high, improper balance could be the cause. IM distortion should be less than 5% and harmonic distortion less than 2% for the most satisfactory results.

DC balance of the output stage can be checked by connecting a high-resistance voltmeter from plate to plate, or cathode to cathode. The meter will read zero when the DC currents are perfectly balanced. In Fig. 1, there are provisions for connecting a voltmeter across the output cathodes. The cathodes connect to opposite ends of a 300-ohm pot, the variable arm of which is grounded. Proper adjustment of this pot will provide DC balance.

AC balance should be checked with an AC VTVM to make sure the two signals reaching the output stage are equal in amplitude. The amplifier of Fig. 1 uses a split-load phase inverter, and the two signal outputs from this stage should be equal. If AC balance exists at the output plates, however, any unbalance in the previous circuitry would not matter.

Unbalance is usually caused by a change on one side of the push-pull circuit. Tubes, resistors, and capacitors often change with age; these should be checked if unbalance exists. For Fig. 1, unbalance could originate in any component between the second section of V1 and the output. It is possible to buy matched pairs of tubes and thereby eliminate unbalance from this source.

If the reactance of one coupling capacitor is considerably higher than its counterpart in the other half of the circuit, the unbalance will be greater for low frequencies than for the highs. To check the various coupling capacitors for balance, apply a low frequency sine wave to the amplifier, adjust for medium output, and measure the AC voltage across each capacitor. If the readings differ by more than 5%, replace the one with the larger voltage drop; then recheck the balance. In some instances, installing a bypass capacitor across a common cathode resistor may decrease unbalance when tube signal voltages are unequal by a small amount. Resistor balance is usually checked with an ohmmeter. If resistors differ in value by more than 5%, replace one or both to achieve the necessary equality.

Hum signals are usually present in an amplifier, but they may be apparent only when unbalance exists. Push-pull output stages generally receive B+ from a less filtered part of the power supply in order to obtain the highest possible voltage. This is true for the amplifier of Fig. 1. If there is any hum (AC ripple) present at that B+ point, it will be readily apparent in the output when the stage is unbalanced. Some amplifiers have an additional balance control across the heater circuit, which can be adjusted to balance out hum caused by heater

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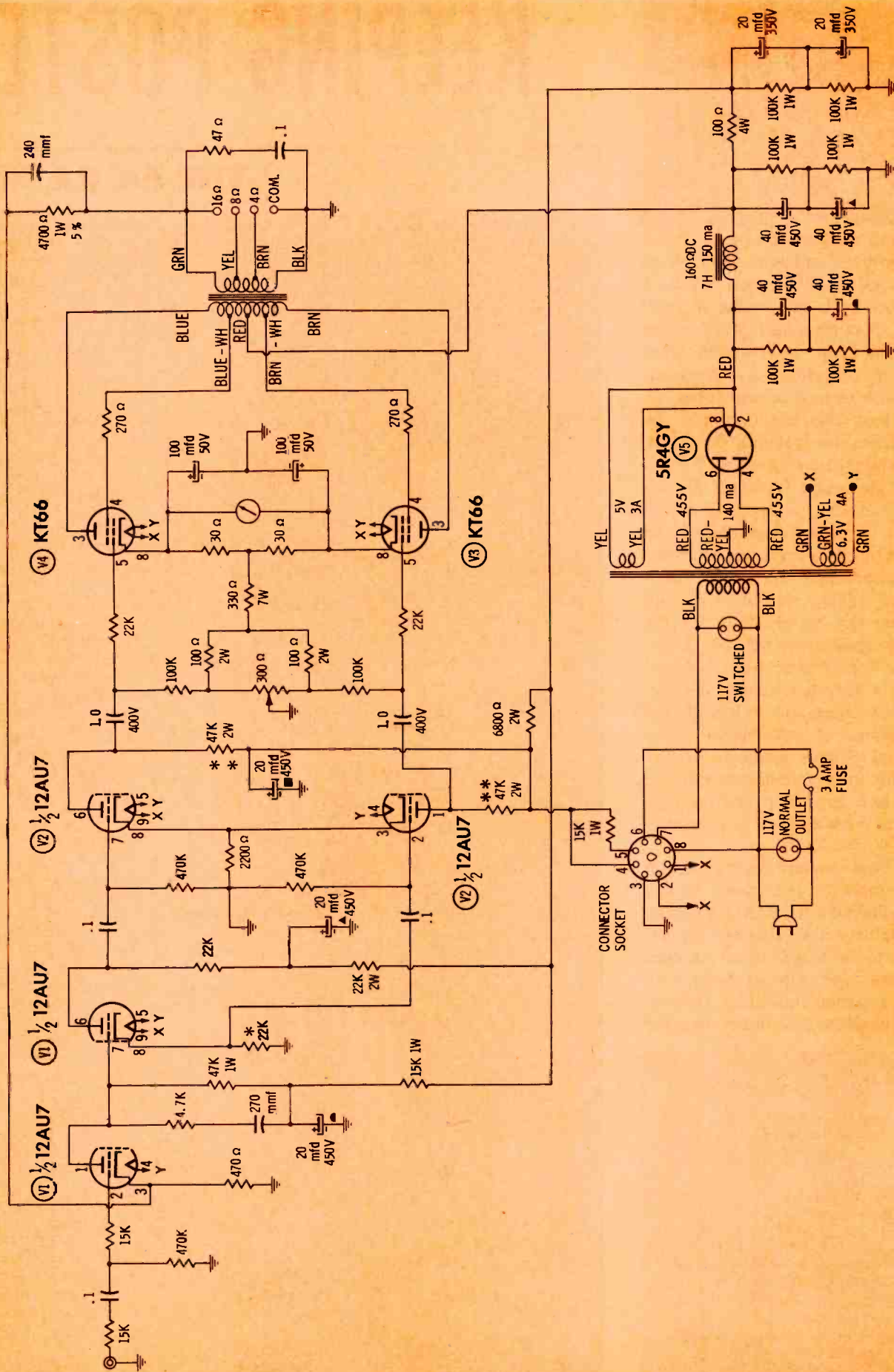


Fig. 1. 25-watt amplifier which uses push-pull driver and split-load inverter stages.

KEEPING POSTED

DIFFERENCES BETWEEN TYPES DESIGNED FOR THE SAME APPLICATION, AND WHERE THE RARER ONES ARE USED.

During the past few years, it has become more and more difficult to keep track of all the new TV tube types being placed on the market. In fact, it is no longer practical for a service shop to maintain what could be considered a truly complete stock of replacement tubes.

We took this situation into account when we prepared the April, 1959 edition of *Stock Guide for TV Tubes*. Departing from our former policy of listing all types in actual use, we omitted a number of the scarcest ones; however, we promised to describe these rare tubes in a separate article, and have therefore compiled this usage chart for the 64 least-used types of TV tubes. Each of these "rare birds" is found in only a very few chassis designs, so we have been able to identify the exact brands of sets, chassis numbers, and circuits employing them. With this information at hand, you should have an easier time deciding whether or not to stock a particular tube.

If you cannot find a certain type number in this chart, take a look at the most recent *Stock Guide*; the tube may have become popular enough to be listed there. Absence of a new type number from both lists is a strong indication (though not an absolute guarantee) that the

THE 64 RAREST

Type	Class	Circuit Application	Chassis Where Used
1S2A/DY87	D-9	HV rect	Mot LTS-430
2EN5	2D-7	horiz phase det	Phil 9H25
2ER5	D, T-7	RF amp	Adm 15B2
3BA6	P-7	sync amp	Trav 740-78 & similar
*3BN4	T-7	RF amp	Zen 15A26, 15B20 West V-2373, -83 Air GTM-4200A, -4300A
3BY6	H-7	sync sep	Hoff 338 Air WG-4043A ser. Tru 2D1840A Coro TV2-9485A ser. DuMont RA-406, -7
*3CY5	Te-7	RF amp	Phil 9H25 Silv 9118, -9 Silv 9104, -5
*4AU6	P-7	sound IF	RCA KCS109, -11 Silv 9104, -5
*4BC5	P-7	RF amp	Air GRX-4030A, -4130A
*4BZ7	2T-9	RF amp (alt)	Son 664 Ser. Adm 17AF1 Coro TV2-9417 Tru 2D1730A
*4CS6	H-7	sync sep	West V2373, -83 Air GTM-4200A, -4300A
#4CY5	Te-7	sound det	Phil 9H25 GE "T"
*4DE6	P-7	RF amp (alt)	Phil 9H25
*4DT6	P-7	1st & 2nd IF sound det	RCA KCS109, -11 Air GRX-4030A, -4130A
5AS8	P, D-9	3rd IF—video det	Son 664 ser. Silv 9104, -5
*5BQ7A	2T-9	RF amp	RCA KCS94, -5
5BT8	2D, P-9	keyed AGC— horiz phase det	RCA KCS109, -11 Air GTM-4044A ser. West V-2372, -82 V-2346, V-2293 V-2367 (color)
5BW8	2D, P-9	2nd IF— horiz phase det	Muntz S-21, S-24
5V6GT	P-8	vert output audio output	Emerson 120343 West V-2293, V-2367 (color)
6AF3	D-9	dampner	Mot TS-552
6AZ8	T, P-9	IF—sync sep several uses	Olympic DY, GY RCA CTC4 (color)
6BR8A	T, P-9	osc-mixer (alt)	GE, Hotpoint M4 Syl 1-533 Phil 9H25 Tech-Master 1930N, 2430N
6BV8	2D, T-9	sync amp— horiz phase det	Packard-Bell 88S2
6BZ8/X155	2T-9	chroma demods RF amp	Mot TS-905 (color) Phil 7L70 & others
6CA5	P-7	audio output	Phil 9L41
6CA7/EL34	P-8	audio output	Hoff 421, 424
#6CE5	P-7	RF amp	GE "T"
6CH8	T, P-9	1st IF-vert osc. 2nd IF-sync amp	RCA KCS102
6CK4	T-8	vert output	Zen 19A30, 19B20, 18C20

EXPLANATION OF SYMBOLS

TYPE:

*—450-ma series string
#—300-ma series string

CLASS:

D—diode
T—triode
Te—tetrode
P—pentode
H—heptode
2D, T—dual diode/triode
Figure following class symbol indicates number of base pins.

CIRCUIT APPLICATION:

(alt) indicates alternate type found in relatively small part of indicated chassis run.

ON TV TUBES

TYPES OF TV TUBES

TUBES USED IN COLOR SETS ONLY

3A2 (D-8)
3B2 (D-8)
6BC7 (3D-9)
6BD4A (T-8)
6BL4 (D-8)
6CL5 (P-8)
6DQ5 (P-8)
6M3 (D-8)

tube hasn't yet been used in a TV receiver.

Different Types With Similar Uses

New tube types are continually being introduced as existing types become outmoded by progress. Each new development in receiver design, such as an increase in deflection angle, causes some difficulties due to the added burden being placed on tubes. Since these problems aren't solved overnight, you'll seldom find a standardized tube type immediately adopted for use in a drastically redesigned circuit. Different set manufacturers take a variety of approaches to every problem, with the result that several different types of tubes for the same application may be put on the market at about the same time. A "survival of the fittest" period then ensues. The best of the new tubes are used again in future designs, and still more new types may be introduced to correct some of the service problems brought to light by field experiences.

All this is confusing to the distributor and the serviceman. The various new tubes developed for a given circuit are often physically similar to each other or to types previously used for the same appli-

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CHASSIS WHERE USED:

Manufacturers' names are abbreviated as follows—

Adm—Admiral
Air—Airline
Coro—Coronado
Hoff—Hoffman
Mot—Motorola
Phil—Philco
Silv—Silvertone
Son—Sonora
Syl—Sylvania
Trav—Trav-Ler
Tru—Truetone
West—Westinghouse
Zen—Zenith

Numbers in this column indicate basic chassis series except for Airline, Coronado, Silvertone and Truetone, where model numbers are given.

Type	Class	Circuit Application	Chassis Where Used
6DR7	2T-9	vert osc-output	Zen 16C20 RCA KCS126
6DT5	P-9	vert output	Hoff 344 Magnavox 26 ser. Phil 9L60 GE "M4"
6EH8	T, P-8	osc-mixer	RCA KCS117
6EM5	P-9	vert output	Zen 16C20
6ER5	D, T-7	RF amp	Zen 16C20
6ES5	D, T-7	RF amp (alt)	RCA KCS126
6FV6	Te-7	RF amp	Mot PTS-546
7EY6	P-8	vert output	West V-2373, -83
*8AU8	T, P-9	video output- sound IF	Air GTM-4200A, -4300A Zen 16Z25, 15A25
8BA8A	T, P-9	video output- sync amp	Silv 9104, -5
*8BH8	T, P-9	video output- sync sep	Silv 9118, -9
*8BN8	2D, T-9	ratio det— AF amp	Silv 9118, -9
8BQ5/XL84	P-9	audio output	Mot TS-551
*8CG7	2T-9	horiz osc	Silv 9118, -9 West V-2373, -83 Air GTM-4200A, -4300A RCA KCS109, -11 Silv 9104, -5 Air GRX-4030A, 4031A Son 664 ser. Zen 15A25, 15A26 Air GTM-4200A West V-2373, -83
*8CM7	2T-9	vert osc-output	Mot TS-551, LTS-430 Phil 9H25
*8CS7	2T-9	vert & horiz oscs vert osc-output	Phil 9L35, -7, -8 GE "T" Mot PTS-546 Mot LTS-430 GE "T"
8EB8	T, P-9	video output- noise canceller	GE "T" Zen 15A26, 15B20 Mot TS-551
*9AU7	2T-9	horiz mult	Phil 9H25
9BR7	2D, T-9	sync sep- horiz phase det	Phil 9L35, -7, -8 GE "T"
#9CL8	Te, T-9	osc-mixer (alt)	GE "T"
9EF6	P-8	vert output (alt)	Mot PTS-546
9EJ5	P-9	audio output (alt)	Mot LTS-430
#9U8	T, P-9	osc-mixer	GE "T"
#10C8	Te, T-9	audio amp & out, vert osc & out	GE "T"
*11CY7	2T-9	vert osc-output	Zen 15A26, 15B20
12AF3	D-9	dampner	Mot TS-551
#12CT8	Te, T-9	video output- sync sep	GE "T" Phil 9H25
*12ED5	P-7	audio output	Air GTM-4201 series
12EN6GT	P-8	vert output	West V-2365, -6 Silv 9118, -9 Phil 9H25
*13DE7	2T-9	vert osc-output	Silv 9104, -5 Zen 15B20
*13DR7	2T-9	vert osc-output	Silv 9118, -9
*17D4A	D-8	dampner	West V-2373, -83 Air GTM-4200A, -4300A Phil 9H25 Silv 9104, -5
#17H3	D-9	dampner	GE "T"
#18A5	P-8	horiz output	GE "T"
21EX6	P-8	horiz output	Mot PTS-546
25EC6	P-8	horiz output	GE-Hotpoint Q2, Q3

Better than ever-- **GENERAL**
Bigger than ever-- **TOTAL**

Service-Designed
6AQ5-A



New getter design promotes high-output performance.
 Low-sublimation cathode prevents grid contamination.
 Improved mica design cuts microphonics.
 Special tests minimize early-life failures.



Service-Designed
6AU6-A



Improved mica design, for lower microphonics.
 Improved plate material, for greater stability.
 Improved heater coating, to ward off premature burn-outs.
 Improved testing, to minimize early-life failures.



Ready to do a better job in more sockets—G-E Service-Designed Tubes for TV!

1B3-GT	3CB6	6AF4	6BQ7-A	6CY5	6U8-A
1H2	3DT6	6AF4-A	6BU8	6DN7	6V6-GT
1J3	5AQ5	6AL5	6BZ6	6DQ6-A	6X8
1K3	5BK7-A	6AQ5-A	6BZ7	6DT6	12AT7
1X2-B	5CG8	6AU4-GTA	6CB6-A	6EA8	12AU7-A
2AF4-B	5EU8	6AU6-A	6CD6-GA	6EU8	12AX4-GTB
3BN6	5U4-GB	6AX4-GTA	6CG7	6J6	12BY7-A
3BU6	5U8	6BK7-B	6CG8-A	6SN7-GTB	12DQ6-A
3BZ6	5V3/5AU4	6BN6	6CL8-A	6S4-A	19AU4-GTA
	5Y3-GT	6BQ6-GA	6CX8	6T8-A	

ELECTRIC SERVICE-DESIGNED TUBES! OF 70 LOW-CALLBACK TYPES!

Service-Designed 6CD6-GA



Gold-plated No. 1 grid reduces grid emission.

Improved cathode processing . . . minimizes cathode chipping.

Carbonized gold-plated screen grid withstands high dissipation. Lower screen emission extends tube life and maintains sweep.



Check the improvements in three popular Service-Designed Tubes at left! These typify quality features that mark the entire line. Over 1,000 advancements give General Electric Service-Designed Tubes top performance, extra reliability!

Install them to *save!* Callbacks are less; your time is kept free for new service work. Install them to *profit!* Service-Designed Tubes cost you no more—customers prefer them—the satisfaction they give builds repeat business for you.

General Electric is broadening constantly the value of these tubes to technicians, by developing additional types to meet growing replacement needs. Now 12 high-quality tubes for hi-fi and radio supplement the extensive Service-Designed TV line.

Here is full coverage of your servicing requirements! Every job you undertake, now can have the benefit of finer, more dependable tube performance. Insist on Service-Designed Tubes! See your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Co., Owensboro, Ky.*

TELL YOUR STORY OF QUALITY SERVICE with this colorful leaflet! Slip it in with invoices, mail it with letters, leave it on calls! Available in quantities from your General Electric tube distributor.



Now... for finer performance... G-E Service-Designed Tubes for Hi-Fi and Radio!

6AV6
6BA6

6BE6
6L6-GC

12AU6
12AV6

12AX7/7025
12BA6

12BE6
35C5

35W4
50C5

In addition, several General Electric Service-Designed Tubes for TV are equally fine performers in hi-fi or radio equipment: namely, Types 5Y3-GT, 6AL5, 6AQ5-A, 6AU6-A, 6T8-A, 6V6-GT, and 12AT7.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

2-111-221

TIPS

for TECHS



"Comb" Leads for Tinning

Do you have a number of wire leads that have to be tinned? This isn't necessarily a time-consuming task if you go about it the right way. First, skin the insulation off as far as necessary on all wires. Then, if the wires are stranded, twist the strands together. Okay — got a pocket comb? Get it out and slip the wires down between the comb's teeth. Now you have all the wires right where you want them—in tinning position. Move right down the line tinning one wire after another. They'll all hold still for you and you won't have to burn up the bench top with the tip of that hot iron.



Foil Focuses Heat from Lamp

Do you sometimes use a heat lamp to bring a thermal intermittent out of hiding? If you do, you realize how heat from the lamp can cause melting of the wax from paper capacitors mounted in a nearby circuit. Ever try using aluminum foil? Simply wrap the lamp with foil and make a small opening in the front. Heat can then be directed so that it strikes only the suspected component.



Handle Prods Like Chopsticks

If you've ever tried using your test prods one-handed like an oriental uses his chopsticks, you have some idea of how much practice it takes to handle them proficiently. And there are many times when you'd like to hold both prods in one hand while using the other to operate a VOM or VTVM. Have you ever thought of attaching both prods together with a double-ended test clip? Try it—you'll be surprised how easy they'll be to manipulate. The barrels of the prods will pivot in the clip's jaws and will reach both test points, whether they are only a fraction of an inch or four inches apart.



Rubber Band Secures Parts Box

If you carry plastic see-through boxes of hardware in your tool box, did you ever have the lid come off and have the hardware spill out all over? Think what an impression it would make on a customer if you were to open up your tool box and expose such a mess while in the customer's home. Don't take unnecessary chances — keep a strong rubber band or two around each of your boxes of hardware.

Alignment-Tool Pickup Aids

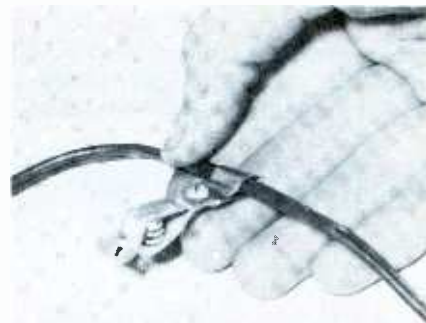
Many alignment tools are difficult to pick up once you have laid them on the bench top. To overcome this difficulty, slip a snug-fitting rubber feed-through grommet over the end of the tool and slide it down to about the middle. This will elevate the implement so that you can pick it up easily.

Repair Loose Tube Caps

Occasionally, one encounters a high-voltage rectifier or similar tube with a loose plate or grid cap. It seems a shame (and extravagant!) to throw away an otherwise perfectly good tube that has many hours of usefulness left in it. To re-anchor a loose cap, unsolder the cap, remove it and stuff the inside with black furnace repair cement. Reseat the cap on top of the tube and solder the plate or grid wire back in place. Hold the hot iron to the cap momentarily to hasten hardening of the cement.

Grommet Stops Dial Slippage

Should you ever encounter a very stubborn case of dial-cord slippage, slip a tight-fitting rubber feed-through grommet over the shaft and let the dial cord ride inside its slot. To insure that the grommet itself doesn't slip, select one that will just make a force-fit over the shaft.



Extra Hand for House Calls

When servicing a set in the customer's home, you sometimes need an extra hand on certain soldering jobs. An ordinary test clip attached to the cord of your iron or gun as shown makes a dandy soldering vise that you won't have to hunt all through your tool kit to find. Drill small holes in both ends of a "U" shaped piece of tin, then wrap the tin around the cord and fasten it to the clip with its own screw.

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Power Point® PLUG-IN CARTRIDGES

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Opening Gun in the Biggest Sales Push Yet!

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All-Diamond–All-Stereo Rack Makes Sales–Cash in on E-V Advertising and Promotion!

There's PROFIT in E-V Stereo Power Point Cartridges! NEW, IMPROVED MODELS—USED IN MORE AND MORE PHONOS. PERFECT FOR CONVERSION TO STEREO NOW—LOW COST!

