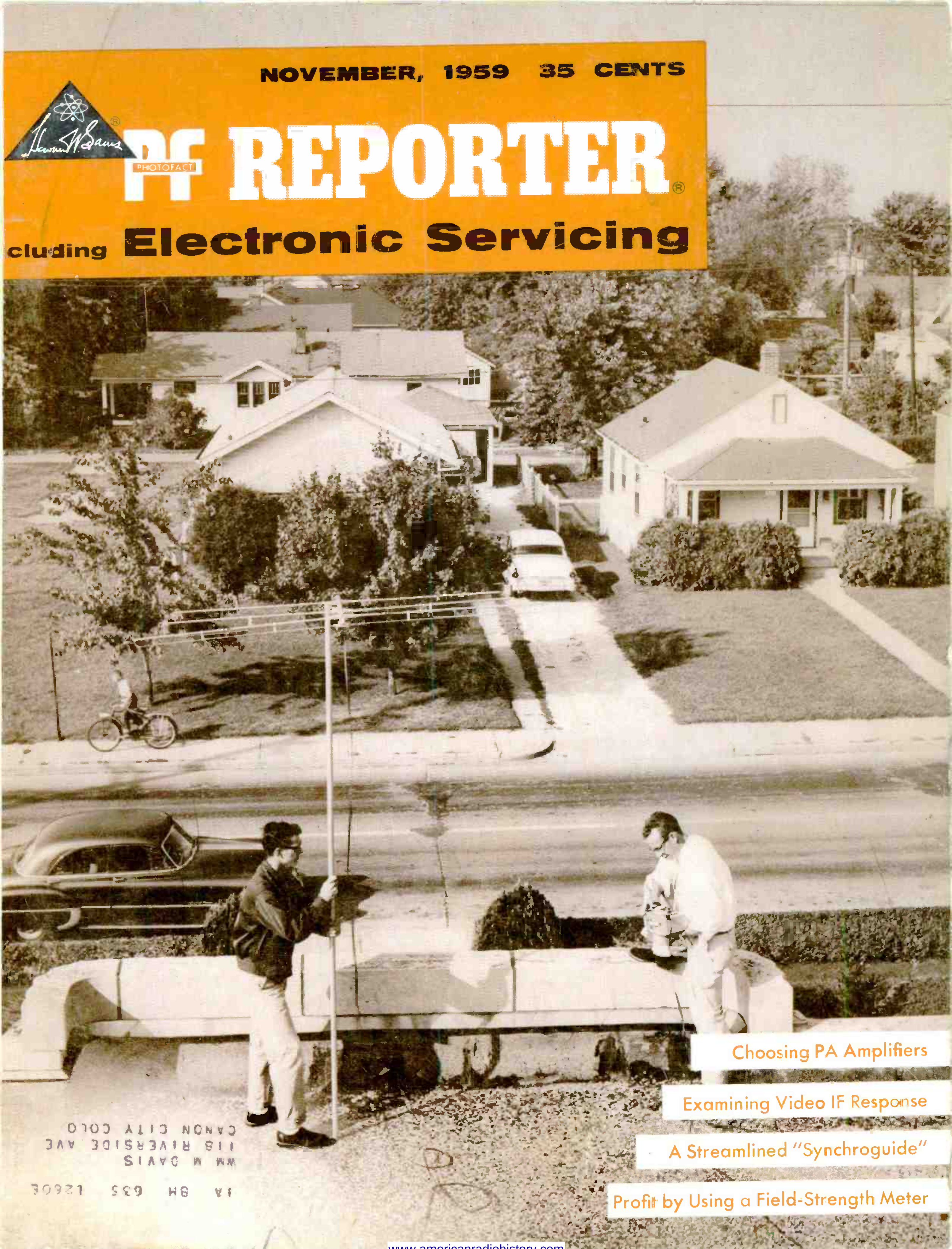
NOVEMBER, 1959 35 CENTS

Howard W. Sams

PF REPORTER

PHOTOFACT

including **Electronic Servicing**



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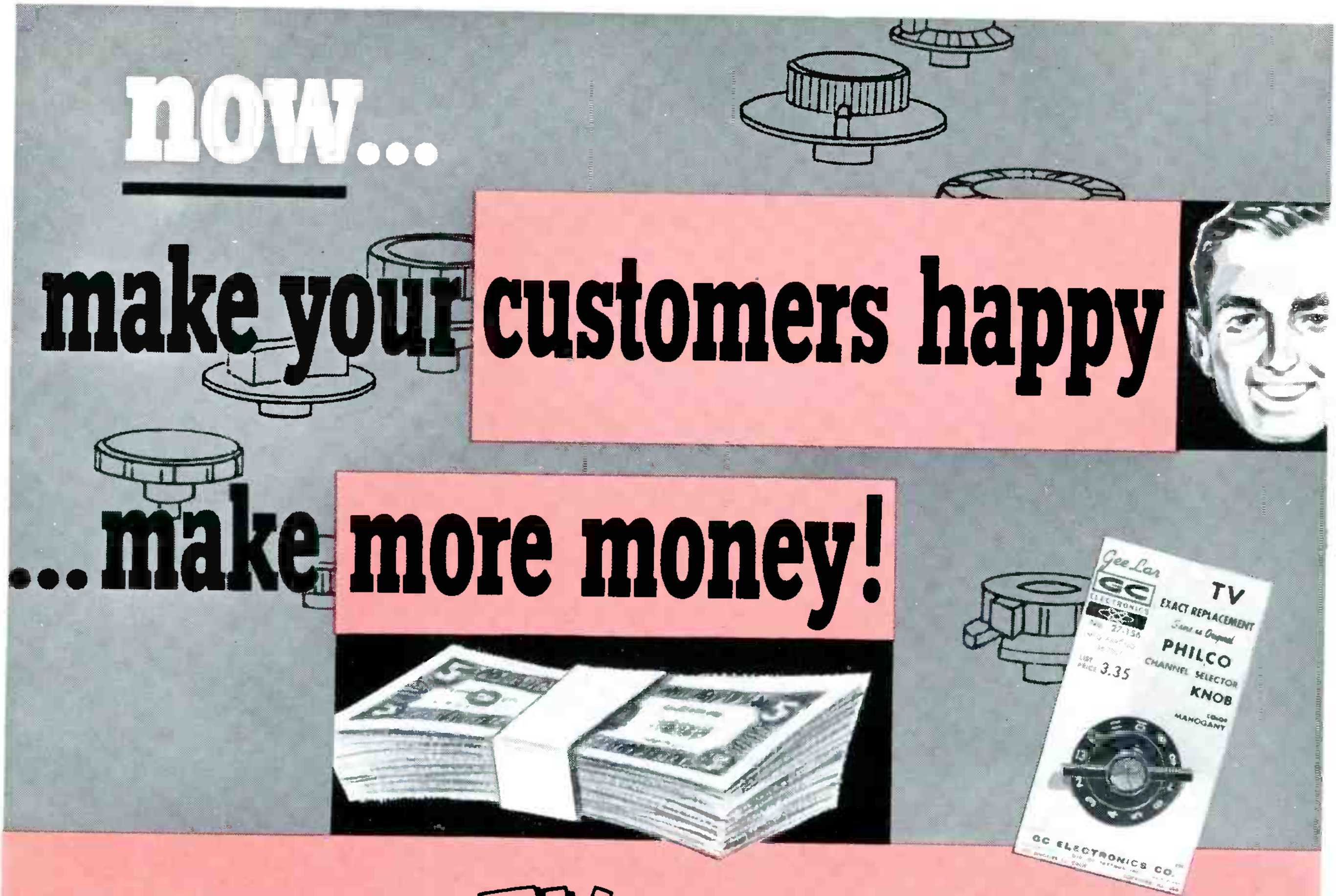

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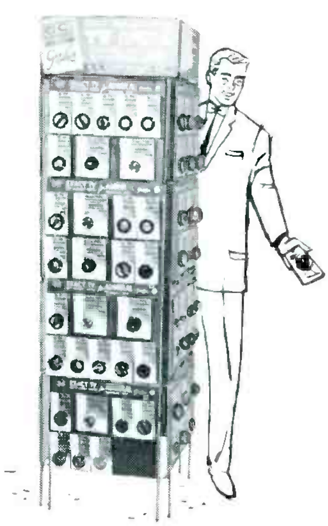

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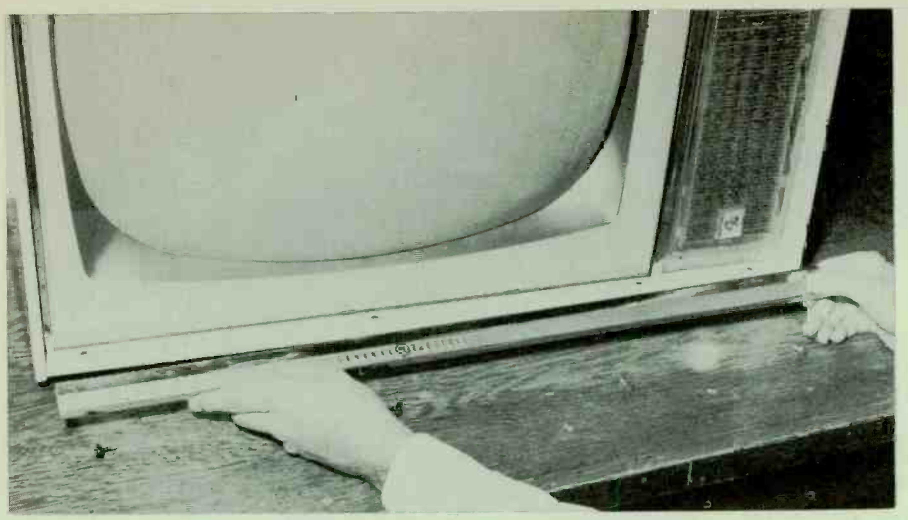
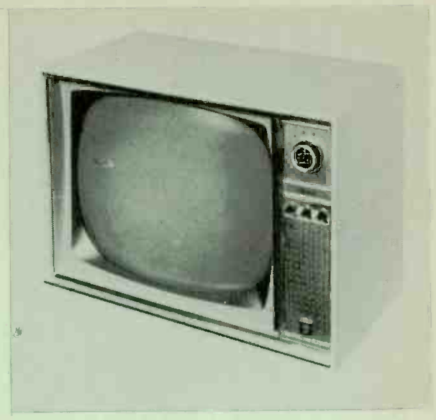
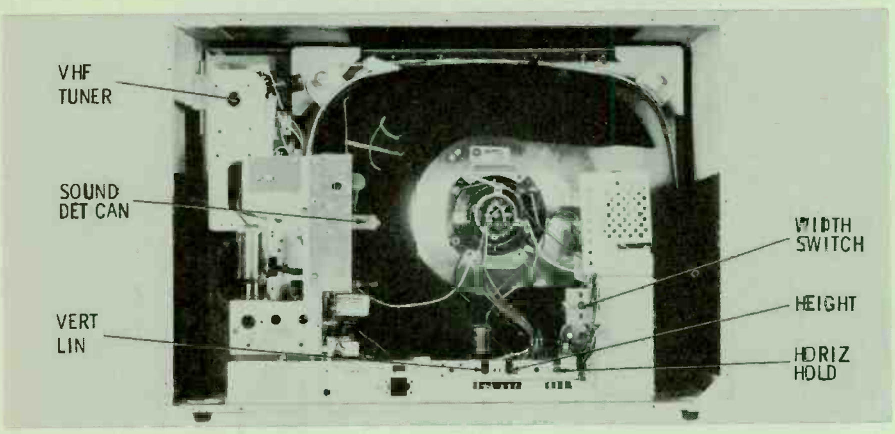
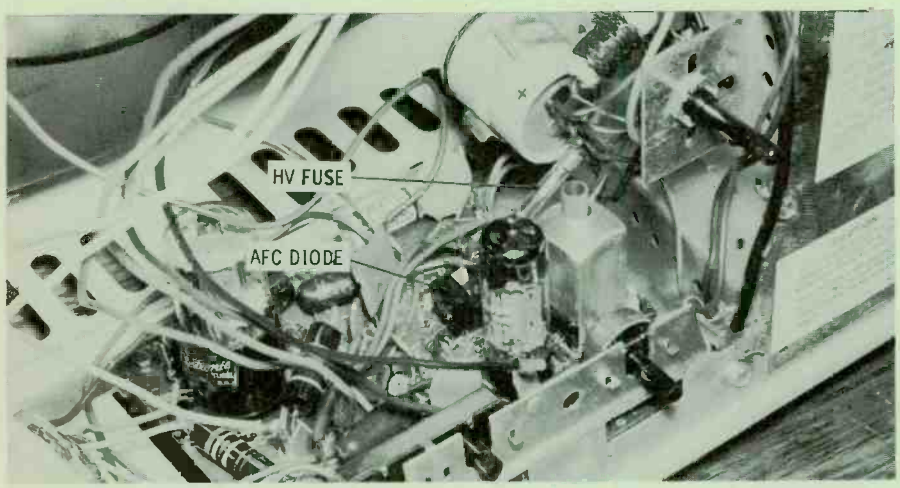
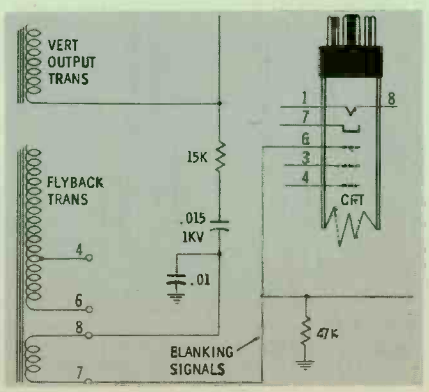










G. E. Model 21T3421 Chassis M5

The new *Designer* series includes this 21" table model with VHF tuner, short-neck 110° picture tube, and all-metal cabinet.

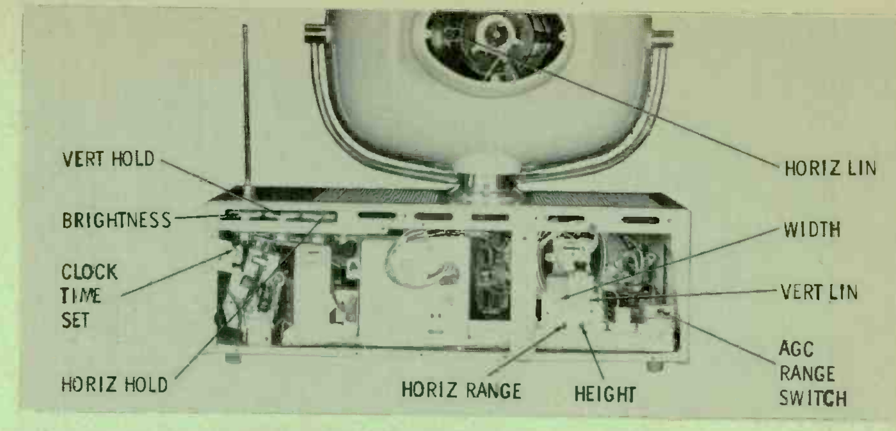
The front safety glass is well sealed, but slips out easily after removal of the bottom trim strip. This strip is held in place by four ¼" hex-head screws located under the front part of the cabinet.

With the back off, you'll find a "U" shaped chassis which employs a power transformer and two printed boards. The VHF tuner mounts in the upper left corner directly above a single 4" PM speaker. As for new tube types, a 6FM8 is employed in the sound detector and AF amplifier stages, while a 6DN7 is used in the vertical sweep section.

From the back of the set, you can look down on the horizontally-positioned sweep-circuit board and see that all components are exposed and identified. A bright yellow tracing on the component side makes it easy to follow the printed wiring paths. The dual diode pointed out in the photo is soldered into the horizontal AFC circuit. Directly in front of a fat, stubby electrolytic mounted above the board, you'll find a pigtail fuse protecting the flyback system. This is a slow-blow unit rated at 375 ma. The printed board for the IF, video, and sound stages mounts vertically on the upright section of the chassis. This is on the left side of the cabinet as you view it from the rear.

Behind the antenna terminal bracket on this section, you'll find a separate line fuse. This is a 3.5-amp slow-blow unit which affords protection to the entire receiver. Although not shown here, the parallel filament circuit is also fused by a 2" length of #26 copper wire. This fuse *link* is soldered to the vertically-positioned board near the 6CX8.

An unusual circuit feature of this receiver is the horizontal and vertical blanking network. From the simplified schematic, you can see that a separate winding on the flyback is used to develop the horizontal pulses, while the vertical blanking signal is obtained from a tap on the vertical output transformer. The vertical pulses are shaped by an R-C network and then combined with horizontal pulses from the flyback winding. Both signals, of a negative polarity, are then coupled to the grid of the picture tube for blanking.



Philco Model H-3412L Chassis 10L43

This new model in the *Predicta* line features a swivel-type 17" picture tube, telescoping antenna, and a clock which will turn the set on and off automatically.

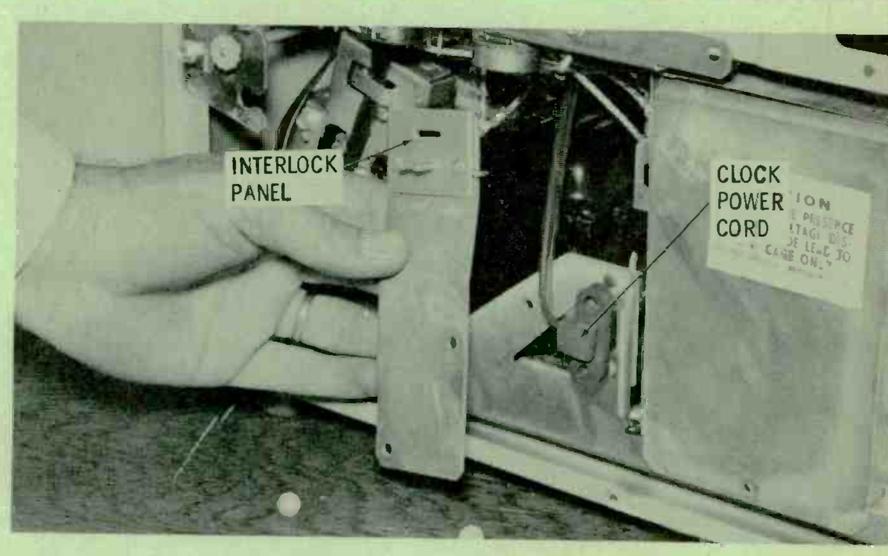
The transformer-powered chassis (less CRT and yoke assembly) is confined to an oblong metal cabinet. The VHF switch-type tuner mounts separately on one side, and a 4" x 6" oval speaker is located up front on the other side. Brightness and hold controls are positioned at the top rear corner of the set, each with a plastic knob that extends through the back cover. All other service adjustments are on the rear of the chassis except the one for horizontal linearity, which is on the yoke assembly.

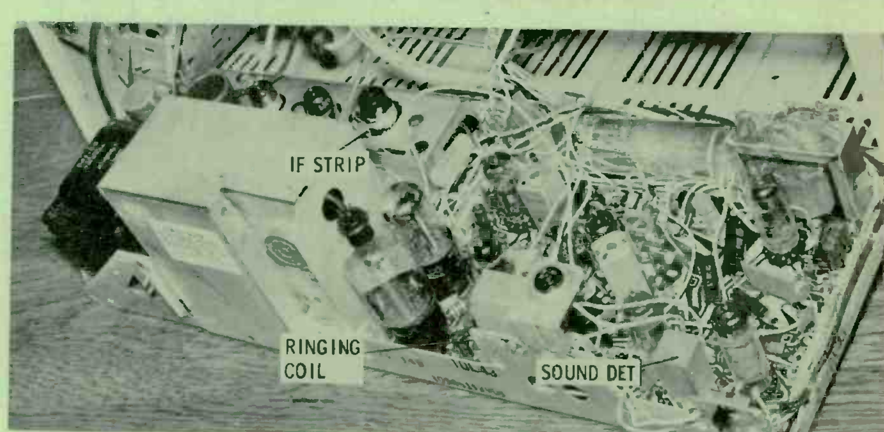
Some of the tubes in this set are a little difficult to get to, so you'll find it easier to service in some cases if you slide the chassis partially out of the cabinet. To accomplish this, remove the two ¼" hex-head screws holding the interlock panel, unplug the clock power cord, and take off the vertical metal brace on the back of the cabinet. After removing the bolts from the bottom of the cabinet, the chassis can be pulled out far enough to make all tubes accessible.

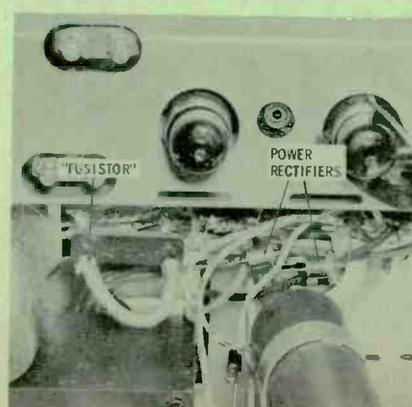
Two printed boards are employed— one for the IF strip and the other for all other sections except the low and high voltage supplies. The only tube in the high-voltage cage is a 1G3GT rectifier. Other tubes of a more recent vintage include a 6BQ5 in the audio output stage, and a 6DR7 in the vertical sweep section. The damper circuit employs a 6DA4, and the video IF's are 6DE6's.

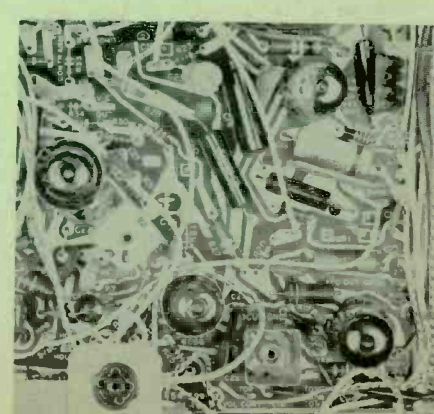
Directly in back of the power transformer is a fusible resistor which is series-connected in the B+ rectifier circuit. This *fusistor* is rated at 5.6 ohms and plugs into a small terminal strip. Although the chassis is isolated from the AC line by a power transformer, you'll find a pair of silicon rectifiers used in the low-voltage supply. These units are soldered in and are located just to the right of the *fusistor*.

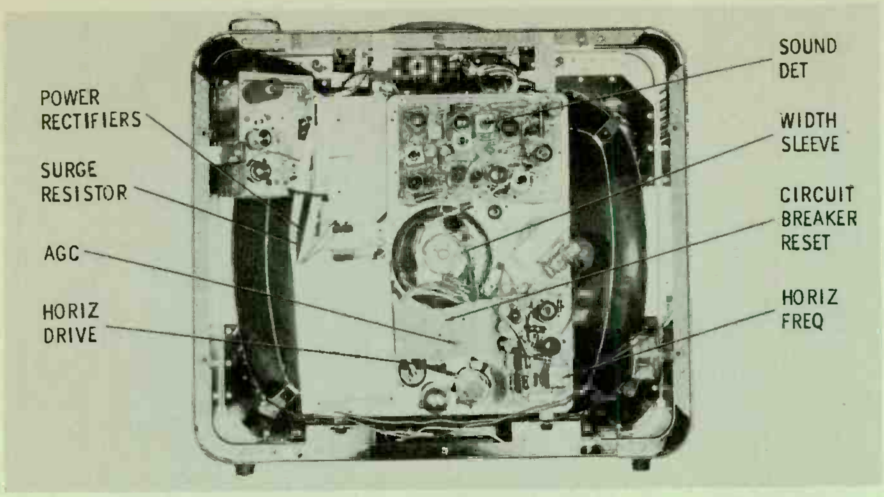
Making a close examination of the printed board, you'll find the tube sockets employed are similar to regular test-socket adapters. This feature makes it convenient to take measurements from the component side of the board, and elevates the test points so that they are not spaced too closely to the conductors on the board. Wiring is traced out on the top side of the board, and all parts, stages, and test points are identified.

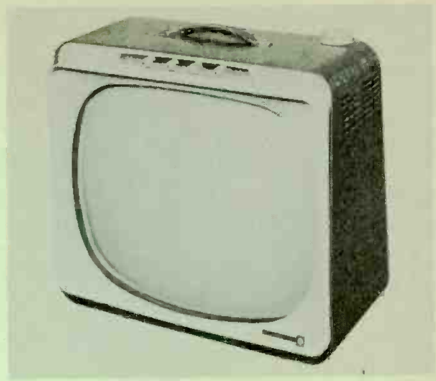












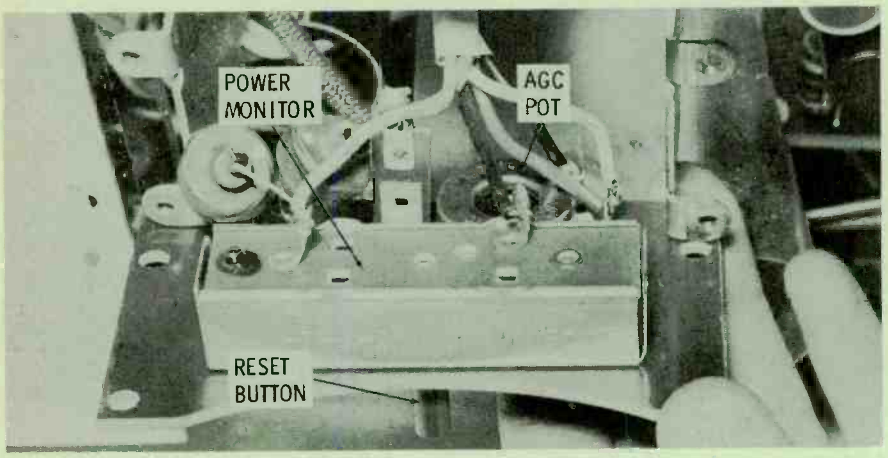
Silvertone Model 118.5 CH-A Chassis 528.51643

The new *Medalist* line features this 21" portable with VHF-UHF tuner and a telescoping antenna built into the rear cover. Controls across the top front include volume control with on/off switch, brightness, contrast, and vertical hold. Station tuning knobs are in one rear corner.

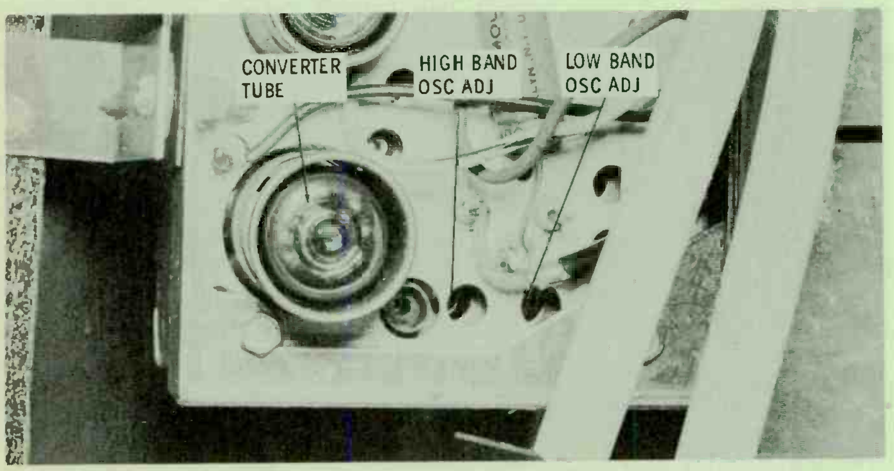
The set employs a vertically-mounted chassis which bolts to both the top and bottom of the cabinet. To make it a little easier to pull the chassis, you'll find that the yoke and speaker have plug-in connections. Two printed boards are used—one for IF and sync stages, and the other for the sweep and oscillator circuits. All service adjustments are pointed out in the photo except height and vertical linearity. These are accessible through the shafts of the brightness and vertical hold controls, respectively.