These new, improved Stereo Power Points are a gold mine. They out-perform by far the old-style replaceable-needle cartridges. More and more of them are being installed daily in tone arms by manufacturers. Yet they cost the same, or less, than old-style needles alone! Everybody's selling E-V Stereo Power Points for STEREO CONVERSION, too. They're replacing old-style monaural cartridges or inferior cartridges—with one of these new E-V Stereo Power Points. It's easy, it's inexpensive, and each conversion assures a steady stream of replacement sales and PROFITS!

SO—GO E-V, the Power Point way—and listen to the music of your cash register! And remember, this is only the first of a series of promotions in this, E-V's biggest cartridge year!



This special, all-diamond, all-stereo promotion is only the beginning!

This marks the start of the biggest year Electro-Voice has ever had for big merchandising—big product news—all good news for you!

Now—if you don't have the details on this opening gun promotion—write Electro-Voice or ask your E-V Rep. You'll get good news!

*Power Point plug-in cartridges are an exclusive development of Electro-Voice, Inc., made under one or more of the following patents: 170,347; 2,793,254; 2,851,541; 2,842,610.



ELECTRO-VOICE, INC., BUCHANAN, MICHIGAN



ROOM AIR-CONDITIONER MAINTENANCE

by Joseph Derman and Harold Seaman

Mechanical systems used in modern self-contained units

Air-conditioner input requirements are expressed in terms of operating voltage and current consumption; output is measured in the amount of air circulated, the quantity of moisture removed from the air, and the temperature reduction achieved in the conditioned space. Another important effect of operating a room air-conditioner is the filtering of circulated air.

In the April installment, we discussed the electrical portion of the air-conditioner. This month we'll cover the mechanical portion of the unit and major considerations for its selection and installation. Some special topics will be discussed at the end.

Major Mechanical Components

As previously discussed, mechanical refrigerating units operate by evaporating and condensing *Freon* in a closed circuit. In this closed circuit (Fig. 1), the compressor pulls gaseous (hot) *Freon* out of the evaporator and forces it under high pressure through the condenser where it is cooled and reconverted to liquid form. The capillary tube carries the liquid back to the evaporator, where it again picks up heat and reverts to a gas. This *Freon* movement proceeds quickly and continuously.

Evaporator

Cooling is always associated with evaporation. Even in a common alcohol bath, alcohol boils off the skin — which it does readily at normal temperature and pressure — to cool the body. The body in this case furnishes the heat to change the

alcohol from a liquid to a vapor. In much the same way, liquid *Freon* boils in the evaporator, using heat of the room air in the process.

As shown in Fig. 2, the construction of an evaporator resembles the radiator of an automobile. *Freon* flows through the coils of copper tubing so that the heat of the room can be absorbed. Many thin aluminum fins are bonded to the tubing in order to improve the heat exchange between the room air and liquid *Freon*. Any interference with the effectiveness of this heat exchange will impair the operation of the air-conditioner.

The length of copper tubing, the area of the fins, evaporator pressure, and capillary tube size are such that all the liquid *Freon* entering the evaporator will become a vapor before leaving it.

An evaporator fan (squirrel-cage type) is used to bring the hot, humid room air into the evaporator, and then to discharge the cool, dehumidified air back into the room.

Dehumidification (moisture condensation) accompanies temperature reduction of air, because air is capable of retaining less moisture as temperature is reduced. As the air temperature is lowered, moisture condenses on the evaporator surfaces. This condensed humidity (condensate) is collected under the evaporator and piped by means of a rubber hose to a pan beneath the condenser fan for further use before it is expelled to the outside.

Compressor

The compressor draws off *Freon* vapor at such a rate that a pre-

signed pressure is constantly maintained in the evaporator. (See Fig. 3 for details.) It also compresses the gas so that its temperature rises about 25° above the average outside temperature. The compressed gas is directed into the condenser where it gives up its heat to the outside air and becomes a liquid again.

The compressor thus separates the low-pressure side in the evaporator coil from the high-pressure side in the condenser coil. For the compressor to operate satisfactorily, adequate gas must be available from the evaporator, and gas removal from the compressor must be sufficient.

Condenser

The condenser, like the evaporator, is a heat exchanger. Both units are similar in construction, having copper tubing with surface-extending fins. Sufficient contact surfaces (fins, tubing surface, etc.) must exist in the condenser for the gas to be completely liquefied before it leaves the condenser coil. Any interference with the effectiveness of heat transfer will lead to malfunctioning of the air-conditioner. The condenser construction and condi-

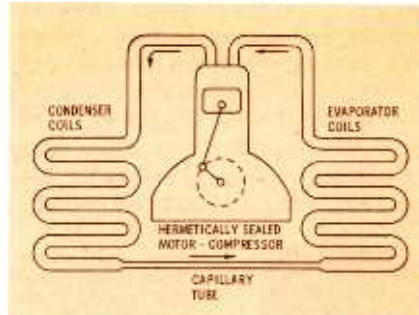


Fig. 1. Diagram showing the flow path of refrigerant used in air-conditioners.

tion of the surface (i.e., cleanliness) must be favorable, so that heat picked up by the gas in the evaporator, as well as heat generated by the compressor when the gas is compressed, is liberated to the outside air.

A condenser fan (propeller or squirrel-cage type) is always associated with the condenser. This fan brings the outside air through the condenser to cool it. To increase efficiency of this cooling action, condensate from the evaporator is sucked up by aspirator action of the condenser fan, picked up by the slinger ring of the propeller fan, and directed against the hot condenser. The moisture is thus used for additional cooling while it is being expelled to the outside.

Capillary Tube

The capillary tube is a simple copper tube of small bore (inside diameter about .05") and is relatively long (5'). The resistance this simple tube offers to the flow of *Freon* determines how much refrigerant flows around the circuit every hour. A given air-conditioner requires a capillary tube of specific dimensions.

In addition to serving as a metering device, doling out a desired amount of *Freon* to the evaporator, the capillary has another function. When the air-conditioner is turned off, the capillary allows the high and low pressures in the system to equalize. When the compressor starts up, therefore, it does so against a low head pressure. This head pressure (condenser side) builds up gradually until the working high and low pressures are established. During the working periods, however, the capillary tube serves to keep the pressures from evening out. (This should explain why it is absolutely necessary to observe the caution found on all air-

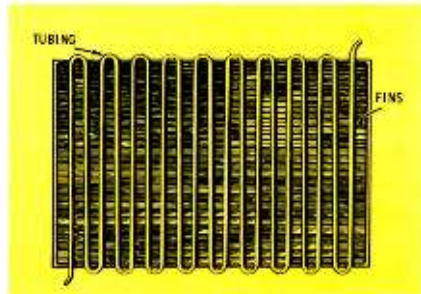


Fig. 2. Evaporator consists of copper tubing to which fins are bonded.

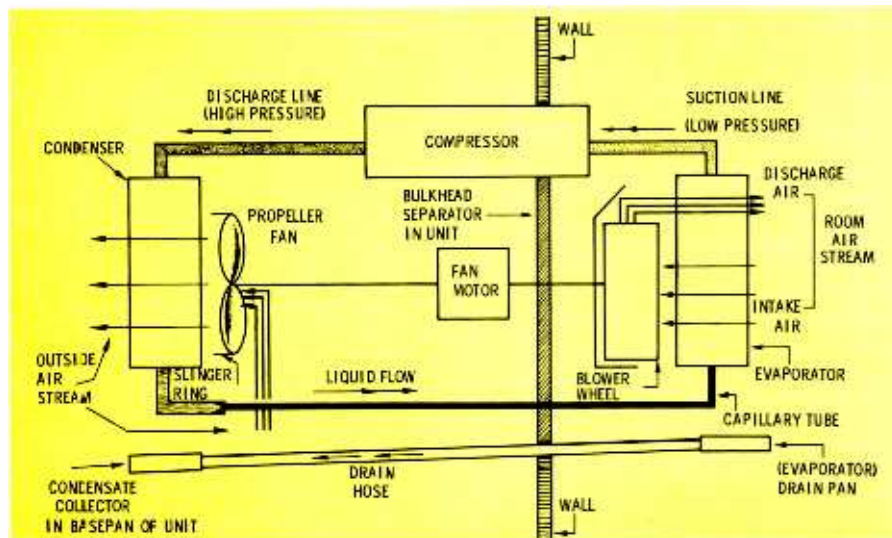


Fig. 3. Mechanical component arrangement for a typical room air-conditioner.

conditioners in one form or another; after the compressor is turned off, wait at least two minutes before turning it on again). Failure to observe this will result in the overload kicking out.

Inside Air Stream

The inside air stream is a very important factor in the operation of an air-conditioner. Room air furnishes the necessary heat for the *Freon* to evaporate. Air should reach the evaporator coils in the amount and within the temperature range for which the air-conditioner is designed. The fins of the evaporator must be clean for maximum exchange, and the filter must be unobstructed to permit a sufficient quantity of air to reach the unit. In other words, for optimum operation of the air-conditioner and for the greatest consumer comfort, room air must reach the evaporator freely. ALWAYS USE A CLEAN FILTER.

Outside Air Stream

The outside air stream is another vital part of air-conditioner operation. To liquefy the hot and compressed *Freon* gas, the outside air must remove the heat picked up in the evaporator and the heat added during compression. If the air stream is insufficient (dirty condenser coil, slow fan, etc.) or too hot, head pressure will rise (because of insufficient condensation of the *Freon*) and cooling efficiency will decrease. If the outside air is too cold, the reduced pressure in the high side will eventually cause a reduction in the amount of liquid available for the evaporator, and

again, cooling efficiency will decrease.

Selecting a Unit

No air-conditioner will be effective if it is not of the proper size for a given heat load. The heat load is the total heat and humidity, expressed in terms of BTU/hr., that the unit must absorb for adequate comfort.

Since an active person generates an amount of heat and moisture equal to 900 BTU/hr., the average number of people occupying the room must be considered. In addition to the people present, outside heat and humidity are constantly seeping into the room, adding to the heat load.

Manufacturers of air-conditioners prepare work sheets or charts (sometimes called Cooling Load Estimate Charts) to assist the sales company in computing the total heat load for a particular room. To use such a chart, it is necessary to know the dimensions of the room, the size and position of each window, the type of insulation in the walls and ceiling, the other appliances to be used in the room, and the number of people normally occupying the room. For each of these, the chart provides multiplying factors which, when applied, give the heat load each contributes. These figures are then added to give the heat load, and the air-conditioner is chosen to suit the needs of the particular installation.

Major Installation Considerations

Improper installation will make

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even the best unit unsatisfactory. In every installation, there is a best window to choose. On the inside, make sure alternating current is available, avoid extension cords (if absolutely necessary, use one with AWG-12 or larger wire), and plan for a minimum of interference in the air circuit to and from the unit. On the outside, find an exposure that has the greatest amount of shade and unimpeded air circulation about the unit.

Secure installation and adequate tilt (outside lower than inside) are the other general precautions that can be mentioned in this brief account. Every manufacturer prepares detailed installation instructions. Careful examination of these before starting the installation will be very worthwhile.

Service Hints

Assuming that the unit was properly selected, and keeping only the mechanical circuit in mind, note the following:

1. Installations: See that there are no air leaks about the unit. Make sure tilt is enough to insure that the condensate will collect in the base pan beneath the condenser fan. The installation should be secure, with no wobble.
2. Filter: Make sure it is clean. If you can't see through it, replace it (disposable type) or clean it (permanent style).
3. Evaporator: Observe the condensate collection. Check to see if the drain hose is in place and the passage through it is clear. If the evaporator is frozen, note the direction of the discharge air grilles. Cool discharge air must project into the room — not return (recirculate) directly into the evaporator. Check operation of the evaporator fan. If frost appears on the evaporator when inside and outside temperatures are not too low, and the air streams are free, the unit is short of *Freon* and will have to be taken to the shop for repair.
4. Condenser: Check to see if the outside air circulates freely about the condenser. Check fan operation. Be sure the slinger ring is close enough

(1/8") to its base pan to pick up the condensate.

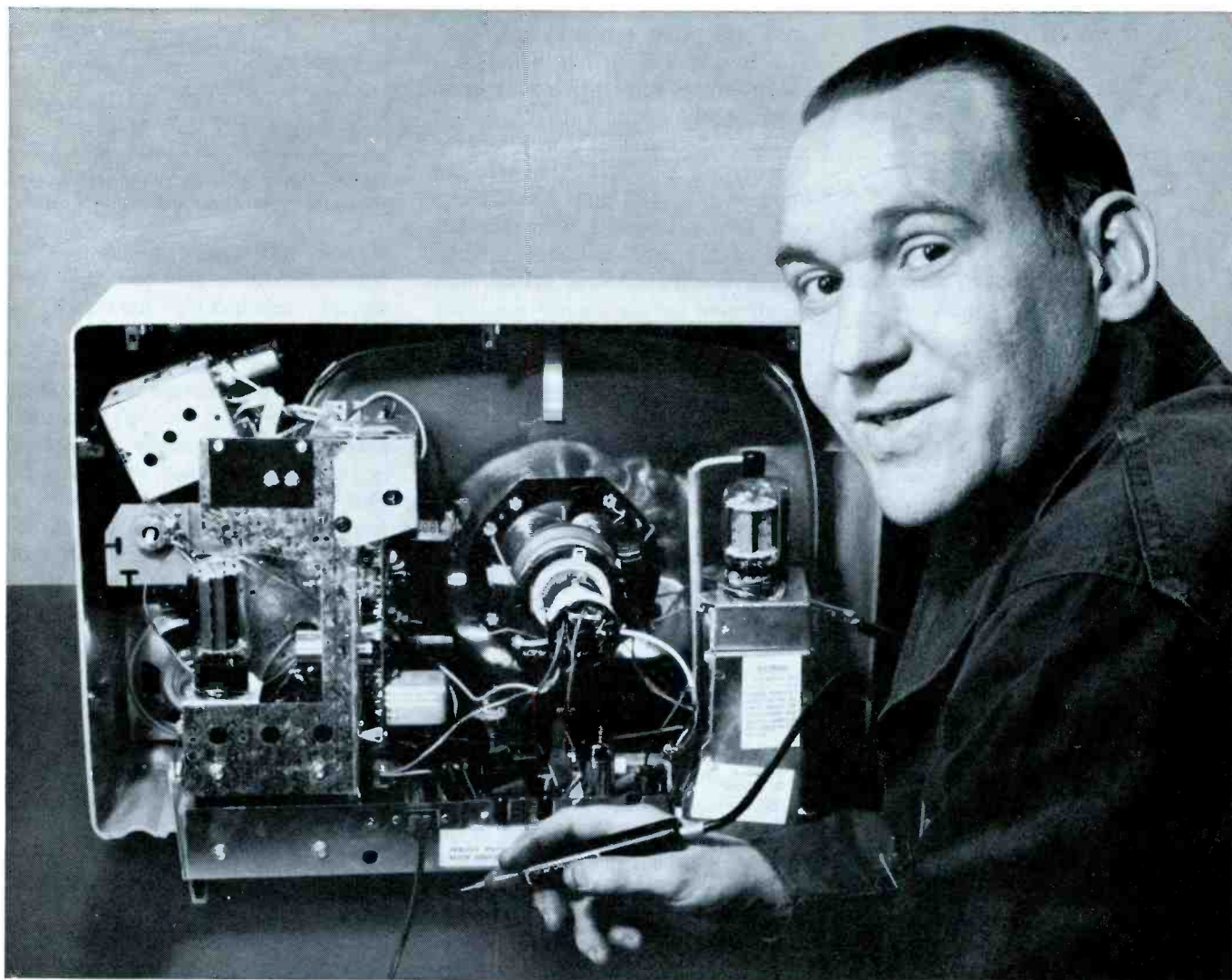
5. Noise: If the noise is a heavy thumping kind, examine the compressor hold-down bolts. In externally spring-mounted compressors (3/4 h.p. and above) the nuts must be loosened or removed to permit the springs to take up the vibration developed by the compressor. A defective compressor may also generate noise due to internal mechanical failure. Under severe operating conditions (high head pressures), noise will be present when the compressor first starts on each cycle. Look for loose mechanical parts, fan blades striking chassis and poorly dressed tubing (vibration may cause rubbing).

Special Topics

Ton of Cooling vs. Horsepower Rating: Unfortunately, these terms are frequently used interchangeably. The ton of cooling figure refers to a rate of cooling and is derived from the amount of cooling developed by melting one ton of ice over a 24-hour period. 144 BTU's are absorbed when one pound of ice melts; therefore, 288,000 BTU's (2,000 x 144) are absorbed over a 24-hour period, or 12,000 BTU's per hour. In other words, one ton of cooling equals 12,000 BTU's per hour.

The horsepower of a motor indicates its mechanical rate of work. How close to one ton of cooling an air-conditioner using a one-horsepower motor will produce depends upon many factors, i.e., whether the condenser is air-cooled or water-cooled, the efficiency of the compressor, the sizes of the evaporator and condenser coils, etc. An air-conditioner is properly specified in terms of current and voltage input and BTU's per hour output.

The 7.5-amp Unit: In most communities, power demands (even during the summer) are very close to, and quite often in excess of, available electrical facilities. Individual branch circuits servicing many houses and apartments are rated at 15 amps, unless rewired recently. A standard air-conditioner connected in a circuit already supply-



“IT’S A CINCH

to get at the chassis in a G-E ‘Designer’”

says **CHARLES RODEN, Service Supervisor, Planet Service Corp., Richmond Hill, N. Y.**

“Take the back off a General Electric ‘Designer’ TV receiver and it’s a cinch to get at the chassis,” says Service Supervisor Charles Roden of Planet Service Corp., Richmond Hill, N. Y.

“You almost never have to pull the chassis to circuit trace or replace parts and this means we can do 9 out of 10 repairs in the home. Customers like this—the bill is easier to take and their sets stay in service.

“Our higher home completion rate plus time saved by not having to pull the chassis mean we can make *more calls per man*, and *more money*.

“We like the way the ‘Designer’ is put together so that you can get at both sides of the printed boards while the *chassis is still in the cabinet*. Also,

tubes are directly replaceable, fuses are accessible, and you can get at key check points. And the painted schematic on the boards helps us find our way around.”

Precision Etched Circuitry is the name General Electric gives to its circuitry and it is used in all sets. This circuitry is reliable and *uniform* so that when you’ve serviced one you don’t have to puzzle over the next one.

“Designer” TV—the easiest-to-service sets in television! General Electric Company, Television Receiver Department, Syracuse, N. Y.

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ing a few lights or a small appliance will often cause an overload. The fuse will blow, or worse yet, the air-conditioner will not operate satisfactorily.

The 7.5-amp unit was designed to meet this situation. This unit can be used on a 15-amp branch circuit in conjunction with another load of 7.5 amps without trouble. Where the BTU rating of this unit is sufficient for the load, it is a great boon to consumers who are pressed for current capacity, even though it is somewhat more expensive.

Sealed Refrigeration System Repair Policies: These articles have not intended to advise or instruct the reader in the repairs of the sealed refrigeration system. Most manufacturers stipulate that their service companies, or organizations they specifically designate, perform sealed system work for the warranty policies to apply. The practice is, therefore, for a serviceman (if he is not approved for this particular work with a given manufacturer) to bring the unit to an approved repair station.

Heat Pump: In many parts of the country, the heat pump is becoming an accepted all-year air-conditioner. During the summer, indoor cooling is accomplished in the manner described above: the heat of the room is pumped to the hot outdoors, thereby cooling the space about the evaporator and heating the air about the condenser.

For winter heating, the unit can be turned around in the window so that the condenser is located inside, while the evaporator is outside the room. The heat of the condenser then warms the room. Larger units achieve the same result by reversing the direction of *Freon* flow, when heating is desired, through use of a reversing valve.

It should be mentioned, however, that some heat pumps use the outside air as the source of heat in winter and for disposal of heat in summer. Other units use water or the earth as the corresponding medium.

Thermoelectric Refrigeration: This refrigeration effect seems to have great promise for the not too distant future. The basic principle is more than 100 years old, and is known as the *Peltier Effect*. Electronics enthusiasts are familiar with the thermoelectric effect, where tem-

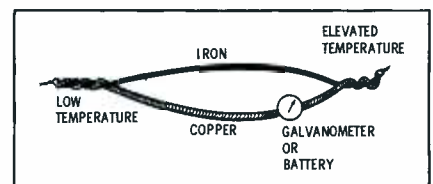


Fig. 4. Thermoelectric refrigeration operates on the thermocouple principle.

perature difference produces an electromotive force between two dissimilar conductors arranged as shown in Fig. 4.

The reverse of this principle is the effect we are interested in; i.e., when direct current is made to flow in such a circuit, a temperature differential is established at the two junctions. One junction will be cooled or heated depending upon the direction of current flow. A number of American manufacturers have demonstrated working models of refrigerators and room coolers based on this amazing principle.

The Automobile Air-Conditioner: This is rather recent application of mechanical-refrigeration principles to automobile riding comfort. Because of the nature of the power available for the compressor, however, a number of important modifications will be found in the automobile air-conditioner.

The compressor is not hermetically sealed with its motor drive as is the case in the window unit. Instead, it is belt driven from the auto's crankshaft. The speed of the compressor, and therefore the amount of cooling, varies considerably. To minimize this fluctuation, various techniques are employed. The speed of the compressor can be controlled by a specially designed clutch mechanism, or the cooling effect can be altered by suitably bypassing the *Freon* flow.

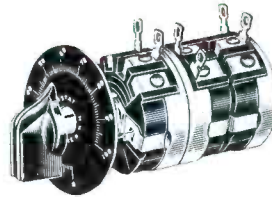
Additional components will be found in the car air-conditioner: a sight glass to "see" into the *Freon* system, driers to remove moisture from the *Freon*, and speed regulators for the fans are the major ones.

All in all, the car air-conditioner is more critical than the window unit, having more components, more severe operating conditions (vibration, location of condenser on auto radiator, absence of hermetically sealed construction, variable power supply, etc.) and consequently a greater number of service problems can be expected. ▲

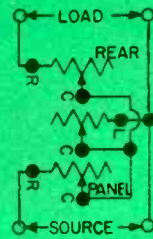
CLAROSTAT CONTROLS FOR AUDIO

CONSTANT IMPEDANCE CONTROLS

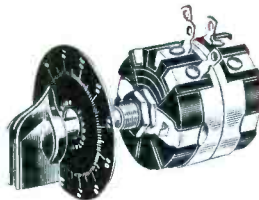
Clarostat Constant Impedance T-pads are utilized in circuits to maintain constant required values for perfect balancing. In either input or output. Knob and dial are supplied. Resistance range available of 4 to 2,000 ohms. 10 watts audio.



SERIES CIT

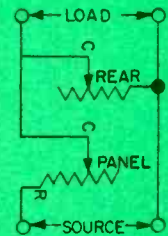


CONSTANT IMPEDANCE CONTROLS



SERIES
CIL

For circuits requiring an L-pad, to maintain balance of associated circuitry. Provide continuous range of from 0.5 to 30 db attenuation in 90% of rotation; last 10%, infinite attenuation. Handles up to 10 watts audio. Resistance range of 4 to 2,000 ohms. Knob and dial included.

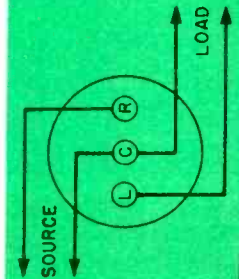


CONSTANT IMPEDANCE OUTPUT ATTENUATORS

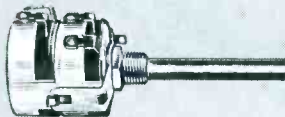


SERIES
CIB

Handle up to 30 watts audio. Linear attenuation in 3 db steps up to 24 db, then 30 db. Recommended as an output attenuator to individual speaker or group of speakers, or as input attenuator to power amplifier. Resistance range of 6 to 600 ohms. Single-hole mounting. Knob and dial included.

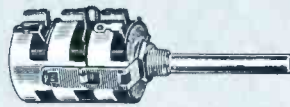


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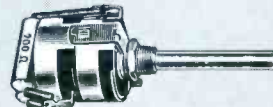
SERIES CIL43

These units provide audio control at low cost and in minimum space. They will handle up to 4 watts audio and are ideal for individual-speaker control. Resistance range of 4 to 500 ohms.



SERIES CIT43

CIT43 and CIBT43 have constant input and output impedances, while CIL43 has constant input impedance only.



SERIES CIBT43

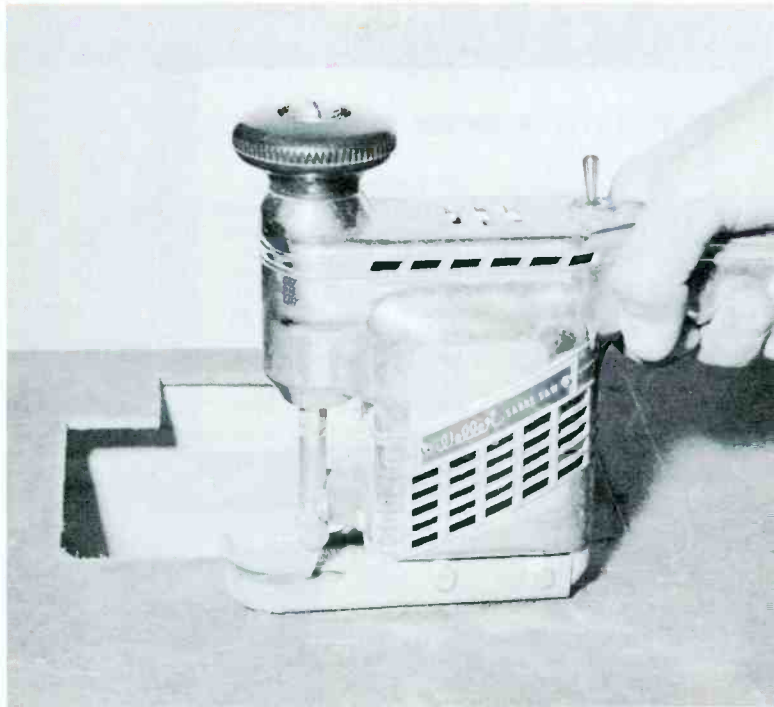
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Build a portable unit for

RADIO TESTING



1. After you have decided where to position the VOM, cut an access hole just a little smaller than the meter case—say $\frac{1}{4}$ " smaller all around. This will help hold the VOM in place.

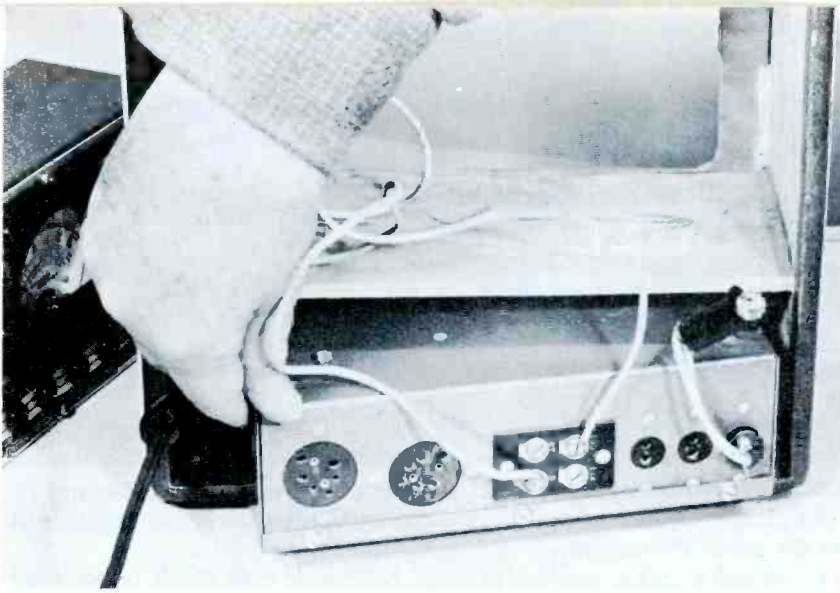
2. Since the case used here had previously housed a portable radio, it had a loop antenna already cemented to it. The addition of two binding posts permits this antenna to be used for any radio being tested. If your case doesn't have a loop, fasten a ferrite loopstick assembly to one of the ends and connect it to the binding posts as shown.

Being a serviceman myself, I realize that most of you aren't too interested in construction projects. However, the unit shown here is a very handy item to have around the shop, and can be easily assembled from commercially-available components.

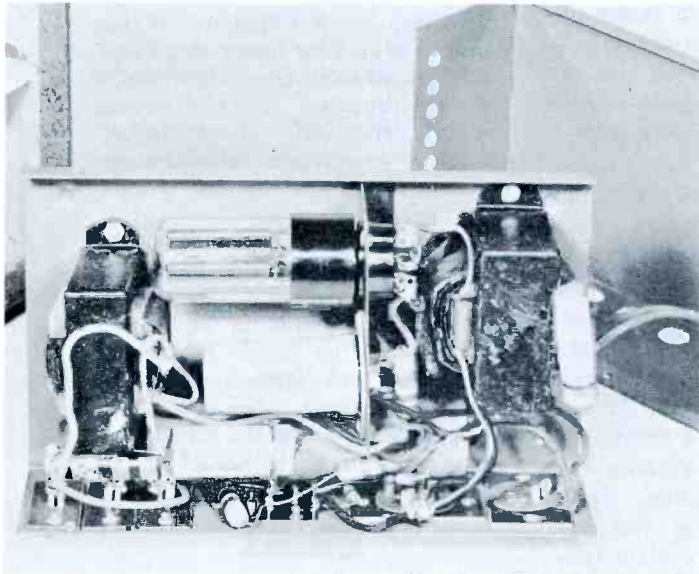
A lot of time can be saved when servicing AC-DC or portable radios if a small speaker, loop antenna, power supply and VOM are mounted in a single case. This groups some of the most-often-needed and easily misplaced items in a single, portable container. The case shown in this story is about 12" x 10" x 5½", and was originally used to house a small AC-DC battery-type portable radio; however, a case from a portable phono could also be used.

If the case you use is larger, or the VOM is smaller, you might make the speaker, antenna terminals, VOM and power supply all accessible from one side, rather than use two sides of the case. Your own modified design will make your unit most adaptable to your particular needs.

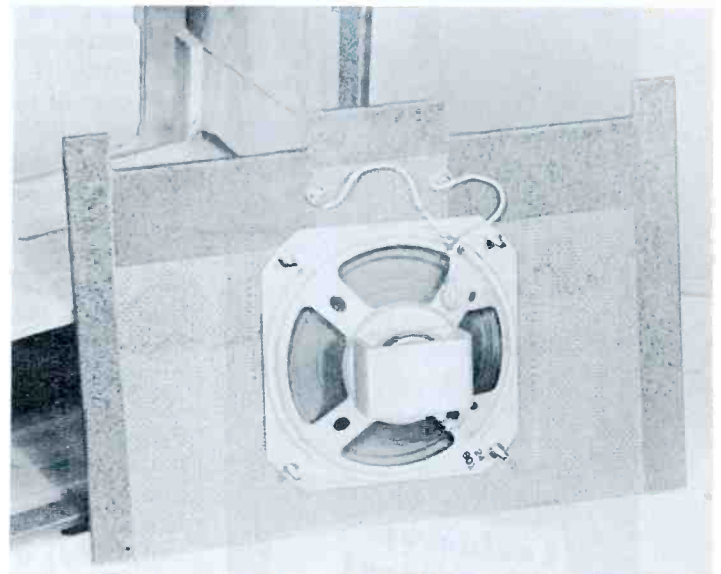




3. A small DC power supply of the type intended as a substitute for the battery pack in a portable or battery-powered radio is now mounted in the case. The unit shown measures 8" x 4" x 2 1/2", and supplies DC voltages of 67, 112 and 132 volts and sufficient current to power a standard AC-DC radio. Low DC voltages of 1.5 to 4 volts are also available.



4. Internal view of power supply unit showing isolation transformer, filter capacitors, 5Y3 rectifier, and voltage divider to provide various voltage outputs.



5. Small speaker (4" to 6") is mounted on rear cover of the case; the voice coil is connected to hold-nut arrangements through the rear cover.



6. With all equipment in place, the rear cover is installed to complete the construction. A group of smaller holes would provide protection for the speaker and could be used instead of the single large hole shown. Note the on-off switch used for the unit's power supply.

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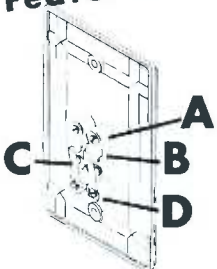


New Type FD-1PK MOSLEY TV & FM Outlet permits multiple antenna outlets to be wired in tandem without losses due to stub effect of unused line.

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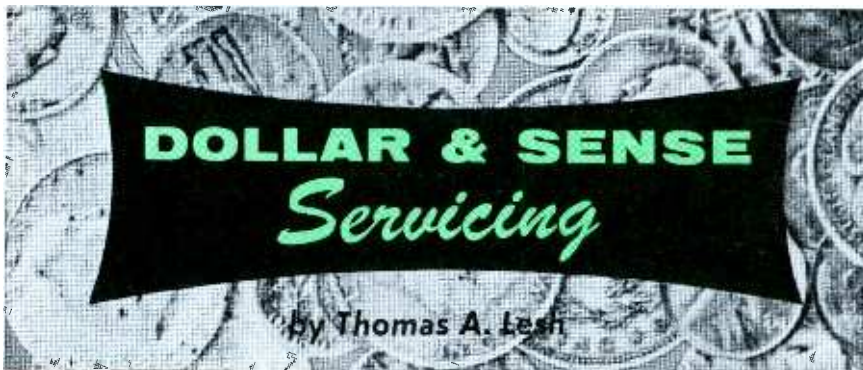


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Is Color Worth Studying? Think over the latest figures about the market for color TV receivers:

—An estimated 450,000 sets are in service.

—About 100,000 to 150,000 new ones are being sold each year.

Suppose one of your best customers decided to join the ranks of this year's hundred thousand color-set buyers — and expected you to take care of the maintenance on his new set. Could you handle the job?

This might be a good time to obtain a color set and install it in the shop for tinkering purposes. You can pick up a lot of valuable, practical experience from just this one receiver, if you keep experimenting with it over a long period of time. Fortunately, color-set design has been stabilized to a great degree during the past couple of years, indicating that service information on late-model sets (including both troubleshooting procedure and circuit theory) is likely to remain reasonably up-to-date for a longer time than you might expect.

\$ & ¢

Time Tip—III. When you wind up a major bench job fifteen minutes before lunch time, what do you do — pitch in on another job, or just mark time until the lunch hour arrives. It's a great temptation to coast along for those last few minutes, but why not put in a few extra licks while you're in the swing of it? Filling the "chinks" in your daily schedule with productive work is one of the best ways to stay caught up on all your chores.

You naturally aren't inclined to get absorbed in a major troubleshooting job when you know you'll be putting it aside in a few minutes, but you could polish off a lot of little housekeeping jobs in a short long run because you can complete interval. By keeping the shop in good order, you'll save time in the

service jobs with fewer interruptions to search for tools or repair test equipment.

Replenish your stock of resistors and capacitors if necessary, and straighten up the tube stock so that you can always lay your hands on the one you want. Take care of the little maintenance jobs on test instruments, too. Fix that frayed lead connection so your meter won't suddenly stop functioning when you're halfway through a series of voltage checks. Periodically check the accuracy of your scope calibrator circuit — don't just sit and wonder how dependable it is.

If everything is fairly well shipshape, you might start preparing for the next big bench job. Go through the routine motions of laying the work out on the bench, assembling equipment and service data, and possibly checking tubes. Then you can launch right into the job at your next opportunity, instead of getting off to a slow start.

\$ & ¢

Good Old TV'S Never Die, said Stan Prentiss at the beginning of his *Across the Bench* series, and we agreed with this statement without fully realizing the extent of its truth. Come to find out, the longevity of TV sets is even greater than we had ever suspected. Frank Mansfield, director of EIA's Marketing Data Department, recently completed a statistical study which indicated an average TV-set retirement age of *nine* years! This isn't all; according to the same survey, the life span of receivers is expected to increase.

Since the most popular and longer lasting of the old-time chassis designs are just as much a part of the service picture as 110° tubes and transistor radios, being proficient at making the rather extensive repairs likely to be required in "Granddaddy" sets is a definite asset in today's service business.



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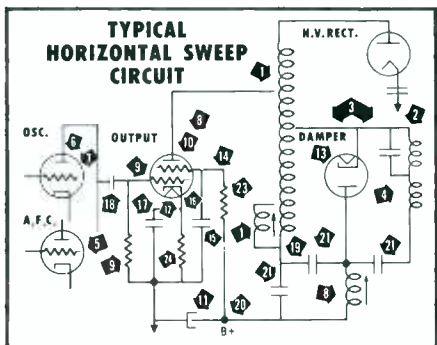
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| 3. Flyback-Yoke Match | 12. Amplifier Heater Voltage |
| 4. Yoke Inductance (mh) | 13. Damper Heater Voltage |
| 5. A.F.C. Sync. Range | 14. Amplifier Screen Voltage |
| 6. Oscillator Frequency (cps) | 15. Amplifier Screen Condenser |
| 7. Oscillator A.C. Output | 16. Amplifier Cathode Voltage |
| 8. Amplifier Cathode Current | 17. Amplifier Cathode Condenser |
| 9. Amplifier Grid Condition | 18. Oscillator Coupling Condenser |
| | 19. Boost Voltage |
| | 20. B+ Voltage |

STATIC CIRCUIT TESTS (RECEIVER OFF)

- | | |
|--------------------------------|------------------------|
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THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

TV Interferes With Radio

How can I eliminate the interference which my radio picks up from nearby television receivers? They put a "birdie" at 10- to 20-kc intervals all the way across the dial, completely blocking out distant stations.

G. H. DOTY

Dayton, Ohio

As you probably are aware, higher-order harmonics generated by TV deflection circuits cause most of such interference problems. Frequencies above the 100th harmonic of the 15,750-cps horizontal sweep frequency are often radiated. Unfortunately, the most effective remedies for this interference have to be applied at the TV receiver rather than at the radio.

A high-pass filter in the TV antenna lead will tend to keep the deflection signals off the antenna and thus prevent them from being radiated so strongly. In addition, .01-mfd capacitors from the AC line terminals of the TV set to ground will help to prevent interference from being carried to the radio through a common power-line connection. Since the deflection yoke and its cable tend to radiate signals, they are sometimes shielded in an effort to reduce radiation. In some instances, shielding has also been applied to the bell of the picture tube or to the entire TV chassis. These last few measures frequently do not result in enough improvement to justify the difficulty and expense of installation.

Not much can be done at the radio to reduce interference, but an external radio antenna can sometimes be installed far enough away from the offending TV set so that a better radio signal can be received without a corresponding increase in the strength of the interference.

Too Many Pictures

An Emerson Model 1183 will lock into sync with either two or three pictures side by side on the screen, but I can never get it settled down to where it will pull in a single picture. When the set first came in, I had to shock the horizontal oscillator into operation by shorting the grid to ground or throwing

the on-off switch.

I've changed the oscillator frequency and phasing coils, all capacitors in the oscillator circuit, and several resistors that were off value. In spite of all these efforts, the circuit still seems to be running far off frequency for some reason

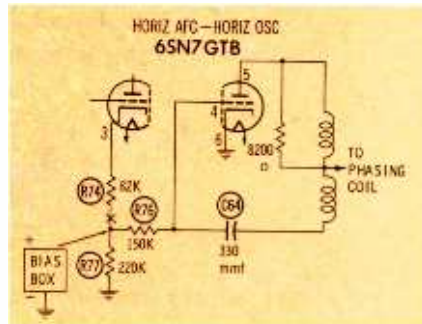
RALPH S. THOMPSON

Sebastian, Fla.

As you probably realize, the running frequency of the oscillator depends largely on the time C64 takes to discharge through R76 and R77 between periods of tube conduction. The discharge rate is slightly increased by a small, controllable positive voltage developed in the cathode circuit of the AFC tube; as more of this voltage is applied to the oscillator, it will run faster. Of course, plate-circuit components also have some effect on oscillator frequency.

In cases where horizontal sweep operation is seriously defective, it helps to know whether the oscillator is badly detuned or whether it is simply being overcontrolled by AFC. To answer this question, you can temporarily isolate the oscillator from the AFC stage without too much difficulty. Disconnect R74 from its junction with R76 and R77, attach a source of variable positive voltage to the latter junction to serve as a manually-regulated substitute for the AFC voltage.

A few volts from the temporary source should normally be enough to lock the oscillator into sync. A correctly-operating set will produce a single picture, which may shift rapidly back and forth but will otherwise be stable. Suspect oscillator trouble if you can't lock in the picture with any combination of slug



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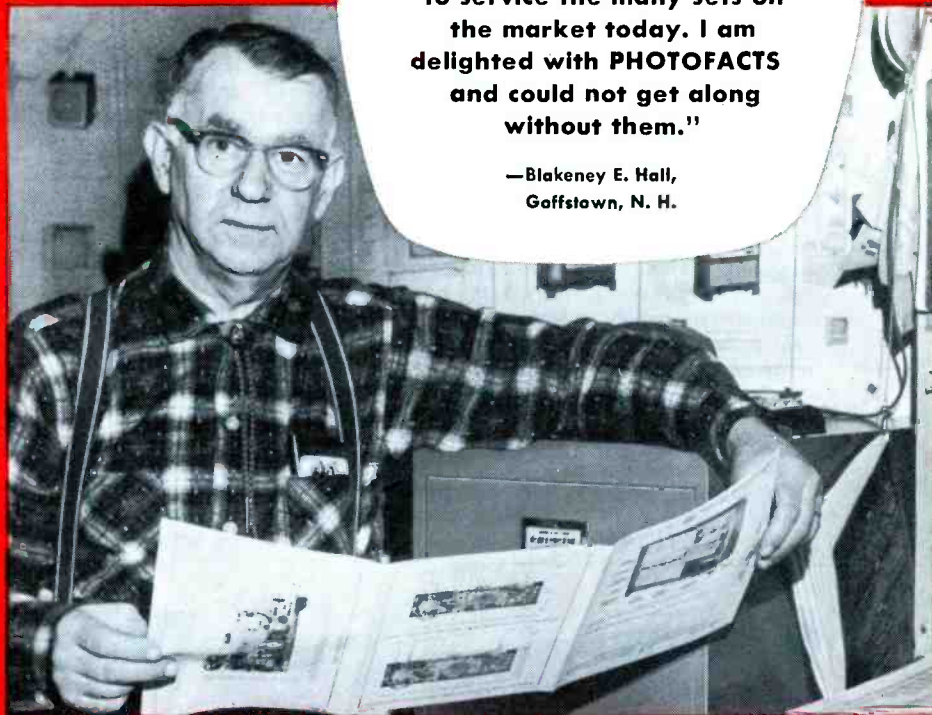
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adjustments, or if more than about 5 volts is required to restore normal operation. Under such conditions, you may have to alter some of the component values in the oscillator to get it working properly. (Before doing this, be sure to try a new 6SN7GTB!)

If the AFC-substitution process was successful, turn your attention to the AFC stage and try to find out why it isn't delivering a normal control voltage.

She's Too Fat For Me

A Muntz Model 321D1N consistently has too much width, and it lacks a horizontal-size control. Please tell me how I can insert such a control or use some other means to decrease the width.

R. L. ARNOLD

London Bridge, Va.

Even though this set has no width adjustment, it does have horizontal linearity and drive controls. You might obtain some improvement by readjusting these for minimum width, consistent with satisfactory picture linearity. In addition, there are two capacitors in the horizontal-sweep circuit which sometimes yield a decrease in width when changed to the next smaller standard value. These are the .033-mfd boost capacitor (connected to terminal 1 of the flyback) and the .047-mfd capacitor across one half of the horizontal linearity coil.

To take a different approach, you might place a cylindrical brass sleeve around the neck of the picture tube and

slide it in between the neck and the yoke. As this sleeve is pushed inward, it absorbs progressively more energy from the horizontal yoke windings and thus makes the picture narrower. Insulation must be placed between the sleeve and the yoke to prevent short circuits; you can install this yourself by lining the center hole of the yoke with fish paper and cementing it in place.