Like previous Silvertone portables, this set employs 450-ma series-string tubes. Here's the lineup:

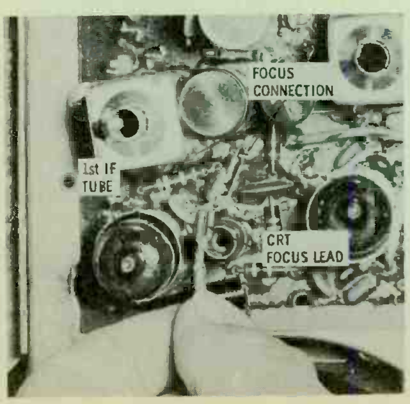
3CY5-RF amp	6U8A-sound IF/sync
6U8-conv.	4DT6-sound det.
3AF4A-UHF osc.	6AQ5A-audio out
4BZ6-1st & 2nd video IF	13DE7-vert. osc./out
6AM8A-IF/vid. det.	8CG7-horiz. AFC/osc.
8BA8A-vid. out/sync	17DQ6A-horiz. out
4AU6-AGC keyer	17D4-damper
	1K3/1G3-HV rect.

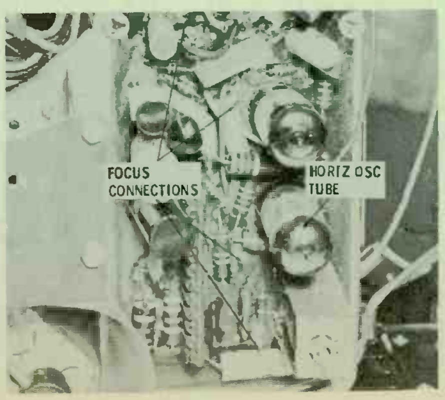


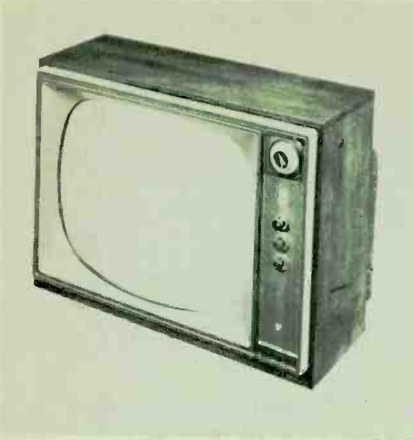
The *power monitor*, a circuit breaker positioned on a small panel next to the high-voltage cage, acts as a fuse in the input circuit to the low-voltage rectifiers. Since a momentary overload may cause the breaker to open, always check the reset button if tubes light up but raster and sound are not obtained. The "hot" chassis is powered by two silicon units located on the left side behind the chassis pan. You'll also find a 4.5-ohm, 10-watt surge resistor in this area. This component, too, is in series with the B+ rectifier circuit. If it becomes necessary to touch up RF oscillator frequency, you'll note from the photo that two adjustments are provided—one for the high band and one for the low band. Remember not to exert undue pressure on the slug or you may distort the shape of the coil.

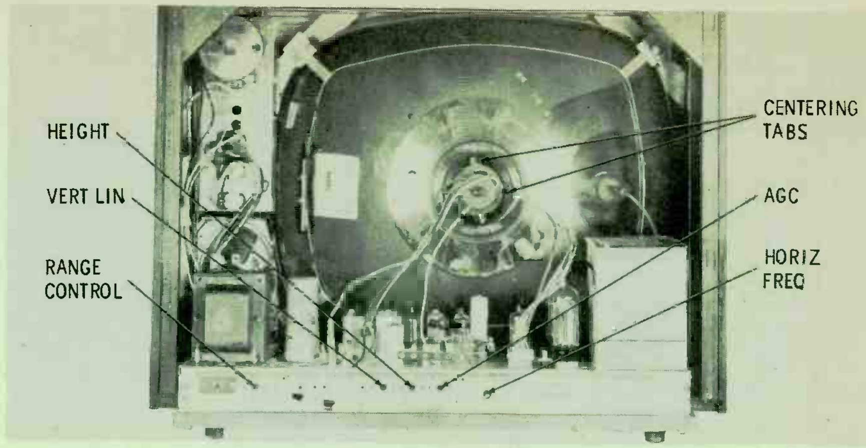


Five individual terminals for picture tube focus voltage are provided on the chassis. One connection is located on the upper printed board, and four are on the lower board. These represent five different potentials ranging from chassis ground to 600 volts positive. The blue lead from pin 4 of the CRT should be permanently connected to the point that gives the sharpest focus at maximum brightness.









Trav-Ler Model 821T901 Chassis 1051-19

A 21" 110° short-neck picture tube and VHF tuner are incorporated in this set. Front operating controls are aligned along the right side, and include a *set-and-forget* volume control. If you're asked to clean the safety glass on this set, don't try to pry the mask off. The chassis and picture tube must be removed to perform this service.

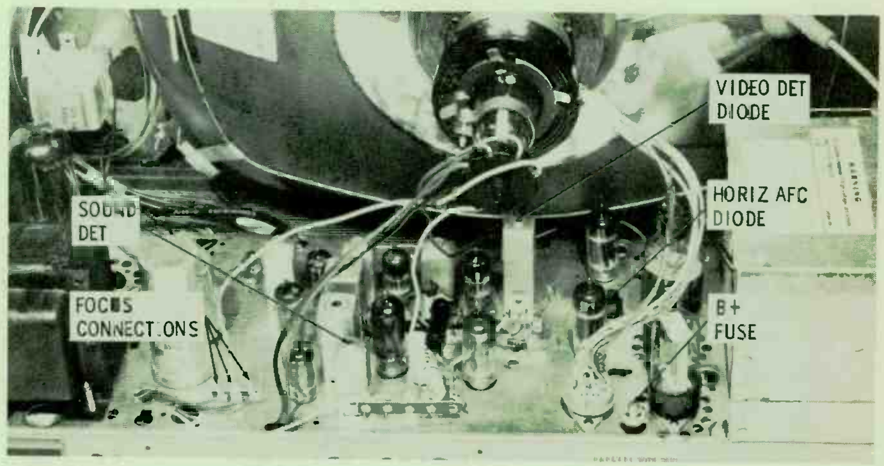
You'll find that the chassis is a horizontal style which mounts across the bottom of the cabinet. It makes use of a power transformer and a parallel circuit for tube filaments; however, no printed wiring is used. The RANGE control located on the rear apron is used to improve sync in fringe areas. It should be set to the most counterclockwise point that provides good sync stability. The latest tube you'll run across in this receiver is a 6DB5 in the vertical sweep section. Incidentally, the 6AS5 audio output tube is used as a voltage divider in the B+ system, so don't forget that it can affect operation of other circuits.

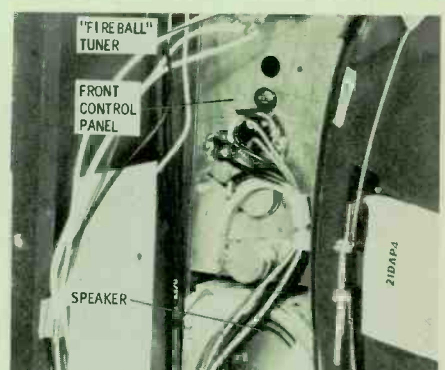
On top of the chassis near the high-voltage cage, you'll find a B+ fuse connected in series with the ground return lead of the power transformer secondary. This "N" type unit is rated at ¾ amp (slow-blow). The only other fuse in the set is a short length of #26 copper wire for the tube filament supply. It is soldered to a terminal board directly below the power transformer on the wiring side of the chassis.

To get to the high-voltage rectifier (1B3GT), remove only the screw on top of the cage and slide the lid back as shown. The only other major component in the cage is the horizontal output transformer.

A separate control and tuner panel is attached to the front of the cabinet as shown. This assembly comes out after removal of four screws. In this area, you'll also find a #47 dial lamp serving as a channel indicator in front of the *Fireball* tuner. A 4" x 6" oval speaker, with plug-in leads, mounts below the panel.

To adjust the VHF oscillator of the tuner, remove the button plug located on the upper right side of the cabinet. The hole in the cabinet provides access to the oscillator slug for the channel indicated by the selector knob. The adjustment requires a nonmetallic tool with a tip no wider than ⅛", and no less than 4" in length.





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VOLUME 9, No. 11 — NOVEMBER, 1959

CONTENTS

ABOUT THE COVER

You could say our cameraman was "up in the air" the day he took this month's cover photo. The scene shows a field-strength meter being used to indicate the best position for a TV antenna. Additional uses for F-S meters are covered in the picture story on pages 32 and 33.


Delco Radio
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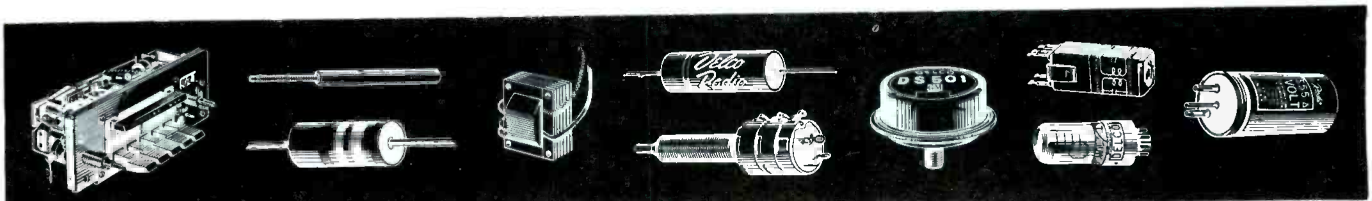


Letters to the EDITOR

Dear Editor:

Since the lad on your August cover looks like a juvenile, I would suggest he be advised to lay off the ice cream, soda and candy, and avoid attracting bumblebees to his face.

As long as shops employ drugstore cowboys for servicing (which is a mature man's job), mishaps will be a daily occurrence.

Let's cut out the funnies and utilize the valuable cover space for something instructive and educational! Or at least don't create the impression that all servicemen are silly juveniles.

JERRY A. KOUTNIK
Bellaire, Mich.

Our cover man's three children cried when they read what you had to say about their daddy.

We subscribe to the belief that life these days tends to get too terribly serious—in the literal meaning of the word—and a little comic relief serves as good medicine. But we edit the magazine for ALL our readers. What say you, men, about our covers? Like the man says, tell us what you want and we'll give it to you.—Ed.

Dear Editor:

Please send me a corrected four-page reprint of *Video Speed Servicing* for June. I highly compliment you on your speedy correction of such mishaps, and thoroughly understand that any normal human being (editors included) has to make a mistake sometime.

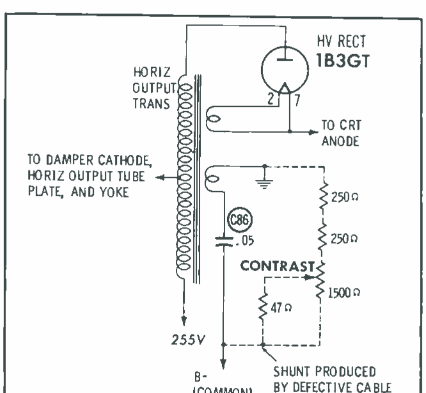
I'm very much satisfied with the contents of your entire magazine, and consider it a strong crutch on which to lean when tackling complicated service jobs.

DAVID FULLER
Furman, Ala.

Sorry you had to run into a splinter in your "crutch," Dave. If anyone else wants reprints of the June VSS, they are still available on request.—Ed.

Dear Editor:

I believe I have a possible solution for Oscar Van Kan's problem (*Troubleshooter*, September issue). The type of flyback used in the Motorola Chassis TS-



52 produces an induced voltage from B— to chassis ground, which modulates the video signal and causes an interfering vertical bar pattern in the picture.

To remedy this condition, a small winding is placed around the flyback core. One end is connected to chassis ground, and the other is returned to the B— (black-and-white) line through the .05-mfd capacitor C86. The special winding develops a pulse 180° out of phase with the undesirable induced voltage and equal to it in amplitude, thus resulting in cancellation. I suspect an open C86 or a poor solder connection to this component.

EARL A. HAMILTON
Oklahoma City, Okla.

Dear Editor:

Thanks for your helpful suggestions referring to my trouble with a Motorola TV set. You might like to know that the real source of trouble was the long shielded wire running from the contrast control to the cathode of the 6AH6 video output tube. Its rubber insulation had badly deteriorated, and a single strand of wire in the shield evidently made occasional contact with the center conductor—effectively grounding the 6AH6 cathode. Replacement of the wire cured the trouble.

OSCAR VAN KAN
Cleveland, Ohio

These seemingly unrelated bits of information have a very interesting connection with each other. It seems strange at first that vertical bars on the screen would be produced by grounding the cathode of the video output tube, but the situation is clearer in the light of Mr. Hamilton's logical assumption. The shield on the defective cable is connected to chassis ground, whereas the cathode circuit proper is returned to the common B— bus instead of the chassis. Therefore, the short in the cable would have produced a low-resistance shunt across C86 and the special transformer winding, upsetting the balance between the two out-of-phase pulse signals in the B— circuit. As a result, pulse interference found its way into the video output stage.

We suspected all along that the trouble was due to sweep interference, but we didn't realize it would take this route to reach the picture tube! In a set as old as this one (approaching 10 years), it would be a good idea to replace C86 as a matter of preventive maintenance, even though replacement of the cable seemed to cure the defect.—Ed.

Dear Editor:

In the August *Letters* column, your reply to a query on pay television did not include the latest news on the subject.

The world's first actual *pay as you see* TV system is now being installed in West Toronto, Canada. It will be on cable (rather than over the air) and will reach an immediate potential of 13,000 homes.

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• *Please turn to page 20*

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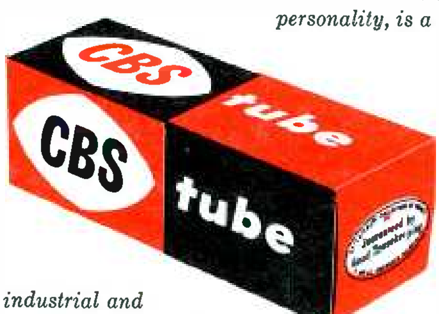

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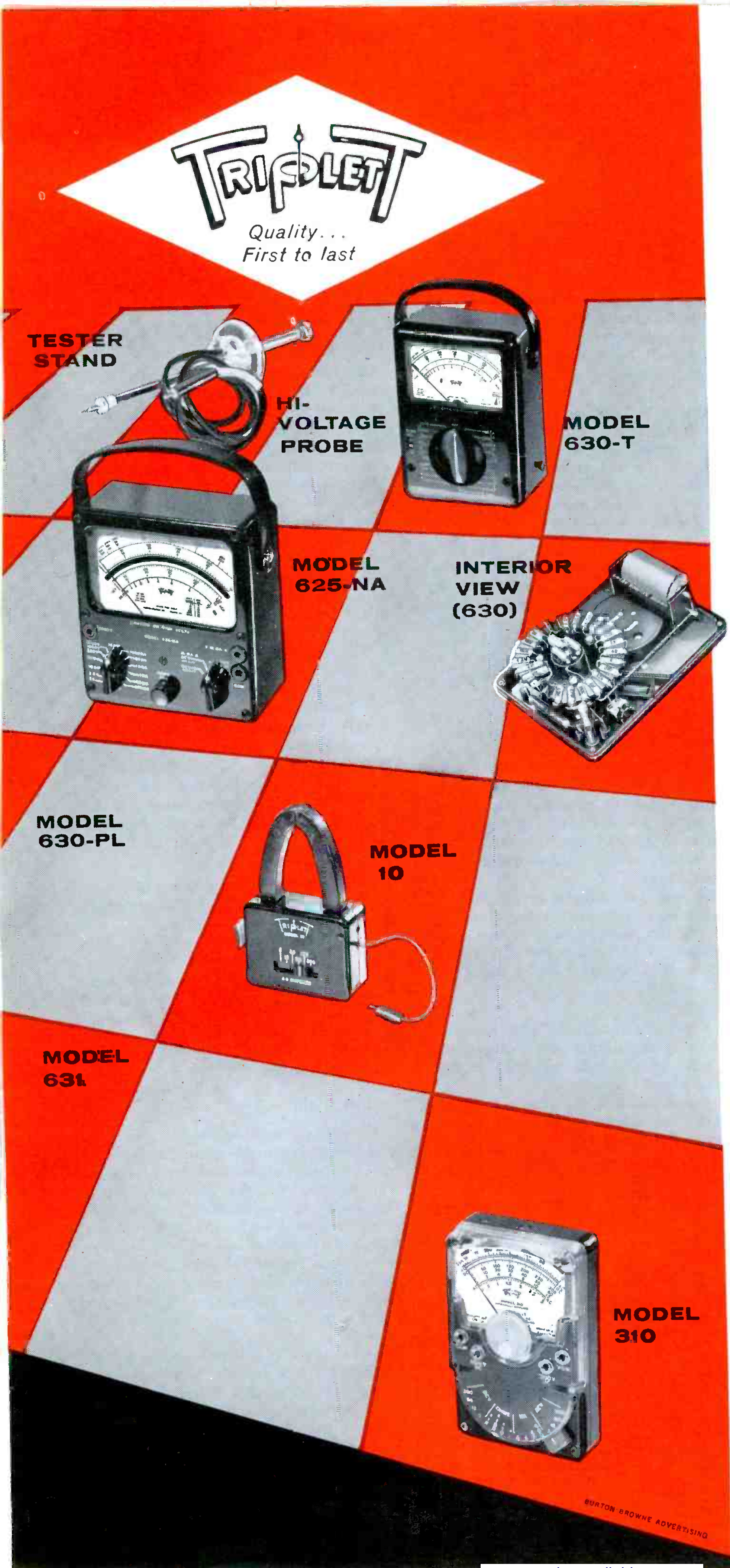

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Model Pt. T-225-A-33 Tester Stand $0.50. Metal, holds tester in approximately 45° angle; facilitates easy reading.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Letters

(Continued from page 14)

Canada Telemeter Ltd., a Division of Famous Players Canadian Corp. Ltd., the largest motion picture theater chain in the Dominion of Canada. The system will utilize Telemeter transmitters and home units developed by International Telemeter Co., a Division of Paramount Pictures.

Canadian Bell Telephone Co. is now installing 84 miles of overhead and underground cable to carry the three-channel program service to be offered. The system will begin operating before the end of this year.

WILL BALTIN
International Telemeter Co.
New York, N. Y.

This should help to settle the question once and for all as to whether people will pay to see television shows! We'll be watching with an interested eye for further developments.—Ed.

Dear Editor:

In July *Letters*, you mentioned that two volumes of *Video Speed Servicing* have already been published. I would like to know if they are made up like the sheets in PF REPORTER and where they can be purchased.

EARL W. WEHR
Barnesville, Ohio

Essentially, the information in these books is presented in the same manner as in PF REPORTER. *The main difference is that the schematics in Volumes 1 and 2 use the manufacturer's component designations (R- and C- numbers), whereas* PF REPORTER *uses* PHOTOFACT *numbers. Volume 3 of VSS, just published as a Sams book, uses the same format employed by us.*

Ask your parts distributor for the first two volumes; if he doesn't have them on hand, he can order them for you. Copies of Volume 1 (what few are left) sell for $4.95 each; Volumes 2 and 3 are $2.95 each.—Ed.

Dear Editor:

We expectantly await each month's issue of PF REPORTER, which is probably the most widely read magazine in our organization.

For your records, our new officers for 1959-60 are: Ralph Johonnot, president; Everett Pershing, vice-president; Gene Sheppard, secretary; Jimmie Scarborough, treasurer; and E. L. Bizzell, Felix Garrett, Winfield Howie, Ralph Singleton, and Walter Heuman, members of the board.

GENE SHEPPARD
Secretary, Society of Radio & Television Technicians, Inc.
Glendale, Calif.

Congratulations, gentlemen. Our best wishes for your success at the helm.—Ed.

Dear Editor:

I prize the information in *Video Speed Servicing* along with some of the most expensive data I have. While I'm at it, I want to thank you for such a wonderful magazine. I have stopped my subscription to two other publications because yours has everything I need.

Please keep PF REPORTER the high-class publication that it is, and don't ever cut down on any section—especially the *Troubleshooter* column. I'm not trying to flatter you; this is just the way I feel about your magazine.

JOSEPH J. MASARONE
New York, N. Y.

Thank you.
You're welcome.
Thanks again.
We'll do our best.
Thank you.—Ed.

Dear Editor:

In September *Letters*, Gene's Radio and TV Shop requested your assistance in securing information on European-made tubes UCH71 and UEL71 for a Schaub radio. As you stated, these tubes are probably difficult to find on the U.S. market. You suggested he should contact an European supplier, and perhaps he has done so by now. However, if he has not been able to correspond with a German firm, I should like to put him in touch with a good friend of mine who is a jobber for Lorenz/Schaub and might be able to help him. His address is:

E. Ruppert
c/o Radio Lorenz
284 Eckenheimerlandstr.
Frankfurt Main
W. Germany

Please mention my name in any correspondence.

Hoping this information will be a small sign of my appreciation for the nice job you do for us service people.

KARL H. PAQUEE
Stratford, Con.

Small sign? With an address like Ruppert's, it's more like a billboard! Many thanks for your help.—Ed.

Dear Editor:

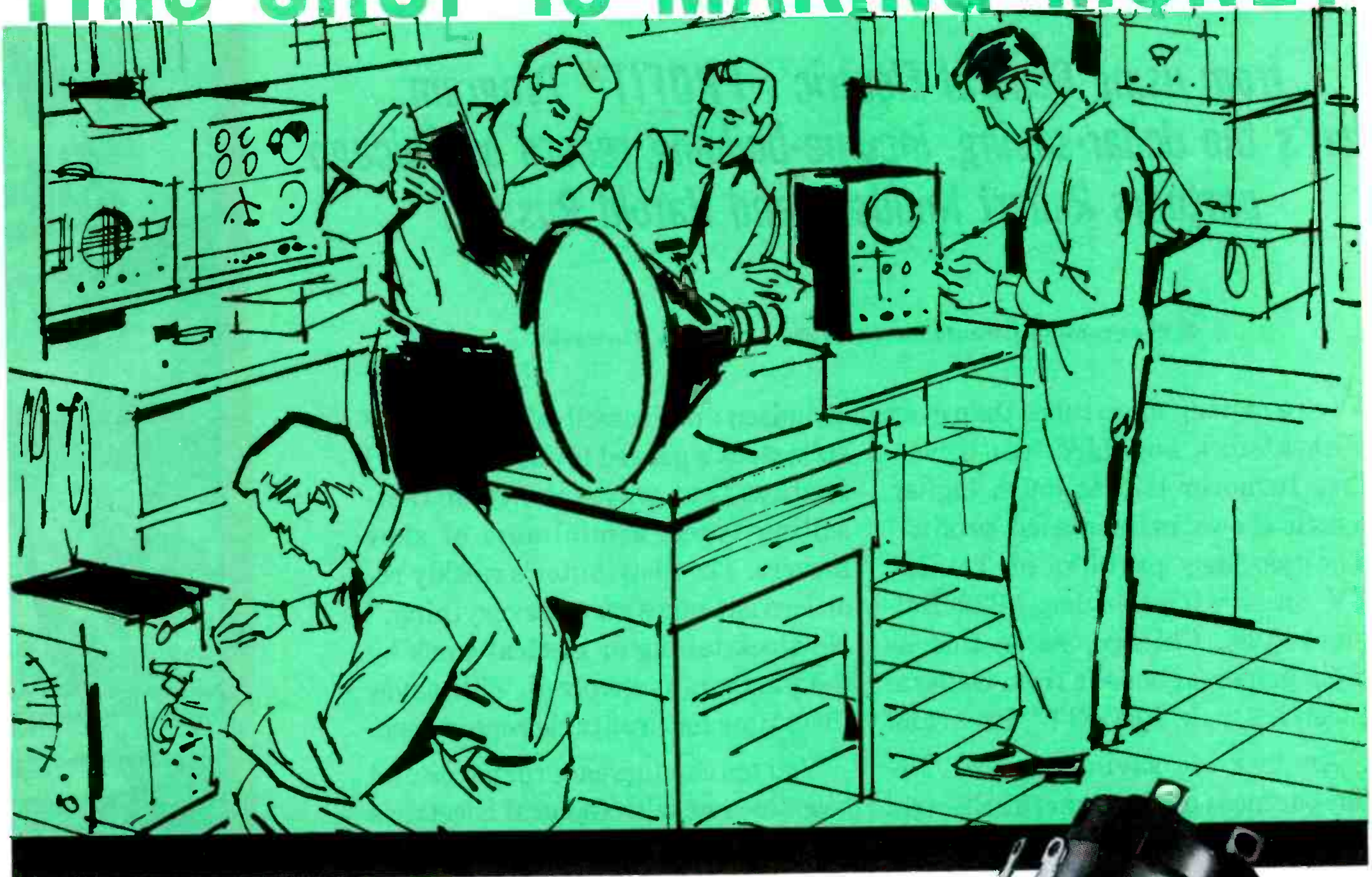
Do you have a recommended tube stock list for radios only? I would like to stock a tube kit for radio servicing, so I won't have to lug along my big 400-tube TV caddy when I get a call to repair a radio.

A. G. HESHMATI
Carmel, Calif.

We haven't made up a stock guide for radio tubes, since only a small number of well-known types are used in most post-war radios. Now that you have called this matter to our attention, we are suddenly reminded that quite a few radios almost a generation old are still in service. Perhaps we'd be doing a useful service if we made up a chart of radio tubes, including the obsolescent types with which our younger readers are not well acquainted.

Speaking of tube stock requirements, our Stock Guide for TV Tubes *appeared in the last issue. The later version has been expanded to include a new feature —a recommended tube-caddy stock comprising 350 tubes of approximately 200 types. You should find this listing helpful whenever you refill the 400-tube "whopper" you carry on TV calls.—Ed.*

THIS SHOP IS MAKING MONEY



with CLAROSTAT RTV controls

Radio and television repair shops in all parts of the country are increasing their profits with Clarostat RTV controls—the controls that are *right* for the job, *right* from the carton.

RTV controls are manufactured as matched replacements under rigid quality control standards at the factory. Clarostat offers the direct replacement for practically every radio and TV set control ever produced. RTV controls can save you many hours per man per week, raising your output and multiplying your profits.

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Shop Talk

TAILORING YOUR SERVICE TECHNIQUE TO THE CIRCUIT

MILTON S. KIVER

In my last column, I outlined the preliminary steps in servicing a defective television receiver. This includes finding out all you could about the behavior of the set from the owner, noting which section appeared to contain the trouble, and then checking tubes in that section. Simple as this procedure is, it will uncover many of the troubles normally encountered.

Now the question is, "If none of the tubes are defective, what do you do next?" The answer depends on the section of the receiver suspected of harboring the trouble. For example, in the sync and sweep sections, waveform analysis will initially be of more value than voltage measurements. On the other hand, a VTVM generally proves more useful than a scope for checking AGC and power supply circuits. In signal-amplifying stages, a signal-injection procedure is more likely to yield faster results than any other.

Thus, we see that *different* sections of a TV receiver require *different* servicing approaches. And, if you are to gain any speed in your work at all, it is important that the difference in treatment be carefully learned. It is here that the experienced technician achieves his greatest advantage over the beginner. The man with experience knows which test instrument is best suited for certain jobs, and he uses it right from the start.

In the discussion to follow, it is assumed that the tubes associated with a section have been checked and found to be good.

The Power Supply

In some power-supply circuits, semiconductor diodes are employed in place of a rectifier tube. These components are prime suspects in the event B+ voltage is low. Here's the quickest way to locate trouble within a tubeless power supply:

First, check the DC output voltage as shown in Fig. 1. If it's low, measure the rectifier input voltage and then the AC line voltage. If the latter two measurements are normal, the semiconductor rectifiers should be tested by instrument or by direct substitution.

As for tube-type power supplies, the condition of the rectifier can readily be determined by simple substitution, but if a new tube fails to restore full B+, further tests (similar to those outlined above) should be tried. See Fig. 2.