Lots of Picture in the Snow

A new Philco Slender Seventeener portable has a very snowy picture, even though contrast seems to be normal. The sound is good. I tried several different antennas, as well as new tubes in the tuner and IF section, but none of these produced any change in the picture. There is still too much snow for comfortable viewing.

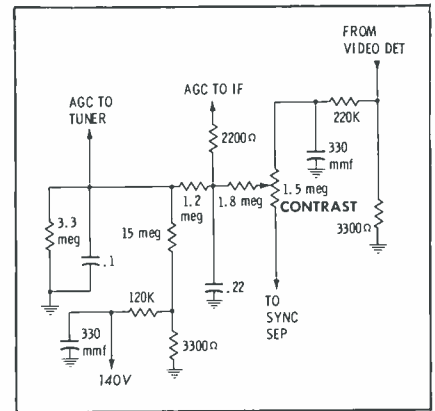
WALTER NOVAK

Baltimore, Md.

The feed line which supplies AGC to the tuner is equipped with a delay network including a high-resistance connection to B+. This minimizes snow by preventing the RF-AGC voltage from reaching too high a value. It would be a good idea to check for defects in this delay circuit, which is shown in the accompanying schematic.

Note that the contrast control varies the strength of the input signal applied to the AGC filter; this may have something to do with your problem.

A course-grained appearance of the



picture can sometimes be due to insufficient rather than excessive AGC bias. In certain cases, a lack of normal AGC voltage can cause an RF or IF stage to operate with an unusually high internal noise level. This circuit noise, when amplified and fed to the picture tube, gives somewhat the same effect as ordinary snow; however, the picture tends to be overly dark or contrasty in such cases instead of having the washed-out look usually associated with weak signals.

If you can find nothing wrong with the AGC system, check tube-socket voltages in the tuner to see if these will give some clue to the defect.

Selenium Rectifiers

Is it all right to replace a selenium rectifier with one having a higher current

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rating, and how much higher can you go? For instance, could you safely use a 500-ma unit to replace any TV rectifier rated at 250 ma or more?

CHARLES W. RUFFNER

Tucson, Ariz.

The output voltage of selenium rectifiers tends to fall off as the current drain is increased, but a replacement unit having a higher current rating than the original will deliver a higher output voltage at a given value of output current. In practical terms, this means that installation of higher-rated rectifiers will often result in an increase of 10 to 20 volts in B+ voltage with no change in current drain. Many servicemen therefore replace old selenium units with "oversize" ones as a matter of course, since the extra margin of output voltage helps to keep B+ at an adequately high level after the rectifiers begin to age.

You are usually safe in replacing 250-ma rectifiers with 350- or even 400-ma types. Using 500-ma rectifiers of either the selenium or silicon type is also okay, as long as it is feasible from an economic standpoint. Technically speaking, one factor definitely limits the increase which can be made in rectifier current ratings: The output voltage must be kept within the limits imposed by ratings of components in the rectifier load circuit. For example, filter capacitors used in voltage doubler circuits are generally rated at 300 volts. If B+ exceeds this value after you have installed higher-rated rectifiers, you should substitute the next smaller size or else install a series dropping resistor in the rectifier input circuit.

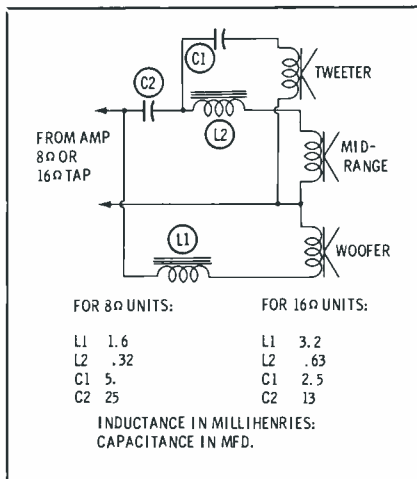
Woofers-Squawker-Tweeter

I'd like to know where I can obtain information on wiring a three-way crossover network for a high-fidelity speaker system.

JOSEPH GULINO

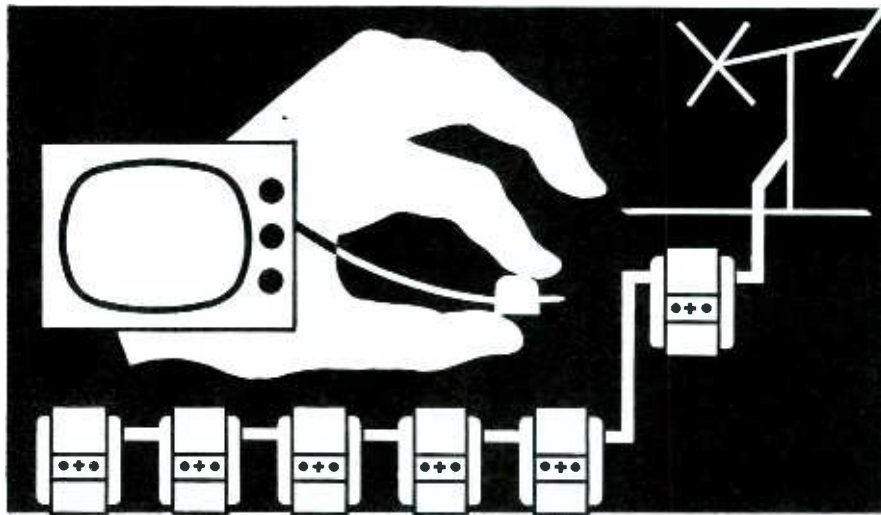
Brooklyn, N. Y.

Here is a system which will provide attenuation of 6 db per octave beyond the crossover frequencies of 800 and 4,000 cps. We've listed two sets of values for all parts used; this will enable you to use the network with speakers having a voice-coil impedance of either 8 or 16 ohms.



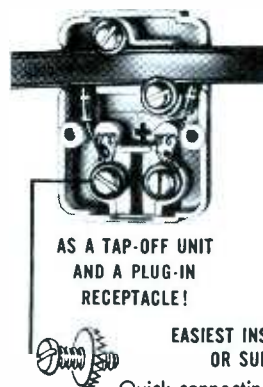
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ing ... cannot be plug-
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JERROLD

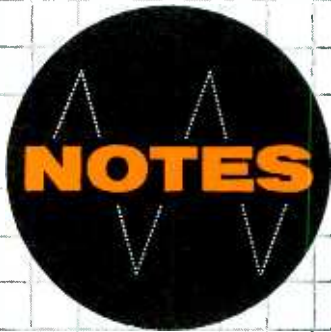
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NOTES on test equipment

by Les Deane

informative reports from the lab

Companions in Power

The two units pictured in Fig. 1 are new products of Service Instruments Corp., Addison, Ill. The *Transi-Pak* Model PS-103 is a battery eliminator designed for operating transistorized radios and other low-current devices. The *Tru-Load* Model BT-101 is a battery tester which checks all units under manufacturers' recommended loads.

With the advent of transistors, pocket-size radios seem to be flooding the market, and undoubtedly you'll get a fair share of the portable repair business this summer. Since these two time-savers are ideal bench instruments for powering both portables and checking their power packs, this is an appropriate time to discuss them.

Specifications for the PS-103 are:

1. Power requirements—115 volts 50/60 cps; power consumption variable with load; isolated by line transformer.

2. DC Output—adjustable from 0 to 24 volts at 100 ma continuously, or up to 200 ma on short peak intervals; separate lead provides 1.5-volt source for units with tapped supplies; low output impedance.
3. Output Meter—combination DC voltmeter with 0 to 24 volt scale, and DC milliammeter with 0 to 100 ma scale; meter function switch provided on panel.
4. Size and Weight—5" x 4½" x 2½", approx. 2 lbs.

Adequate filtering in an instrument of this kind is a must, especially when operating transistorized equipment. A supply with poor filtering will usually produce hum and feedback problems, or even permanently damage transistors and miniature electrolytics. Working with the Model PS-103 on a number of transistor portables, I found the instrument had no such problems, and regulation seemed quite adequate.

Since the *Transi-Pak* is a relative-



Fig. 1. Sencore's new battery eliminator (left) and battery tester (right).

Call	Time	From	To	Call	Time	From	To
400	1.0	W	100	4.0	1.0	W	100
401	1.5	W	100	4.1	1.5	W	100
402	2.0	W	100	4.2	2.0	W	100
403	2.5	W	100	4.3	2.5	W	100
404	3.0	W	100	4.4	3.0	W	100
405	3.5	W	100	4.5	3.5	W	100
406	4.0	W	100	4.6	4.0	W	100
407	4.5	W	100	4.7	4.5	W	100
408	5.0	W	100	4.8	5.0	W	100
409	5.5	W	100	4.9	5.5	W	100
410	6.0	W	100	5.0	6.0	W	100
411	6.5	W	100	5.1	6.5	W	100
412	7.0	W	100	5.2	7.0	W	100
413	7.5	W	100	5.3	7.5	W	100
414	8.0	W	100	5.4	8.0	W	100
415	8.5	W	100	5.5	8.5	W	100
416	9.0	W	100	5.6	9.0	W	100
417	9.5	W	100	5.7	9.5	W	100
418	10.0	W	100	5.8	10.0	W	100
419	10.5	W	100	5.9	10.5	W	100
420	11.0	W	100	6.0	11.0	W	100
421	11.5	W	100	6.1	11.5	W	100
422	12.0	W	100	6.2	12.0	W	100
423	12.5	W	100	6.3	12.5	W	100
424	13.0	W	100	6.4	13.0	W	100
425	13.5	W	100	6.5	13.5	W	100
426	14.0	W	100	6.6	14.0	W	100
427	14.5	W	100	6.7	14.5	W	100
428	15.0	W	100	6.8	15.0	W	100
429	15.5	W	100	6.9	15.5	W	100
430	16.0	W	100	7.0	16.0	W	100
431	16.5	W	100	7.1	16.5	W	100
432	17.0	W	100	7.2	17.0	W	100
433	17.5	W	100	7.3	17.5	W	100
434	18.0	W	100	7.4	18.0	W	100
435	18.5	W	100	7.5	18.5	W	100
436	19.0	W	100	7.6	19.0	W	100
437	19.5	W	100	7.7	19.5	W	100
438	20.0	W	100	7.8	20.0	W	100
439	20.5	W	100	7.9	20.5	W	100
440	21.0	W	100	8.0	21.0	W	100
441	21.5	W	100	8.1	21.5	W	100
442	22.0	W	100	8.2	22.0	W	100
443	22.5	W	100	8.3	22.5	W	100
444	23.0	W	100	8.4	23.0	W	100
445	23.5	W	100	8.5	23.5	W	100
446	24.0	W	100	8.6	24.0	W	100
447	24.5	W	100	8.7	24.5	W	100
448	25.0	W	100	8.8	25.0	W	100
449	25.5	W	100	8.9	25.5	W	100
450	26.0	W	100	9.0	26.0	W	100

Fig. 2. In addition to this chart, new data is supplied free for two years.

ly low-current supply, I thought it would be interesting to check its maximum DC output under different line voltage conditions. Employing the built-in meter for both voltage and current indications, I made several tests in the following manner: I first connected the instrument's AC line to a special line monitor. This gave me fairly accurate meter readings of the AC power applied. The monitor's AC input was then taken from a variable AC supply connected to the 60-cycle power source in our lab.

For a variable load on the instrument's output, I used a resistive decade with incremental step adjustments. Varying the current load up to 50 ma, I found that I could obtain the full 24-volt output with the line voltage no higher than 117 volts AC. With loads less than 20 ma (typical transistor radios), I also found that the supply delivers its full output at a line voltage of only 100 VAC.

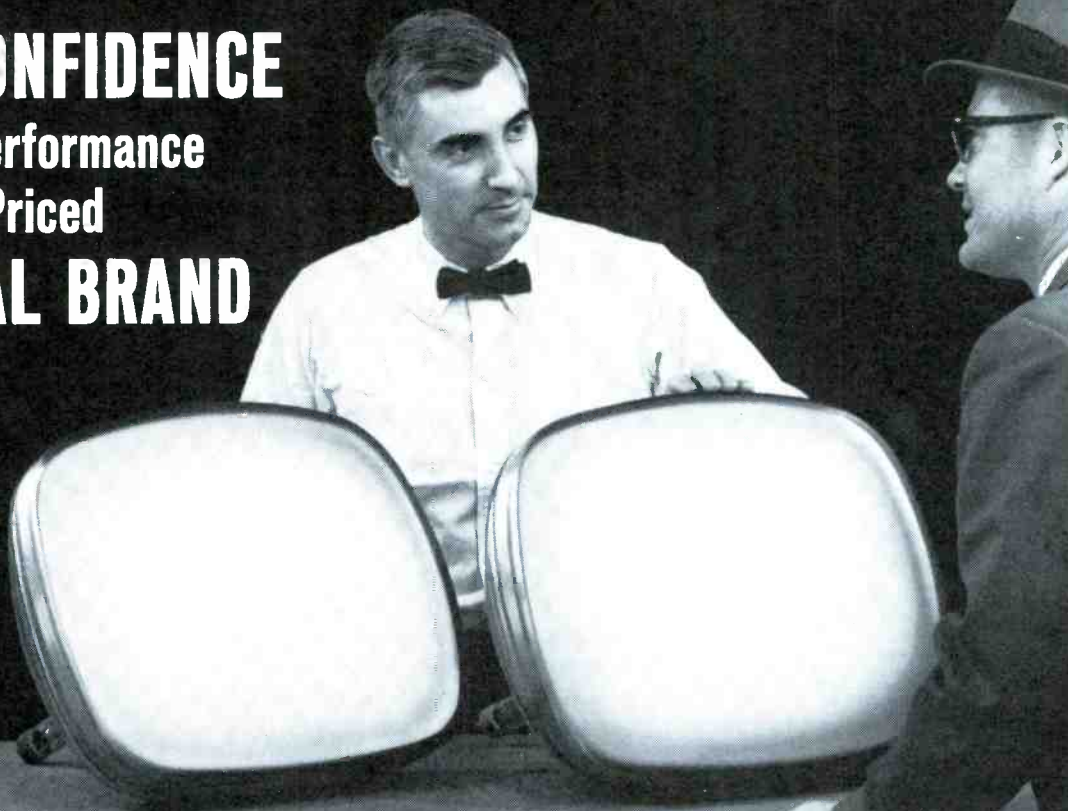
At high-current loads of 100 ma and low line voltage, the maximum DC output naturally dropped—as it would in any supply without line-voltage compensation. The unit I examined had an output of about 19 volts with full load of 100 ma and a line voltage of only 110 volts.

Using an oscilloscope and a peak-to-peak voltage calibrator, I thought it would also be interesting to determine the ripple content present in the instrument's output. In so doing, I found that the peak AC component never exceeded 1% of the DC output level for loads up to 20 ma. Under a maximum load of 100 ma, the ripple remained only

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slightly higher than 2% of the DC value. Since this ripple indication represented less than 1/10 of 1% of the applied line voltage, you can see why the supply is free of interfering hum when powering a transistor radio.

Specifications for the BT-101 are:

1. Battery Test—dynamically checks all dry and mercury-type batteries up to a potential of 105 volts under rated loads; NO-LOAD ADJ. control and 12-position load selector provided on panel.
2. Built-in Meter—0-3 ma movement for direct indications on BAD-WEAK-GOOD scale; calibration marker provided for no load adjustment.
3. Test Leads—black (—) and red (+) 24" leads attached to instrument; alligator clips and banana plugs provided on test ends.
4. Size and Weight—5" x 4 1/2" x 2 1/2"; approx. 1 1/4 lbs.

Making use of one of the True-Load testers in our lab, I found its operation extremely simple, yet its accuracy very good. To simulate various load conditions, the instrument makes use of 12 individual resistors ranging in value from 1 ohm to 39K ohms. By testing a number of different types, I discovered that a battery would read in the GOOD area if its voltage under load remained within 90% of rated value. Batteries which tested WEAK were usually 10-30% below par, and those indicated as BAD retained less than 70% of their original potential. Each section of a dual bat-

tery is tested separately, while batteries with tapped supply points are checked for the highest, or over-all voltage.

To select a load for the particular battery under test, the operator need only refer to the large 8 1/2" x 21" chart supplied with the Model BT-101. A section of this chart is shown in Fig. 2. Approximately 1,000 different batteries are listed numerically and/or alphabetically for all major manufacturers, in addition to operating instructions and notes on test results. Under each manufacturer, you'll find the battery number, voltage, and exact load setting. This chart information is also printed in the operating manual which, incidentally, fits into a convenient retainer on the back of the instrument.

Let Your Customer Do It

For a quick test of radio and TV tubes as well as auto radio vibrators, the self-service instrument pictured in Fig. 3 is designed for home, counter, or bench servicing.

Produced by Shell Electronic Mfg. Corp., Westbury, New York, this emission-type checker features 18 pre-wired test sockets. The P-18 Test-O-Matic is also available with legs for use as a space-saving floor model.

Specifications and features are:

1. Power Requirements—110/120 volts,

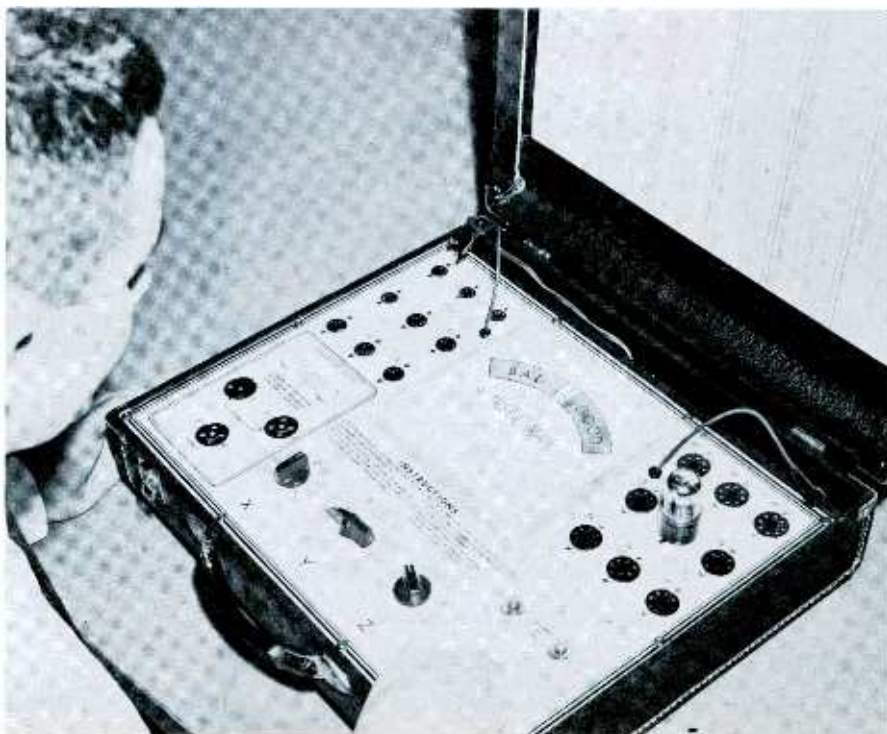


Fig. 3. Shell checker features 18 pre-wired sockets and only 3 setup controls.

60 cps; power consumption less than 5 watts without test load.

2. Tube Test—checks more than 800 tube types; automatically indicates interelement shorts and gas on two panel lamps; emission indicated on large meter scale calibrated BAD-WEAK-GOOD; multipurpose tube sections tested separately.
3. Vibrator Test—output condition of 6- or 12-volt units indicated on twin panel lamps; two 12-volt and one 6-volt test socket provided on panel.
4. Other features — 18 separate tube sockets and two pin straighteners for both 7- and 9-pin miniature tubes provided on panel; operating instructions printed on panel with setup data for over 200 tube types inside detachable lid.
5. Size and Weight—approximately 5" x 19" x 17", 12½ lbs.

In order to familiarize you with the rather simple operation of the Model P-18, let's see what it takes to check a typical tube.

With the line cord plugged into an AC outlet, the first step is to locate the tube type number on the large yellow chart inside the lid. A small portion of this chart is shown in Fig. 4. The three panel control knobs are positioned to the alphabetical and numerical listings shown in columns X, Y, and Z. If testing a 6BK7, for example, the X switch is rotated to position D, control Y is set at 20 on its 0 to 100 scale, and switch Z is placed on the letter C.

The last column on the chart gives the socket number to be used. In the case of the 6BK7, this is socket #8

TUBE CHART

SEE INSTRUCTIONS ON PANEL

Socket	Type	X	Y	Z	Socket	Type	X	Y	Z	Socket	Type
19	6BE6	D	20	D	8	6DG6	G	20	F	12	6Y4
8	6BE6	D	20	E	9	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	E	10	6DG6	D	20	C	18	6Y4
8	6BE6	D	20	A	11	6DG6	D	20	F	12	6Y4
13	6BE6	D	20	C	12	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	F	13	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	B	14	6DG6	D	20	B	3	6Y4
16	6BE6	D	20	C	15	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	D	16	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	E	17	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	F	18	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	G	19	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	H	20	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	I	21	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	J	22	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	K	23	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	L	24	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	M	25	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	N	26	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	O	27	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	P	28	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	Q	29	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	R	30	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	S	31	6DG6	D	20	B	3	6Y4
8	6BE6	D	20	T	32	6DG6	D	20	B	3	6Y4

Fig. 4. Chart of P-18 lists type socket number, and 3 setup designations.

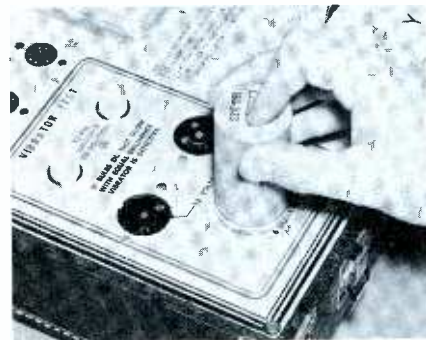


Fig. 5. The Test-O-Matic tube checker also features a test for most vibrators.

to the left of the meter. After permitting the tube to warm up for about 30 seconds, you observe the two indicating bulbs on the right side of the panel. If either glows, the tube is shorted or gassy and should be rejected.