In case none of the foregoing tests uncover the trouble, disconnect all the load lines from the power supply, and see if this brings the voltage back to normal (or above). If not, leaky filter capacitors may be pulling down the B+ voltage. If the output does return to normal, the trouble is due to excessive current drain resulting from low resistance

• Please turn to page 79

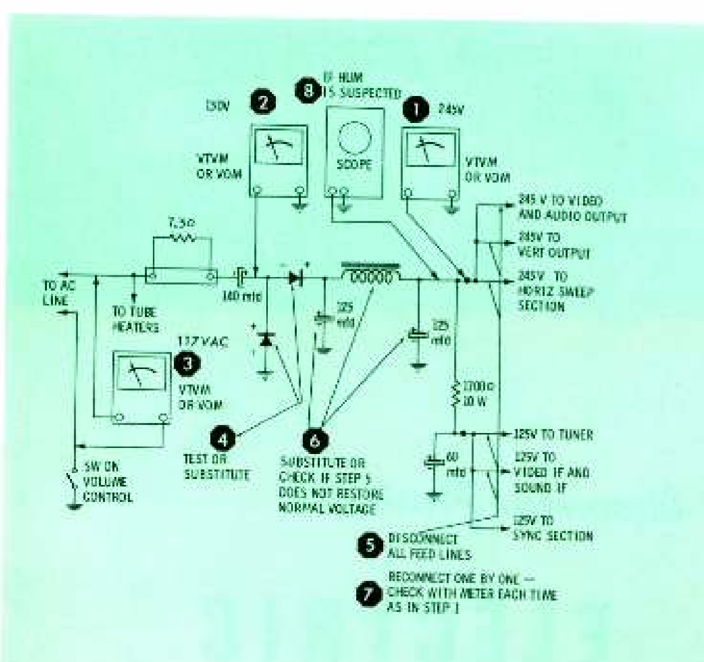


Fig. 1. Troubleshooting a semiconductor power supply.

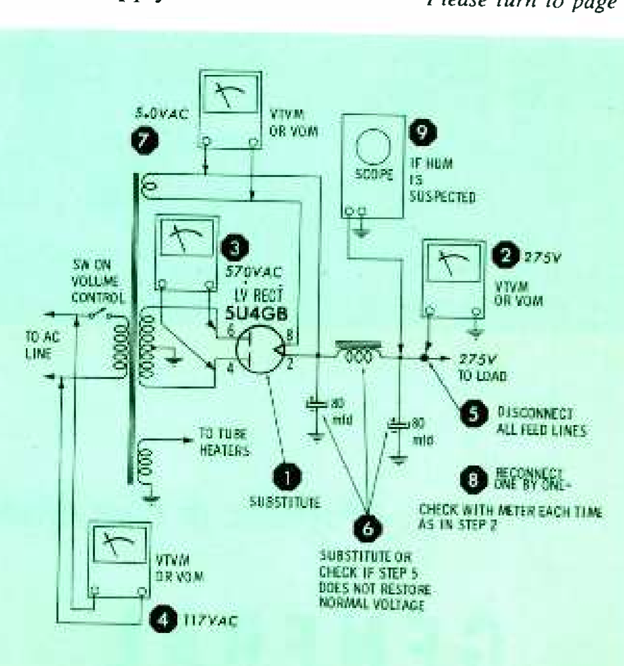
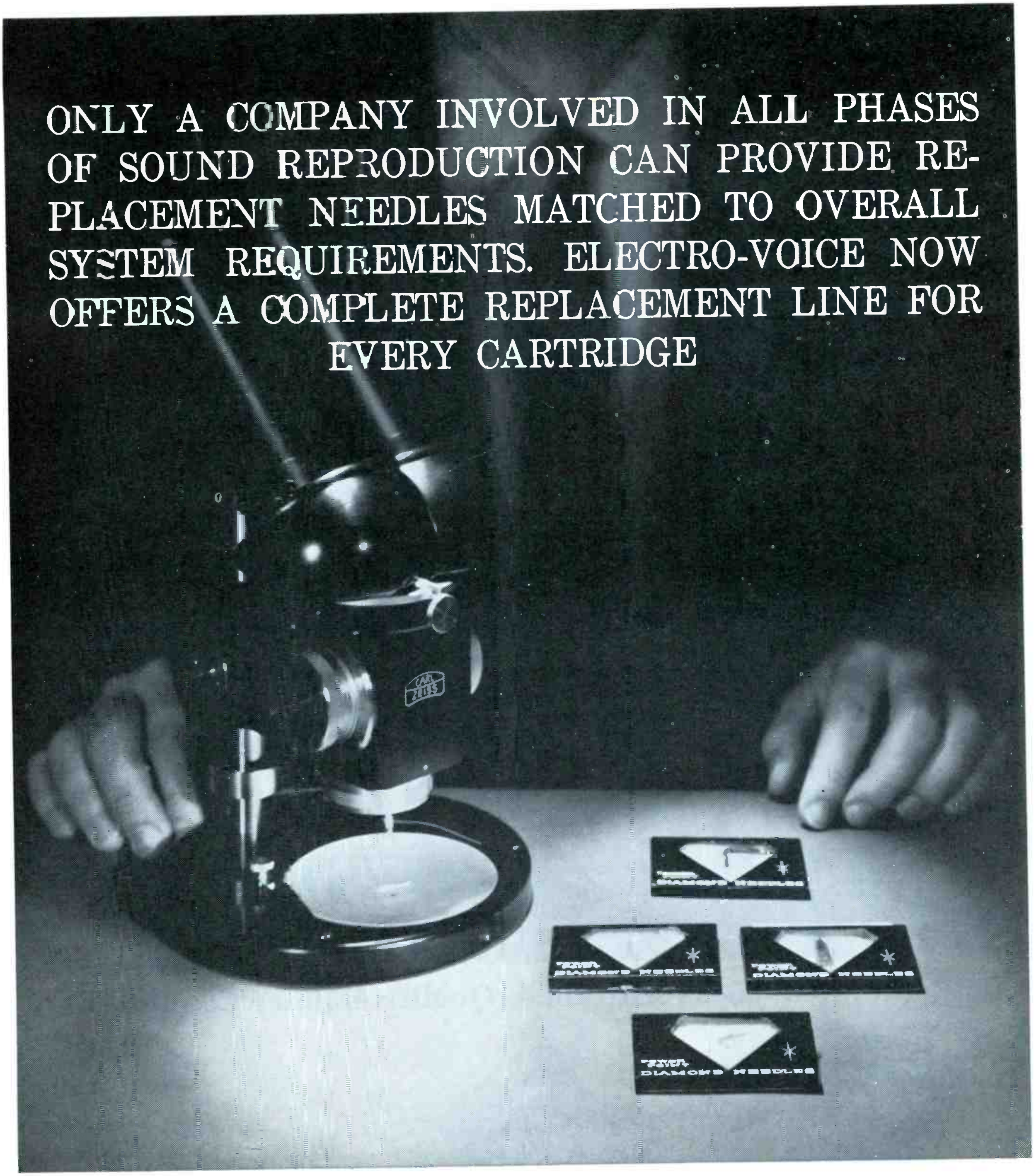


Fig. 2. Troubleshooting a tube-type power supply.



The great strides of recent years in the design and production of high-fidelity systems have been noticeably lacking in the area of replacement needles. Virtually every needle sold today was designed by a cartridge manufacturer. Few needle producers satisfy the rigid requirements of cartridge manufacturers. Now, E-V the leading cartridge manufacturer, with its large staff of engineers and trained personnel, offers you the opportunity to sell replacement needles that will produce the finest sound available.

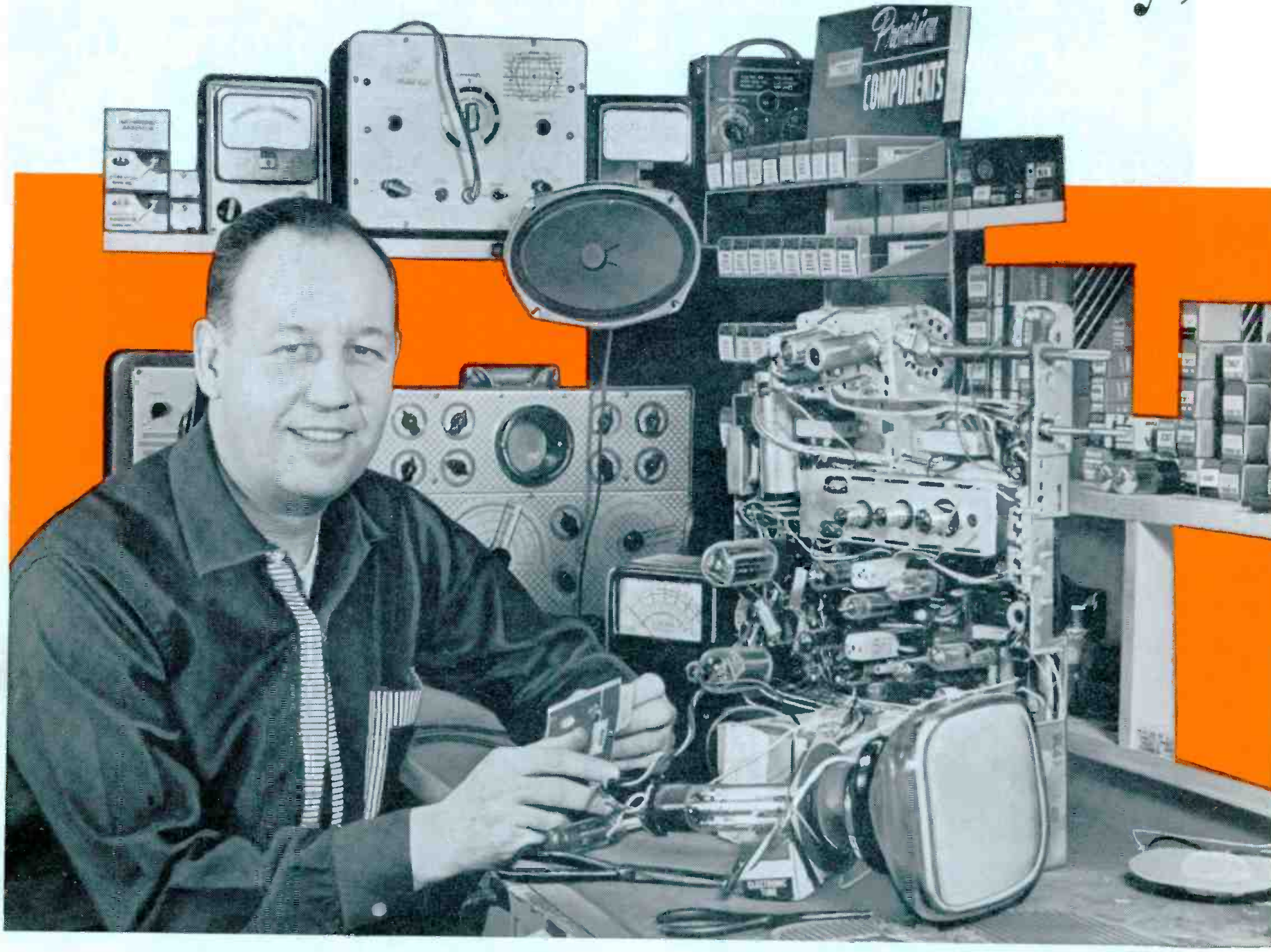
- Only from Electro-Voice, originator of the permanent needle cartridge would you expect to receive the high standards of quality and performance demanded by modern sets.
- Only from Electro-Voice, marketing and sales promotion innovator, would you expect to receive dynamic promotions that increase and safeguard profits.
- Only from Electro-Voice, with its vast facilities, would you expect to receive service and delivery which solve your inventory problems.

Write for your copy of the new Electro-Voice Needle and Cartridge Replacement Guide

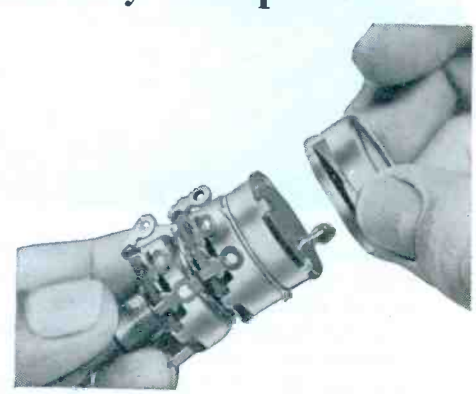
Electro-Voice INC., BUCHANAN, MICHIGAN—*the complete quality replacement needle line*

TV Technician TAYLOR THURMAN Explains . . .

"In Precision Circuitry,



Stop Call-backs with these Quality Mallory Components



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

FP Electrolytics—The Mallory FP—the original 85°C capacitor—now has improved shock-resistant construction and leakproof seal. Its etched cathode construction—standard in all FP's—assures hum-free performance.

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

"It's good business to use this 90-day Repair Bond," says Ken Rodrigue. "We find it helps the customer feel, more than ever, that he has received full value from his service dollar."

"Most Constructive Step in the Industry"

"The new Raytheon Bonded Dealer Program is the best step yet towards identifying competent and reliable service organizations.

"It really goes a long way in assuring the public that its investment in qualified service is the best means —maybe the *only* means— of enjoying trouble-free radio and TV.

"And this assurance is actually put right in their hands with the Raytheon 90-day Repair Bond.

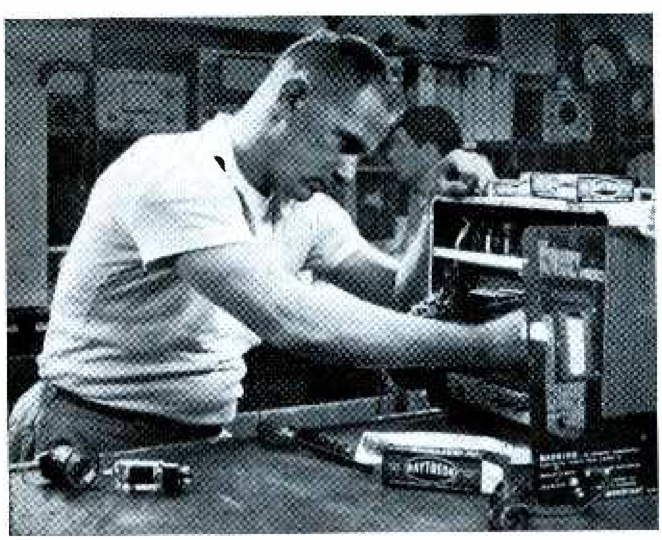
"In addition, Raytheon backs the Bonded Dealer Program with national consumer advertising. And the Raytheon distributors supply local direct mail and advertising support. The average dealer couldn't afford this. Speaking for ourselves, we've tied into these programs with great success.

"Of course, we know that advertising promises have no value without quality products to back them up. Nine years of Raytheon tubes and CRT's have proved to us that a dealer can count on the Raytheon brand name.

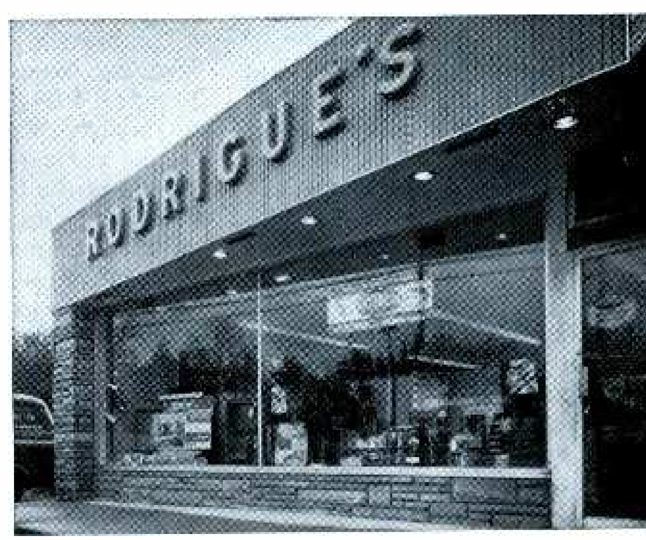
"Congratulations on the whole Bonded Dealer Program—we know that it's helping us to increase profits."

K. J. Rodrigue, President
Rodrigue's Radio & Television, Inc.
Milford, Conn.

Cash in! If you haven't signed up as a Raytheon Bonded Dealer, call your Raytheon Distributor today to march with the profit parade.



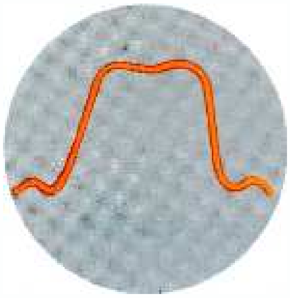
"We average over 6000 service jobs a year," says Ken. "To achieve this kind of volume we depend on the skill and efficiency of our service technicians and top-quality Raytheon Tubes."



"As Milford's largest servicing organization we have counted on Raytheon quality since the day we opened," relates Ken. "In addition I like the 24 hour service I get from my Raytheon distributor."

RAYTHEON COMPANY • DISTRIBUTOR PRODUCTS DIVISION

RAYTHEON



How circuit design affects bandpass characteristics by Irving Tepper

EXAMINING VIDEO-IF RESPONSE

The bandwidth of a video IF amplifier system must be very broad, so that the wide range of modulating frequencies on the TV picture carrier (approximately 0-4 mc) will all be equally amplified. There is no getting around this fact, even though a technique called vestigial-sideband transmission is used to restrict bandwidth to a minimum.

If conventional double-sideband transmission were employed in TV, as it is in radio broadcasting, a video IF bandwidth of over 8 mc would be required. However, most of the lower sideband is filtered out of the TV signal, leaving only a small portion containing frequencies up to about 1.25 mc (see Fig. 1 for details). This arrangement permits a reduction in IF bandwidth to 6 mc or less with no loss of picture detail.

Vestigial-sideband transmission makes it necessary to tune the IF strip in an unconventional manner. Ordinary IF amplifiers of the type used in radios are designed to amplify frequencies on either side of the carrier equally. If the same procedure were followed in amplifying the video IF signal, the lower modulating frequencies (present in both the upper sideband and the remnant of the lower one) would produce twice as much power output as the higher modulating frequencies (which are present only in the upper sideband). This situation is illustrated in graph form in Fig. 2.

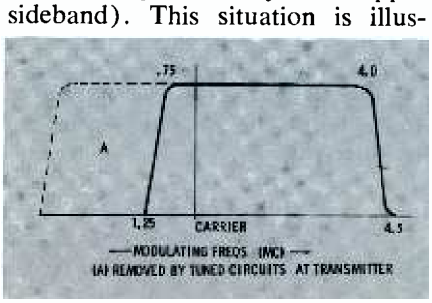


Fig. 1. Part of one sideband is omitted in vestigial-sideband transmission.

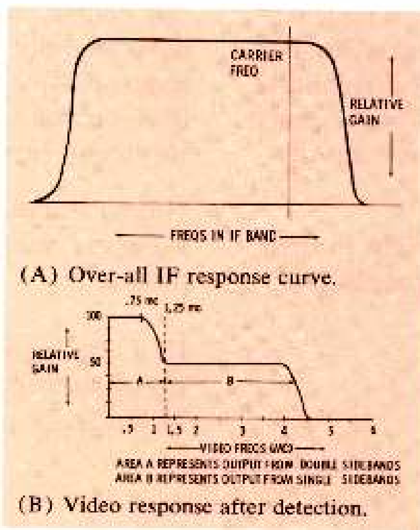


Fig. 2. Response curves when all sidebands receive 100% amplification.

To prevent overemphasis of the low video frequencies, it is necessary to tune the IF strip so as to produce a specially-shaped gain-versus-frequency curve (Fig. 3). Placing the picture-carrier frequency at the midpoint along the sloping side of this curve (in other words, allowing only 50% of full gain at this frequency) serves to compensate for the presence of a vestigial sideband.

Fig. 3 demonstrates that dual sidebands are present for modulating frequencies between 0 and 0.75 mc, but that each sideband receives only partial amplification. The curve is shaped so that the total gain for any given frequency will be equal to 100%. For example, a modulating frequency represented by point A on the upper sideband will receive only 75% of full gain; but this same frequency on the lower sideband (falling at point B) will receive additional gain amounting to 25%. Due to partial amplification of the two sidebands at all frequencies from 0 to ±0.75 mc (between points E and F in Fig. 3), the same results are obtained as for straight 100% amplification of a true single-sideband signal.

Response to Sound Carrier

While most TV receivers have similar over-all IF response curves, there are some differences between intercarrier and split-sound receivers with respect to curve shape. The major point of difference is that the intercarrier IF must amplify the sound carrier as well as the picture carrier. In the split-sound set, the sound carrier is excluded from the video IF amplifier strip by resonant trap circuits; thus, the sound-carrier frequency in the response curve of Fig. 4A appears to rest in a "notch" at virtually zero gain. On the other hand, a typical intercarrier IF curve (Fig. 4B) shows the sound-carrier frequency receiving about 5% to 10% of full gain.

Curve Formation

The over-all video response curve may be formed in one of several ways. The most generally-used method is known as *stagger tuning.* Each stage in a stagger-tuned IF strip is resonant to a slightly different frequency, and the response curves of all stages add together to produce a broad, flat-topped over-

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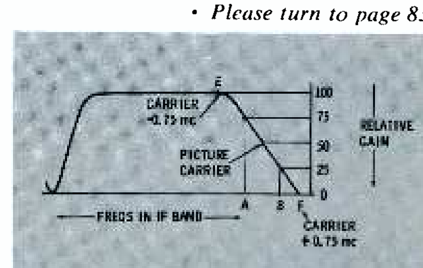
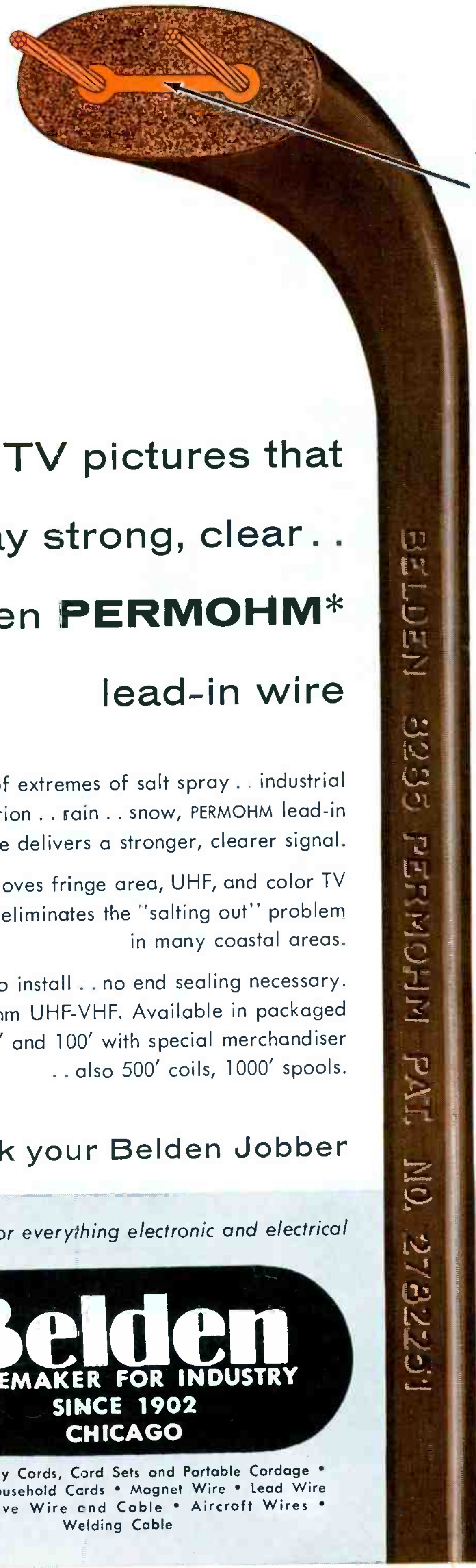


Fig. 3. Side of IF curve is sloped to compensate for vestigial sideband.



PERMOHM* means constant impedance . . because its conductors are protected by encapsulation in cellular polyethylene.

for TV pictures that stay strong, clear . .

NEW Belden PERMOHM*

lead-in wire

In spite of extremes of salt spray . . industrial contamination . . rain . . snow, PERMOHM lead-in wire delivers a stronger, clearer signal.

PERMOHM improves fringe area, UHF, and color TV reception, and eliminates the "salting out" problem in many coastal areas.

PERMOHM is easy to install . . no end sealing necessary. 300 Ohm UHF-VHF. Available in packaged lengths of 50′, 75′ and 100′ with special merchandiser . . also 500′ coils, 1000′ spools.

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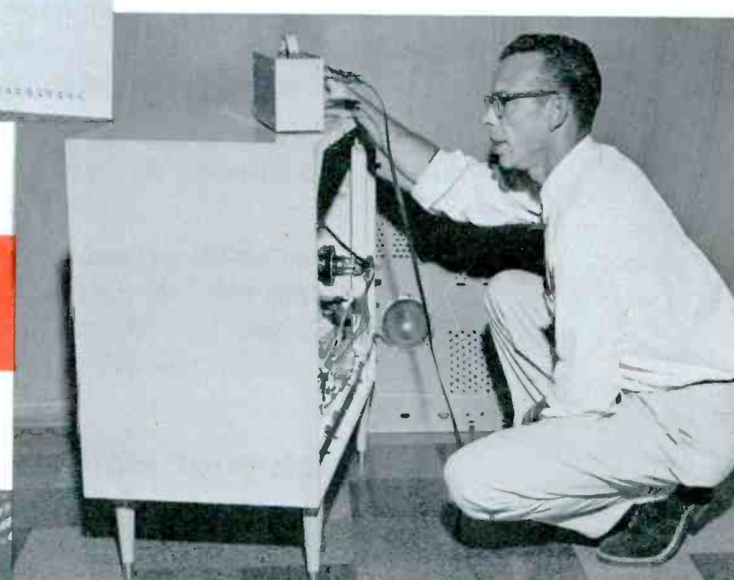
8-1-9

making use of the FIELD STRENGTH METER

High-gain tuners and increased station power have not obsoleted the field-strength meter as a valuable test instrument. On the contrary, it is more valuable than ever as a servicing aid and business-builder.

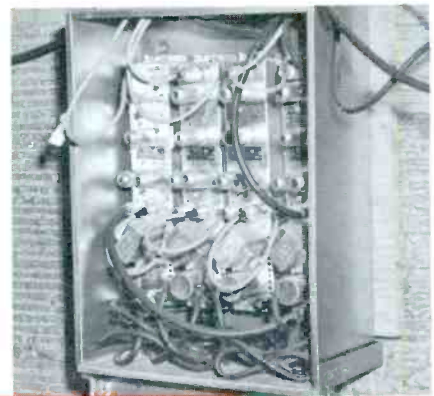
In slack work periods, a brief field-strength survey can be included on each home service call at no charge to the customer. The results can be used quite successfully to promote antenna sales or maintenance jobs. When suggesting antenna work, stress the importance of preventive maintenance in assuring your customers of uninterrupted service from their antenna systems. Even though these field-strength surveys may not immediately result in contracts for antenna service, they help to establish good will for you—thereby providing just the "push" required to get antenna jobs at a later date.

A daily reading and recording of signals at the shop will provide a reference against which other readings taken during the day can be compared.



At the customer's home, a field-strength meter can be used to check the ability of the antenna system to deliver a consistent signal of acceptable strength.

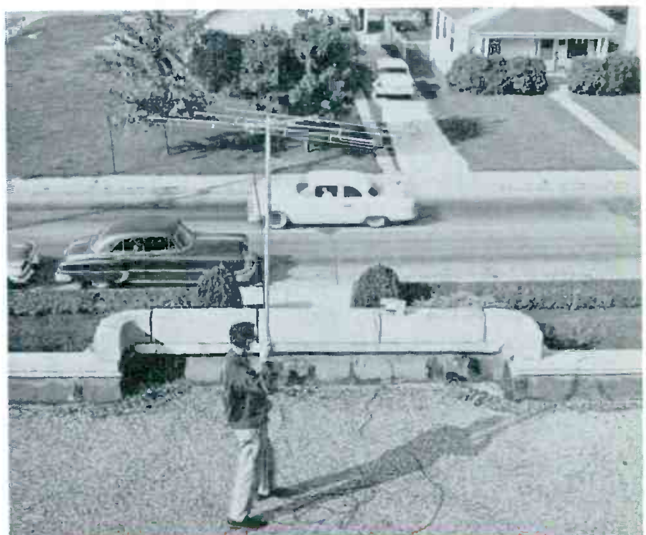
A receiver tag containing the date, channel, signal level, shop reference reading, reception quality, and technician's initials proves very useful in isolating troubles on subsequent calls. If reception is poor, and a new reading shows serious loss of signal, you'll have definite proof that the installation requires replacement or repair.



When it has been definitely proved that the antenna system is at fault, the field-strength meter makes it easy to pinpoint the cause. Multiple antenna receptacles and master antenna systems are used extensively today—not only in hotels, motels, and apartments, but in homes as well. Point-to-point signal tracing is easily accomplished by use of the meter.

TYPE OF LINE	ATTEN. (db per 100 feet)	
	CHANNEL 2	CHANNEL 13
Open-wire (350 ohms)	0.13	0.25
Coaxial, air insulated	0.7	1.4
RG—8/U (53 ohms)	1.4	2.6
RG—58/U (53 ohms)	2.7	5.1
RG—11/U (75 ohms)	1.3	2.4
RG—59/U (75 ohms)	2.5	4.6
Twin-lead (300 ohms)	1.3	2.8
Twin-lead (150 ohms)	1.6	3.5
Twin-lead (75 ohms)	3.0	6.8

Another consideration important to the evaluation of signal readings is the natural line loss between antenna and receiver. This chart shows the line losses to expect under ideal conditions. Humidity, age, and other factors will result in increased losses. Becoming familiar with typical line losses will save you from looking for troubles that don't exist.



For determining antenna location and orientation, a field-strength meter is a great time-saver, eliminating the need for a communications setup between the receiver and the roof. In fact, one man can handle the entire job in many cases.

BLONDER-TONGUE
MODEL FSM-1—direct-reading
Power Supply—battery-operated
Frequency Range—54-216 mc continuous
Range—10 uv to 3V
Input impedance—75 ohms (300- to 75-ohm matching network supplied)
Accuracy—±1 db full scale using 100-uv input
Output jacks for video or sound
Size and Weight—8½" x 12" x 9¼", 14 lbs. less batteries.

JERROLD
MODEL TMT—direct-reading
Power Supply—Battery-operated—four 1.5V cells
Frequency Range—Channels 2 through 6, 7 through 13 continuously
Range—100 uv to 2V
Input impedance—75 or 300 ohms
Accuracy—±3 db
Output jacks—none
Size and Weight—10¼" x 5½" x 4½", 4½ lbs. less batteries

SIMPSON
Model 498A—direct-reading
Power supply—117V, 60 cps or 6V rechargeable battery
Frequency range—channels 2 through 83.
Range—10 to 50,000 uv
Input impedance—300 ohms
Accuracy—±6 db VHF, ±8 db UHF
Output jacks for 40-mc IF and audio modulation
Size and Weight—11⅜" x 7⅜" x 9½", 14¾ lbs. less battery

A STREAMLINED "SYNCHROGUIDE"

by THOMAS A. LESH

RCA has made some interesting changes in its time-honored *Synchroguide* horizontal oscillator circuit. Although the basic layout still consists of a triode-type AFC tube and a blocking oscillator, a number of important details have been altered enough to have a marked effect on troubleshooting. Oscillator waveforms and voltages are noticeably different from those in older *Synchroguide*-equipped sets, and horizontal-sweep alignment is simpler.

The revised circuit (Fig. 1) is found in the RCA Chassis KCS122 and all higher-numbered series, as well as last year's KCS116 and -117. Note that the transformer is now located in the grid-cathode circuit of the oscillator stage. In addition, the hold control has been moved from the plate of the AFC stage to the oscillator grid circuit, and a fixed-tuned horizontal-frequency coil is employed. (The latter two features are not brand-new, but were gradually adopted during the last few years as early steps in the evolution of the present circuit.)

Fig. 2 is a view of the area around the 6CG7 horizontal AFC-oscillator tube of the 17" *Sportable* receiver (Chassis KCS126), showing how the new circuitry fits into the compact printed-wiring arrangement of the latest models. The sweep-circuit printed board in this portable is identical to the one employed in 21" models for 1960, but is mounted in a different position. It has several interesting physical features, including built-in test jacks in the tube sockets and a "road map" (white markings) to indicate the path of conductor strips on the opposite side of the board.

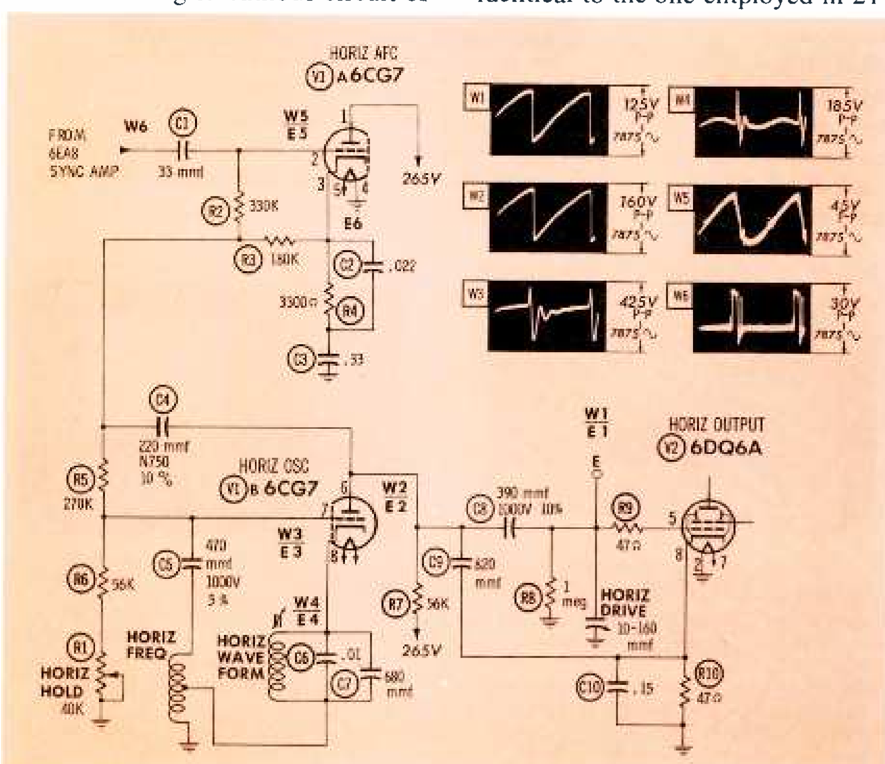


Fig. 1. Horizontal sweep circuits of the RCA *Sportable* (Chassis KCS126).

To make up for the absence of a horizontal-frequency slug, an unusually sensitive horizontal-hold adjustment is provided. The control (Fig. 3) is electrically a conventional 40K-ohm potentiometer, but it is equipped with a type of planetary drive which gives a vernier-tuning effect. The inner end of the control shaft, tapered into a slender pin, is surrounded by three ball bearings which are turned by the shaft when it rotates. Riding on the outer surfaces of the bearings is a plastic carriage attached to the potentiometer slider. Approximately 10 turns of the shaft are required to move the slider through its entire range; thus, hold-control rotation produces a very gradual resistance change. The picture remains in sync over only a small portion of the control's total range—usually less than one complete turn of the knob. Therefore, from the set user's point of view, the hold control appears to behave about the same as the one on his previous set.

Signal Waveforms

Let's turn on the scope and have a look at the signals in the horizontal circuit of the *Sportable*. We'll use a low-capacitance probe for this job, since some portions of the *Synchroguide* circuit would be severely loaded by a direct probe. The peak-to-

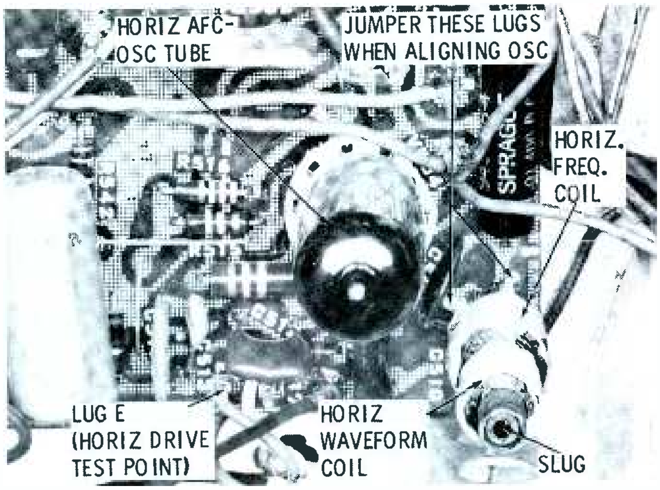


Fig. 2. Horizontal oscillator transformer is mounted on one corner of printed-wiring board next to 6CG7 tube.

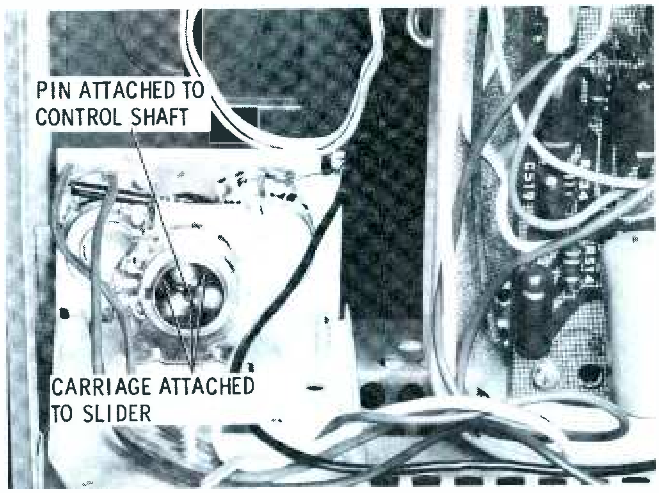


Fig. 3. Ball bearings serve to "gear down" horizontal hold control in order to permit more precise adjustment.

peak voltage readings obtained in our tests will be multiplied by the probe's attenuation factor to arrive at the true amplitude figures mentioned in this article; don't forget to do the same thing when using your own scope probe.

Let's begin by finding out what sort of output signal the modernized circuit produces. In an older-model set, we'd automatically touch the scope probe directly to the grid pin of the horizontal output tube in order to examine the drive signal. This approach doesn't work so well in the RCA KCS126, since the output-tube socket is a bit awkward to reach; so let's check the service data to see if we can find an easier way. How about the other side of the series grid resistor R9? As you can see in Fig. 2, this point in the circuit is right out in the open—at lug E near the bottom edge of the printed board. The green wire fastened to this lug will quickly steer you to it. Scoping this point, we find a conventional drive signal of modified sawtooth shape (W1 in Fig. 1). It has a lusty peak-to-peak amplitude (about 125 volts) for driving a 110° sweep system.

Moving back to the 6CG7 AFC-oscillator tube, we can easily obtain waveforms at the test point on the tube socket. The oscillator plate waveform W2 (at pin 6) is a nearly pure sawtooth with a somewhat higher amplitude than W1. Do you wonder where the sine wave went? The sinusoidal hump which was a familiar feature of the standard *Synchroguide* plate waveform (Fig. 4) has disappeared, because the plate circuit no longer includes the oscillator transformer with its associated sine-wave coil. The shape of W2 is due almost entirely to the repeated charging and discharging of sawtooth-forming capacitor C9.

Oscillator grid waveform W3 (at pin 7) hasn't changed much as a result of the circuit revision. A moderate rise in grid voltage takes place during trace time (just as in all blocking oscillators); but, as Fig. 5 demonstrates, the resulting upward slope of the waveform is very difficult to see because it is dwarfed by the 425-volt pulses which occur during horizontal retrace.

When we check cathode waveform W4 at pin 8 (see Fig. 6), at last we find the sine-wave component which was missing from W2. (It appears in W4 because the cathode is returned to ground through the oscillator transformer.) This sine wave looks pretty puny in comparison with the 185-volt retrace pulses, doesn't it? Since the regular "adjust for equal peaks" procedure is obviously impossible with W4, this waveform won't be of much help during alignment of the horizontal section. Nevertheless, it's useful as a trouble indicator; if the circuit cannot be satisfactorily aligned by the recommended method, you can try checking the shape of W4 to see if the waveform adjustment is correct. To interpret W4 properly, remember that its sinusoidal component is 180° out of phase with that of the plate waveform in the standard *Synchroguide* circuit. The new-style sine wave has just passed its positive peak, and is negative-going at the instant the oscillator reaches the end of the trace period. Since the cathode voltage is rapidly becoming less positive at the same time the grid voltage is becoming less negative, the bias quickly decreases to the critical point at which the oscillator tube can conduct and initiate retrace. If the cathode voltage does not "run down toward the grid voltage" in this manner, it furnishes less precise control over the exact time when tube conduction begins—and the oscillator is less stable.

You may recall that the sine-plus-sawtooth plate waveform in the old-

• *Please turn to page 89*

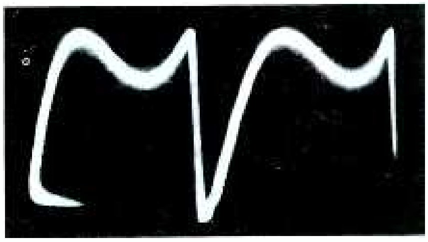


Fig. 4. "Adjust for equal peaks" plate waveform of older-type *Synchroguide*.

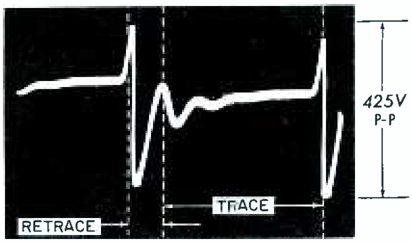


Fig. 5. Oscillator grid waveform actually has upward slope during trace time.

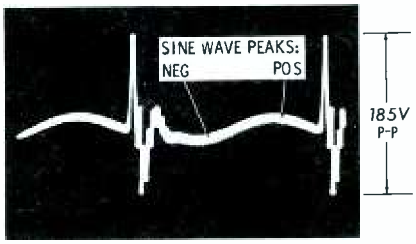


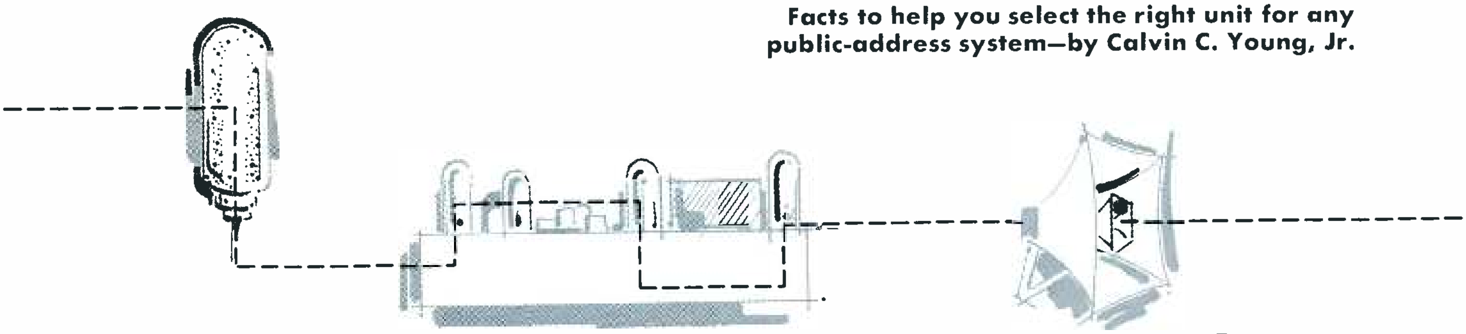
Fig. 6. Sine wave in cathode signal is of much lower amplitude than pulses.

Chart 2—Specifications for Various Brands of PA Amplifiers

MFR.	MODEL NO.	INPUTS	OUTPUTS: Impedances					OUTPUTS: Voltages		POWER OUTPUT	FREQUENCY RESPONSE	Facilities for Mobile Operation
			4	8	16	250	500	25	70			
Altec-Lansing	342B	4	4	8	16				70	35 at less than 5%	±1 db, 20-20,000	
	346A	3		8	16				70	20 at less than 2%	±2 db, 20-22,000	
Bell-Sound	5630	5	4	8	16		500		70	30 at less than 5%	±2 db, 30-20,000	
	5615	4	4	8	16		500		70	15 at less than 3%	±2 db, 30-20,000	
	5625-M3[1]	4	4	8	16		500		70	25 at less than 3%	±2 db, 30-20,000	operates on 6 or 12VDC, 117VAC
	PM-33	3	4	8	16				70	33	±2 db, 30-15,000	
	PM-20	2	4	8	16				70	20	±2 db, 30-15,000	
	PM-212M3[1]	2	4	8	16				70	20	±2 db, 30-15,000	operates on 12VDC, 117VAC
	PM-10	2	4	8	16					10	±2 db, 30-15,000	
Bogen-Presto	MX30	4	4	8	16			25	70	30 at less than 1%	±2 db, 35-20,000	
	MX60	4	4	8	16			25	70	60 at less than 1%	±2 db, 35-20,000	
	M330	3	4	8	16			25	70	30 at less than 1%	±2 db, 35-20,000	
	M60	3	4	8	16			25	70	60 at less than 1%	±2 db, 35-20,000	
Fanon	3310	2	4	8	16				70	10	30-20,000	
	3320	3	4	8	16				70	20	20-20,000	
	3340	3	4	8	16				70	40	20-20,000	
	3370	4	4	8	16				70	70	20-20,000	
	3525	2	4	8	16				70	25	30-15,000	operates on 6 or 12VDC
Newcomb	KX-25	6	4	8	16	250	500		70	25 at less than 3%	±1 db, 20-20,000	
	KX-50	6	4	8	16	250	500		70	50 at less than 3%	±1 db, 20-20,000	
	H-15	3	4	8	16	250	500		70	17 at less than 5%	±2 db, 20-20,000	
	H-25	4	4	8	16	250	500		70	25 at less than 5%	±2 db, 20-20,000	
	H-50	5	4	8	16	250	500		70	50 at less than 5%	±2 db, 20-20,000	
	E-25MP3[1]	3	4	8	16		500			25 at less than 5%	±2 db, 50-15,000	operates on 6VDC, 117VAC
Precision Electronics (Grommes)	10PA	2	4	8	16		500		70	10	±2 db, 70-10,000	
	20PA	2	4	8	16				70	20	±2 db, 30-15,000	
	30PA	3	4	8	16	250			70	30	±2 db, 30-15,000	
	30MPA	3	4	8	16	250			70	30	±2 db, 30-15,000	
	60PA	3		8	16	250			70	60	±1 db, 30-15,000	operates on 6 or 12VDC, 117VAC
	G20	3	4	8	16	250	500		70	20 at less than 5%	±2 db, 50-10,000	
	G40	4	4	8	16		500		70	30 at less than 5%	±2 db, 50-10,000	
	G75	6		8	16	250			70	50 at less than 5%	±1 db, 50-10,000	
Rauland-Borg	1916	3	4	8	16	250	500		70	16 at less than 5%	±1 db, 40-20,000	
	1925[1]	3	4	8	16	250	500		70	25 at less than 5%	±1 db, 30-15,000	operates from 6 or 12VDC, 117VAC
	1932	5	4	8	16	250	500		70	32 at less than 5%	±1 db, 40-20,000	
	1960	6	4	8		250	500		70	60 at less than 5%	±1 db, 40-15,000	
Webster Electric	TP10	3	4	8	16		500		70	10 at less than 5%	±1.3 db, 40-15,000	
	TP15	3	4	8	16	250	500		70	15 at less than 5%	±1.3 db, 40-15,000	
	TP25	4	4	8	16	125	500		70	25 at less than 5%	±1.5 db, 40-15,000	
	TP50	4	[2]						70	50 at less than 5%	±1.5 db, 30-15,000	
	TP90	5	[3]					25	70	90 at less than 2.5%	within 1.3 db, 35-20,000	
	TP20M	2	4	8		250			70	22.5	within 1.5 db, 30-10,000	plugs into cigarette lighter receptacle for 12V operation
	TP20MP[1]	2	4	8		250			70	22.5	within 1.5 db, 30-10,000	plugs into cigarette lighter receptacle for 12V operation

[1] includes top-mounted, 3-speed phono [2] 7 ranges from 6 to 392 ohms [3] 7 ranges from 4.5 to 343 ohms

Facts to help you select the right unit for any public-address system—by Calvin C. Young, Jr.



CHOOSING PA AMPLIFIERS

In spite of the fact that the choice of a PA amplifier for any given installation is not difficult, several questions must be answered before any unit is decided upon. For example: How much area is to be covered? What is the ambient noise level? How many outlets are required? How many, and what kind of inputs are needed? Will use of the system be expanded or modified at a later date?

This article tells how the answers to these questions affect the selection of an amplifier.

Power Requirements

A number of methods can be used to determine the minimum power rating of the amplifier. The easiest and quickest way is to consult a chart where power requirements are cross-referenced with the area to be covered (see Chart I). If we consider, for example, that an auditorium is 30′ wide and 100′ long (3,000 sq. ft.), we can see that a 15-watt rating will suffice if the ambient noise level is average, but the amplifier would have to be continuously operated at maximum power. A 20-watt rating would provide a cushion, but a 25 or 30-watt unit would be more practical.

Type and Number of Inputs

Since one of the major functions of any PA system is voice distribution, microphone inputs will be required. For our 30′ by 100′ hall, three mike inputs is the minimum recommendation. This would allow one mike for each 10′ of building width; any fewer would be inadequate for large panel discussions or civic events. Microphone inputs with facilities for accepting plug-in matching transformers (as shown in Fig. 1) will permit the use of any mike, regardless of impedance. You simply choose a plug-in transformer that provides the proper match between microphone and amplifier input. If only one or two mikes are to be used at the outset, the amplifier need be equipped with only the matching transformers for those specific mikes. Whenever additional mikes are purchased, the needed transformers can also be obtained.

Each input circuit should have a gain control as shown in Fig. 1 so that the outputs can be balanced. In some units, the final output can be adjusted with a MASTER GAIN control. (Note: Not all PA amplifiers have such a control; some depend solely on the individual gain controls to regulate output, as well as the balance between the various inputs.)

In the event sound pickup points are not located more than a short distance (8′ to 10′) from the amplifier, high-impedance microphones can be used, thus eliminating the need for matching transformers. Further, if there is no foreseeable need for low-impedance inputs (for mikes located some distance away from the amplifier), the amplifier chosen need not have plug-in transformer facilities.

Type and Number of Outputs

Basically, there are two types of

Chart I—Amplifier Power Required to Supply a Given Area.

AREA IN SQUARE FEET	AMPLIFIER RATING IN WATTS
50,000	100
40,000	100
15,000	30 to 50
10,000	30 to 50
8,000	30 to 50
5,000	30
4,000	15 to 30
3,000	15
2,000	15
1,000	10 to 15
500	10

NOTES: 1. Extremely noisy areas require a higher rating than shown.
2. Use lower wattage figure if noise level is below average.

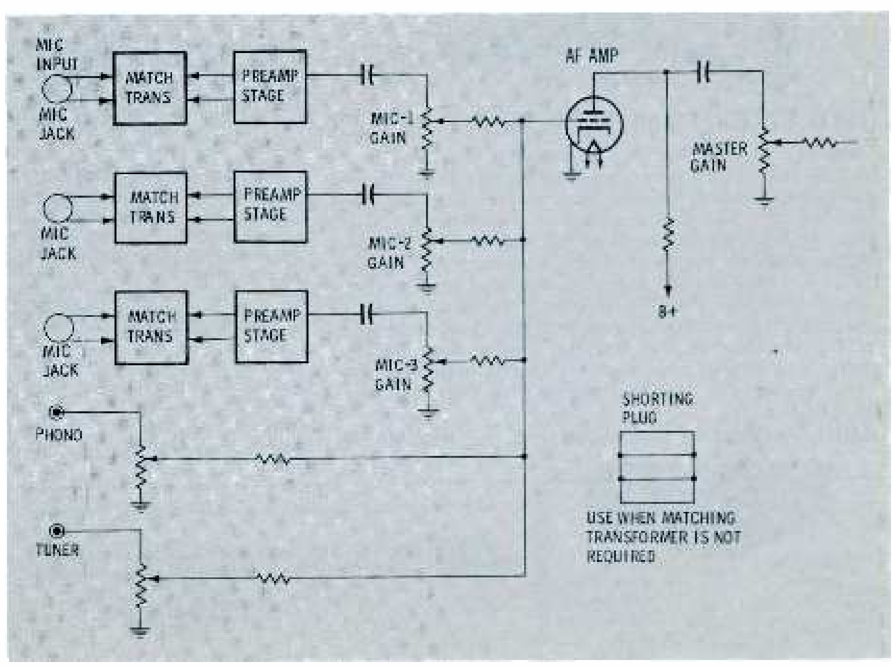


Fig. 1. Diagram of hook-up for multiple inputs and individual gain controls.

output circuits — constant impedance and constant voltage—but the number of output jacks may vary widely. Some amplifiers are equipped with several jacks so that a number of speakers, each equipped with the proper plug, may be connected directly into the amplifier. This is a valuable feature when the amplifier is to be used in a small system that employs only two or three speakers. It is also very useful in systems that require speaker cables to run in several directions.

If the proposed PA system requires adjustable output levels at one or more speaker locations, the amplifier chosen should have provisions for constant voltage output. This eliminates the power-consuming T and L pads which would otherwise be required.

When a tape recorder is to be included in a system, the PA amplifier should have some provision for supplying the recorder input with a suitable audio signal. Some amplifiers have an output jack for this purpose. If an otherwise acceptable amplifier does not have such a jack, one can be installed very easily. Simply mount a phone jack on the amplifier and run a shielded cable from it to the top of the volume or MASTER GAIN control as shown in Fig. 2. This places the input of the tape recorder in parallel with the volume control; however, the recorder input has a very high impedance and will not adversely affect amplifier operation.

Frequency Response and Distortion

Voice communication can be handled very nicely by an amplifier with frequency response limits of 200 to 3,000 cps. In fact, reducing amplifier response to this range is actually desirable for clarity in reproduction. Distortion is another

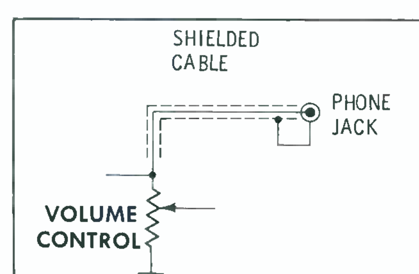


Fig. 2. Recorder jack connects to top of volume control via a shielded cable.

matter. Even though this narrow band of frequencies is best for voice transmission, a small amount of hum or harmonic distortion can play havoc with understandability of speech.

An amplifier should have a minimum frequency response range of 50 to about 12,000 cps if it is to be used for music distribution. Response at frequencies above or below these limits is not required in PA work, since allied equipment normally used will limit the system to this range anyway. Again, distortion (either intermodulation or harmonic) must be kept low if best results are to be realized. Generally speaking, intermodulation and harmonic distortion should be less than 5% and 1%, respectively, at rated power output.

Normally, PA systems are used for both paging (voice transmission) and music distribution. The bass and treble controls can be adjusted to provide either the narrow response desired for voice work, or the wide response desired for music distribution. The controls should be set at minus-6 and minus-8 positions for voice amplification, or at plus-4 and minus-4 positions for music (see Fig. 3 for details).

Other Considerations

Naturally, all PA installations won't be in small auditoriums, nor will they all require multiple microphone inputs. The small office or business will probably need only one microphone input, and one other input for phono or tuner. Also, power requirements for small systems are fairly low. Generally, the PA amplifier that has single mike and phono inputs will have an output rating of 6 to 10 watts. Naturally, lower-powered units use single-ended power output stages, and often are rated at peak power rather than average power output. For permanent installations, a push-pull amplifier is desirable. Distortion levels in single-ended units are higher than is normally tolerable. The small low-power amplifier is most useful as a portable unit for occasional or emergency use.