To perform the emission test, the pushbutton below the short lamps is depressed, and the condition of the tube is read directly on the large 7" meter. Additional sections of multipurpose tubes are tested by throwing switch Z to other letter positions indicated in column Z of the chart. For the 6BK7, switch Z is first set to position C and then to position F. In the case of a 6BC7 triple diode, three separate emission tests are made in switch positions A, E, and G. You can see from the preceding operation that the setup is elementary and straightforward, and therefore applicable not only to the busy technician, but also to the unskilled do-it-yourselfer. With an instrument like the Test-O-Matic on your front counter, the customer can easily check his own tubes or vibrators without taking you from your other shop duties.

The vibrator test section of the instrument (see Fig. 5) is perhaps even easier to operate than the tube section. To check a vibrator, switch X is flipped to position A, which merely turns on the instrument. The 3- or 4-prong vibrator under test is then plugged into one of the standard 6- or 12-volt sockets. This action should cause the two panel lamps just above the sockets to light. As stated in bold print on this section of the panel, "IF BULBS DO NOT GLOW WITH EQUAL BRILLIANCE VIBRATOR IS DEFECTIVE."

Removing the instrument from its case, I examined the vibrator test circuit to see exactly how the test was performed. The two #44 pilot lamps are connected in series with each side of what would normally be the pulsating DC output of the unit in a conventional auto radio hookup. Thus, when each output pin makes contact with the vibrating reed, the lamps light or flicker at the vibrator frequency rate. A loss developed across one contact will cause that lamp to glow with less brilliance. Test potentials are derived from 6.3- and 12.6-volt AC supplies in the filament circuit of the tube-testing section. ▲

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QUICKER SERVICING

By Calvin C. Young, Jr.

Hot Chassis Safeguards for the Customer

Most discussions on hot-chassis safety have centered around protecting you, the serviceman; however, don't forget that the customer must also be protected. Set manufacturers have, during the last several years, taken many steps to make their sets safe for use by the consumer; it's up to you to keep them that way.

Antenna Isolation

One feature used by all manufacturers is the RC network (Fig. 1) between the antenna-input terminals and the input transformer of the tuner. This network consists of a high-value resistor, usually between 470K and 1 meg, and a small capacitor of non-critical value but with a voltage rating of at least 1,000 volts. The capacitor readily passes any RF signal and thus permits the desired input signal to reach the input transformer. Current flow between the antenna-input terminals and earth ground because of a completed path through a body con-

nected between these points is limited to a safe value by the resistor. Earth ground in this case could be a steam radiator, water pipe, concrete radiator, shorted electric lamp or other appliance, etc. The RC network won't prevent a person from getting a slight "tingle" if he gets between the antenna and ground, but it will prevent fatalities.

Cabinet Isolation

Metal cabinets are isolated from the chassis pan by suitable insulators. To keep the cabinet from collecting a charge (the cabinet is one plate of a capacitor, the chassis the other), an RC network is employed (Fig. 2). This network prevents any static charge from collecting on the metal cabinet, and thereby prevents the customer from getting "bit" each time he touches the cabinet. The resistor also acts as a current limiter should the chassis be "hot" with respect to earth ground. (See Fig. 3 for details.) If the AC plug is connected so that the chassis is "hot" (117VAC to earth ground), the voltage divides between the person

and the resistor in the RC network. The value of the resistor is quite high (about 1.5 meg), and since the human body has an internal resistance of 100K ohms, or less, the remaining voltage is too small to provide a serious shock. A person might feel a slight "tingle," but nothing that would be fatal. Even this can be prevented by installing the AC plug so that the chassis is at earth ground potential. (Note—by coding both plug and wall plate and informing the customer of the reason, the receiver may always be connected to maintain a "cold" chassis.)

Control Shafts and Panels

Since the customer has access to various controls and you can't be sure all knobs will always be in place, steps must be taken to insure that a "hot" control shaft or panel won't be the cause of a customer's sudden demise. This can be accomplished in one of two ways. Insulated shafts can be used on controls in conjunction with sheets of fish paper (Fig. 4) to make sure that, when a control knob is removed, the customer can't come in contact with the "hot" chassis. The second method consists of isolating the control panel from the chassis with insulators, then connecting an RC bleeder network as shown in Fig. 5. Always be certain to install controls with insulated shafts wherever necessary, and reinstall fish-paper barriers when replacing controls to maintain the protection provided by the manufacturer.

Cabinet Back

Heretofore, you may have considered the cabinet back as that thing you remove to service the set. It would pay you to consider it as much more. For example, this rear cover keeps the customer away from a chassis that is potentially lethal 50% of the time (depending on AC plug polarity). It also provides protection in case of CRT implosion. The many screws used to hold the back in place, rather than being a nuisance, are necessary for the reason just mentioned — as well as for discouraging curious fingers of small children.

How to Check for "Hot" Chassis Safety

If you are a serviceman who likes to use the best equipment, chances

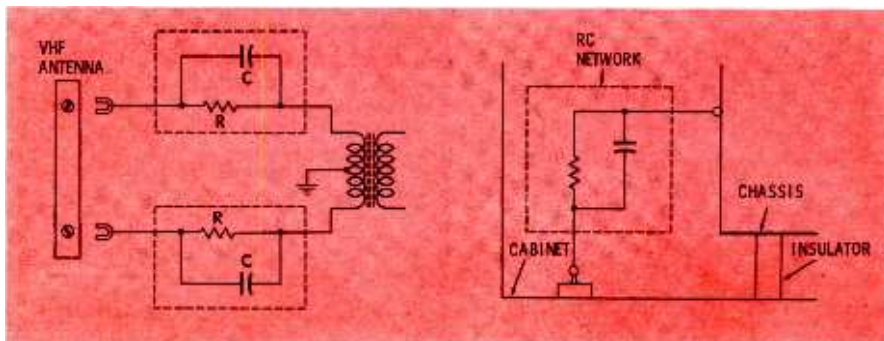


Fig. 1. RC networks provide isolation between chassis and antenna terminals.

Fig. 2 Network between cabinet and chassis prevents static-charge build-up.

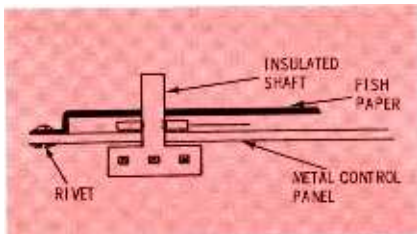


Fig. 3. Line voltage divides between isolation resistor and grounded person.

are you'll reach for a VTVM to check for voltage between a metal cabinet or metal back, and earth ground. Imagine your surprise when the VTVM reads only about 10 volts lower than the AC line level. If you really dig in, you should come to the conclusion that nothing is wrong in about an hour. "Why then do you get such a high voltage reading, and isn't this a shock hazard?" you ask yourself. The internal impedance of your VTVM is at least 10 to 11 megohms, and this impedance is in series with the resistance in the RC network. With this voltage division, most of the voltage appears across the input resistance of the VTVM and you read almost 110 volts (line voltage 120 volts).

Now let's consider what will happen if we make the same test with a VOM. Since we measured 110 volts with the VTVM, let's set the VOM to the 250-volt AC scale and again measure between the metal cabinet and earth ground. Surprise again—this time we measure only 55 volts! If you consider that the AC impedance of the VOM is 5000 ohms/volt, the internal resistance of the meter (on this scale) is 1.25 megohms— $250 \times 5,000 = 1.25$ meg. But what would happen if we switched the meter to the 50-volt scale? Off scale, you say. Better figure again. The internal impedance of the meter is now $50 \times 5,000$, or 250K ohms, so we read much less than 50 volts between the chassis and earth ground. In fact, the reading is only about 19 volts in this case.

All of this should serve to emphasize that the VTVM, even

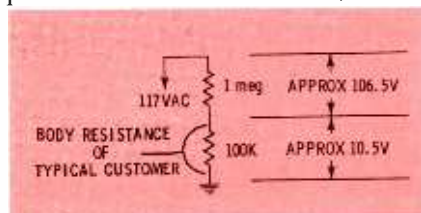
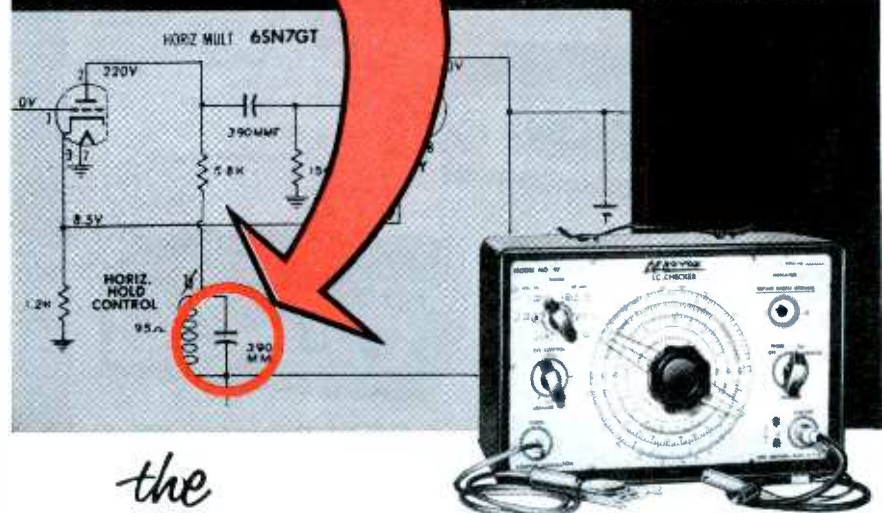


Fig. 4. Insulated shaft and fish-paper barrier isolates panel from "hot" set.

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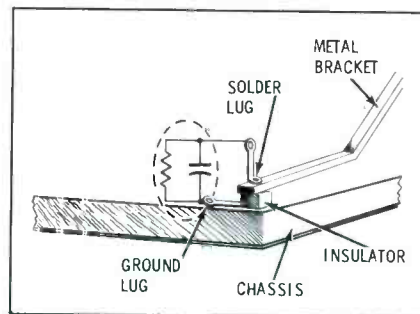


Fig. 5. RC network between bracket and chassis prevents static build-up.

though it is usually more accurate, doesn't fill the need in this application. The fact that the VTVM doesn't load the circuit under test and doesn't draw a significant amount of current from the circuit under test is why it won't give suitable results when testing for "hot" chassis danger.

If you should measure more than about 50% of applied line voltage between the metal cabinet and earth ground when using a 5,000-ohm/volt VOM, look for a leaky capacitor or a defective insulator. If your VOM has 10,000-ohms/volt sensitivity on AC, the readings you'll get will naturally be higher.

Protecting Shop Test Speaker

If you have a speaker built into a shop panel for test purposes, most likely you have already ruined more than one voice coil or cone when testing high-powered amplifiers. If this is the case, and you wish to eliminate future failures of this nature, connect a pair of low-current silicon rectifiers (front to back in parallel) across the voice coil as shown in Fig. 6. Each rectifier should be capable of handling 250 ma in the forward direction, and should have a PIV rating of at least 50 volts. Types 1N536 and 1N2072 are two which will serve the purpose.

The rectifiers act as shunt limiters by conducting heavily on signals greater than about .6 volts. Any signal of less amplitude doesn't cause the diodes to conduct. Since power equals E^2 divided by R, the maximum power that can be applied to a 3.2-ohm speaker is about .11 watts. This isn't enough power to damage any speaker; however, it is enough to produce an acceptable volume level for monitoring purposes.

If you install a pair of diodes as

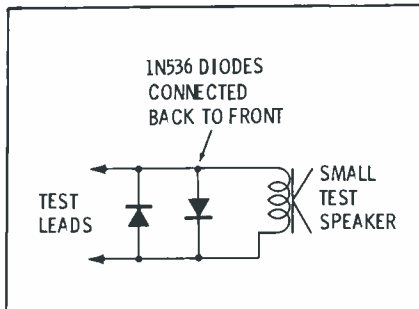


Fig. 6. Silicon diodes permit small speaker to be used with any amplifier.

shown, you'll find that the volume can be increased without distortion until the diodes begin to conduct. From this point on, volume remains the same, but distortion goes up. All amplifier or audio checks should be made at volume settings that produce no distortion. ▲

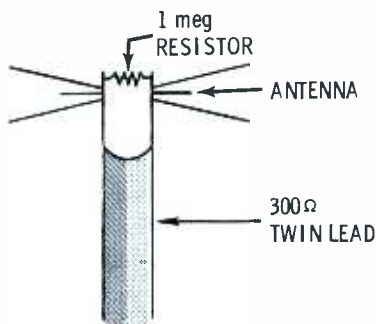
Testing TV Lead-In

by George D. Philpott

It is most desirable to be able to make a quick check on antenna lead-in wire for continuity without having to climb on the roof.

High winds, snow, rain, and age all take their toll on the antenna and lead-in. Where the antenna is not of the dipole type, it is perfectly permissible (during the initial installation) to bridge the phasing-bar terminals with a good quality 1-meg resistor as shown in the drawing. This establishes a fixed resistance across the line which may be easily read on a VTVM at the receiver end of the line.

From then on, it's very easy to check for an open conductor and determine whether or not to get out the ladder and safety belt. This resistor will not cause any appreciable loss in signal, since it has little effect on the characteristic impedance of the line.



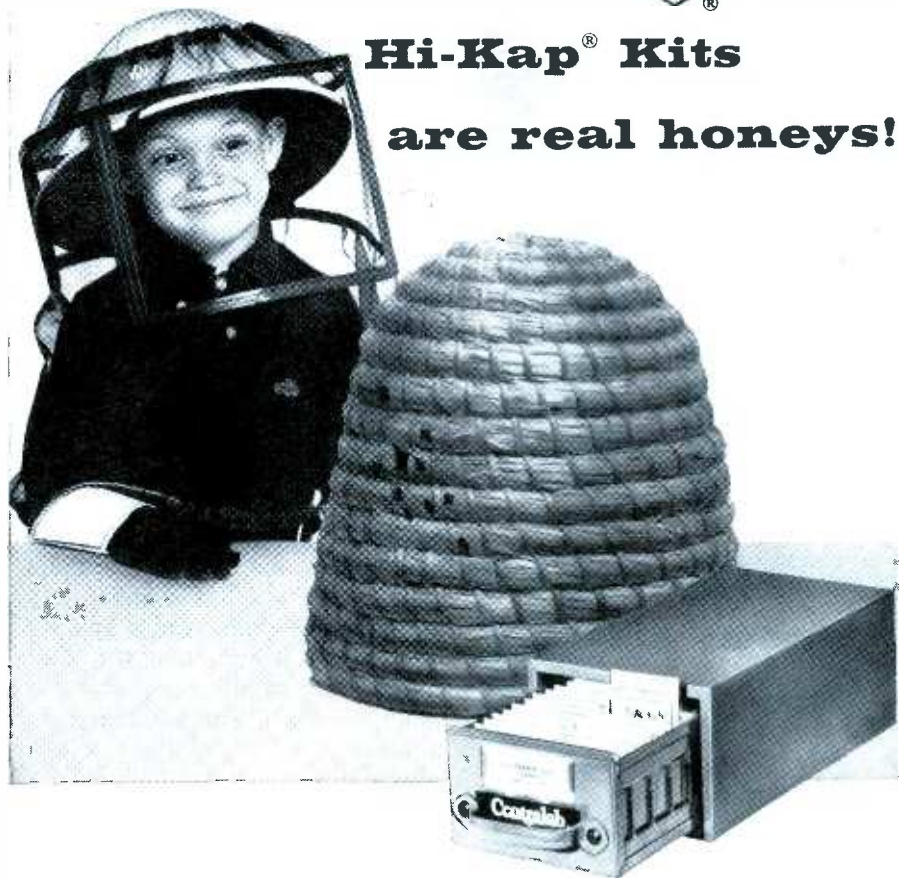
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Across the Bench

(Continued from Page 22)

via diode M1. Closer examination revealed that screen current actually flowed through the horizontal-yoke coils and the secondary of the horizontal-output transformer. The path to the screen grid is then completed by the series-connected 4700-ohm resistors.

I further discovered that audio-output screen current also flows through the yoke and the flyback secondary winding. This small amount of DC current (less than 20 ma) through the yoke affects raster centering. Centering is accomplished by moving the focus coil. If you've ever had trouble centering an old model GE or Trav-Ler that employed only a focus coil for centering, you will surely appreciate the aid given by the small DC current through the yoke.

The presence of a 110-volt p-p signal at the screen grid was quite a surprise. I finally managed to find the reason for this signal, and it's really a pip. Notice that the yoke doesn't have any damping network; thus, yoke-signal feedback helps to eliminate the ringing that would otherwise occur.

The selenium rectifier M1, first thought to supply screen voltage, was finally pinned down as an aid to centering the picture. Actually, what it does is provide a starting reference for each horizontal scan line, and thereby lines up the left edge of the raster. If M1 should open, the left edge of the raster will appear ragged, because each line will start at a slightly different point. If M1 should short, the raster would probably disappear; should it short while you were watching the CRT screen, you would see the raster

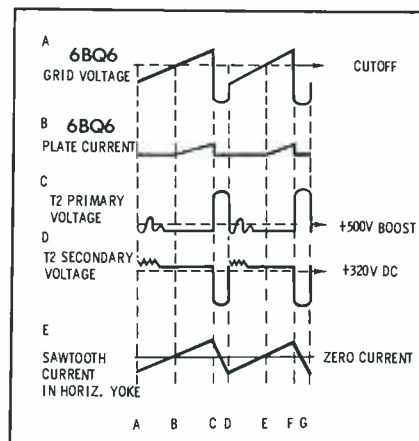


Fig. 4. Voltage and current waveforms for the horizontal-output circuit.

collapse to a single vertical line and then slowly fade out.

A final word on this circuit. Note that a .15-amp fuse is employed. A shorted audio-output tube could cause excessive current to flow through the flyback or yoke, and the installation of a larger fuse size is a sure invitation to disaster. Since the 6BQ6 screen current also flows through the fuse, always test the 6BQ6, 6AS5 and 6W4 whenever the fuse is found open.

Now that we have covered some of the more unique circuit features, let's see what actually happens in the flyback circuit when the 6BQ6 is driven by a 15,750-cps sawtooth signal of about 70-volts p-p. Pertinent waveforms are shown in Fig. 4. We'll stretch the waveforms a bit so you can mentally separate the top four from the yoke-current signal shown in the fifth.

A. The waveform at the grid of the horizontal output tube starts below cutoff (time a), rises to cutoff (time b), and the tube begins to conduct.

B. Plate current flows in the hori-

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zontal-output tube between times b and c.

C. Tube conduction increases linearly, producing a magnetic field around the output transformer and deflection coils—of constantly increasing strength.

D. When conduction has reached maximum, grid voltage goes sharply negative—times c and d—and the magnetic field begins to collapse. This produces a very high pulse voltage that is positive at the top of the primary winding of T2, and negative at the top of the secondary winding.

E. At the same time, current through the horizontal-deflection yoke, that has been steadily rising to a maximum—time c, rapidly drops to zero and then increases to maximum in the opposite direction—time d.

The output circuit now oscillates at a resonant frequency in the neighborhood of 70 kc. At the end of the first half cycle, this oscillation must be suppressed to prevent ringing in the picture. On this first half cycle, the damper tube does *not* conduct and this voltage builds up to a high negative value (about 3 kilovolts).

On the second half of the cycle (beginning at time d in Fig. 4D), the voltage at the plate of the damper swings positive, the damper conducts, presents a low impedance to the transformer secondary, and damps the large oscillation seen in the primary of the flyback transformer (times d and e of Fig. 4C) so that it appears as hardly more than a ripple across the now positive-going secondary. Current in the deflection coils continues to rise,

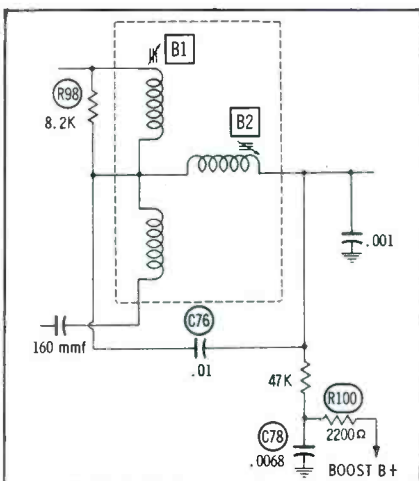
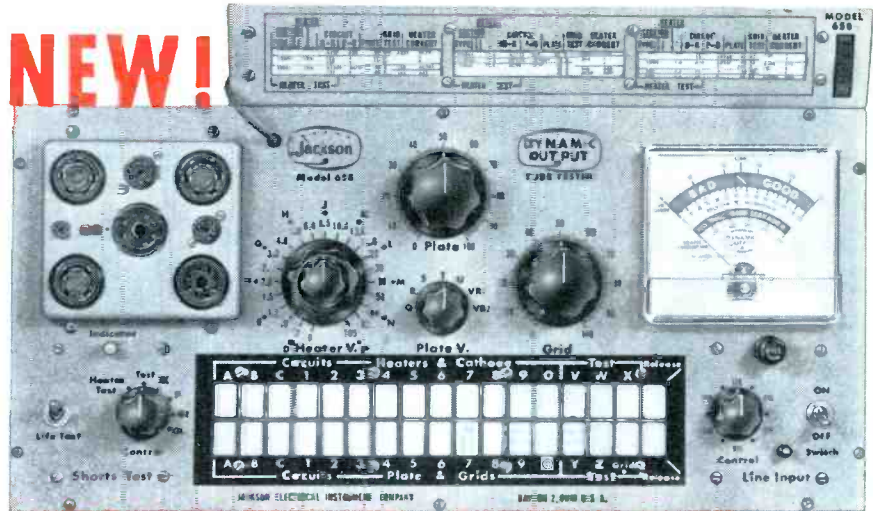


Fig. 5. Shorted C78 cooks R100 and ruins damper and low-voltage rectifier.