A PA amplifier with only two inputs can serve systems that require microphone, phono and tuner inputs, provided the tuner used has a phono

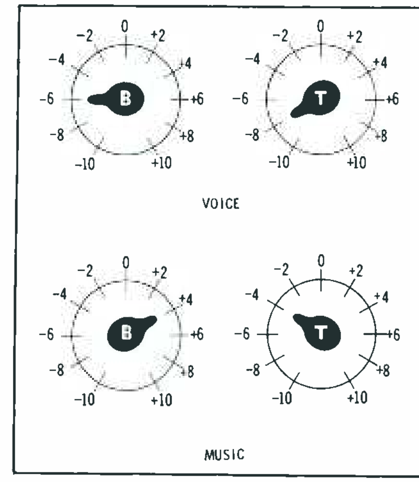


Fig. 3. Typical settings of tone controls for voice and music distribution.

input jack and facilities for selecting either phono or tuner operation. A system connected in this manner would appear as shown in the block diagram of Fig. 4. In fact, this system is the type most often employed in small offices or business places. Electrically, the amplifier mentioned above has controls for volume, bass and treble; high-impedance, high-gain mike inputs and additional inputs for phono or tuner; output impedances of 4, 8, 16, and 500 ohms; and a 10-watt push-pull output stage.

A final point to consider when choosing a PA amplifier is whether or not the unit will be used in mobile operation. Any amplifier that is to be powered from a low-voltage DC supply (6-, 12-, or 24-volt battery) should have either a built-in DC-to-AC converter, or else the necessary provisions for operation from an external converter. For most temporary mobile applications, a 10- to 20-watt amplifier will suffice. Frequency-response characteristics, number and type of input and output circuits, and other requirements will be generally similar to those of a fixed PA system of compact size. ▲

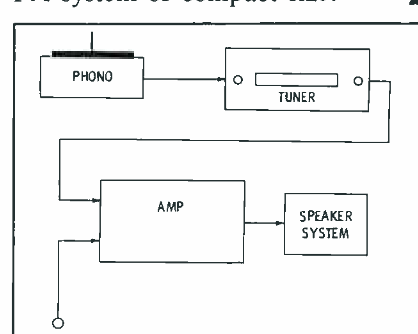


Fig. 4. How a phono, tuner, and mike can be used with dual-input amplifier.

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Type Load . . . . Any
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DOLLAR & SENSE *Servicing*

by Thomas A. Lesh

Santa's Helper. Christmas shoppers, always short on gift ideas, welcome suggestions for unusual and practical items to please their relatives and friends. As the holiday season gets into full swing, there is a tendency for people to buy almost anything (within reason) which strikes their eye.

All too many owners of "strictly service" shops pass up the chance to share in the business boom during this most generous spending season of the year. Perhaps it's because they don't realize what an excellent gift their stock in trade— service — can be. Taking a cue from the department stores, why not offer a Christmas gift certificate? It could be for a stated value to apply against the cost of service work as needed. One of the most appealing ideas along this line would be a "new picture tube for Christmas" theme.

Fulfilling these gift promises, by the way, would help keep business lively during the after-holiday period.

Some "gifts of service" can be performed beforehand and unveiled to the lucky one on Christmas morn. For example, a serviceman could install a personal, earpiece-type speaker for a hard-of-hearing or late-viewing member of the family, hiding it behind the set until the time arrives for it to be revealed. Or an old, neglected second set could be sneaked out of its dark corner during December and restored to top condition—"for your own room, dear" — by Christmas-time.

If your shop now sells radios, TV sets, hi-fi and accessories, you are already loaded with gift opportunities. If your store window is not yet decorated with an appealing holiday display, your trucks aren't carrying bright signs offering gift suggestions, and your ads haven't adopted a holiday theme— it's time to "get with it!"

For the service specialist as well as the store owner, there are still more ways to spread the news about holiday gift ideas. For instance, the serviceman on each home call can casually mention "service specials" being offered. The service bill itself can even carry a printed note: "Ask about our 'new picture tube for Christmas' gift plan," "Come in and see the latest portable stereo sets," or simply, "Smith's — Christmas gift headquarters."

$ & ¢

Switcheroo. Want to attract attention to an outdoor or window sign while having it painted? Try the whimsical idea put to use on a new billboard by a local firm. When the first coat of paint was applied, one letter — the "R" in the word *fresh* — was painted in backwards. It was left this way for a few days, and then the painters came back and corrected the "R" — but this time reversed the "E" instead. After several more days during which the sign received hundreds of puzzled "double-takes" from passers-by, the painters finally straightened out the sign for good.

This type of crazy mixed-up sign should be professionally painted; if it looks homemade, prospective customers may miss the point and decide that you really don't know any better.

$ & ¢

Skin Deep. Some TV dealers encourage their service technicians to insert the opening wedge for new set sales whenever the opportunity occurs. This often works out well, since the customer who asks a technician about TV sets expects to get an impartial, well-informed opinion instead of a sales talk.

Let's imagine that we're looking in on a serviceman in this situation. The customer has just asked in an offhand way, "What kind of set do *you* think is the best?" Our hero replies shrewdly, "Well, I've always liked a "Zapperino" because they give less trouble than any other brand I've worked on." (This just happens to be one of the major

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brands sold by his shop!) He goes on to brag a bit about the transformer-powered chassis in the latest "Zapperino" consoles.

Then, the customer, perking up at the thought of such a fine set, inquires, "Do they have any models that would look nice in this room?" Oh-oh! If the customer pursues this line of questioning, he'll have our technician friend out on a limb in no time. The poor guy is like most of us; he seldom pays any conscious attention to the outside of a TV receiver except when he's trying to get the cabinet out of the way of the chassis. And here stands the customer, all set to drown him in a sea of questions such as, "Is there a '990' chassis in that neat lowboy with the wrought-iron legs that I saw in a magazine? Can I get it in blond wood? Would the top of it line up with my bookcase? And say, does their new glass fiber cabinet on the portable set resist cigarette burns?"

We don't recommend that all TV technicians take a course in interior decorating — but those who are seriously interested in promoting set sales would be smart to know plenty about "appearance" features. The easiest solution is to be well-armed with illustrated brochures that will tell the prospective customer whatever he wants to know about styling features.

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Big Brother. You don't have to be a Boy Scout leader to work with young people in your community. As an electronics expert, you have something special to contribute. You're right in the midst of a field which fascinates many youngsters, and you could do them a good turn by helping them pursue electronics as a hobby. Perhaps you could spend some spare time "coaching" them on construction projects; or, if you have the patience to answer a flood of questions, you could let them know they're welcome to drop in during your off hours for an occasional bull session.

When you carry on your own particular type of "youth activities," you do everyone a favor. Besides staying busy on something worth while, the kids also get an early start on the technical education which will help them hold down responsible jobs sometime in the future. Your efforts benefit the electronics industry as a whole, since you'll undoubtedly influence several capable young people to choose this field for their life's work. There's something in it for you, too. In addition to the deep satisfaction you get from helping others, you are building good will for your business and establishing yourself as an important member of your community. What's more, it could be part of the answer to your trained-help problem.

$ & ¢

Ham Pals. When you promote cordial and friendly relations with your neighborhood radio amateurs, you are tapping an impressive source of immediate and potential business — particularly since hams are an ever-growing group.

For one thing, most hams (like other people) are TV set owners. And, while some of them may have sufficient electronic "know-how" to take care of minor and obvious troubles with their own sets, they more often have definite limitations in their shop equipment and special-

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Model A-104 — 4 set coupler, list 4.50; Model A-105 high-low antenna list 3.50; A-107 UHF-VHF Mixer, list 3.50; A-100 Outdoor Mounting Kit, list 90¢

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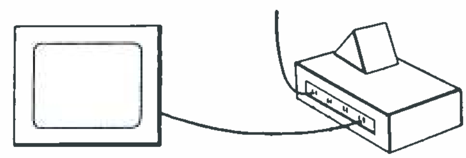
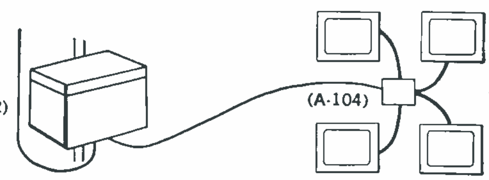
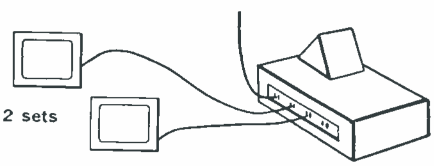
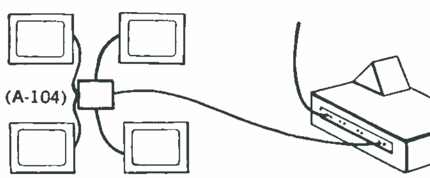




PRIME SIGNAL AREA





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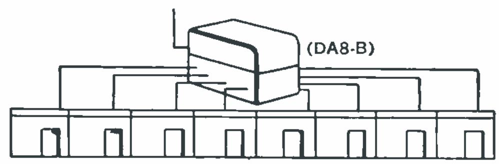

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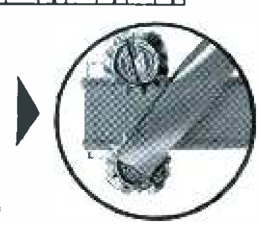

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hi-fi components • UHF converters • master TV systems • industrial TV cameras • FM-AM radios ized knowledge. Thus, the average ham will more than likely seek professional TV service. Does he come to you? Not if he doesn't know you! Through contacts with other hams, he soon locates a TV man who has been a "good Joe" and has been doing a satisfactory job. Then business which could have been yours is taken elsewhere — perhaps even out of town.

Of course, TV sets aren't the whole story. Every ham worth his salt either *has* a good communications receiver or is feverishly hoarding his shekels to buy a better one. He generally has the knowledge, ability and shop facilities to care for his receiver to the extent of replacing damaged components, but he is likely to need expert help in performing alignment and similar operations which call for more test equipment than the average ham shack boasts. If you can do such jobs, let your local hams know it; a few satisfied customers will spread the word. To save time and trouble, be sure to have hams bring factory instruction books for their communications radios along with the sets themselves. Another tip: encourage their friendship by inviting them to participate in the work.

Your potential ham business does not end with the ham himself; almost invariably, his non-technical friends and neighbors will appeal to him for help in repairing their ailing radio and TV sets. Many hams hesitate to do more than "look at it"; in many cases, they will say they are not equipped to do the actual repairs, but will recommend an established shop. Will the shop they recommend be *yours?* It could be!

Make hams feel welcome; if you have the facilities, perhaps you could even offer them a place with a suitable "electronic atmosphere" to hold club meetings or training sessions. Your local hams would *like* to be your friends; *make* them so, to your mutual benefit.

$ & ¢

Time Tip—IV. A TV set with an intermittent trouble is like a spoiled child; it tries to hog your attention and distract you from your other work.

Why not treat this type of receiver like the brat it is? Ignore it when it stubbornly refuses to act up—let it sulk in the corner until you can deal with it more effectively. Go ahead and do your regular work, rather than waste time on anything more than routine efforts to make the trouble appear. But watch the wayward set out of the corner of your eye, and pounce on it when it finally decides to cooperate.

You're probably thinking, "I'd like to let that intermittent sulk, but then how would I keep the *owner* of the set from sulking, too?" Well, that depends on the individual customer. If he is at all reasonable, be frank with him. Explain that the set can't be properly analyzed except when the trouble is actually present. Some of the public will understand your problem and will agree to let you take the time needed to complete the job.

If someone unreasonably insists on a quick repair of an intermittent trouble, we wouldn't blame you for turning down the job. Without adequate time to test the receiver thoroughly on that first trip to the shop, you'd be leaving yourself wide open for a series of embarrassing and profitless callbacks.

check that TEMPERature

by Calvin C. Young, Jr.

When returning a color set that was recently in the shop for bench repairs, I checked color reproduction with a color-bar generator and found it to be satisfactory. At this time (the set was turned on for only a very short while), it seemed that color temperature and convergence were good, so no further adjustments were made. I collected for the repair and left. Needless to say, I was somewhat disturbed when the customer called the next day and complained that the colors were all wrong. In the customer's words, "the grass is blue and people's faces are murky." The customer requested that another call be made during a color transmission so I could see for myself. The next color program was at 7:30 that evening, and an appointment was made for that time. Arriving about 7:15, I began to make several preliminary tests. Operation of the various controls was checked, using the received black-and-white signal and the color-bar generator. It was noticed that a good black-and-white picture could be obtained if the brightness and contrast controls were judiciously adjusted. At low brightness settings, however, the picture took on a bluish hue. At higher settings, everything was tinged in green.

However, since it was time for the colorcast, the program was tuned in and the set adjusted for the best hue and color levels. Again, I found that by very careful adjustment of the brightness, contrast, hue, and color controls, an acceptable picture could be obtained on close-up scenes. But when a distant scene was shown, the grass appeared blue instead of green!

For the next 20 minutes, I carefully readjusted the color temperature controls for correct black-and-white balance. In simplified terms, the procedure consisted of adjusting screen controls for gray values at normal brightness settings, and adjusting the background controls for gray values at low brightness settings (see Fig. 1). The procedure was repeated several times until the balance was maintained during normal variations in brightness and contrast control settings.

Now that this tedious task was over, I tuned in the station with the scheduled colorcast but, alas, the program had just ended. Fortunately, another was to start in a few minutes. While waiting, I couldn't help but worry and wonder, "Did the adjustments do the trick?" When the program came on, my worries were over. The picture was excellent, and, the customer was very pleased.

Needless to say, a thorough check of black-and-white balance is now a regular part of my color servicing procedure.

Home Call Can't Be Completed

On a recent call for a "no raster" condition, the customer insisted the set be fixed in the home. By asking the usual preliminary questions, I obtained an idea of how the set had failed. After removing the rear cover and plugging in my "cheater cord," I attempted to draw an arc from the 6BQ6 and 1X2B plate caps with a screwdriver. Getting nary a spark, I disconnected the power cord and tested the fuse. As suspected, it was open. After a VOM check of resistance from both sides of the fuse holder to chassis failed to reveal a short, I installed a new fuse.

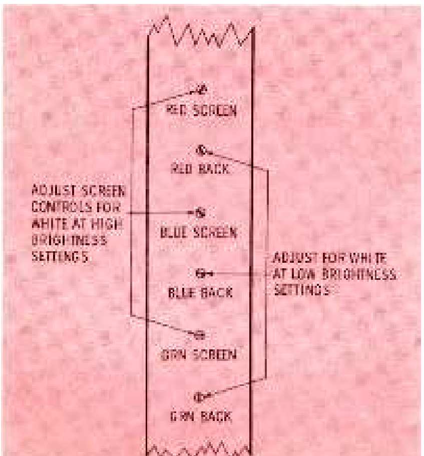

Fig. 1. Controls which are adjusted for proper black-and-white picture balance.

When AC power was applied, the picture and sound both came on, but the picture wasn't too good. While I was checking the various horizontal sweep circuit adjustments, the picture started to shrink horizontally. Replacing the horizontal output tube cured this defect, and told me why the fuse had blown.

At this point, the set had been repaired for the defect the customer complained about — yet it wasn't *fully* repaired! The sound still had an annoying buzz, and the picture quality was poor. Touch-up adjustment of the ratio-detector transformer secondary had no effect on the buzz. Feeling that improper AGC action might be causing both the poor picture and the audio buzz, I decided to check the tuner, video IF, and video amplifier tubes for leakage and gas. Surprisingly enough, all of the tubes checked good — no leakage, no gas, good Gm.

Since the receiver was being operated on an outside antenna system, orientation of the antenna was checked. While some improvement was gained by turning the antenna slightly, picture and sound still weren't up to par.

Armed with all the facts—good tubes, proper antenna orientation, poor picture, and buzz in sound—I was convinced the set needed a trip

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Blue Chip Quality TUBES • TRANSISTORS • DIODES to the shop. Preparing myself for the worst, I simply told the customer exactly what I thought was wrong with the set and that it could only be repaired in the shop. To my surprise, the customer countered with, "Can you make the picture and sound good again if you take it into the shop?" Carefully explaining in layman's terms that the set required realignment, in addition to repairs to the AGC network, this customer was given my personal assurance that the job could be done. The customer okayed the shop repair without even a mention of price—and this was a brand-new customer, too!

Why? It's simple enough. My actions were convincing, and the customer quickly realized I had tried everything possible. Furthermore, the equipment I carried made it look as though I had every intention of fixing the set in the home. A brief explanation of the additional equipment needed for the job was the clincher. And payment for the job was made on delivery—with a smile and a thank you as well.

Printed Board Problem

A customer brought in a portable phonograph outfit and complained that it had suddenly gone completely dead. There were three tubes in the unit but, as luck would have it, they all checked good.

After visual examination failed to reveal any burnt resistors, etc., I applied AC power. Allowing a few seconds for warm-up, I turned up the volume control and touched my finger to the "hot" lead of the cartridge. Absolutely no sound came from the speaker.

A completely dead set usually means an open winding in the speaker or output transformer, so I next checked for plate and screen voltage on the output stage. Normal voltage at the screen and none at the plate

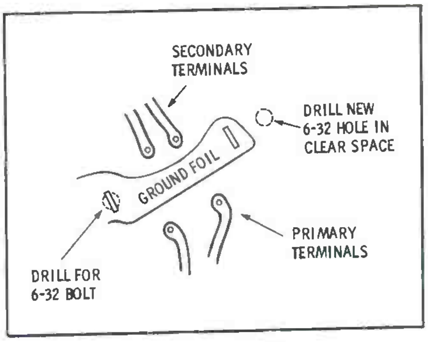

Fig. 2. Layout of printed board section modified to mount a new transformer.

meant only one thing—an open output primary. An ohmmeter test verified this and likewise eliminated the possibility that a short had caused the failure.

Now came the real problem. The service literature didn't list any standard replacement for this transformer. Furthermore, special spear lugs were used to mount the original to a printed board. Since I knew the customer would be unhappy at having to wait until an original replacement could be obtained, I decided to try my luck at installing a universal unit we had on hand.

Checking the printed board, I figured out how the new unit could be securely mounted. As shown in Fig. 2, I could drill out one of the original mounting holes so it would accommodate a 6-32 screw, and drill a new hole through a clear spot on the board. The flexible primary leads could be soldered to the original connection points without any problem. The secondary connections were another matter, however, since the replacement had several secondary lugs rather than wire leads. This matter was resolved by soldering wire leads from the proper lugs to the secondary terminal points on the board. Correct secondary impedance was determined from the specifications for the speaker in the replacement parts list, and by checking the speaker hook-up. Since, in this case, two four-ohm speakers were connected in series across the secondary of the output transformer, the replacement unit was connected to provide the necessary 8-ohm secondary impedance. A subsequent operating test confirmed the soundness of the repair.

The moral of this story is—don't get flustered because a part mounts to a printed board. Very often standard parts can be installed without too much trouble. ▲

THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

Skip-Mute

The muting switch on an RCA Model 3-HES-5 record changer is not working properly. It checks all right electrically, but its contacts never close during any part of the change cycle. How is this switch supposed to be tripped?

D. J. RECKTENWALD
Seattle, Wash.

An arm or projecting bar on the slide mechanism (under the turntable) is supposed to strike the muting switch during the change cycle, thereby grounding the output lead of the phono cartridge. Better check to see if any part of this mechanical linkage is bent or broken.

Sorry we couldn't send you a personal reply to your question, but you didn't furnish your complete address.

Juice Hog?

The owner of a Motorola Model 56T1 transistor radio complains that the battery runs down too fast, and only strong local stations can be picked up.

Checking voltages against those given in PHOTOFACT Folder 339-12, I find them all normal except on the converter transistor, a 2N172. The collector potential is normal; however, I measure .8 instead of 1.1 volts on the base and .7 instead of 1.1 volts on the emitter.

ALFRED WOODHAMS
Kalamazoo, Michigan

The 9-volt battery in this miniature set cannot be expected to last indefinitely. The receiver draws approximately 6 ma at full volume; according to battery specifications, only about 15 to 60 hours of actual operation should be anticipated at this level of current drain. (Service life varies according to several factors such as volume setting, operating temperature, and whether usage is continuous or only for short periods.) Thus, the receiver is probably normal unless a milliammeter in series with the positive lead of the battery indicates over 6 ma with the radio running "wide open." If you do find excessive current drain, look for such troubles as leaky filter capacitors across the power supply.

The slightly off-value voltages on the converter transistor are probably no cause for concern. DC potentials on the converter can be affected by several variables such as oscillator injection voltage, random noise fed in from the antenna, and differences between individual transistors.

You might be able to improve the sensitivity of the radio by slightly touching up the alignment.

Mysterious Fadeout

A DuMont Model RA-162 is plagued with an intermittent loss of raster, accompanied by a slight loss of width on the right side just before the raster fades. The horizontal output tube evidently loses heater voltage, since it goes dark when the trouble occurs. At first, I thought the trouble was nothing more than an intermittently-open filament in the tube; however, replacement with a

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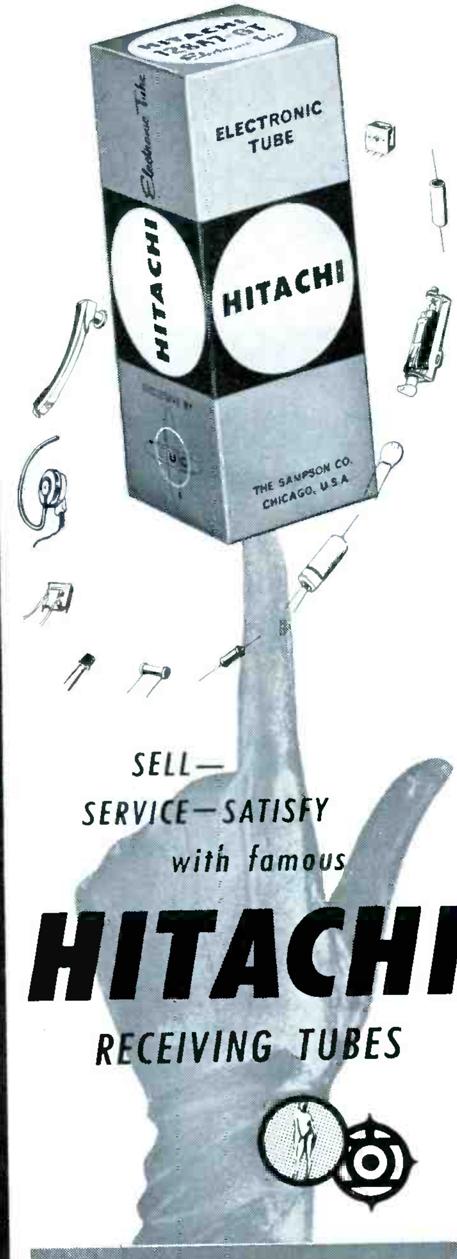

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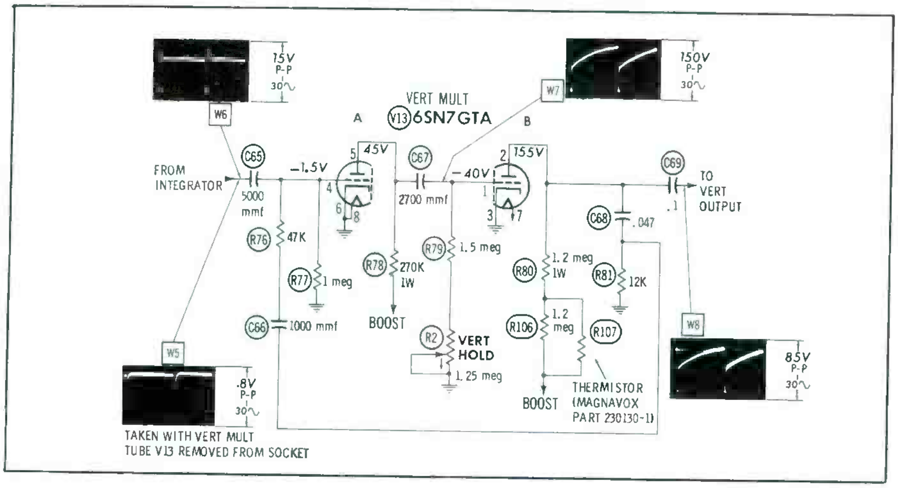

new 6CD6 did not cure the defect. The power-transformer winding which supplies filament voltage to the output tube is apparently in good condition, since two other tubes connected in parallel across this same winding continue to receive voltage after the 6CD6 goes out. Measurement of filament voltage at the 6CD6 socket, with the defect present, showed that proper voltage was available. The socket was replaced, but the trouble still exists. Although the drive waveform on the grid is normal at all times, the DC voltage drops to about half of normal because no current is flowing in the output tube. Mechanical jarring of the ground and filament leads at the 6CD6 socket does not cause the symptom to appear.

ROBERT W. GREGWARE
Troy, N. Y.

You've made just about every possible test; offhand, I can think of only one more which you may not have attempted. This is to resolder the chassis ground connection of the lead going to the bottom side of the 6CD6 heater (pin 2 of socket). If this solder joint developed an intermittent high-resistance condition, filament voltage would be removed from the output tube; but you would still measure 6.3 volts AC from the high side of the 6CD6 filament to chassis ground.

Sync Almost Lets Go

Vertical sync in a Magnavox 250 Series receiver is critical; the picture slips a frame every now and then. Routine troubleshooting tests, including replacement of the integrator, have not improved operation. I don't fully understand this vertical oscillator circuit (which has a number of unusual features), and would appreciate a little explanation. For example, what is the purpose of C66 and R76?

M. J. MOLINA
Chicago, Illinois

This set has a modified type of plate-coupled multivibrator which operates independently of the vertical output tube. Although this arrangement is not employed too often, it is based on the first and simplest type of multivibrator circuit taught to students in TV training courses. The plate of each section of V13 is coupled to the grid of the opposite section through an RC network. This cross-coupling sets up a feedback action which causes the halves of V13 to "take turns" conducting; in other words, the circuit breaks into oscillation.

V13B remains cut off all through the vertical trace period, and sawtooth-forming capacitor C68 slowly charges from the B+ boost supply to develop the output drive waveform W8. The hold control serves to vary the discharging time constant of the RC network at the grid of V13B, thereby regulating the length of the trace period so as to control the frequency of oscillation.

At the end of trace time, V13B suddenly conducts and discharges C68. A negative going retrace pulse then appears in W8, and a spike of negative voltage is fed back through C66 and R76 to the grid of V13A in order to cut off the latter tube. V13A remains in the "off" state until its grid-circuit network becomes sufficiently discharged to let the tube resume conduction. At that time (the end of the retrace period), V13B is once again driven into cutoff.

Incoming sync pulse W5 is a negative spike which helps to achieve cutoff of V13A at the beginning of vertical retrace. Actually, cutoff occurs a little sooner than it would if no sync pulse were present. Therefore, if the sync signal is momentarily interrupted (as would happen during camera changes, between commercials, etc.), even a normally-operating vertical oscillator might temporarily slow down enough to cause one or two frames of vertical rolling.

If intermittent frame-slipping cannot be explained by fluctuations in the sync signal, you may assume that the oscillator is slightly unstable. This trouble is unlikely to be solved by voltage measurements or ordinary component-testing procedures; a better approach is to check resistors and capacitors (and the tube!) in the oscillator circuit by substitution.

There has been a production change in this chassis series, involving R80, R106 and R107. The schematic shows the most up-to-date version, which you might find advisable to install.

Pop Goes the Transistor

The output transistor in an auto radio sometimes becomes shorted because of a simple, easily overlooked defect in the radio or in the car's electrical system. We have recently heard several interesting reports of such troubles.

In a number of '58 Ford Model 84BF receivers, the cause of transistor burnout has been traced to the bias potentiometer in the audio output circuit. The case of this unit (which is grounded) has a hole on one side, and a terminal lug for the "high" end of the pot is brought out through the gap. In some receivers, there is insufficient slack in one of the leads attached to this lug. The lead thus exerts a constant sidewise pull on the lug, which eventually becomes shorted to the case. When this happens, the transistor's base is grounded — so it burns out. Next time you work on one of these radios, check the bias-pot leads

"Lord, what a day!"

and lengthen them if necessary.

Another '58 Ford radio had similar trouble symptoms for an entirely different reason—strictly automotive this time. When the radio would not play in the car after being repaired, the battery polarity was checked and found to be reversed! Come to find out, the battery was incorrectly marked; the + sign was at the wrong end. For this reason, it had been installed backwards when the car was built. The glow of the red NOT CHARGING *dash light caught the eye of the mechanic who inspected the car upon delivery. Deciding that the generator was incorrectly polarized, he "corrected" it. The generator then agreed in polarity with the battery; but, unfortunately, both were wrong.*

Another case of wrong polarization, involving a '58 Oldsmobile, came to the serviceman's attention when he noticed that the blower motor of the heater was running backwards and sucking air out of the passenger compartment.

Polarization, which takes place during the manufacture of the generator, provides its field with enough residual magnetism to enable the unit to start charging as soon as it goes into service. Normally, repolarization is not necessary except when the generator field is rebuilt; but, if you ever have to perform this service, you can do so by disconnecting the FIELD *and* BATT *wires from the voltage regulator (with engine off!) and momentarily connecting them together. This serves to remove the residual magnetism from the generator field and allow it to build up in the opposite direction.*

Fuse Clues

In one of your early columns, we notice that Frank Szwanek reported having trouble with repeated failures of the fusible resistor in an RCA Model 17D8185 for no apparent reason. We found that the original 5-watt resistor (RCA stock number 100151) overheats because of its closeness to the 17AX4 and 17DQ6. By replacing the original with a 100117B, rated at 7 watts, we found that we could eliminate the failures. We also understand that the 3/10-amp, L-type fuse should be replaced with the new chemical fuse, number 105042.

In regard to E. J. Carolan's trouble with fuse failure in a Model 21D8588, the vertical output tube current passes through this fuse and can cause repeated fuse failure if excessive. Even if the vertical circuit is OK, however, the original 3/10-amp fuse should be replaced with the number 105042 chemical fuse as mentioned above.

JOHN NOWAK,
Service Mgr.
Shelborne Electronics, Inc.
Wilkes-Barre, Pa.

I hadn't seen this field service information at the time I answered the above letters. Thank you for bringing us up to date.

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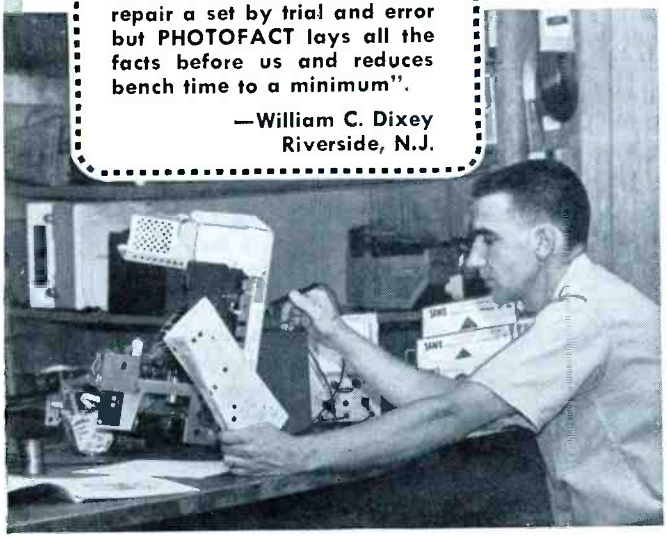

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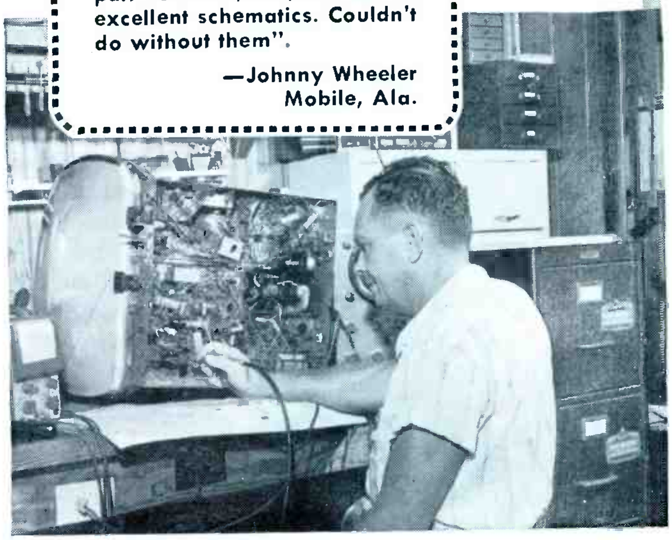

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Class A AMPLIFIERS

Their use in power and voltage circuits accounts for over half the stages in a TV set.

Did you know that most of the circuits in a TV or radio receiver are class-A amplifiers? We have the RF amplifier in the tuner, video IF amplifiers, sync amplifiers, video amplifiers, the entire audio section (IF, amplifier and output), and the sweep amplifiers. Some of these are designed for voltage amplification, while others are power amplifiers. A better understanding of these two types of circuits will help you become master over a large percentage of the circuits in any TV or radio receiver.

Voltage Amplifiers

A class-A voltage amplifier stage generally employs a triode or a pentode biased so that the input signal never drives it into saturation or cutoff (See W1 of Fig. 1). The tube operates on the linear portion of its Eg-Ip curve (Fig. 2), and the signal is thus amplified without becoming distorted.

Class of operation is but one aspect of voltage amplifiers. Other factors are just as important; namely, supply voltage, applied signal voltage, plate- and grid-load impedances and characteristics of the tube itself. In order to explain how and why these factors are important, we'll use RC-coupled audio amplifiers as examples; however, the principles outlined will also be applicable to other types of class-A amplifiers. Let's select a common audio amplifier tube, say the 12AX7, and use it in the standard circuit of Fig. 1. The values shown were taken from the circuit of an often-used circuit. Using these and the 12AX7 specifications listed in the tube manual, let's figure the gain furnished by this stage.

Incidentally, you may be wondering why the grid-load resistor of the 12AX7 is missing. Well, it's because its value has little or no effect on the gain of this stage. Voltage gain is a function of the mu and internal resistance of the tube, and load impedance. Load impedance of a voltage amplifier depends on the values of Rp, C and Rg. Consult the simplified diagram in Fig. 3 and note that C and Rg are in series, and they, in turn, parallel Rp. This combination makes up the total load impedance Zo of this stage. (Rp does not actually connect to chassis ground but to signal ground via the B+ filters.)

The voltage gain of a triode at mid-audio frequencies may be found using the formula,

$$VG = \frac{mu \times Zo}{Zo + Ri}$$

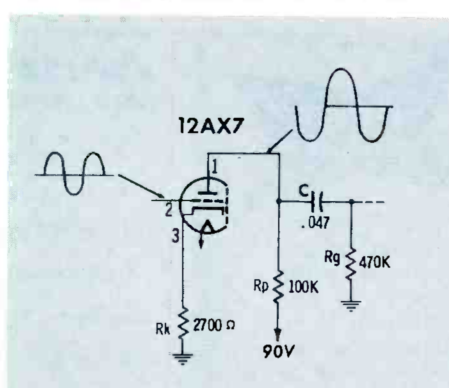


Fig. 1. Parallel combination of Rp and Rg form the total load impedance Zo.

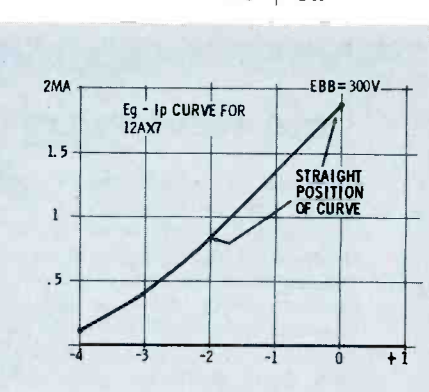


Fig. 2. Linear portion of Eg-Ip curve for 12AX7 tube with 300-volt plate E.

where Ri is the internal plate resistance of the tube, mu is the amplification factor of the tube, and Zo is the equivalent output load impedance. The impedance of C is insignificant above a few hundred cps; thus, output impedance is the equivalent of Rp and Rg in parallel, or 80.5K ohms. The tube manual lists mu as 100 and internal plate resistance at 80,000 ohms. Substituting these into the formula, we find that VG = 50.

Thus, using a tube with a theoretical gain factor (mu) of 100, we actually achieve a stage gain of 50. The full potential isn't realized because to do so would mean the tube would have to be driven from cutoff to saturation, and serious distortion would result.

Frequency Response

We mentioned that the impedance of C could be ignored for mid-audio frequencies; however, it cannot be ignored at very low frequencies. This follows since the signal voltage developed across Rp must be coupled through C to Rg, and if the impedance of C is high, an appreciable amount of signal will be developed across it, thereby reducing the signal across Rg.

High-frequency response is governed by the input capacity of the following tube, the output capacity of the amplifier tube, and the stray wiring capacity in the circuit, all of which effectively shunt the plate load (Fig. 4).

If we assume that the following stage uses a 6V6GT power amplifier and that there is about 10 mmf of stray wiring capacity, we find that the total shunt capacity is approximately 20 mmf. Its impedance at 20 kc is approximately 398K ohms. Being in parallel with Rp and Rg, it effectively lowers the plate-load impedance of the circuit at the higher frequencies. The mathematics required to calculate the exact load impedance at high audio frequencies is complex and will be omitted; it is only necessary that you understand the factors limiting the high-frequency response of a circuit.

Now let's apply this theory to a practical circuit—the audio section of a TV receiver. As is seen in Fig. 5, the high frequency response has been purposely limited by the installation of a 43-mmf capacitor from the plate of the 6T8 amplifier to ground. This capacity, added to the 20 mmf normally contributed by the tubes and the wiring, results in a total of 63 mmf, which has a reactance of about 170K ohms at 15 kc. Since the effective load impedance at mid-range is the parallel arrangement of Rp and Rg, or 235K ohms, it can be seen that the load has been effectively lowered at 15 kc by the shunting capacity. This lowering of load impedance means a reduction in the high-frequency gain of the stage. This is desirable in this case since the low-frequency response of the speaker (a 5″ or 6″ unit) is very poor, and reduction of the high-frequency gain helps to equalize the ratio of "highs" to "lows." The listener is thereby given an illusion of better fidelity.

Driving Signal

It was previously stated that the grid signal couldn't be permitted to drive the grid into conduction or cutoff; and, as we continue, the reasons for this will become clear.

Let's get back to the Eg-Ip curve

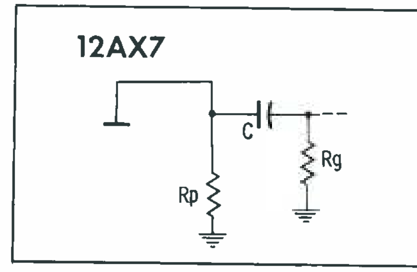


Fig. 3. Simplified load circuit class-A amplifier consists of Rp, C, and Rg.

mentioned very briefly at the beginning of this article. You are probably wondering just where this curve was obtained, since it isn't given in the ordinary tube manual. Well, the data from the average plate-characteristic chart in a tube manual was transferred to graph paper as follows: Consult the curve in Fig. 2 and notice that plate current is plotted vertically, while grid voltage is plotted along the horizontal axis. Since zero bias will produce higher plate current than a more negative bias, the zero bias point is located toward the right side of the graph. At equally spaced points along the horizontal plane, graduations corresponding to the bias curves from the tube manual are marked. Since 300 volts is the value of B+ often used to supply a 12AX7 stage, follow straight up the 300-volt line in the tube manual chart and plot plate-current flow for each bias voltage. You should find that current is 1.9 ma with zero grid volts, 1.4 ma at -1 grid volts, .85 ma at -2 grid volts, .4 ma at -3 grid volts, and .1 ma at -4 grid volts. Connect the points thus obtained and you have the Eg-Ip curve, or transfer curve as it's often called. The curve between -2 volts and 0 volts is linear, since for a given vertical change along this portion there will be an identical horizontal change.

Practical Applications

The 6AT6 voltage amplifier, with a plate-load resistance of 100K ohms and a grid signal of 2 volts, can produce an output signal of 75

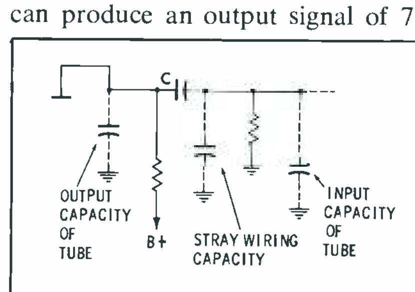


Fig. 4. Input, output, and stray capacitances limit high-frequency response.

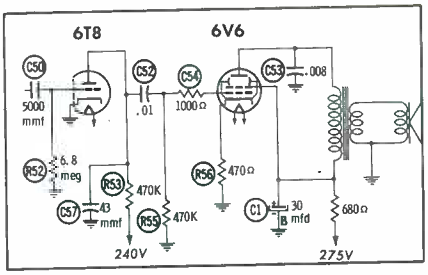


Fig. 5. Typical single-ended power amplifier circuit showing part values.

volts p-p if the DC supply is 250 volts and bias is -2 volts. From tube manual data, we can see that this exceeds the 8.5 to 12.5 volts p-p required to drive a single 6V6GT to full output. This explains why the sound on a TV receiver will distort when the volume control is turned to maximum.

Now, you may ask, "Why is this excess gain built into an amplifier?" It's possible to hold the output signal down to the required level by simply adjusting the volume control; however, there is no control to make up for lack of signal. This high gain factor is very useful in fringe areas where the signal at the grid of the audio amplifier is much less than 2 volts p-p.

Power Amplifiers

A few power-amplifier circuits will employ power triodes; but, because a pentode or beam-power tube has a much greater power sensitivity, most will employ one or the other of these. Power sensitivity is the ratio of signal power input to signal power output. Let's look at a couple of examples to emphasize this point. Using data from the tube manual, we find that 8.5 volts of audio signal is required to drive a 6V6GT to its full output of 2 watts. We know from experience that 470K ohms is a standard grid load for a 6V6, and we know from basic theory that power equal E^2/R, so we can readily determine that .154 milliwatts is sufficient to drive the tube to the limit.

Now let's look at a similar case with a 2A3 power triode. Again using data in the tube manual, we find that 45 volts of audio signal across a grid load of 500K ohms is needed to produce a maximum audio signal output of 3.5 watts. Thus, if we square 45 and divide by 500K we find that 4.05 milliwatts is required to drive this power triode to full output. Now if we divide the output power by the input power in each case, we will have a comparison of the power sensitivities of these two tubes. For the 6V6GT, it is almost 13,000 while it is only 864 for the 2A3.

The chief advantage of the power pentode or beam-power types over the power triode is, therefore, much greater power sensitivity. Power pentodes have only slightly less power sensitivity than their beam-power equivalents.

We previously stated that voltage amplifiers employ plate-load impedances of fairly high values, (about 100K ohms) and that plate current is normally on the order of a few ma. In power amplifier circuits, just the opposite is true; i.e., low-impedance plate loads are employed and plate current is high (on the order of 35 to 50 ma for a single-ended stage and higher for push-pull stages). With the exceptions of the low plate-load impedance, high plate current, and large grid signal, the single-ended power amplifier operates much the same as a voltage amplifier.

There is one other point we should make about single-ended power amplifiers, and that has to

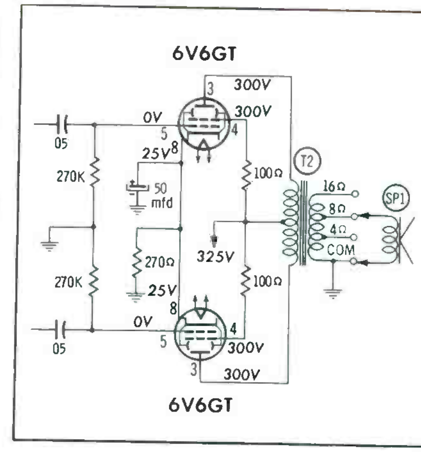


Fig. 6. Push-pull circuit provides three times the power of single-ended stage.

do with frequency response. The factors that affected frequency response in voltage-amplifier circuits also apply to power amplifiers; however, there are a couple of other factors which must also be considered. These are the frequency-response characteristics of the output-load impedance and the effect of the cathode load.

The audio-output transformer (the usual load impedance for an audio power stage) seriously affects the frequency response, and in all but expensive hi-fi units, the output transformer may actually limit the response to a range of 200 cycles to about 7 or 8 kc. This is considered adequate for voice and popular music and will be completely satisfactory to most customers.

Referring back to Fig. 5, you will notice that the cathode load resistor is not bypassed. The signal developed across it is 180° out of phase with the grid signal, reducing the gain of the stage slightly. At the same time, however, this helps improve frequency response since it tends to flatten the gain-versus-frequency curve.

Push-Pull Output Stages

The tube manual shows that only 5.5 watts, at 12% harmonic distortion, can be obtained from a single 6V6GT. However, two such tubes in a push-pull, class AB amplifier (Fig. 6) can deliver 14 watts with only 3.5% harmonic distortion. The reduced distortion is due to cancellation of even harmonics by the push-pull operation. Hum due to plate-voltage variations is also cancelled—a good reason why B+ to a push-pull amplifier may be obtained directly from the output of

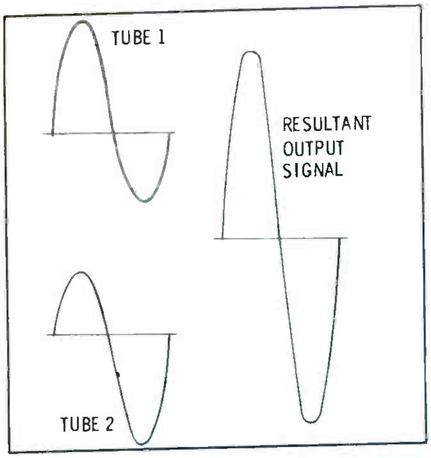


Fig. 7. How signals in push-pull, class-AB amplifier produce increased output.

the rectifier. In case you happen to be wondering just why it is desirable to connect the power amplifier directly to the output of the rectifier instead of to the filtered output, consider that the power-output stage draws more current than the remainder of the circuits in that unit. By not having its current pass through the filter resistor, the required wattage rating of this component is reduced. Then, too, the voltage at the output of the rectifier is higher, permitting higher output power to be obtained.

We mentioned briefly that a push-pull power amplifier using 6V6GT tubes operating class AB could produce 14 watts of audio signal power. This is almost three times the power that can be obtained from a single tube operated class A. To make this possible, the tubes are biased closer to cutoff so that each tube amplifies one-half of the signal more than the other. However, due to the driving arrangement, one tube amplifies the positive half of the signal more than it does the negative, while the other tube amplifies the negative half of the signal more than it does the positive. As shown in the drawing of Fig. 7, two power-amplifier tubes operating push-pull on a non-linear portion of the Eg-Ip curve can produce a linear (distortion-free) signal at relatively high output power.

If you thoroughly understand the major points of voltage- and power-amplifier operation presented here, you should have no trouble in locating and repairing any troubles that might be encountered in either circuit—providing you stop, analyze the symptoms, and think about how the circuit operates. ▲

The writing on the wall

BY MELVIN WHITMER

"When did the pump stop?"
"What caused the improper chemical mixture?"
"How much does the temperature vary over an 8 hour period?"

The answers to these questions are vital to maintenance men in today's industrial plants, and are provided by the tireless vigilance of graphic recorders. Transducers which convert mechanical variations into an electrical signal are coupled to electro-mechanical devices that record the variations on ruled graph paper. Part of the value of graphic records is that they are always available for review; thus, a technician may determine the exact time of a breakdown. When several recorders are used to monitor different variable properties within one system, they may also be used to isolate the probable source of trouble.

For example, a service technician was called in when an automatic plating machine failed to plate evenly. Analysis of the various graphs obtained from the system recorders indicated there had been a gradual increase in copper sulphate in the plating-tank electrolyte. This alone would cause an increase in plating thickness—not a decrease. Another graph indicated a sudden drop in plating current about ten minutes before the inspector had stopped the plating operation. A graph from the voltage-monitoring recorder clearly established that the voltage had increased at the same time the current decreased. This information eliminated the power supply and electrolyte concentrate feeders as possible sources of trouble. Armed with the facts obtained from all the graphs, the technician checked the electrical connections leading from the tank to the power supply. One high-resistance connection, caused by a loose bolt which led to subsequent corrosion, was found in the negative return cable. The technician cleaned the connection and replaced the bolt to complete the repair.

Pen Positioners

Within each of the groups of pen-positioning mechanisms, there is a wide variety of specific devices. The technician should understand how the recorder operates because it is, for his purposes, a piece of test equipment. He is rarely called upon to service the recorders, but systems analysis is simplified by making use of the permanent records available from these instruments.

Electric Meter Positioners

The type of meter movement used in recorders depends on the input signal. Most DC recorders use a

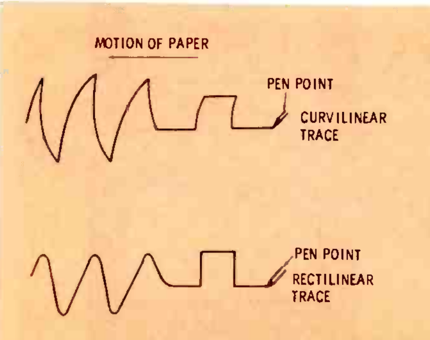


Fig. 1. Difference in appearance of curvilinear and rectilinear patterns.

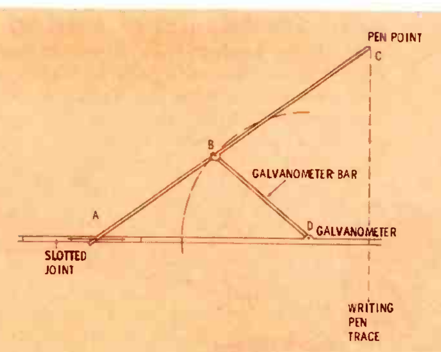


Fig. 2. Mechanical linkage used to provide rectilinear recorder trace pattern.

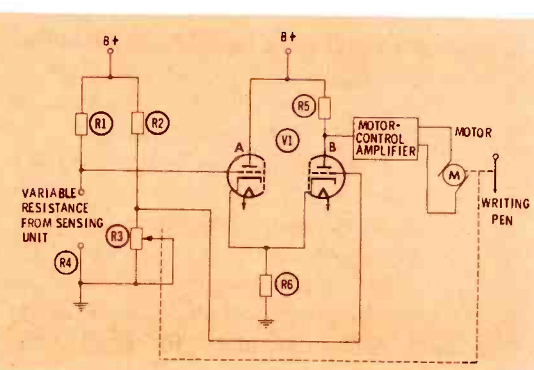


Fig. 3. Diagram of the potentiometer type DC null-balance recorder circuit.

galvanometer, while AC recorders use either vane-type meters for voltage readings or wattmeters as power indicators.

Galvanometers are more common, since most production variables can be readily converted into DC voltages; AC voltage measurements commonly pertain to power sources only. The galvanometer is a moving coil placed in the gap of a horseshoe magnet. Current in the coil generates a magnetic force which moves the coil, and therefore the pen, by pushing against the permanent magnetic field.

Recording is accomplished by a flow of ink, heating of temperature-sensitive paper, completing a circuit through electro-sensitive paper, scribing on blackened or pressure-sensitive paper, or applying pressure to the latter type of paper by means of an actuating bar.

Although the recording pen moves from side to side in response to input signals, it does not travel backward and forward over the paper. The trace is produced by moving the paper underneath the pen at a steady rate.

When the pen is connected directly to the moving coil, side-to-side motion produces a curved trace —as though the pen were the "business end" of a pair of compasses. The resulting *curvilinear* trace is shown in Fig. 1A. To produce a *rectilinear* pattern which is more nearly like a conventional oscilloscope trace (Fig. 1B), a mechanical linkage can be employed as illustrated in Fig. 2.

The outer end of the pen rides in a slotted joint at A. Attached to pivot point B on the pen shaft is a bar connected to the moving coil of galvanometer D. As the coil is turned, pen tip C is driven by the

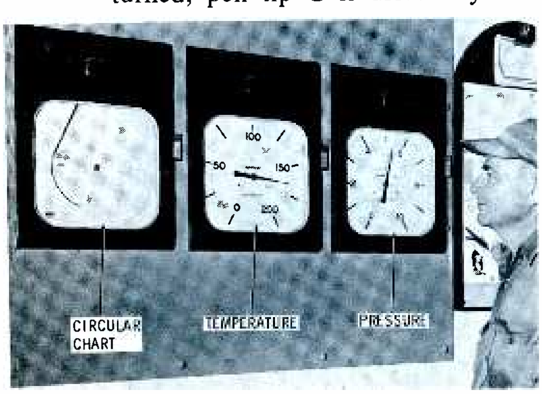


Fig. 4. Bristol recorder that indicates conditions at a station 30 miles away.

action of the galvanometer bar and the writing arm.

Null-Balance Recorders

A second basic type of pen positioner, used in null-balance recorders, relies on a voltage-divider network, an amplifier, and a power-drive unit. Fig. 3 shows the potentiometer version of a DC system. The process variable to be recorded is transformed to a resistance change in a voltage divider (R4 in Fig. 3). The resultant increase or decrease in the grid voltage of V1A is cathode-coupled through V1B to the motor-control amplifier. As the motor responds to the amplifier output voltage, it changes the position of the writing pen and also, through a mechanical linkage, the value of R3. Since resistors R2 and R3 form a voltage divider, the voltage at the grid of V1B will increase or decrease until the current through V1B is restored to the original value. The motor-control amplifier voltages will thus revert to normal, and the motor will stop, leaving the pen in a new position on the graph.

An AC bridge null-balance system is similar, except capacitors are used in the voltage dividers, and the amplifier is AC rather than DC coupled.

Other balance circuits use oscillator frequency changes and a discriminator, differential transformer, and photo-electric movements. However, these circuits are not as widely used as those in galvanometer or potentiometer-type recorders.

The null-balance system is particularly useful as a part of an automatically controlled process. Most power-drive units have enough torque to control other factors in addition to the positioning of the recorder pen—for example, corrective signals to compensate for process variations. Open and closed loop controls using null-balance recorders are the subject of a later installment, which will include a description of combination recorders and control units.

Recorder Charts

As mentioned previously, chart tracings are obtained in a number of ways. Ink is most frequently used on circular charts which, in operation, could be compared to phonograph records without grooves. The writing

Fig. 5. Strip-chart device that records and corrects temperature variations.

pen is positioned by a galvanometer, and contains enough ink to record during one revolution of the chart. One revolution may take 1, 4, 8, or 24 hours, depending on the expected rate of change in the factor to be recorded. On the 24-hour chart, radial divisions mark off 15-minute intervals, while circular divisions identify incremental changes in the sensed variable. Such a chart is useful for recording slowly-changing variables or maintaining day-to-day records, but greater accuracy is provided with faster revolution speeds.

In Fig. 4, a 24-hour circular recorder is shown as part of a remote indicating panel. Conditions at a pumping station 35 miles away are observed from this point. The recorder pinpoints the exact time of any changes, and in case of breakdown, assists in isolating the probable cause.

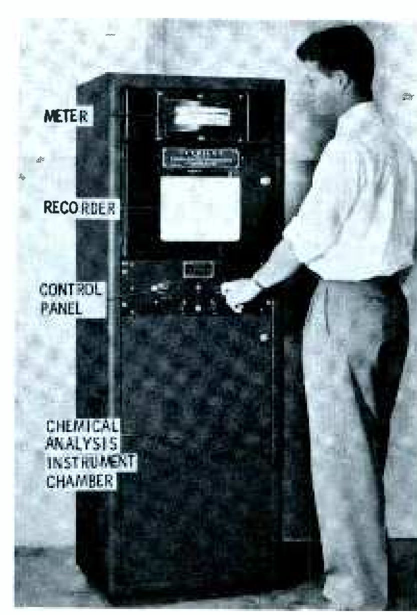


Fig. 6. This "Titrilog" recorder senses and controls chemical mixture balance.