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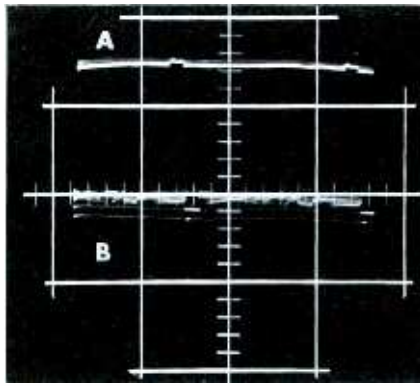


Fig. 6. Video-output signals. (A) Plate—100V/division. (B) Grid—2V/division.

changing linearly from maximum in one direction to maximum in the opposite direction—d, e, f, in Fig. 4E—until the entire cycle is again repeated after cutoff of the sawtooth waveform at the grid of V13. At any time in the cycle, the plate voltage of the damper is equal to the algebraic sum of its plate supply voltage and the instantaneous voltage across the secondary of the flyback (note that terminal 6 of T2 is connected directly to B+). Boost is developed across C56 during conduction of the damper; it goes to the plate of the horizontal-output tube through the primary of T2, and also to the height control and vertical-output tube V11.

Trouble Experience

When one of these receivers was brought in the shop recently, there was no high voltage. A few rapid checks revealed that 6W6 was occupying the socket meant for the horizontal oscillator (a 6SN7), and the whole receiver showed signs of having been worked over by a suburban handyman's happy, hairy hand. Thanks to some sort of Providence, however, no soldering or

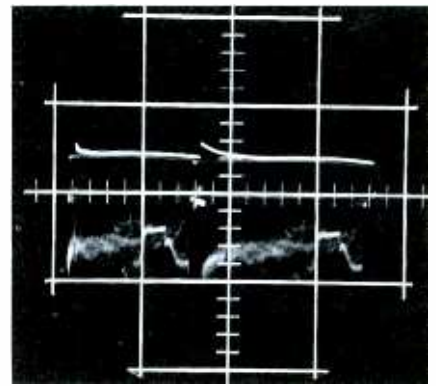


Fig. 7. Signal at the input of the sync separator has a 1.5-volt DC level.

component changes had yet taken place.

I first checked tubes and placed a 6SN7 in the horizontal-oscillator socket, but still there was no high voltage. B+ was measured and found to be over 300 volts, so I knew at once this wasn't the trouble. Selenium diode M1 was measured for both opens and shorts, and was given a clean bill of health. Next, I opened the plate circuit of the horizontal-output tube by removing the lead to terminal 2 of the flyback. The horizontal oscillator wobbled into life, but it wasn't too steady.

This pretty well isolated the trouble; either the flyback itself was shorted, or some component in the flyback or deflection-yoke circuit was bad. To check at least the primary of the flyback, I removed the damper and high-voltage rectifier from the circuit and connected a flyback tester between taps 2 and 3. The overload indicator on the instrument didn't glow very brightly, so I knew the primary wasn't shorted. This left one other very good possibility. Since filter capacitor C58 was paper and not the faithful ceramic "doorknob" type, I

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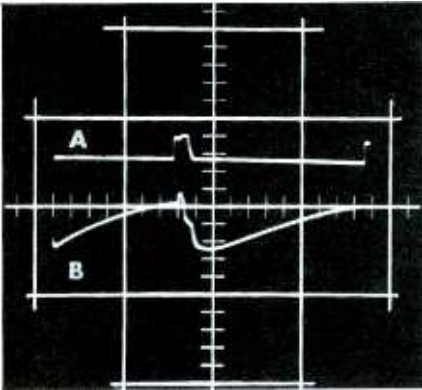


Fig. 8. (A) Sync-separator plate is +60 volts DC. (B) AFC grid is at -25 volts.

slipped the leads of an ohmmeter across it. Resistance was about 10 ohms—a very shorted capacitor indeed! Of course, I replaced it and restored lead connections, after which the high voltage took off very nicely.

P. S.

There are a couple of other things of which you should be aware. For instance, the aquadag coating of the CRT must be firmly grounded. If it isn't, you'll have a frustratingly audible "pop, pop" or arc each time you turn the set on and off. Strap this—or any other identically connected CRT aquadag to ground, and the arc will promptly disappear (assuming there's nothing wrong with the high-voltage filter capacitor and the rectifier socket isn't gummy with dirt). Most of the time you can simply bring your hand near the CRT aquadag coating and feel any "hot" voltage. A taut wire from the metal yoke-mounting strap will usually solve the problem very easily. Of course, you could be real fancy and use a copper spring.

Because this set uses a DC-restorer tube, the DC restorer will hold the CRT at cutoff when there is no video signal. Therefore, turn up the brightness control at once when servicing this type of receiver, and always check the high voltage if there is any doubt about its presence. Carelessness with any receiver employing a DC restorer can mean a lot of wasted time.

The third thing worth remembering is the small but important accumulation of large-value paper capacitors in the damper, horizontal-oscillator, and horizontal-output circuits. After seven or eight years of operation, you may want to replace many or all of them if there is *any*

indication of trouble in these sections of the receiver. Particularly watch C46, C47, and C48 in the horizontal-AFC circuit and C54, C55, C56, and C57 in the horizontal-output circuit. The horizontal-hold control won't work worth a darn if C46 is leaky. Note that faults in either the audio IF or output tube can cause both loss of video and sound since they also serve as video voltage regulators. And finally, DC voltage readings given in service literature were taken with a 20,000 ohms/volt VOM,

often on the lower scales; the readings will be higher than specified in easily-loaded circuits if you use a high-impedance VTVM.

105 Series Magnavox

The set I encountered had a drifting horizontal oscillator that responded to strictly routine handling; an off-value 8200-ohm R98 and a leaky .01-mfd C76 (Fig. 5) were replaced on its first trip to the shop. Strangely enough, however, two weeks after the set was returned to its owner, it suddenly blew a



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5U4, cooked the plates of the damper tube, and burned R100 beyond recognition. A quick check with an ohmmeter showed that a relatively new .0068-mfd C78 had shorted to ground, dropped the full DC load across the damper, and drew enough current from the power supply to destroy low-voltage rectifier V20. Of course, with replacement of the two components and tubes, the receiver operated hand-somely.

At this point, I made a routine check of the sync circuits using the DC scope amplifiers, and I thought you'd like to see how they looked. Follow the AC and DC voltages I'll give you along with the waveforms, keeping in mind that a large waveform (A in Fig. 6) can look quite small when the scope's vertical input amplifier is set for 100 suffered some clipping in the process of adding both a large and a small waveform on the single composite picture). Fig. 6B shows the negative-going 3-volt p-p signal at the input of video output tube V7.

Incidentally, the DC levels for the waveforms were 150 and 1.2 volts, respectively. This was indicated by the number of divisions the signal came to rest from the signal-free position of the trace. For instance, the plate waveform moved upward 1.5 divisions from the center. This effect is easily checked, and the voltage change per division on the screen determined. You simply center the beam, touch a known DC voltage with the scope probe (DC input) and note the number of divisions the beam shifts. If the beam shifts off screen, reduce vertical gain and repeat the test. Divide the voltage at the test point by the number of divisions it causes the trace to

deviate, the scope is calibrated.

By leaving the vernier gain as it is, the step attenuator can be switched as needed, using the calibration factor on other step-attenuator scales by either multiplying (higher scale) or dividing (lower scale) by 10 for each step change away from the calibration point. For example, you determine that each division on the X10 scale represents a 10-volt change. When you switch to the X100 scale, each division represents a 100-volt change. On the X1 scale, each division would represent a 1-volt change.

Fig. 7 shows the waveform at the grid of the sync separator. It's at 16 volts p-p and still contains much of the video information. The waveforms in Fig. 8 were taken with the scope sweep set to half the horizontal-oscillator frequency, or 7,875 cps. In all instances, a low-capacitance (10:1) probe was used for the dual purpose of further isolating the circuit under test from the oscilloscope, and also to enable reading the peak-to-peak values directly as they appeared on the oscilloscope screen. ▲



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TV Tubes

(Continued from page 31)

cation. It's natural, then, to wonder if the new tubes are intended to supersede older types, or if the various new types can be used as emergency replacements for one another.

In a few cases, a sort of one-way interchangeability exists among types as a result of a progressive "beefing up" of one basic design. Horizontal-output tubes are a familiar example. The 6DQ6A, a tube capable of 110° service, can be used to replace the 6CU6 found in many 90° sweep systems; in turn, the 6CU6 will replace the 6BQ6GT which is used chiefly in 70° circuits. Unfortunately, the tube situation is not this simple in most other circuits. Let's examine a few cases which have produced a great deal of confusion and misunderstanding in the field.

Vertical Output Tubes

The industry has apparently had a tough time designing a satisfactory vertical-sweep tube for 110° deflection systems, since an unusually large number of new types have been developed for this application. More efficient tubes for 90° systems have also been getting considerable attention.

We've made a study of the similarities and differences between the many new types of vertical-output tubes, and the results are summarized in the following discussion. To let you know when you'll need these tubes, we have included lists of manufacturers using each type. In each case, the number in parentheses after the manufacturer's name indicates the number of basic chassis series in which the tube is found.

A brand-new series of 9-pin pentodes has been developed for 110° service. Their specifications are similar, but not quite enough alike to permit free interchange of types. The most recent one, the 6EM5, has the following maximum ratings: Plate dissipation, 10 watts; peak positive plate voltage, 2,200 volts absolute; cathode current, 210 ma (peak) or 60 ma (average). These ratings are generally a good bit higher than for a typical 90° sweep tube, since wider-angle deflection takes more power. An 8EM5 (600-ma series-string version) may appear in some future receivers.

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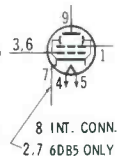
6EM5
 RCA (3)

6DB5
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12DB5
 ADMIRAL (5)

6DT5
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12DT5
 WESTINGHOUSE (1)



The 6CZ5 is quite similar to the 6EM5 except for a considerably lower cathode-current rating and much lower heater current (450 instead of 800 ma). The series-string version has a 5-volt heater.

The 6DB5 is unusual in having a much lower screen-voltage rating than the other tubes in its class. Circuits using this tube type often have a dropping resistor to reduce screen voltage to about 150 volts. A 6DB5 is said to be capable of producing full vertical sweep on a 90° tube when both plate and screen potentials are only 135 volts. Heater current of this tube is 50% greater than for the 6EM5, or 1.2 amps; therefore, the series-string version requires 12 instead of 8 volts.

The 6DT5 also has a high-current (1.2-amp) heater; otherwise, its ratings are fairly close to those of the 6EM5.

Several dissimilar dual triodes (with one low- and one high-powered section) have been especially designed for use in vertical-multivibrator circuits where the second half of the multivibrator serves also as the output stage. One well-known tube designed on this same general principle is the 6CM7, which has been used for several years in 90° circuits.

Dual triodes now being used in 110° or modernized 90° sweep systems are not a direct outgrowth of the 6CM7 design; instead, they have been developed along the lines of the 6CS7, a less widely-used but more powerful 90° tube first introduced in 1956. The latest types are improvements over the 6CS7 in characteristics such as cathode-current and plate-power ratings.

The 6DE7 and 6DR7 have identical output sections, but the input or "oscillator" section is a low-mu type in the former tube and high-mu in the latter. As for the 6CY7, it's so similar to the 6DR7 that Zenith has

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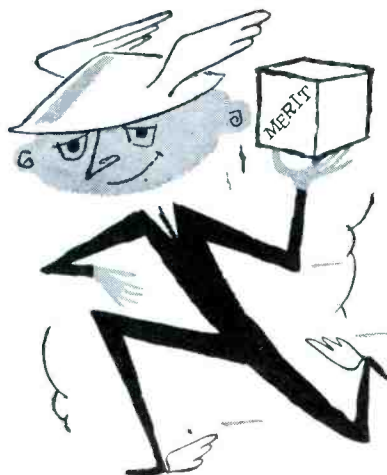
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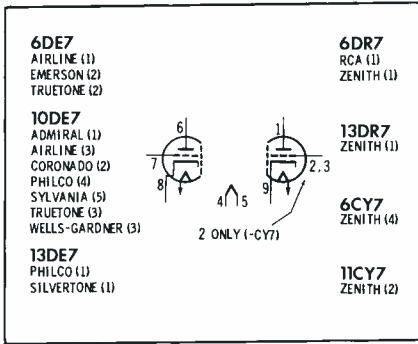
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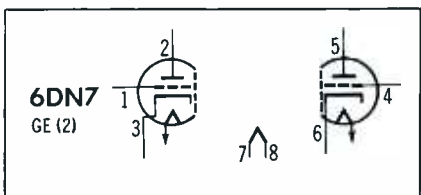
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used both these tubes as alternate types in nearly identical circuits. It may not always be possible to interchange these types freely, since the 6DR7 output section has higher cathode-current and plate-dissipation ratings (but lower DC and peak plate-voltage ratings) than the 6CY7.

The 6DN7 has the same basing diagram as the 6BL7, a familiar fixture in many earlier General Electric sets — but the resemblance ends there. While the 6BL7 has two identical sections with moderately high power ratings, the 6DN7 is a dissimilar dual-triode with one low- and one high-powered section. Specifications of the output triode are ample for producing 110° sweep.

Socket connections of the 7EY6 and 12EN6GT are the same as for the bewhiskered 6W6GT (which is still widely employed in 90° vertical-sweep circuits), but the new tubes are far from being brothers. The 7EY6 is a "souped-up" tube for 110° service. Comparing its specifications with those for the 6W6GT, we see that maximum plate dissipation has been boosted from 7 to 11 watts and maximum peak plate voltage has gone up from 1,200 to 2,500 volts! On the other hand, the 12EN6GT is simply a close relative of the series-string 12W6GT which has been modified for operation in a 90° system with a plate supply of only about 135 volts. This allows a TV set to operate from a simple half-wave B+ rectifier without having to supply vertical-sweep current from the boost B+ line.



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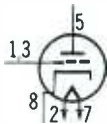
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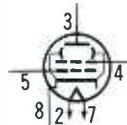
This single triode in an octal envelope, used with a 90° low-Eg2 picture tube in the highest-priced Zenith sets, is not related to any other vertical output tube in current use.

IF Pentodes

You have to hunt around for a long time to find a recent-model TV set with three 6CB6's in the IF strip! This "old faithful" tube type is being displaced by specialized designs capable of better performance.

The original 6CB6 is not fully adequate for present-day receivers because reception conditions are not the same as they used to be. The number of "maximum - power" TV stations has steadily increased during the past half-dozen years. This

7EY6
MOTOROLA (1)



12EN6GT
AIRLINE (1)
WESTINGHOUSE (2)

trend has resulted in extremely high signal levels in areas near transmitting towers; furthermore, it has opened up vast new fringe areas where the received signal is barely strong enough to produce a viewable picture. As a consequence, modern IF strips must be able to operate over a tremendously wide range of AGC bias levels; in addition, they must be capable of high gain to provide adequate picture contrast in fringe areas. To take care of these strenuous requirements, two separate groups of new IF pentodes are evolving from the basic 6CB6 design. One group is suitable for operation in extended-range AGC-controlled circuits, and the other is intended for use in extra high-gain stages with no AGC applied.

An example of the first group is the 6BZ6, which is being used in the first and second IF stages of a great many late-model sets. This tube behaves much the same as the 6CB6 at low bias voltages, but a great difference in performance appears as the AGC bias builds up. When this reaches a value of —6 to —8 volts, a 6CB6 will be cut off; but a 6BZ6 will continue to conduct. The latter tube is a remote-cutoff type which can operate in normal fashion with bias far in excess of 10 volts.

The 6DE6 is another tube often seen in first and second IF stages. It has about the same transconductance as the 6CB6 in the zero-bias region, but Gm declines less rapidly as AGC bias voltage builds up. Cutoff does not occur until bias is on the order of 9 volts.

Even when these extended-cutoff tubes are used in the first two IF stages, you'll often find a 6CB6 in the third stage because it is not AGC controlled. However, some manufacturers have started using a "hotter," sharper-cutoff pentode than the 6CB6 as a third IF tube in order to provide higher stage gain. One new type of non - AGC - con-



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trolled tube is the 6DK6, which has about 50% greater transconductance than the 6CB6 at low values of bias. Another new type, the 6EW6 used in the final IF stage of the newest General Electric sets, has even higher Gm than the 6DK6. This last tube can be cut off with only about 3 volts of bias!

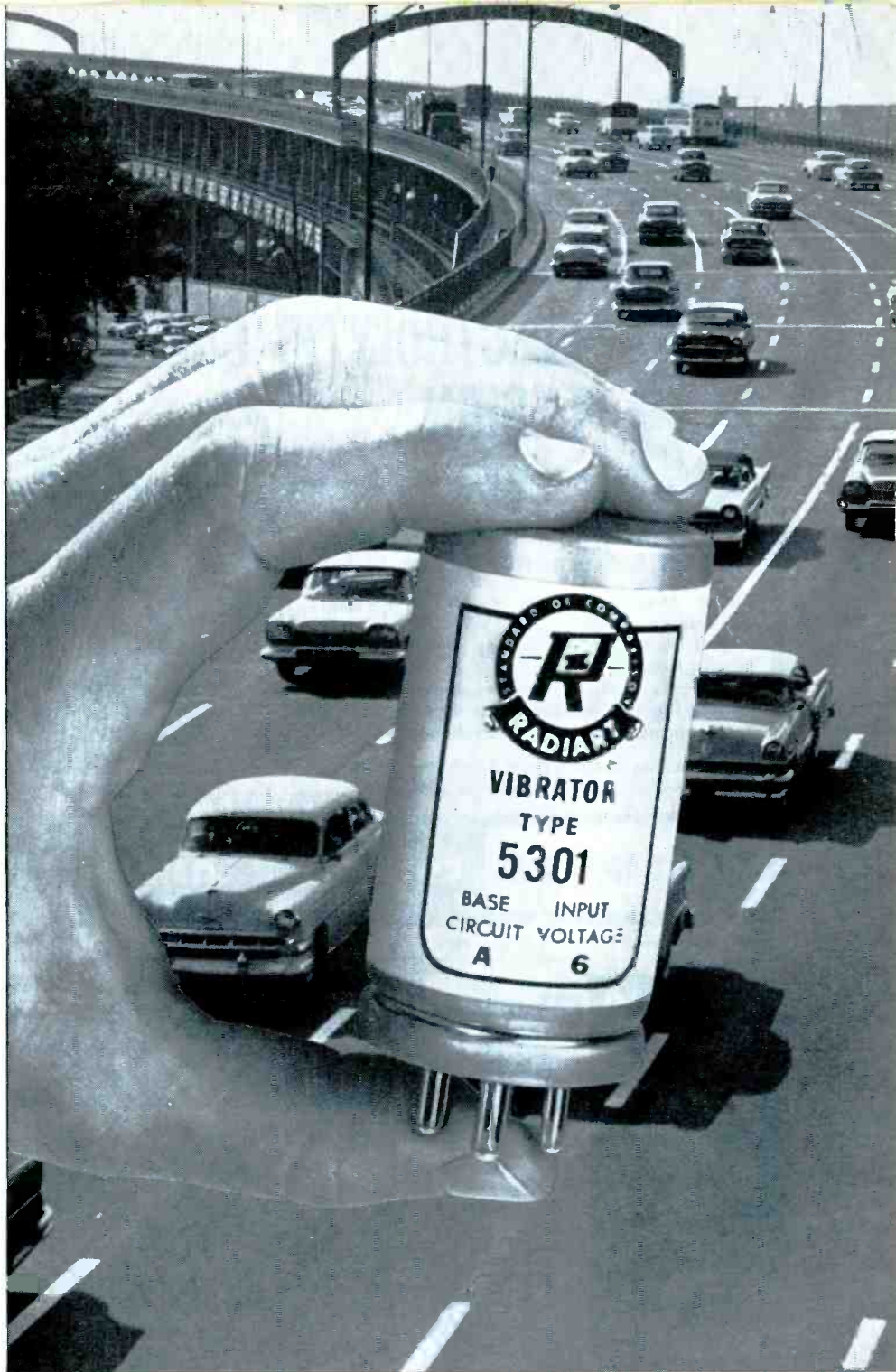
To restore a set to operation temporarily, you can usually substitute one type of IF pentode for another without too much difficulty; but permanent substitution is not generally recommended. These tubes have different characteristic curves and will not provide the same amount of gain at given bias values; therefore, type-changing will play havoc with the alignment of stagger-tuned IF strips. Further troubles, such as overloading, may also result.

Damper Diodes

By now, most servicemen are familiar with the fact that the 6AX4GTA damper tube is superior to the old 6W4GT, and can be used to replace it. However, not too much is known about the several additional octal-base dampers which have been introduced in the past few years. It's generally understood that these new types have higher ratings than the 6AX4GTA, but there is much uncertainty about the relative ruggedness of the different types and the degree to which they can be interchanged.

The 6DA4 (with its 600-ma 12D4 and 450-ma 17D4 series-string versions) is somewhat huskier than the 6AX4GTA. Its heater-current requirement is the same—1.2 amps for the 6.3-volt version. Replacing a 6AX4GTA with a 6DA4 will not cure arcing due to excessive pulse voltages, since both tubes have the same peak-inverse voltage rating of 4,400 volts; however, the 6DA4 can handle about 20% heavier DC and AC current loads than the 6AX4GTA with no strain.

The 6AU4GTA (and series-string 19AU4GTA) have even higher plate-current ratings than the 6DA4 series. There's also a slight increase in maximum peak inverse voltage, to 4,500 volts. Usefulness of the 6AU4GTA as a replacement for other types may be limited by the fact that its heater draws 1.8 amps—half again as much as required by



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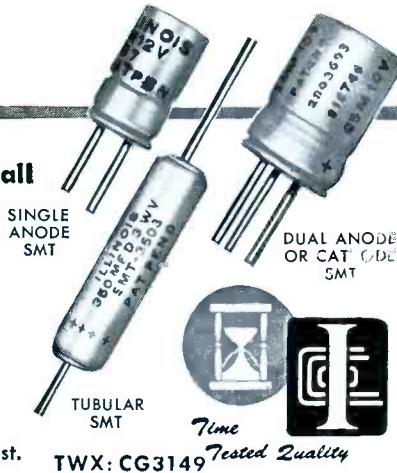
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the previously - mentioned 6-volt dampers.