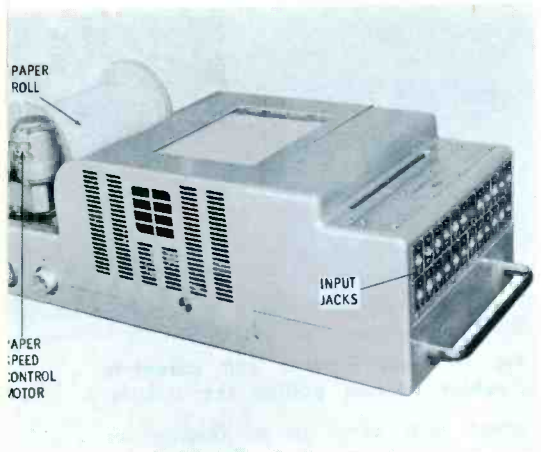


Fig. 7. Century Electrograph for airborne use handles 12 signals at a time.

Strip-chart recorders use rectangular graph paper, which moves under the recorder pen from a roll. Speed of the graph paper is measured in inches per second, and is usually adjustable to fit the input signal characteristics. The length of time a strip-chart recorder may operate unattended depends on paper speed and the size of the roll. Typical conditions allow four hours of continuous recording.

Application Examples

The actual means of recording on strip charts varies with application. Those most commonly used include pen and ink, current-sensitive paper and wire pen, light-sensitive paper and beam source, and temperature-sensitive paper and heated pen.

Fig. 5 shows a unit that records temperature deviations from a desired value. A thermocouple sensor provides an output voltage that changes with temperature. The desired temperature is preset by establishing a fixed reference voltage for comparison. The comparison-circuit output is applied to a galvanometer and controls the position of the pen.

Another use for a strip-chart recorder is shown in Fig. 6. Chemical solutions are often required to be neutral, i.e., neither caustic (like bleaches) nor acid. For instance, modern detergents and cleaners are advertised as being mild to hands, a factor that depends on the neutrality of the chemicals they contain. During the manufacturing of such products, the chemical neutrality is measured by devices like the one in Fig. 6. The recorder section is a standard galvanometer strip-chart recorder.

Oscillographs

Oscillographs are wide-range instruments which use the strip-chart principle. Such units are not generally used in industrial process-control systems because chart speed and frequency response are not suitable. Fig. 7 shows an oscillograph designed for airborne operation. Notice that it has several input jacks, denoting multiple channels for recording many variables at one time. Galvanometer-type movements are most often used because of their fast response characteristics.

The recorder is a precision instrument and should be calibrated by the manufacturer. Field service consists of cleaning and oiling (or other lubrication) or changing tubes. A recorder's usefulness as a means of rapid trouble analysis is of greatest importance to the technician.

Additional features of recorders, especially the null-balance system, will be described along with open and closed loop systems in the January issue. ▲

by LES DEANE

Dynamic Horizontal Sweep Tester

Have you ever stopped to wonder how many TV sets with horizontal sweep or high-voltage troubles cross the service bench each year? We don't know the exact figure, but it certainly must be a phenomenal number. Wouldn't it be simple in these cases if we could isolate trouble without pulling the chassis, removing a printed board, or unsoldering a slew of parts? The *Pioneer 250*, shown in use in Fig. 1, is designed expressly with this in mind. The instrument is manufactured by Doss Electronic Research, Inc., of Kansas City, Mo., and is identified as the Horizontal Sweep *Quantalyst*.

Specifications are:

1. *Power Requirements—two self-contained 1.5-volt batteries for resistance measurements, replaceable with size AA penlight cells.*
2. *Dynamic Tests—checks of B+, boost, and output-tube screen and cathode voltages; substitution of output-tube screen and cathode bypass capacitors; measurement of output-and damper-tube heater voltages, horizontal AC drive, oscillator frequency, gas or grid emission in output tube, B+ ripple, cathode current of output tube; tests yoke and flyback for opens and shorts, yoke to flyback match, and yoke inductance.*
3. *Static Tests—ohmmeter measurements of output cathode and screen resistances, resistance between boost supply and common negative, and resistance between boost and B+.*
4. *External Voltmeter—two DC ranges 0 to 100 volts and 0 to 1000 volts, sensitivity 10,000 ohms/volt; AC range 0 to 150 volts (rms), sensitivity 2000 ohms/volt.*
5. *External Ohmmeter — three ranges 0 to 1000, 0 to 50K, and 0 to 500K; zero-ohms adjustment provided.*
6. *Panel Features—3" meter with eight scales for ohms, DCV, ACV, AC drive, cathode ma, gas, and DC drive functions; six neon bulbs individually indicate presence of B+ or boost, open heaters, output-tube shorts, and flyback type; three test leads, two adapter cables, and plastic carrying bag supplied; accessory cables for uncommon tube types available.*
7. *Size and Weight—12½" x 7" x 4¾"; 7 lbs. complete.*

From personal experiences in the lab, I found that this new Doss instrument can be used to troubleshoot a horizontal sweep circuit in "jig" time, and with very little effort on the part of the operator. The *Pioneer 250* automatically selects in-circuit test points, and indicates pertinent resistance, current, and voltage values on various scales of its built-in meter. Basically, it accomplishes all of this through the use of eight switches and three panel controls, plus a separate 17-position inductance selector.

The uniqueness of the instrument lies in the fact that it has special tube-socket adapters which plug into the horizontal output and damper stages of the set to be serviced (Fig. 2A). Two cables are supplied — each with a socket adapter on one end and a plug for connection to the instrument on the other (Fig. 2B).

The cables supplied can be used for all except output tubes of the 6AU5 and 6AV5 type, or miniature dampers such as the 6V3 and 6AF3. Adapter cables for these and other less common tube types are available from the manufacturer.

About the easiest way to understand the instrument's theory of operation is to follow through the step-by-step procedures discussed in the manual (also outlined in chart form inside the detachable lid). Before proceeding with the first step, however, a ground lead must be connected from the 250 to the chassis or common negative point of the set. (This connection is in addition to the regular cables.) The switch labeled HORIZ. AMP. TYPE, located directly below the panel meter, must also be placed in its proper position. This switch has only two positions — one for tube types BQ6, CU6, DQ6, etc., and the other for types BG6, CD6, DN6, etc. In addition, the meter should be zeroed by pushing the OHMS CALIBRATE switch upward and adjusting the OHMS ZERO control.

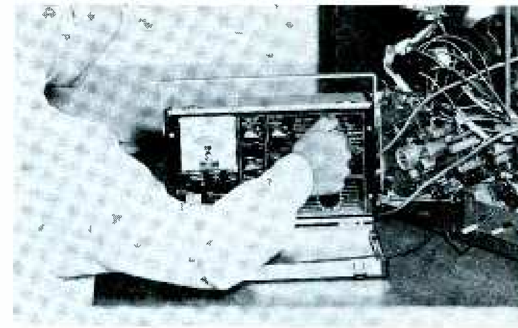


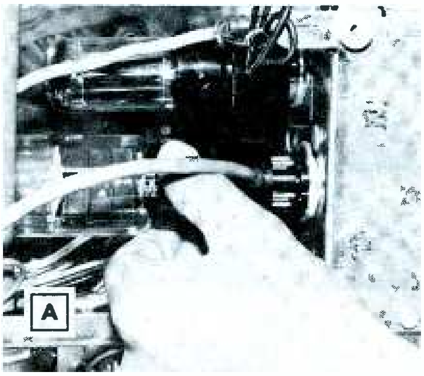
Fig. 1. Doss *Pioneer* 250 pinpoints troubles without pulling the chassis.

The first four positions of the VOLTS/OHMS selector, found in the upper-right corner of the panel, are for ohmmeter measurements without power applied to the receiver. (See photo of front panel in Fig. 3.) In step number one, corresponding to selector-switch position #1, the resistance from the output-tube cathode to ground is automatically indicated on the 1K-ohm scale of the panel meter. If a resistor is used in the cathode circuit, its value is, of course, important to the proper operation of the sweep system.

In position #2, the screen resistor for the output tube is measured, and its ohms value shown on the 50K scale. I noticed that this check is made between output screen and plate of the damper tube (which is actually B+). In this step, one must make sure that the screen circuit returns to B+. If screen voltage is obtained from boost or any other source, this reading would be inconclusive. The test in position #7, however, will determine whether or not screen voltage is normal. Position #3 gives you a resistance reading between the boost supply line and common ground, while position #4 indicates any leakage path between boost and B+. These checks can quickly pinpoint a leaky boost filter, defective yoke, or shorted damper tube.

With the receiver turned on, the VOLTS/OHMS selector is then advanced to position #5, and B+ voltage is indicated on the 1000-volt DC scale. This measurement is made from damper plate to the cathode of the output tube. In selector position #6, boost voltage at the cathode of the damper tube is monitored, again using the output cathode as reference. It is interesting to note that a special stripping network is employed to protect the meter from any pulse voltages during both these tests.

In addition to measuring output screen voltage in position #7, the instrument simultaneously provides a substitute for the screen bypass capacitor. Position #8 measures output cathode voltage and also connects in a bypass substitute; therefore, if an original bypass is open, you



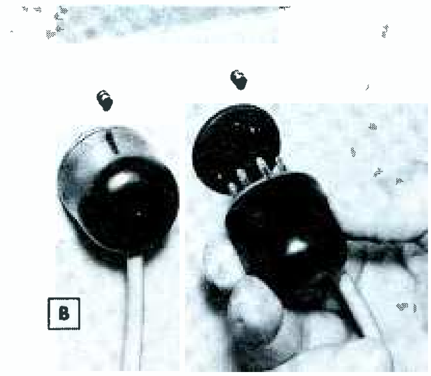


Fig. 2. Special adapter cables connect to (A) receiver, and (B) Doss unit.

Fig 3. Model 250 switch positions follow a logical troubleshooting sequence.

should expect a change in set operation when the selector is moved to either of these two positions. Screen voltages are indicated on the 1000-volt scale, while cathode potentials are read on the 100-volt scale.

Voltage measurements are also obtained in positions #9 and #10, but from an rms scale calibrated with 6.3, 12.6, 17, 19, 25, and 30-volt markings. These two steps measure heater voltages for the horizontal output and damper tubes, respectively. An open heater is indicated by the glow of the neon bulb located directly below the associated number. You'll also find two positions not numbered on the selector switch. These are used for external voltage measurements and, incidentally, the selector should be placed in one of them for the remaining steps #11 through #19.

From Fig. 3, you can see that the middle section of the front panel is devoted to horizontal oscillator tests. If you move the switch in this section up to position #11, the panel meter will indicate the AC drive on the grid of the output tube. The meter scale for this function is graduated in steps representing sufficient drive for the various 50- to 110-degree sweep circuits. With this same switch in #12 position, the oscillator frequency can be measured in cps. The dial to the right of the switch is rotated until the meter peaks, and the frequency is read directly from the dial markings.

The switch section at the top left of the panel is employed for steps 13 through 16, which include a gas and grid-emission test of the output tube, a measurement of DC drive or grid bias on the output stage, a test for the presence of AC ripple on the B+ line, and a measurement of cathode current for the output tube. A separate 300-ma scale is provided for this latter test.

In the next step, the horizontal yoke leads are disconnected, and the switch found in the lower left section of the panel is flipped up to position #17. A variable inductor is automatically substituted as a load on the flyback and, by rotating the INDUCT-O-GRAPH switch and monitoring cathode current, one can determine whether the flyback or yoke is defective. In a similar manner, only with the switch in position #18 and the use of external test leads, you can check the flyback-to-yoke inductance match. Step #19 is an actual measurement to determine yoke inductance. Here, too, the built-in variable inductor and peaking indications of the meter are used. This feature can also be of value in measuring other inductors as long as they fall within the 4- to 36-millihenry range of the INDUCT-O-GRAPH.

Although you may locate a trouble without going through the entire procedure, I found that I could complete all of the above tests in about ten minutes, whereas a serviceman might normally take an hour or more by using conventional techniques. The nature of the trouble encountered may warrant variations in the order of test; however, you should find that this step-by-step procedure works very well for most practical cases. In the back of the Doss instruction manual, you'll find a list of normal and maximum cathode currents for most output tubes, as well as several hints on servicing the horizontal sweep system.

Push-Button Tube Checker

The Jackson Electrical Instrument Co. of Dayton, Ohio, is currently marketing the Model 648R Dynamic Tube Tester, featuring a keyboard switch bank and top-view roll chart (see Fig. 4). As can be seen in the photo, this portable instrument comes in a leatherette-covered case with a complete set of operating instructions inside the detachable lid.

Specifications are:

1. *Power Requirements — 110/125 volts, 50/60 cps; power consumption less than 5 watts in stand-by condition; line calibration switch graduated in 2.5-volt steps.*
2. *Shorts Tests—shorts and leakage indicated by glow of NE-51 neon bulb; panel control determines leakage sensitivity from 250K to 2 megohms; element selector switch provided.*
3. *Dynamic Test—special plate conductance test indicated in relative micromhos on 4½" panel meter; voltages applied to each tube element by individual push buttons; roll chart supplies setup data.*
4. *Life Test—heater voltage automatically reduced with all other parameters remaining constant; life expectancy indicated by reduction in plate conductance; special switch provided.*
5. *CRT Test—pictures tubes tested under normal receiving tube procedures by using accessory adapters.*
6. *Panel Features — 9 test sockets grouped on 4" x 4½" elevated panel, wired replacement kit available; 3-column roll chart; filament selector providing 23 positions from .75 to 100 volts.*
7. *Size and Weight—16⅜" x 6⅜" x 13⅝"; 18½ lbs.*

When I first opened the lid of the Model 648R, I'll have to admit that the double bank of push buttons gave me the impression that the instrument was rather involved and probably complicated to operate. After reading the instructions and actually checking a few tubes, however, I found that first impressions don't mean a thing. The setup procedure is simple and straightforward. I noticed, too, that the roll chart is up out of the way where your hands and arms don't hide it. As the manufacturer puts it, "The setup time of the tester is less than the warm-up time of the tube."

To familiarize you with this particular instrument, let's run through the steps necessary for checking a tube. The first step, after turning the tester on and adjusting the LINE CONTROL to compensate for variations in line voltage, is to locate the tube type on the roll chart. By the way, this three-windowed chart is arranged so that when you reach the bottom of the first column, you merely refer to the middle column and the next numerical-alphabetical designation appears. This also applies when going from the second column to the third, which naturally eliminates a lot of unnecessary thumbing of the roller.

After you make sure that all push buttons are in a neutral position by pressing the two release keys at the right end of the switch bank, you proceed by setting up the filament selector and plugging the

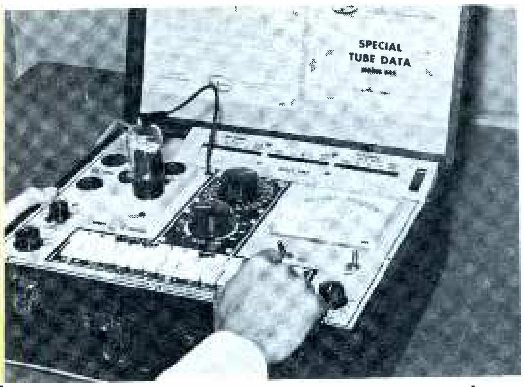


Fig. 4. Jackson 648R plate-conductance tester features special life test.

tube into the proper test socket. Incidentally, the 23 positions of the filament selector are not merely numbered or designated by alphabetical letters, but are identified by actual heater-voltage values.

In the next step, you set up the buttons in both top and bottom rows, which are referred to as circuits D and E. With this completed, the shorts-leakage test is next in order; however, I found it more convenient at this point to go ahead and adjust the PLATE control for the conductance test while the tube is still warming up.

The shorts test is performed by rotating the SHORTS TEST switch (located in the lower-left corner of the panel) through its four tube-element positions. During this check, the leakage control directly above the switch should be in the extreme clockwise position, thus making the circuit more sensitive to high-resistance shorts. Approximate leakage values can be determined by slowly rotating the control counterclockwise until the neon short bulb is extinguished. The leakage control is calibrated from 250K to 2 megohms.

If the tube passes this test, you can proceed with the quality test by placing the SHORTS TEST switch in its TEST position and then depressing the button or buttons designated on the roll chart under PLATE TEST. The panel meter will evaluate the tube immediately. Although the reading is considered to be a relative micromho indication, the meter is calibrated in bad, good, and questionable areas, as well as on a linear percentage scale (see Fig. 5).

An excessive reading classifies a tube as questionable, which indicates that it may be gassy, or have damaged or misplaced

Fig. 5. Note that the "?" area is located at extreme right end of the scale.

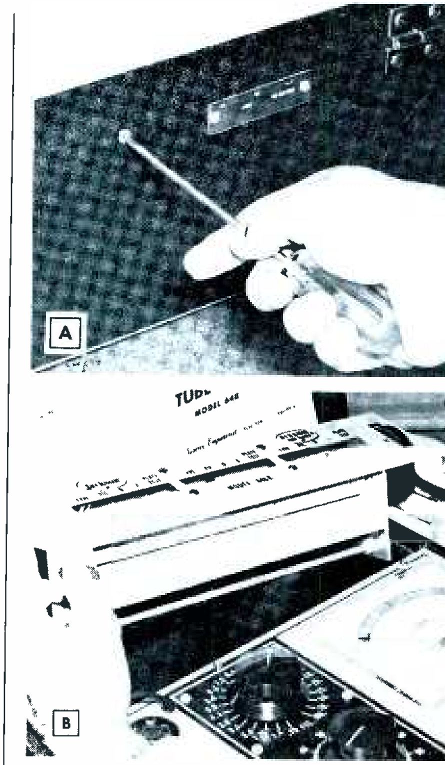


Fig. 6. To change roll chart, remove screw from back of case and lift out.

elements. (On the other hand, it may merely indicate an exceptionally "hot" tube.) By testing a number of known defective tubes in the Model 648R, I found that gassy amplifiers always produced readings somewhere above the 120% mark. In cases where the readings were between 120 and 130%, I discovered that the gas content was not necessarily sufficient to produce a trouble symptom. Tubes having enough gas to produce troubles, however, always registered in the questionable area.

If you can't seem to pinpoint an apparent tube trouble, yet suspect low line voltage as the basic cause, the special LIFE TEST afforded by the Jackson tester may help you solve the problem completely. To perform this test, you merely check plate conductance in the prescribed manner and, while holding down the test button or buttons, flip the LIFE TEST switch to its TEST position. The switch is a spring return type located directly below the panel meter; when held in its test position, filament or heater voltage is automatically reduced, while all other test voltages remain constant. Tubes with sufficient cathode coating will show little change in conductance under this condition; however, those on their last legs will cause the reading to drop considerably.

When I checked a 12BE6 converter tube that appeared to be causing drift in a radio, I noted that it passed both the shorts and quality tests of the Model 648R. However, in the life test, conductance of the pentode section dropped sharply from good to bad.

I also noticed that the gassy tubes I tested had more of a tendency to resist change in conductance under the life test. The best way to gain usable and concrete information from the life test function of the Model 648R is to familiarize yourself with both the normal and abnormal readings obtained from known high quality tubes, and those that are weak or that you suspect are approaching the end of their useful life.

Another desirable feature of this instrument is its easy-to-remove roll chart. As shown in Fig. 6, the roller assembly can be taken out by removing only one screw located on the back of the case. Obsolete and seldom-used tubes have been omitted from the chart, but can be found in a tube data booklet which is stapled to the lid of the tester.

VOM Features Accuracy

Ohm's law involves only three interrelated terms—voltage, resistance, and current. In all fields from design to maintenance, all types of instruments have been developed for measuring their values.

A recent contribution to this category of instruments is the Model 270 VOM manufactured by Simpson Electric Co. of Chicago. Pictured in Fig. 7, the unit features a high degree of accuracy, is housed in a heavy black bakelite case, and comes complete with two 4' test leads and batteries.

Specifications are:

1. *Power Requirements — five self-contained 1.5-volt batteries, one size D and four size Z flashlight cells.*
2. *DC Voltmeter—seven ranges of 0 to .25, 2.5, 10, 50, 250, 1000, and 5000 volts; sensitivity 20,000 ohms/volt; accuracy to 1000V ±1.5% of full scale at 77°F. ±2% within 10° variation; polarity switch provided.*
3. *AC Voltmeter—six rms ranges of 0 to 2.5, 10, 50, 250, 1000, and 5000 volts; sensitivity 5,000 ohms/volt; accuracy to 1000V ±2% of full scale at 77°F, ±3% within 10° variation; frequency response essentially flat to 30 kc, within 0.5 db to 200 kc on lower ranges.*
4. *AF/db Meter—AF output ranges*

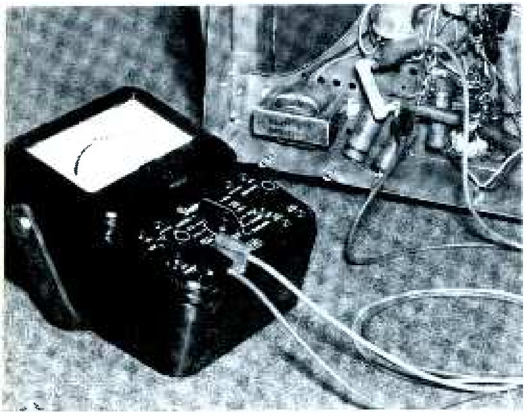


Fig. 7. Carrying handle supports 270 VOM in convenient sloping position.

0 to 2.5, 10, 50, and 250 volts; power level ranges from –20 to +10 db, –8 to +22 db, +6 to +36 db, and +20 to +50 db, zero db= 1 milliwatt of AC power across a 600-ohm impedance; separate jack with blocking capacitor provided.

5. *Ohmmeter—0 to 20 megohms in three ranges of R X 1 (center scale 12), R X 100, and R X 10,000; accuracy ±1.5° of scale arc at 77°F, ±2° within 10° variation; zero-ohms adjust provided on panel.*
6. *DC Ammeter—six ranges of 0 to 50 ua, 1 ma, 10 ma, 100 ma, 500 ma, and 10 amps; accuracy ±1.5% of full scale at 77°F, ±2% within 10° variation; separate panel jacks provided for 50-ua and 10-amp ranges.*
7. *Meter Accessories—two high-voltage probes for 25 kv and 50 kv measurements; leather or plastic carrying cases also available.*
8. *Size and Weight—5¼" x 7" x 3⅛"; 3¼ lbs.*

This unit differs from its predecessor, the 260, in that it possesses greater accuracy, and features a mirrored wide-angle scale with a special knife-edged pointer. In the lab, I removed the meter chassis from its case, and surmised that its accuracy is directly related to the ½% precision resistors, a frictionless 50-ua meter movement, and the other high-quality components used in the construction of the instrument.

From the photo in Fig. 8, you can see that almost all chassis wiring is confined to a single printed board. The wirewound and deposited- carbon resistors positioned on top of the board are all identified by R numbers etched right on the board. These numbers correspond to the identification given in the instrument's parts list and on the schematic.

In the lower-right corner of the board, laying across the function switch, you'll find a pigtail fuse soldered in series with the common test jack. This 1-amp unit protects the instrument from damage due to misuse during ohmmeter and millammeter functions. The range switch, located in the center of the front panel, can be rotated in either direction through all twelve of its positions. Also on the front

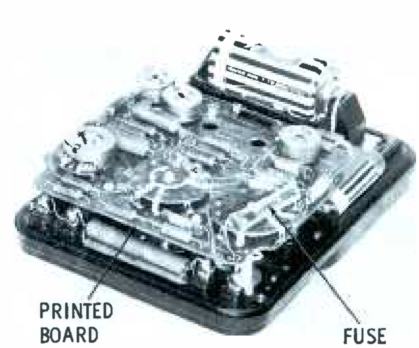


Fig. 8. Simpson 270 chassis comes out of case after removing only four screws.

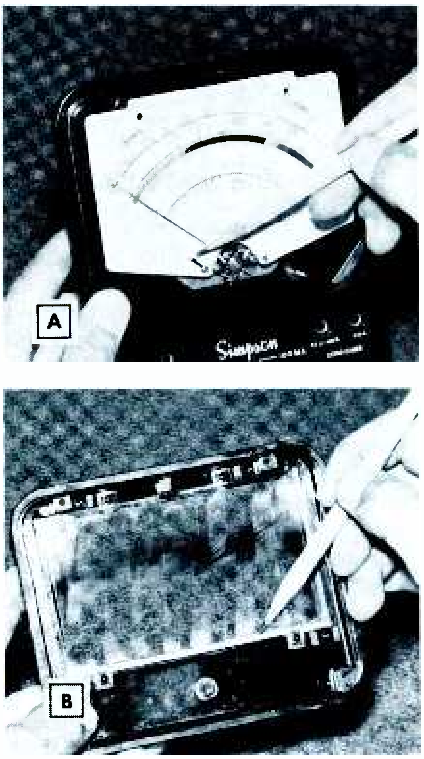


Fig. 9. This feature of the Simpson VOM presents static charge build-up.

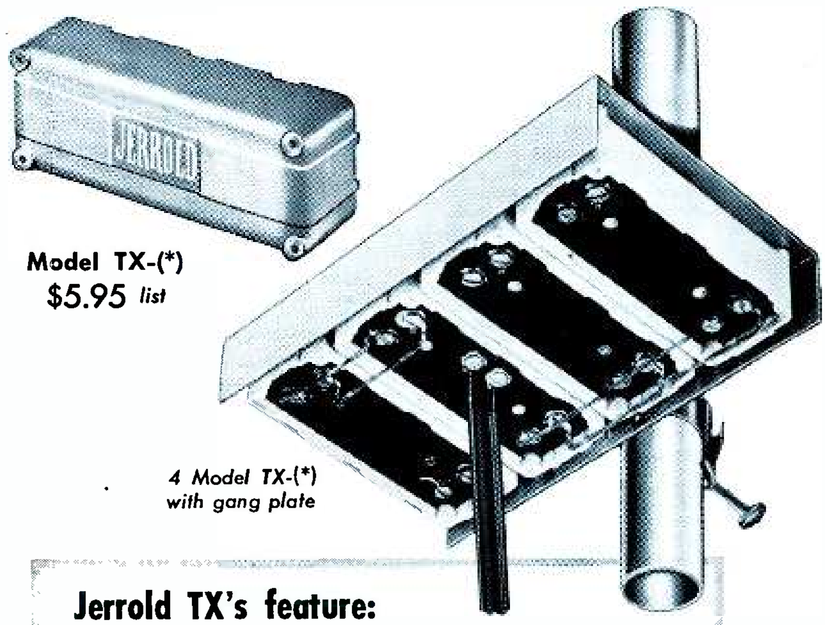
panel, you'll find eight separate test jacks —two in each corner. Aside from the two labeled COMMON and +, these jacks are used for extended ranges or functions of the instrument.

The 4½" meter face has five calibrated arcs with a narrow mirror strip across the center. When I removed the protective frame from the front of the meter, I noticed a small piece of spring metal protruding from the base of the dial (see Fig. 9A). After examining the frame assembly, I found that this piece makes contact with the strip of metal foil pointed out in Fig. 9B. This effectively eliminates a buildup of any electrostatic charge on the glass or frame surrounding the pointer and meter movement.

Applications of a VOM are, of course, numerous; however, I found the Model 270 of particular value in checking current drain and bias potentials in transistor radios, measuring critical AGC voltages in TV receivers, and when looking for slight circuit changes in stubborn intermittent cases. I also found the unit's accuracy useful in the calibration and troubleshooting of other test instruments.

Speaking of accuracy, I'd like to point out some factors you might not know about. For example, accuracy of meter movements are affected by ambient temperature, operating position, and external magnetic or electrostatic fields. Even the use of steel-clad batteries in the case can change the instrument's sensitivity by forming a magnetic shunt in close proximity to the movement!