Another tube in roughly the same class as the 6AU4GTA is the new 6DE4 (or series-string 17DE4), which has the highest PIV rating of all—5,000 volts. Maximum diode current for this type is just a little less than for the 6AU4GTA. The heater-current drain, 1.6 amps, is also below that of the 6AU4GTA—but still plenty high if you're thinking about putting a 6DE4 in place of a 6AX4GTA.

High-Voltage Rectifiers

Several new tube types have recently been offered as replacements for the 1B3GT high-voltage rectifier diode. One of these, the 1G3GT, is identical to the prototype except for being a half-inch shorter in over-all height. Two other tubes, the 1J3 and 1K3, feature a redesigned internal structure which is said to provide greater durability, especially at anode potentials close to 20 kv. Either of these two new types can be substituted for the 1B3, even though they are different enough from the original type to require different tube-tester settings. The 1J3 is the same size as the 1B3GT, and the 1K3 has a "stubby" envelope like that of the 1G3GT. It's a good idea to keep both standard- and short-bulb types in the tube caddy, since physical clearances sometimes prohibit replacing one type with the other.

Dual Type Number?

One of the newest triode/pentodes, the 6EA8, is sometimes referred to by the dual type number 6EA8/6U8A. This can be taken to mean that the new type supersedes the popular 6U8, and this assumption is partially true. However, the 6EA8 has less internal shielding between sections and may not work properly as a replacement for the 6U8 in some critical applications such as oscillator-mixer service.

The above information serves to explain why many different types of tubes have been developed for similar applications. This by no means solves the problem of having to deal with all these types, but knowing why and where specific tubes are used will help to minimize your inventory problems. ▲

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Audio Facts

(Continued from page 28)

to cathode induction.

Hum can also be caused by ground loops when ground connections are made at different points on the chassis. Circulating currents within the chassis can set up potential differences which introduce hum. To avoid this type of trouble, a ground buss can be connected to the chassis at only one point, usually the input jack where the signal is lowest. In some amplifiers, hum may also be reduced by connecting the ground terminal of the speaker output to the tube cathode receiving feedback (see Fig. 2).

Feedback

If, after balancing, distortion levels are still too high, look for trouble in the feedback networks. Hi-fi amplifiers use negative feedback to decrease distortion, improve frequency response, and reduce certain types of noise. The amount of feedback is usually expressed in decibels, and is calculated by using the difference in output voltage with and without feedback. Most amplifiers use between 10 and 30 db of feedback in one or more loops. Feedback of a single loop is always less than 20 db. Gain is reduced in direct proportion to the amount of feedback, i.e., 20 db of feedback reduces gain by 20 db.

In Fig. 1, negative feedback is utilized between the output transformer and the cathode of V1A. The performance of the amplifier is improved by applying the feedback ahead of a number of stages. The amount of feedback depends upon the resistance in the loop — 4700 ohms in this case. As this resistance is increased, feedback is decreased. Current feedback is obtained by

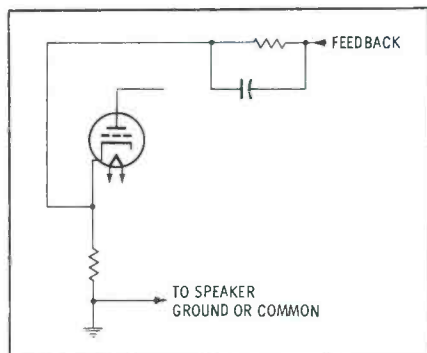


Fig. 2. Connect speaker ground at cathode resistor to eliminate ground loop.

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leaving cathode resistors unby-passed.

Several possibilities for trouble exist in feedback circuits. The loop could open and cause a complete loss of feedback. If this happened, distortion and noise would increase, and frequency response would be seriously altered.

The more troublesome service cases occur when a feedback component changes value. The amount of feedback obtained will be affected, or its phase may be shifted to the extent that positive feedback occurs. The latter circumstance will cause the stage receiving the feedback to act as an oscillator. For proper operation, the feedback must be degenerative and not regenerative. This difference can easily be maintained for mid-frequencies, but the highs and lows may cause trouble. Circuit components ahead of the feedback network (reactive units such as output transformers and coupling capacitors) cause a phase difference to exist between high and low frequencies. If this difference is great enough, positive feedback will result, causing the amplifier to be unstable.

This instability could be a steady condition, or it may occur only when feedback amplitude is high. Various steps can be taken to reduce these undesirable effects; for instance, low-leakage output transformers, large-value coupling capacitors, and direct coupling will keep phase shift at a minimum. Phase correction networks are of further help in this respect. In Fig. 1, the 240-mmfd feedback capacitor and the 4.7K and 270-mmfd units in the plate circuit of VI, and the 47-ohm resistor and .1-mfd capacitor across the output-transform-

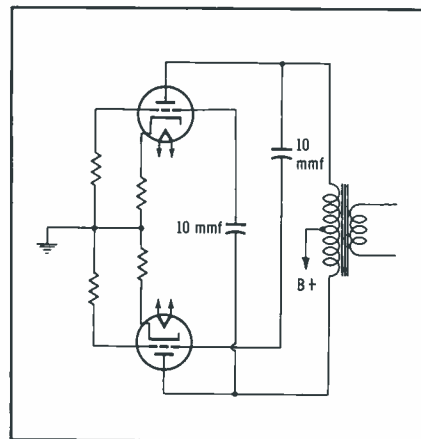


Fig. 3. Small capacitors are cross-coupled to neutralize triode output stage.

er secondary serve this purpose. The feedback capacitor (240-mmfd from the 16-ohm tap to pin 3 of VI) offsets the inductive phase shift produced by the output transformer.

Reversing connections of the output transformer gives positive feedback and causes oscillations. This is unlikely to happen except by accident during servicing procedures.

Stability Checks

Spurious oscillations can have frequencies that fall within the audio band, and thus cause howls or squeals to be emitted from the speaker. Or, as is most often the case, they can have frequencies above the audio range, causing distortion or loss of output power. Most oscillations, even those that are inaudible, can be seen with an oscilloscope. Scope checks should be made both with signal applied and not applied. In this way, oscillations that occur only on signal peaks, as well as those that are always present, can be detected. On the scope, parasitics show up as distortion of the regular waveform, or else as "riders" superimposed

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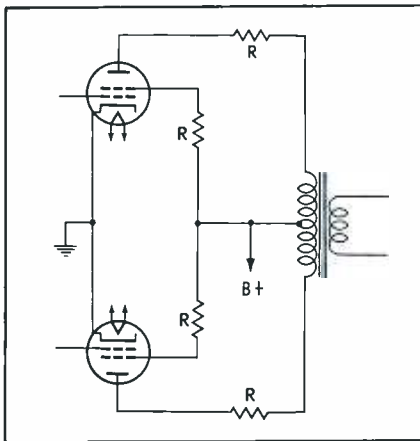


Fig. 4. Small resistors in plate and screen leads help eliminate parasitics.

on the desired signal. When there is no signal input, parasitics may appear only as a spreading of the horizontal trace unless a very high sweep frequency is used.

Two other checks can be made to see if parasitics are being produced. The first consists of locating a broadcast receiver near the amplifier and tuning it across the BC band. If the amplifier is oscillating, an audible output will be obtained from the receiver. If this output discontinues when the amplifier is turned off, you'll know the amplifier is oscillating.

The second method involves the insertion of a milliammeter in the B+ lead to the output transformer. Disconnect the feedback loop, and note the plate current change. If it decreases when the loop is removed, regenerative feedback is most likely causing oscillations.

One of the first steps that should be taken when trying to locate the source of spurious oscillations is to substitute tubes. If the output tubes are triodes, proper neutralizing may help; a pair of small capacitors (less than 10 mmf) connecting plates and grids should help cancel positive feedback occurring here (see Fig. 3). Some output stages even use small resistors in series with the grid and plate leads as parasitic suppressors (Fig. 4). Their values may change, so they should be checked. If they are not used in the circuit being repaired, their addition may help remedy the trouble. Use low-value resistors (47 to 100 ohms). When tetrodes are connected as triodes, resistors are connected between screens and plates as parasitic suppressors; these should also be checked.

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Feedback through the power supply also can cause oscillations; phase will be such that oscillations will be initiated for at least some of the stages. The actual fault may be inadequate power-supply filtering, or defective decoupling networks, wherever they are used. If little or no decoupling is used, installation of such networks may sometimes effect a remedy. Increasing decoupling may also help eliminate "motorboating." If separate cathode resistors are used in the driver stage, parasitics may be cured by bypassing them with very small capacitors; try various values until results are

best. Small bypass capacitors decrease phase shift at high frequencies without having too much effect on the lows. However, some of the advantages of current feedback are lost through this method.

Any fault in the feedback capacitor (wrong value, open, or leaky) may cause oscillations. If the amplifier does not use one, and other procedures fail, capacitors of several values may be tried (from about 10 mmf up). To determine the correct value, and the effectiveness of a capacitor in the circuit, apply a square-wave signal of about 5 to 10 kc to the amplifier input

and monitor the output with a scope. Permanently install the capacitor which causes the square wave to be most accurately reproduced. Check resistor values in the feedback loop, including the cathode resistor across which the feedback is applied. Feedback could either increase or decrease, depending upon which resistor changes value and the direction of change.

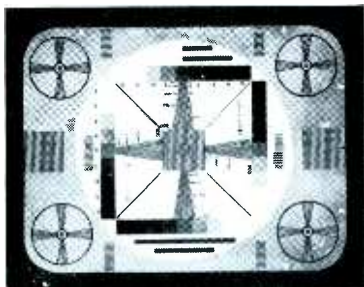
Two "last-resort" remedies are available for reducing or eliminating oscillations caused by improper feedback. Size of the feedback resistor can be increased, thereby decreasing the feedback. (A potentiometer or decade unit could be used to determine the optimum value for the feedback resistor.) Change the resistance value as little as possible.

If all else fails, bypass the cathode load receiving the feedback with a small capacitor. This reduces feedback at high frequencies (where X_c is low) and may reduce the positive feedback below the level required for oscillations. Since both these methods also disturb circuit design, and neither locates the actual trouble, they should be reserved for a last-ditch stand.

Disconnecting the feedback loop has certain advantages that aid in checking the amplifier. For example, intermodulation distortion can be measured with and without feedback. With the loop in the circuit, distortion should be less than half the value obtained with no feedback. Disconnecting the loop also helps in making waveform analyses, since without feedback, each stage functions independently of the others. This makes it easier to tell where a specific defect is originating. Removing the feedback increases output considerably, so less input signal is required.

Damping

Once a speaker cone is set in motion, it has a tendency to continue vibrating. This "hangover effect" adds new sounds and causes poor signal definition. A speaker can be designed to eliminate these extra movements, but then it would not be able to follow high-frequency variations. Therefore, these unwanted vibrations are eliminated by a process called damping. In any electronic device, damping can be



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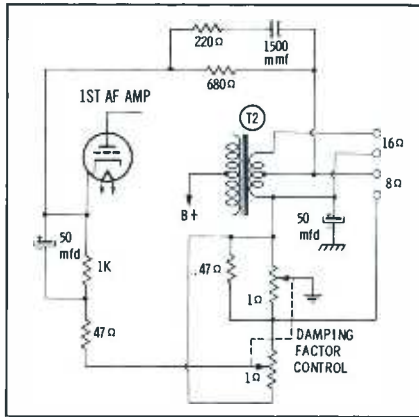


Fig. 5. Damping factor control in commercial amplifier varies feedback.

achieved by connecting a low resistance in parallel with the device.

The internal resistance of the amplifier has a damping effect on the speaker. As this resistance is decreased, damping is increased. Resistance of the amplifier can be controlled with feedback, thus giving another reason for its use. To measure the damping factor of an amplifier, feed in a sine-wave signal and connect a dummy load (equal to output impedance) across the output. Adjust the input signal to an amplitude of about one volt and measure the output. Disconnect the dummy load resistor and measure the output again. Now calculate the internal resistance of the amplifier using the equation:

$$R_i = \frac{R_L (E_{NL} - E_L)}{E_L}$$

where R_i = internal resistance of amplifier

R_L = load resistance

E_{NL} = voltage output without load

E_L = voltage output with load

The damping factor is the ratio of R_L to R_i .

Damping factors normally range from less than one to about 20. The use of negative voltage feedback increases damping, while current feedback decreases it. Faults in the feedback circuit can also affect damping, and what may sound like speaker trouble actually can be traced to the feedback circuits. Some amplifiers contain facilities for varying damping, using controls which vary current and voltage feedback. They are usually adjusted to produce proper bass level, because lack of damping is usually more apparent on low-frequency signals. ▲

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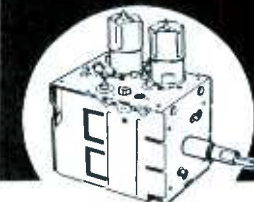
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(Continued from page 27)

transformer-operated chassis), are a newly-developed 6AF3 miniature damper tube and a width potentiometer in the screen circuit of the horizontal output tube. This control, a screwdriver adjustment at the rear of the chassis, is pointed out in Fig. 2.

Just like last year's transformer-operated chassis, the new TS-552 and RTS-544 both incorporate a number of 3-volt tubes — the kind usually employed in series-string sets. These are grouped into several pairs, each pair wired in series across the 6.3-volt filament transformer. The main advantage claimed for this series-parallel hookup is longer tube life; statistics have shown that tubes with the 3.15-volt, 600-ma heaters have a noticeably lower failure rate than conventional 6.3-volt types.

A 3BU8 tube is employed again in '59 as a combined noise limiter, AGC keying tube, and sync separator. Use caution when troubleshooting the Motorola version of this circuit! The cathode of the 3BU8 is 240 volts above ground, and the potentials on several other elements are correspondingly higher. The keying pulses at the plate of the AGC section are good, healthy ones with a peak value of 600 volts.

Alignment Hints

Even though the alignment procedure for the TS-552 isn't particularly unusual by current standards, it's interesting to review the alignment instructions and observe the changes in technique which have taken place during the past several years.

For instance, consider the time-

honored practice of using a dummy oscillator/mixer tube (with one of the pins in the oscillator section cut off) to disable the local oscillator during video-IF alignment. This has become increasingly more impractical as the number of different oscillator/mixer tube types has multiplied. One modern solution for this problem is to provide a convenient means of grounding one tube pin in order to kill the oscillations. In the TS-552 and similar chassis, this can be done by connecting a jumper from ground to the oscillator-grid test point on top of the tuner (Fig. 4).

Another tried-and-true procedure which has recently run into trouble is the use of an ungrounded tube shield as a capacitive device to couple the sweep-generator output into the mixer. Users of this technique were utterly frustrated by riveted-down tube shields until somebody thought of the following idea, given in alignment instructions for the TS-552: Cover a thin metal strip with insulation, slip it down



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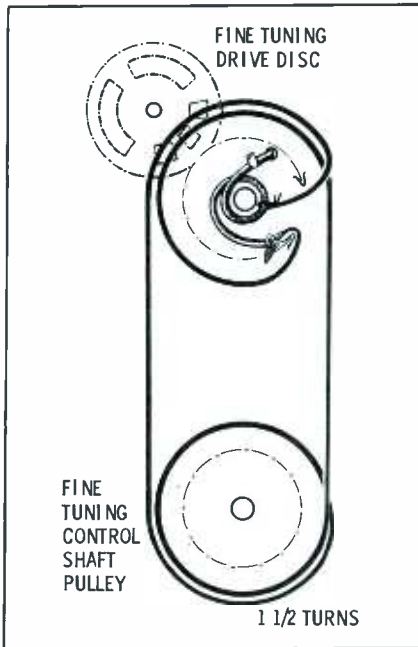


Fig. 5. Stringing guide for fine-tuning drive cord used on Motorola tuner.

between the tube and the captive shield, and clip the generator lead to the projecting metal tip.

Those old-timers who are in the habit of automatically hooking up a 3-volt bias pack for alignment had better check the service data on some of the newer sets. Many of them are designed to operate at higher levels of AGC voltage under strong-signal conditions, and this fact is reflected in alignment specifications. The TS-552, for example, should have a 6-volt bias on the IF-AGC line during most steps in the procedure. This voltage can conveniently be fed into the set at the test receptacle on the rear of the chassis (Fig. 2). Incidentally, the various terminals on this receptacle are arranged the same as in previous Motorola sets.

Drive Cord Restringing

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luminated channel-indicator window on the front of the cabinet, the fine-tuning control is not concentric with the channel-selector knob. Instead, a separate control shaft drives the fine-tuning capacitor through the

cord-and-pulley arrangement visible in Fig. 4.

This drive cord should normally have no more tension than necessary to operate the driven pulley, so slippage can occur in case the

control is turned beyond its normal limits of rotation. However, enough cord tension (or dial-cord dressing) is present in some sets to prevent such slippage.

In this event, the TS-552 is a booby trap for the unwary owner—especially the one who has small children. The drive cord will withstand considerably greater torque than normal, but a persistent attempt to force the fine-tuning control past its limit will snap the cord in two. Thus, it's likely that servicemen will be receiving frequent calls to restring the cord on this model. Fig. 5 is presented to aid you in accomplishing the job.

Note that the edge of the driven pulley engages a disc attached to one plate of the fine-tuning capacitor. After you have finished restringing the cord, *but before you reinstall the tuner-and-control subchassis in the cabinet*, turn on the set and adjust the drive disc. Here's how: Set the fine-tuning control to mid-range, hold the driven pulley stationary with one hand, and use the other hand to slide the fine-tuning disc around until the picture is perfectly tuned. While you're at it, check the tuning on all active channels and readjust the oscillator slugs if necessary. ▲

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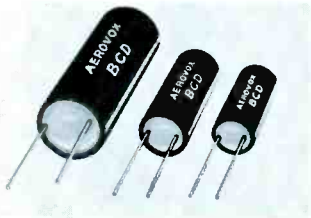
SERVICE INSTRUMENTS CORP. 121 Official Rd. • Addison, Ill.

See other SENCORE ads in this issue.

PRODUCT report

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

Upright Electrolytics (42E)



Aerovox Type BCD electrolytic capacitors have both leads at one end to permit mounting in an upright position on a printed wiring board. Leads are made at least 1" long so that the capacitors can be conveniently installed by hand; to take advantage of this feature, insert the leads in the board *before* trimming off excess length.

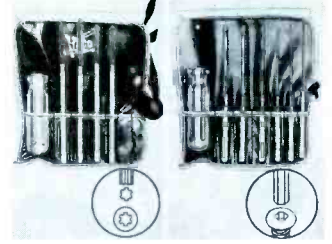
Stereo Amplifier With Preamp (43E)



Sensitivity of the Pilot Model 245-A stereo amp-preamp (input signal needed to produce 1 volt at audio output jack) is 3 mv for phono or mike inputs and 110 mv for radio tuner or tape recorder. Power output is 40 watts—20 per channel. Features include speaker-selector and automatic shutoff switches. Price is \$199.50.

Hex and Spline Wrenches (44E)

Vaco has announced two new kits of wrenches for recess-head screws. ZF40 contains a plastic handle (with clutch) and four interchangeable spline or Bristol bits in sizes 5, 6, 8 and 10-12. Kit ZA-70 contains a handle and six hexagonal (Allen) bits in 1/16", 5/64", 3/32", 1/8", 5/32", and 3/16" sizes.



Remote Volume Controls (45E)

Switchcraft remote volume controls are mounted on 2 3/4" x 4 1/2" brushed-brass wall plates that fit standard wall-outlet boxes. The control element is a 4-watt, constant-impedance T-pad. Types 651 and 652 (\$15 each) are for use with speaker systems having 8- and 16-ohm impedances. No. 653 (\$16.50) is an 8-ohm unit featuring a front-panel phone jack for extra speakers or headphones.

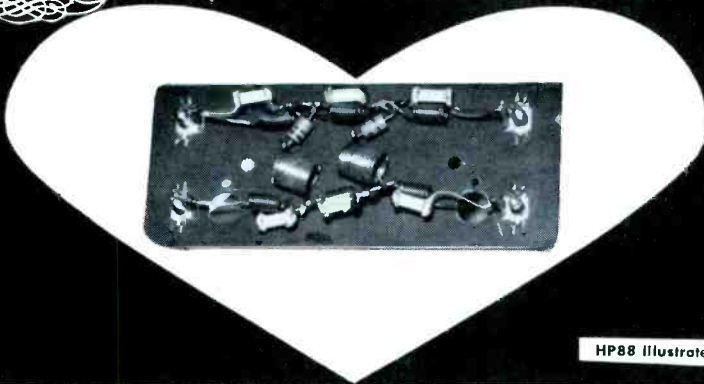


Push-Pull Tubes (46E)

Matched pairs of audio output tubes, carefully selected for close similarity to each other in a number of characteristics which affect audio performance, are being marketed in special "twin" packages by CBS - Hytron. Four popular types of high-fidelity amplifier tubes are available in matched pairs: 6BQ5, 6V6GT, 5881, and 6550.



SERVICE-SAVERS HAVE HEART!



HP88 illustrated

Take popular JFD TV Set Couplers for example. Ultra low-loss ferrite core transformers and bifilar coil design effect better inter-set isolation (12 db.), flat signal response, no increase in normal line SWR, insertion loss of less than 1 db across the band, optimum impedance match. Result: Maximum signal transfer across the band for crisp picture detail. Available in both outdoor and indoor types.

INDOOR TV SET COUPLERS



Housed in handsome molded non-breakable, high-impact styrene case for convenient out-of-sight installation.

model	description	list
BC2	Joins 2 sets	\$2.85
BC3	Joins 3 sets	3.20
BC4	Joins 4 sets	3.60

RELY on JFD Service-Savers—the TV accessory line with HEART—to beat your reception problem. Write for complete literature.

OUTDOOR TV SET COUPLERS



Encapsulated in water-proof weather proof col-plast. U-bolt provides quick, easy installation on mast.

model	description	list
AC40	Joins 2 sets to 1 antenna	\$3.50
AC60	Joins 3 sets to 1 antenna	4.00
AC70	Joins 4 sets to 1 antenna	4.85

OUTDOOR ANTENNA COUPLERS



Combination of high pass and low pass filter networks gives 25 db or better isolation between bands, 2 db or less insertion loss flat pass-band characteristic, 300 ohm balanced image impedance, 6 db/per octave attenuation in stop band. U-bolt provides fast on-the-mast mounting.

model	channels	list
AC10	UHF-VHF	\$3.50
AC20	VHF-UHF	3.75
AC30	LO-VHF-HI-VHF-UHF	4.85

INTERFERENCE ELIMINATORS



Knock out RF, FM and other TV interferences. Model HP50 features high-pass 3-section pi-type network, 18 db per octave attenuation below 50 mc., 0.5 db insertion loss in pass band, 300 ohm balanced image impedance. Model HP88 features 2-section band elimination filter, 12 db per octave attenuation in stop band, 0.5 db insertion loss in pass band, 300 ohm balanced image impedance.

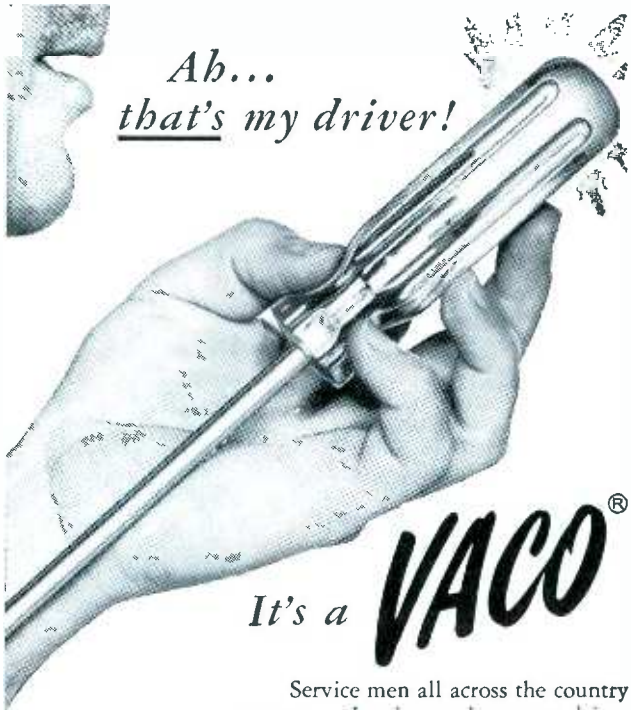
model	description	list
HP50	Below 50 mc. interference	\$4.50
HP88	FM interference	5.95



Pioneers in electronics since 1929
ELECTRONICS CORPORATION
BROOKLYN 4, NEW YORK

JFD International
15 Moore Street
New York, New York

JFD Canada Ltd.
51 McCormack St.
Toronto, Ontario, Canada



Ab...
that's my driver!

It's a **VACO**[®]

Service men all across the country agree . . . there's no other screw driver or nut driver with the built-in comfort of the VACO "comfordome" handle. Makes service work easy! Enjoy the luxury grip of a VACO . . . the driver that gives plenty of power, yet is always kind to hands. Next time choose a VACO and *feel the difference!*

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VACO PRODUCTS CO., 317 E. Ontario St., Chicago 11, Ill.
In Canada: ATLAS RADIO CORP., Toronto 19, Ontario

ONLY \$1.00 JUST OUT! NEW EDITION!
HOWARD W. SAMS
"Replacement Guide for TV and Auto Radio Controls"



Lists recommended replacement controls of **CENTRALAB, CLAROSTAT, IRC, MALLORY**

Complete coverage of replacement controls for TV and Auto Radio models produced from 1947-1959 (over 22,000 TV models; 1000 auto radio models). Each recommended replacement is *currently available*. Exclusive "Industry Part Number" system locates recommended control replacements in just seconds. Helps you maintain inventory of most-needed controls; saves you time in selecting and ordering proper replacements. Actually pays for itself the first time you use it on a control repair job. It belongs **\$1.00** on your bench. 8 1/2 x 11". Order now—only

HOWARD W. SAMS & CO., INC.

Order from your Sams Distributor today, or mail to Howard W. Sams & Co., Inc., Dept. F-39 2201 E. 46th St., Indianapolis 6, Ind.

Send _____ copy(ies) of "Replacement Guide for TV & Auto Radio Controls." (RGC-2). \$_____ enclosed.

Name _____

Address _____

City _____ Zone _____ State _____
(outside U.S.A. priced slightly higher)

Flyback Transformers (47E)

Several exact - replacement horizontal output transformers for Admiral TV sets are among the latest additions to the Stancor line. HO-301 replaces Admiral parts 79D65-2 and 79D65-4; HO-302 replaces 79D65-3 and 79C65-3; HO-303 replaces 79D74-1, 79D74-2, 79C60-10 and 79C60-11; and HO-304 replaces 79D77-1, 79D77-2 and 79D77-3.



Miniature Electrolytics (48E)

Illinois Type SMTUCP miniature electrolytic capacitors are dual units with isolated cathodes but with a common anode connection. Both sections operate independently as filter or bypass capacitors in compact transistorized equipment where the positive side of the battery is grounded. Both axial-lead and upright-mounting types are supplied.



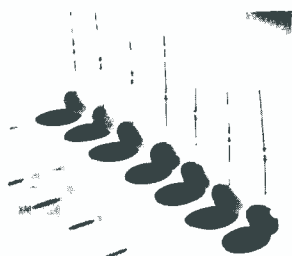
Tape Package (49E)

Irish magnetic recording tape is now available in a novel *Tape Correspondence Pack* containing five 3" reels in cartons suitable for mailing. The buyer has a choice of Type 601 reels (225' of 1-mil Mylar - base tape), at \$5.00 per pack, or Type 211 reels (150' of 1 1/2-mil acetate tape) costing \$3.50 per pack.



Crystal Diodes (50E)

Sylvania has introduced a line of subminiature, glass-encased crystal diodes with a maximum length of .265" and a diameter of .105". "Gold-bonded" types 1N270, 1N276, 1N279, 1N281 and 1N283 feature high forward conduction. Three point-contact types, three types for use in computers, and six silicon junction types are also available.



Desoldering Tools (51E)

Ungar *De-Soldering Tiptets*, a series of soldering-iron tips specially designed for quick removal of certain components from printed wiring boards, are now available in three new styles—a 5/8" triangle for electrolytics, an offset slotted point for hard-to-reach crimped leads, and a hollow-centered cube for center pins of tube



Inductors (52E)

Triad's new D-153 assembly includes a D-53 flyback, linearity coil, three resistors, two capacitors, and a special filament winding designed to remedy the problem of excessive heating in direct-drive circuits. Other new flybacks (D-151,-2,-7) replace various Trav-Ler, Admiral and American TV units.

Additional new items are a Y-28-3 yoke assembly for certain Motorola sets; an A-116X vertical-output transformer that replaces the Muntz TH-0040; and two power transformers (R-74BC and R-75BA) for exact replacement of RCA parts.

Tool for Tight Places (53E)



For delicate work on transistor radios, or for reaching and holding objects in deep recesses or other hard-to-get-at places, Xcelite has developed a new service tool called a *Seizer*. Although it resembles a pair of shears, this item is actually an extra-thin pair of long-nose pliers with an added clamp-on feature. Its list price is \$5.70 with straight nose (No. 42H) or \$5.90 with curved nose (No. 43H).

High-Fidelity Speakers (54E)



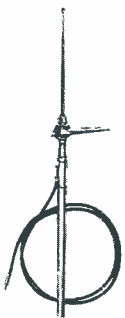
Utah *Dual Diameter* speakers feature a highly efficient magnet consisting of a specially-processed combination of two separate Alnico structures. Two sizes are available. The 8" Model D8LA has a frequency response of 40 to 16,000 cps, depth of 4", with list price of \$24.95. Model D12LA is a 12" unit with 30-16,000-cps response, 4 9/16" depth, with a price of \$29.95. Both are 20-watt, 8-ohm units.

Wire-Wound Resistors (55E)



A series of five *Multi-Range* wire-wound power resistors is being offered by IRC. Each unit includes four separate 10-watt sections (of 2 or 4 different values) in a common steatite housing. The leads of individual sections can be wired together in various combinations to provide 200 different resistance values. A *Handy-Pak* of two units is priced at \$1.20 to \$1.80, depending on value range.

Auto Radio Antennas (56E)

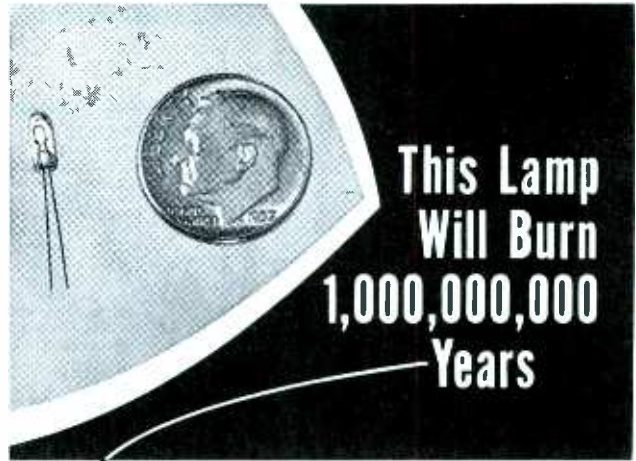


More than 30 different models of Motorola *Golden Beam* auto radio antennas are available—disappearing types, rear-deck styles, and side-mounting units as well as both deluxe and standard top-cowl mounts. All can be installed from the outside of the car. Models are available to fit foreign cars (including sports cars), trucks, and pleasure boats, in addition to all U.S. automobiles. List prices range from \$4.95 to \$15.00.

Garage-Door Transmitter (57E)



A portable, transistorized transmitter for controlling garage-door openers has been developed by Perma-Power to take the place of permanent transmitter installations in automobiles. The 12-oz. portable unit will work with existing Perma-Power systems. Operating frequency is determined by a crystal; 25 different channels are available. Operating range is 50'.



This Lamp Will Burn 1,000,000,000 Years

This tiny lamp, produced initially by Chicago Miniature Lamp Works for certain special applications in aviation, will burn for a billion years, according to calculations based on accelerated life tests.

No such fantastic claims are made for the Chicago Miniature Lamps you obtain from your parts jobber,—but the meticulous attention to quality standards, the precision used in every manufacturing process of every Chicago Miniature Lamp, is reflected in their performance.

You cannot purchase better than a Chicago Miniature Lamp—always ask for them!



CHICAGO MINIATURE LAMP WORKS

1518 No. Ogden Ave., Chicago 10, Ill.
Miniature Lamps for every requirement

For Service Dealers Who Are GOING PLACES

BUSINESS AIDS



by **OELRICH**
BUSINESS FORMS
SYSTEMS and SALESBOOKS

SOLD THRU ELECTRONIC PARTS JOBBERS
• in every major city

- in the 48 states
- in Anchorage in the 49th
- in Honolulu in the 50th
- in Montreal, Sudbury, Toronto and Winnipeg in Canada

Standardized and Specifically Designed for the Radio, Television and Appliance Service Industry

WRITE US FOR CATALOG. **OELRICH PUBLICATIONS**
4308 Milwaukee Avenue, Chicago 41, Illinois. U. S. A.

June, 1959

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ANTENNA SYSTEMS

- 1E. **JERROLD**—16-page booklet on Jerrold's amplified TV-FM Home System shows how to obtain optimum TV and FM reception using a number of outlets throughout the home. See ad page 49.
 2E. **MOTOROLA**—"The Magic Touch," 2-color brochure describing profit possibilities with *Golden Beam* auto antennas.
 3E. **TACO**—Your part of \$350,000,000.00 replacement business can be had—when you follow the promotional "PITCH" outlined in literature. See ad page 75.
 4E. **TENNA**—Auto, television, and "Miracle" line antenna catalogs. See ad page 21.

AUDIO & HI-FI

- 5E. **ARGOS**—Technical bulletin specifications for 8" and 12" PA speakers used in combination with wall and slanting corner baffles.
 6E. **BLONDER-TONGUE**—New consumer booklet entitled "Now You Can Enjoy Hi-Fi—and Stereo, Too!"
 7E. **CLAROSTAT**—Form 751773 on sound system controls, pads and attenuators. See ad page 41.
 8E. **ELECTRO-VOICE**—Catalogue 134—a 30-page, 4-color guide for choosing and locating hi-fi speakers, enclosures, and systems—includes an introduction to stereo sound in addition to the 5 factors to consider in obtaining the ultimate in listening pleasure. See ad page 35.
 9E. **JENSEN MFG.**—Catalog 165-D, a 16-page, 2-color booklet, describes complete line of monophonic and stereophonic loudspeaker systems.
 10E. **SWITCHCRAFT**—8-page catalog S-590 describing molded cable assemblies, adapters, and connectors, plus microphone and audio mixers for hi-fi and commercial sound applications.
 11E. **WEBSTER**—Descriptive bulletin on 1959 *Ekotape* tape recorder and components, and *Teletalk* intercom and sound systems. See ad page 65.

CAPACITORS

- 12E. **ILLINOIS CONDENSER**—Literature on all types of capacitors, including radio, TV, motor-start, Philco flash, miniature, submarine, military, computer, paper, audio crossover network, and tantalum. See ad page 68.
 13E. **SPRAGUE**—Catalog C-912A, 16-page 3-ring binder insert, lists various capacitor types and their applications in motor, air-conditioning, refrigerator, compressor, and other AC circuits. See ad page 10.

CARTRIDGES & NEEDLES

- 14E. **CBS**—Bulletin E-331 entitled "Curves, Facts and Figures" on new *Professional 55* stereo cartridge. See ad page 51.
 15E. **JENSEN INDUSTRIES**—New 1960 Wall Chart. See ad page 75.
 16E. **SONOTONE**—Specification sheet on unutilized ceramic stereo cartridge featuring dual .7-mil needles; also, price list for 75 popular-type electronic tubes. See ad page 70.

COMPONENTS (MISC.)

- 17E. **AMPEREX**—"Condensed Catalog" giving brief information on "Valvo" hi-fi tubes and semi-conductors. See ad page 60.
 18E. **CENTRALAB**—New catalog listing over 1,700 controls, packaged circuits, ceramic capacitors, switches and other components. Contains 128 new products, including exact replacement auto radio controls, stereo controls, transistor capacitors, control kits, etc. See ad page 57.
 19E. **MALLORY**—Capacitor catalog, Form No. 9-140; silicon rectifier catalog, Form No. 9-152. See ad pages 16-17.
 20E. **TRIAD**—Data on new series of transformers for transistor power supplies; 6, 12, or 28 volt DC mobile supply inputs provide wide range of DC outputs. See ad page 72.

FUSES

- 21E. **BUSSMANN**—Completely new television fuse chart describing proper fuses to use, how they are mounted, and which circuit they protect. See ad page 13.
 22E. **LITTELFUSE**—Literature on new indicating 3AG fuse post available in voltage ranges from 2.5 to 250V. See ad 4th cover.

POWER SUPPLIES

- 23E. **ACME**—Bulletin VA-322 explains the importance of automatic voltage stabilization to quality TV reception. See ad page 58.

SERVICE AIDS

- 24E. **E-Z-HOOK**—Convenient reference sheet titled, "How to Build the Five Most Useful Scope Probes," with schematics, mechanical component layouts, etc. See ad page 62.
 25E. **CHEMICAL ELECTRONIC**—Folder on new *Hush* TV tuner cleaner, plus flyer on *Ever-Quiet* control and contact restorer and *Ever-Kleer* formula TV glass cleaner. See ad page 76.
 26E. **J. W. MILLER**—Catalog #60, containing over 1300 items for service and industrial consumers; TV Guide #160, 88 pages of revised and expanded cross-reference listings; Auto Guide #260, 20 new pages to aid coil replacement problems in auto radios. See ad page 71.
 27E. **OELRICH PUBLICATIONS**—28-page catalog listing 30 types of business forms, service orders, and record-keeping systems for television and radio service. See ad page 79.
 28E. **PHILCO**—Power transformer cross-reference listings by component and by set. See ad page 48.
 29E. **SERVICE INSTRUMENTS**—Mailer describing the 10 most popular Sencore timesavers. See ads pages 58, 60, 62, 70, 74, 76.

SPECIAL EQUIPMENT

- 30E. **ATR**—Form 35901 describing use of the *Karadio* for trucks, boats, and small cars. See ad page 12.

TECHNICAL PUBLICATIONS

- 31E. **HOWARD W. SAMS**—Descriptive literature on all Howard W. Sams books covering servicing of radio, TV, hi-fi, etc. Includes data on latest books, "ABC's of Transistors," "101 Ways to Use Your VOM-VTVM," "Servicing Transistor Radios, Vol. 3," "Audio Cyclopedica," and "Marine Electronics Handbook." See ads pages 47, 52, 53, 64, 78.

TEST EQUIPMENT

- 32E. **B & K**—Bulletin ST21-R gives helpful information on new point-to-point signal-injection technique with Model 1075 TV "Analyst"; other bulletins describe "Dyna-Quick" Models 500B, 650, and automatic 675 portable dynamic mutual conductance tube and transistor tester, plus Model 400 CRT cathode rejuvenator tester. See ad page 9.
 33E. **DOSS**—Information on the latest in test equipment, including the *Pioneer 250 Horizontal Systems Quantalyst*. See ad page 46.
 34E. **EICO**—20-page, 1959 2-color catalog describes 65 models of professional test instruments, hi-fi, and "ham" gear in both kit and factory-wired form. Shows how to save 50%. See ad page 56.
 35E. **JACKSON**—2-color folder showing complete line of "Service Engineered" test equipment, including a dynamic tube tester with sequence switching, wide-band high-sensitivity scope, sweep-marker generator and crystal calibrator, all new VTVM with 7" meter, and wide-range capacitance checker. See ads pages 59, 80.

TOOLS

- 36E. **BERNS**—Data on the 3-in-1 picture tube repair tool that serves to crimp pin and element lead to make a solid electrical connection; can also be used as screwdriver and channel selector. See ad page 73.
 37E. **HUNTER**—Catalog on subminiature tools for printed board work, etc. See ad page 68.
 38E. **KEDMAN**—Catalog sheet describing 4 screwdriver displays and specifications on 14 kinds of screwdrivers in company's line. See ad page 75.
 39E. **WELLER**—Flyer on Model 8200K, exclusive dual-heat soldering gun with *Triggermatic* control.
 40E. **XCELITE**—Latest catalog on complete line of tools for the electronic serviceman. See ad page 71.

TUBES

- 41E. **TUNG-SOL**—30-page flip-style chart supplies electrical and physical characteristics for most important industrial, special-purpose, and military tubes. See ad page 45.



TUBE TYPE	MODEL 48		PLATE TEST		MODEL 115/115/561		E.
	TYPE	SEC.	TYPE	SEC.	TYPE	SEC.	
6DM6	6.3	123	A45	18VZ	6.3	7	30
6DL5	6.3	123	A89	18VZ	6.3	7	30
6E58	6.3	237	AC156	40W	6.3	5	6
12DT7	12.6	A123	A45	18VZ	6.3	7	28
		A127	A45	32WX	12.6	7	28
		A127	A89	32WX	12.6	7	28
							9

Latest Chart Form 648-21, 115/115/561-11, 49-5

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



AVOID CALLBACKS DUE TO PREMATURE TUBE FAILURE...

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

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

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

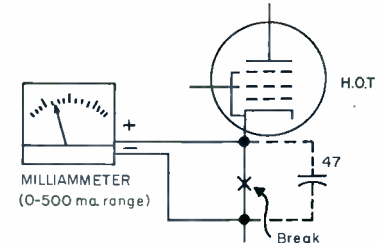


RCA-6DQ6-A—typical of RCA's excellent tube quality. Mount structure is designed to give maximum heat dissipation, prevent "hot spots" on the plate, allow cooler operation of the grids—help cut callbacks! Available at your RCA Tube Distributor.

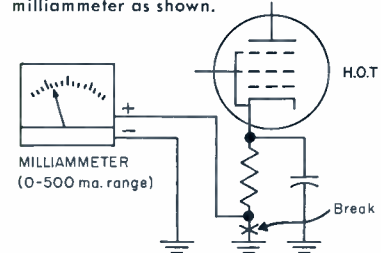


RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

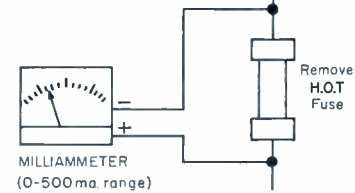
4 SIMPLE WAYS TO MEASURE "H.O.T." CURRENT



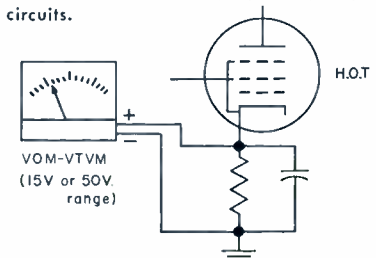
Disconnect cathode circuit at the "H.O.T." socket. Connect 0.47 μ f capacitor and dc milliammeter as shown.



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



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



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

TYPICAL RCA "H.O.T." TYPES AND MAX. A DC CATHODE CURRENT (MILLIAMPERES)

6AU5-GT	110
6AV5-GA	110
*6AV5-GT	110
*6BG6-G	110
6BG6-GA	110
*6BQ6-GT	110
6BQ6-GTB/6CU6	112.5
*6CB5	200
6CB5-A	220
*6CD6-G	200
6CD6-GA	200
6DQ5	285
6DQ6-A	140
12AV5-GA	110
12BQ6-GTB/12CU6	112.5
12DQ6-A	140
17BQ6-GTB	112.5
17DQ6-A	140
*19BQ6-G	110
19BQ6-GA	110
*25BQ6-GT	110
25BQ6-GTB/25CU6	112.5
25CD6-GA	200
25CD6-GB	200
25DN6	200

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

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

dealer-serviceman's fuse rack . . .

. . .for wall mounting



most needed

most wanted

... the FUSEMASTER!



dealer-serviceman's fuse requirements at a glance