Like the 260 series, the 270 will accommodate the new Simpson *Add-A-Testers*. These adapters plug right in and convert the meter into a number of different test instruments. I'll be reporting on them in a forthcoming issue. ▲



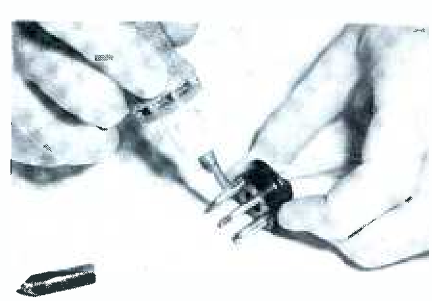
TIPS for TECHS

Put Flux in the Spool

Here's a handy hint for the radio-TV serviceman who likes to carry a can of paste flux in his tool kit. Instead of wasting valuable space, why not put the solder and flux into one container? After plugging one end of the solder spool with a cork, heat the can of flux in a pan of hot water and pour it into the core. When the flux cools, plug the open end with another cork. This arrangement is a space-saver, and you won't have to waste time hunting for your can of flux when it's needed.

Catch-All for Service Truck

A plastic shoe bag attached inside the service truck door comes in handy for holding a flashlight, often-used tools, parts, and other items. Fasten the bag in place with self-tapping screws and large round washers.



Sweat Soldering With Pencil Iron

When a pencil-type soldering iron is used for sweat soldering, you can convey more heat to the work by removing the tip and applying the end of the heating-element barrel directly to the work surface. This will result in maximum heat transmission and raise the work temperature in minimum time.

Hint for TV Line

If you maintain a TV line to subscribers, here is a hint you will find helpful. When you have to hunt down troubles at line amplifiers and line splitters after dark, it's often very hard to locate the poles on which these items are mounted. To make the task easier, put some automotive reflecting tape on each equipment housing. (You might even number the boxes in this way.) Just a dim flashlight beam will indicate the locations of the boxes, and let you hunt down troubles more speedily.

Fuse Inventory Control

Here's how you can keep track of fuses stored in "5-to-a-pack" boxes. You often find yourself pulling out empty boxes just when you badly need a fuse of some particular size. Prevent this by inverting nearly empty boxes in your caddy. The upside-down boxes will remind you to order a fresh supply of the values thus indicated.

Test For Speaker Rub

Ever wish for some quick and easy way to tell whether or not the distorted output from a speaker is due to voice-coil rub? Using your left hand, grasp the speaker by the edge of the field coil or PM magnet housing. Hold the speaker near your right ear and strike the back of the housing with your right hand. If the voice coil *isn't* making contact with the pole piece, you will hear a distinct *boing*. Otherwise, the speaker will give forth a muffled, rasping sound.

Bottles for Tool Kit Chemicals

Ask your wife to save you those sturdy glass nail polish bottles she usually discards. They make mighty handy service chemical containers for your tool box. One filled with solvent (or nail polish remover) will come in handy when you have to remove some enamel insulation from fine wire. A daub of the solvent or remover makes the job a cinch. Fill a second bottle with some extra soldering paste. Others filled with printed circuit paints will come in handy, too. They are practically unbreakable.

Keeping Test Leads Together

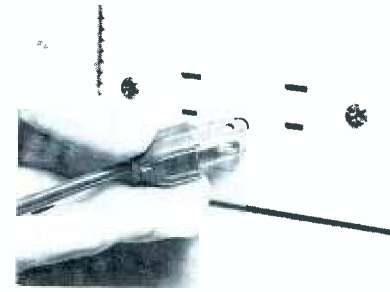
When several pairs of test leads are stored together, mates often become separated and much servicing time can be wasted sorting them out. To keep halves of a pair from becoming separated, fasten them together in the middle with a small compression spring as shown. This permits the leads to be separated quickly and easily should the need arise.

Sharpen Dull Screwdrivers!

Since Phillips screws are used almost universally in all kinds of electronics gear, it doesn't take long for one's Phillips screwdriver bits to become dull and develop burrs. Don't let these dull screwdrivers go unattended—dress the tip once in a while with a small triangular file. This will save time and temper in the long run, and will eliminate those unsightly, chewed-up screw heads that are the mark of an inexperienced serviceman.

Hook for Soldering Gun

A cup hook screwed into a small hole drilled into your soldering gun provides a convenient means of hanging it up when not in use. To insure that the hook doesn't pull loose, take the gun apart, and apply a blob of solder to the hook threads on the inside.

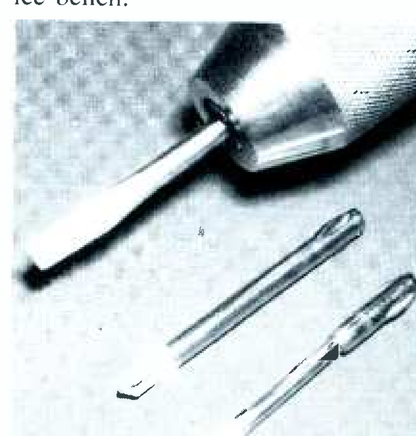


Sure Way to Polarize a Plug

Modern receptacles for AC line plugs have one long and one short slot. The longer one is connected to the grounded side of the power line, if the receptacle has been correctly installed. (Double-check this by measuring voltage from each side of the line to the conduit box.) To take advantage of the safety features offered by this polarized receptacle, modify the line plug of AC-DC radios and other "shockable" equipment as shown. Solder a section of paper clip around the prong which connects to the common ground-return point (B— bus or chassis ground), as determined by actual measurement with an ohmmeter. (Thanks to Mr. Fred J. Ardalino, Brooklyn, N. Y., for this idea.)

Hang Test Leads on Tie Rack

Do you have a spare tie rack lying around the house somewhere? If so, hunt it up and convert it to a test-lead rack for the shop; it's practically made to order for the job. Attach it to the wall near your service bench.



Drill Overpowers Screw

Whenever you encounter a rusted screw that resists all efforts to remove it, just take the blade from an interchangeable screwdriver outfit and insert it into the chuck of your hand drill. You'll get more leverage, loosening the screw more quickly and with less effort.

Shop Talk

(Continued from page 24)

in one of the load circuits. Individual resistance measurements from each feed line to common ground may tell you which circuit is defective, or you can reconnect one line at a time and note the effect on B+ voltage. While each added line will cause the output voltage to drop slightly, a marked decrease will occur when the defective branch is hooked in. The procedure is slow, but there are no reliable shortcuts for this particular type of trouble. (However, if you are definitely sure the filter circuit is not leaky or shorted, you would save some time by disconnecting the load lines one by one, checking B+ voltages as you go.)

An interesting situation, low voltage in only *part* of the B+ system, can occur in those receivers where the audio output tube serves also as a voltage-dropping element (see Fig. 3). Voltage in the power supply itself may be normal, but the voltage on those stages which receive B+ from the cathode of the audio output tube can be low, or even nonexistent. If replacement of the tube fails to cure the low-voltage condition, one of the load circuits may be causing excessive current drain. Disconnect each one individually, check the audio-output cathode voltage, and reconnect the load circuit if the reading hasn't returned to normal. Don't forget the filter capacitors connected to the cathode! Avoid disconnecting several load circuits at once, since this will result in a misleadingly high cathode-voltage reading. If the load circuits all check normal, but the low-voltage condition persists, then make further tests of components in the audio output circuit itself. Low cathode voltage of this stage could be due to excessive bias, too much plate resistance, or related troubles.

The low-voltage power supply is a relatively simple circuit, and resistance and voltage checks are generally sufficient for most troubleshooting procedures. The only time an oscilloscope would be useful is when the hum level seems to be high. In that case, check the peak-to-peak value of the AC ripple. Ordinarily, it will be on the order

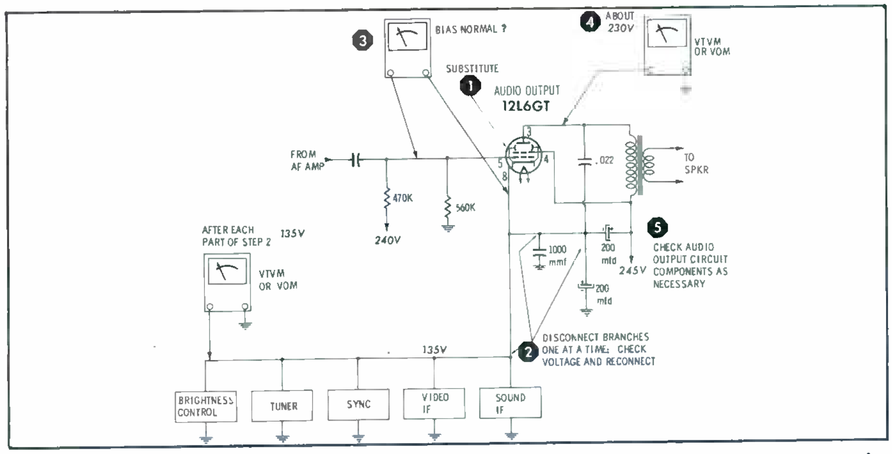


Fig. 3. Troubleshooting procedure to locate defects in a secondary B+ supply.

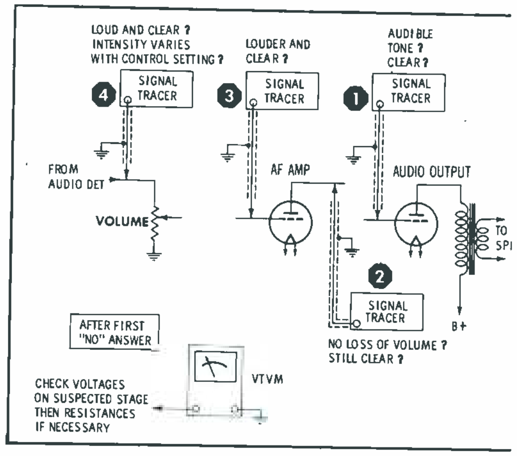


Fig. 4. How to use the signal-injection technique to isolate audio troubles.

of 2 volts or less. If it possesses a substantially higher value, check or replace the filter capacitors.

The Audio Section

The audio section extends from the output of the FM detector to the loudspeaker. Trouble manifests itself here in the form of distortion, or in a complete lack of sound. The same symptoms can also be caused by a defect elsewhere in the sound channel, so your tests should quickly reveal whether or not the audio amplifiers are functioning normally. The quickest way is to use some form of signal injection (Fig. 4). The source can be an audio signal generator, 60-cycle AC taken directly from the filament line, or even your own finger. Apply the signal to the control grid of the audio output stage. A suitable sound should be heard in the speaker, even when you are using your finger. Of course, a signal generator will deliver a cleaner note and thus enable you to spot distortion more quickly. But when the trouble is low volume or none at all, any of the injection methods will work.

Work back from the speaker to the detector output and listen for the results. If sound increases appreciably as you change the injection point from the grid of one tube to the grid of a prior tube, the trouble is elsewhere and there is no point in spending any more time with the audio amplifiers. But, if you find that the sound distorts or disappears during the procedure, the next step is further localization. For example, is the output okay when the signal is injected at the plate of a stage, but distorted when it is applied at the grid? Assuming the tube to be good, check voltages at its elements, particularly the plate and grid. If plate voltage is lower than it should be, follow the circuit to the B+ feed point, checking voltage as you cross each component. There is no point measuring plate load resistors or changing output transformers until you find a *normal* reference point. For instance, if B+ is normal and the plate voltage of a stage is low, we know the trouble is in this stage. But if the applied B+ is low, why look in the stage until the B+ is brought back to normal?

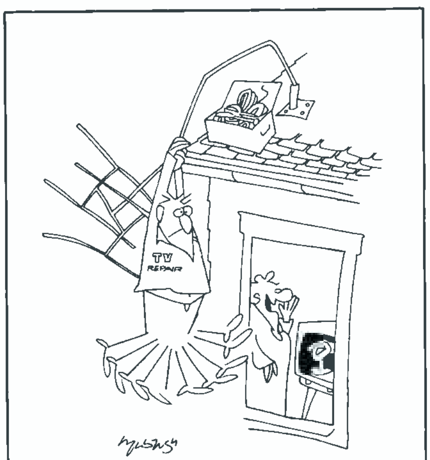
Low plate voltage can stem from the following causes:

1. Control grid less negative than it should be with respect to cathode.
2. Increased resistance in the plate circuit.
3. Decreased cathode circuit resistance.
4. Decreased screen grid resistance.

Conditions 2, 3, and 4 can be checked out in short order. With the power turned off, simply measure the resistance in each of these circuits with a VTVM or VOM. In order for a resistance change to produce noticeable results—such as distortion or lowered volume — it should be on the order of 50% or more. A 10 or 15% variation from rated value will hardly produce a significant change in amplifier operation. Note, too, that in conditions 3 and 4, a resistance decrease is indicated. In condition 3, the decrease will reduce stage bias and cause more plate current to flow. In condition 4, a lowered dropping resistor will increase screen grid voltage, which will have a greater effect on plate current flow than a comparable rise in plate voltage. In condition 2, an increase in plate resistance is indicated. A decrease in resistance will result in a higher plate voltage.

Now let's consider condition No. 1, from the standpoint that the decrease in bias is not being caused by a decrease in cathode resistance (condition 2). The trouble could stem from the tube itself, for example, when gas is present. The preliminary tube check should reveal this, but only if you are sufficiently alerted to this possibility. If you are not, and the tube tester has no simple check for gas, it may easily pass unnoticed. This was pointed out in my previous column, but is being mentioned again because of its importance.

Another reason for condition No. 1 is a leaky coupling capacitor. When the grid resistor has a high value, not much leakage is required to upset grid voltage. With a sensitive VTVM, check the voltage from grid to chassis (or to the low side of the resistor if it returns to a voltage source). The meter reading should be zero. Any slight positive voltage should be regarded with sus-



"That did it . . ."

picion, since the most likely reason is that the grid is drawing current. Use the lowest DC voltage range available — preferably one volt or less.

The opposite condition — plate voltage higher than normal — is another possible indication of distortion, or even complete loss of output. If the plate voltage is equal to the applied B+, no current is passing through the tube. Excessive negative voltage on the grid will cause this, as will an open in the cathode or screen circuits.

There is one additional defect which will reduce the gain of an amplifier noticeably, and that is an open bypass capacitor in the screen grid circuit. (The extent of the decrease is proportional to the operating frequency, so an open screen bypass capacitor will have a greater effect in an IF stage than in an AF stage. In both instances, however, the amplification decrease is noticeable.) The fastest way to check for this condition is to bridge a good capacitor across the suspected unit. A return of normal volume indicates the original capacitor is defective. In this regard, do not overlook any bypass capacitors in the plate circuit. These, too, can cause a similar difficulty.

Table I—Instrument Selection for Troubleshooting a TV Receiver.

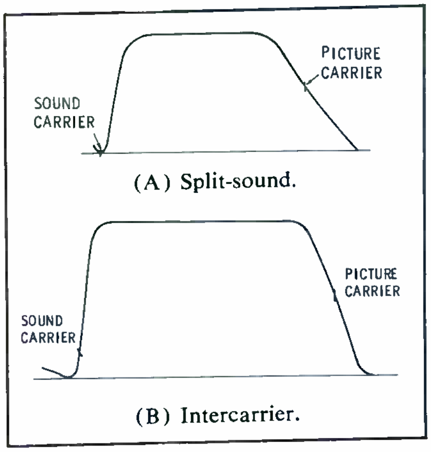
SECTION	PRIMARY TESTS	SECONDARY TESTS 1	SECONDARY TESTS 2
POWER SUPPLY	VOM OR VTVM	SCOPE	—
AUDIO SECTION	SIGNAL GENERATOR	VOM OR VTVM	SCOPE

The primary test instruments for troubleshooting the audio section are first, a signal generator and second, a VTVM or VOM. An oscilloscope can be useful, however, in isolating distortion. Use it to check input and output waveforms, and also to uncover the source of hum leakage. In printed circuits, the closeness of the conductors makes hum interference a not uncommon trouble. By checking control grids for the presence of AC voltage when no signal is being applied, you will discover any sneak paths. The cathode, too, can be another port of entry for AC voltages, either by leakage from the heater, across the socket terminals, or from the bypass capacitor shunted across the cathode resistor. The latter condition can arise when the capacitor is part of a multi-section filter which has leakage between sections.

To recapitulate, in troubleshooting the power supply, the primary test instrument is the VTVM or VOM. A secondary test instrument is the oscilloscope. To check the audio section, the signal-injection technique is the primary means, followed by use of the VTVM or VOM and then the oscilloscope. Table I lists this information, and as we examine additional sections in my next column, they will be added to the chart. ▲

Video IF Response

(Continued from page 30)



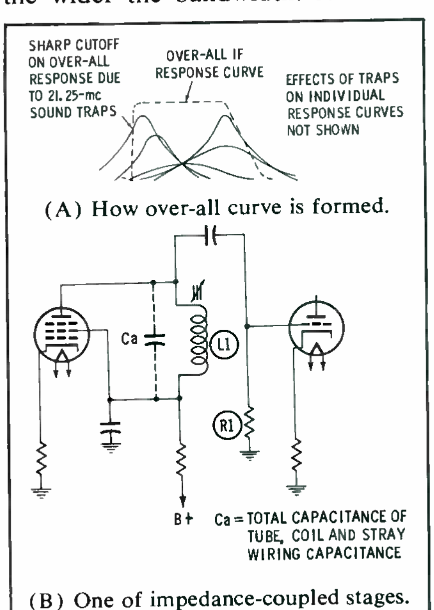
(A) Split-sound.

(B) Intercarrier.

Fig. 4. Position of sound carrier on IF curve in different types of sets.

all response curve as shown in Fig. 5A. The shape of this final curve is determined by three factors—the resonant frequency of each stage, the Q of each tuned circuit, and the nature of the trap circuits.

The resonant frequency of each stage is determined by a combination of the interelectrode capacitance of the tube, the distributed capacitance of the coil, stray circuit capacitances, lead inductance, and the inductance of the coil. The core of each coil is adjustable for alignment purposes. The individual IF stages are impedance-coupled as shown in Fig. 5B. The value of grid resistor R1 will vary the effective Q of IF transformer L1, since its value determines the amount of coil loading. The lower the value of resistance, the greater the loading and the wider the bandwidth. A classic example of this type of design is the IF strip in the RCA 630TS receiver (see Fig. 6).



(A) How over-all curve is formed.

(B) One of impedance-coupled stages.

Fig. 5. Stagger-tuning of an IF strip.

Another method of shaping IF curves, sometimes referred to as *complex coupling,* illustrated in Fig. 7, is used in a number of earlier DuMont sets. Each interstage coupling network is a complete band-pass filter instead of being tuned to some specific frequency within the IF band. Fig. 7A shows the coupling circuit between the mixer plate and the grid of the first IF amplifier. Viewing this circuit in simplified form in Fig. 7B, you can see that it is essentially a single-section, T-type, band-pass filter.

The over-all response curve is determined by the resonant frequencies of the various tuned circuits as well as the degree of coupling between stages. Traps are frequently included in some of the coupling circuits, as shown in Fig. 8. This circuit consists of a combination of band-pass and band-reject elements in a pi-type filter network. The combinations L1-C1 and L2-C2 are trap circuits tuned to 21.9 and 27.9 mc, respectively. The Q of the tuned grid and plate loads is lowered by

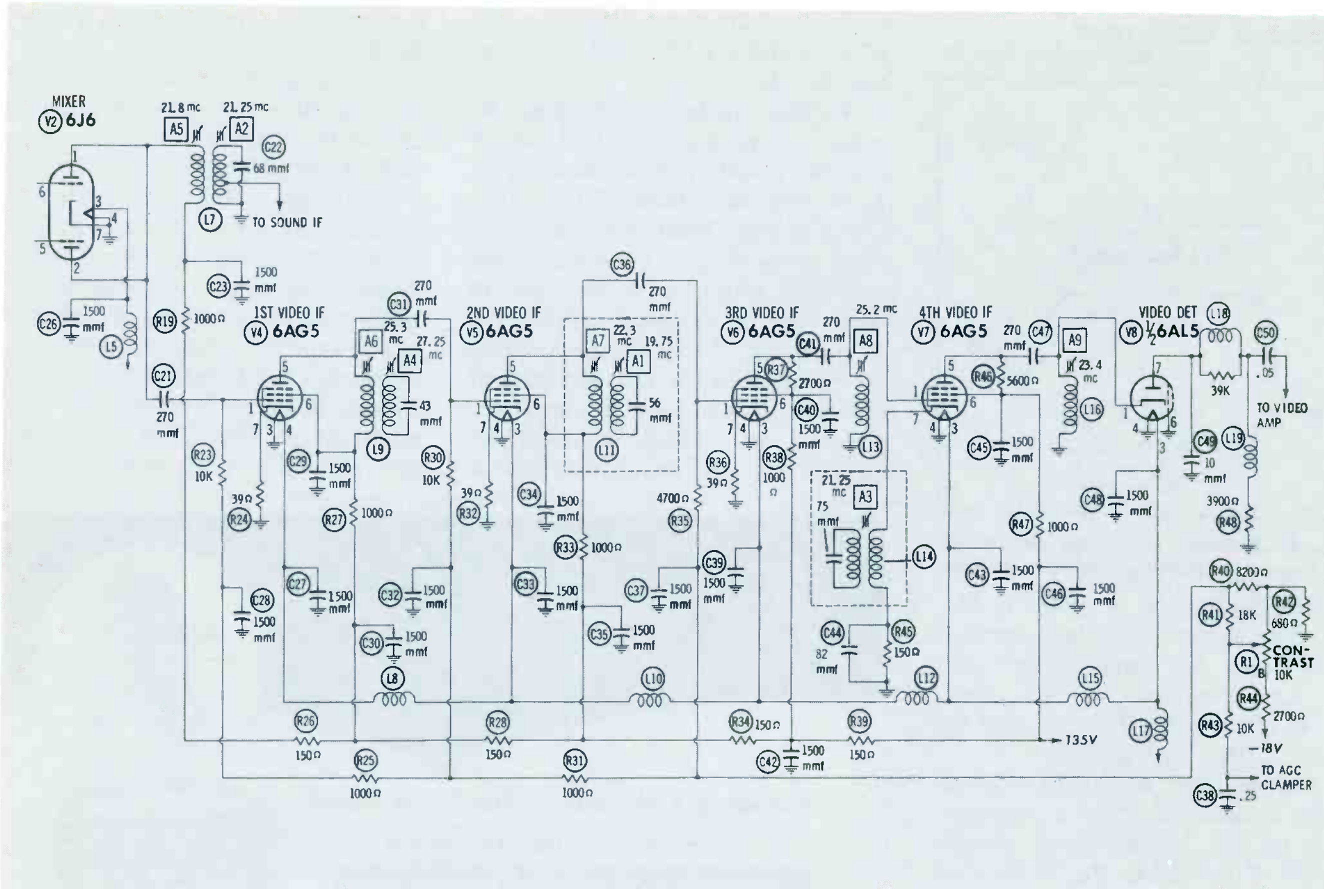
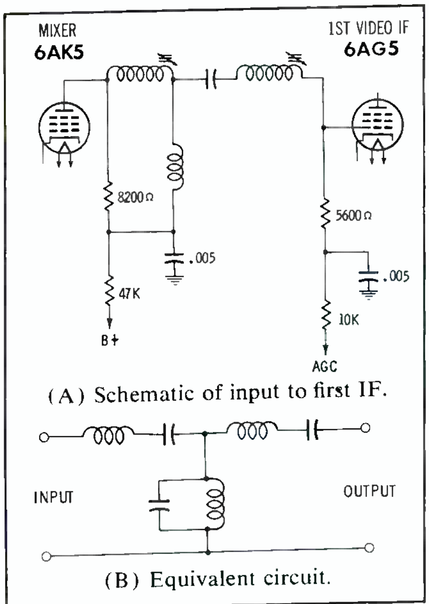


Fig. 6. RCA 630TS IF strip is an example of early stagger-tuned design.



(A) Schematic of input to first IF.

(B) Equivalent circuit.

Fig. 7. Complex interstage coupling circuit employed in DuMont RA-105B.

shunt resistors (R1 and R2), just as in the stagger-tuned circuits. The trap circuits are not shunted since they must have a high Q to insure that they will trap out only a very narrow band of frequencies.

The alignment of complex-type IF circuits is a difficult task if only a signal generator and VTVM are used, since the response of the tuned circuits is so broad that the center of the response curve is almost impossible to locate. A sweep alignment procedure must be employed to obtain best results.

An interesting variation of the stagger-tuning method involves use of a special type IF transformer known as a bifilar-wound coil. The primary and secondary windings of this component are interwound in the manner shown in Fig. 9. The coupling approximates unity; therefore, this circuit is the equivalent of the impedance-coupling network used in the previously-mentioned stagger-tuned circuit (Fig. 5B).

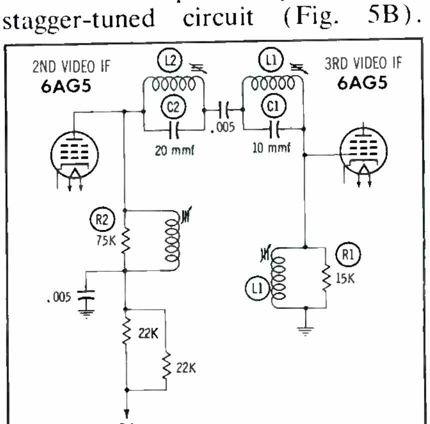


Fig. 8. Traps in second to third-IF coupling circuit, DuMont RA-105B.

Each transformer has only one tuning adjustment, and the resonant frequency of the individual stages is staggered in the conventional manner. Resistive loading is employed to reduce the Q and broaden the curve. An IF amplifier employing this type of transformer is shown in Fig. 10. The main advantages obtained from using bifilar transformers are better immunity to noise in the IF stages, and a reduced number of components.

Trap Circuits

Trap circuits used in video IF

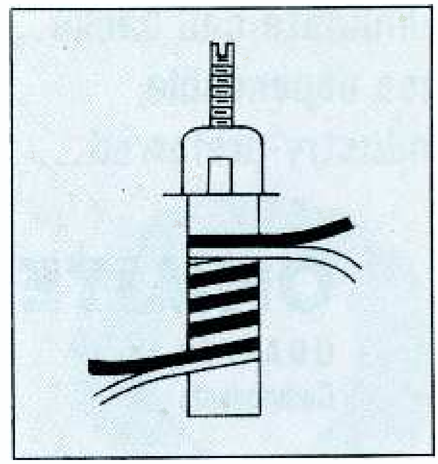


Fig. 9. Bifilar coils in IF transformer.

amplifiers are designed to eliminate undesired signals, including co-channel sound, adjacent-channel sound, and adjacent-channel picture carriers. Generally, traps are constructed with very heavy gauge wire to attain the high Q necessary to trap out only the undesired signal. They may take one of the three forms shown in Fig. 11. The series-resonant trap L26 in Fig. 11A is connected from a point between the plate and grid circuit to ground. At its resonant frequency, the trap will have approximately zero impedance and will therefore conduct the signal to ground. At other frequencies, the trap has a very high impedance and therefore has little effect on the signal.

Fig. 11B typifies the design of a parallel resonant trap. It is always connected in series between the signal load, and either the grid or the plate of the amplifier tube. Since it has a high impedance at its resonant frequency, it will oppose the transfer of signal energy at this frequency.

Fig. 11C shows an absorption trap. Its operation is based on the fact that signals induced from L1 to L2 react as though L2-C2 formed a series resonant circuit. At resonance, X_{L2} will cancel X_{C2}, and the circulating current will be at maximum. L2 and C2 will then absorb the greatest amount of energy from L1 at that frequency. At other frequencies, X_{L2} and X_{C2} don't cancel, and the trap absorbs little if any signal from L1.

Accompanying sound traps, besides being used to remove the sound signal from the video IF channel, may also be utilized to supply an input sound signal to the sound IF amplifier. Refer to Fig. 6 and note L7 in the plate circuit of the mixer tube. The secondary of this coil is an absorption-type trap; but, instead of dissipating the absorbed signal, it feeds it to the grid of the first sound IF. Thus, in addition to acting as a trap for the video IF channel, it functions as a first IF transformer for the sound channel.

Miller Effect

Designers of video IF stages must take into account a phenomenon known as Miller effect. Simply stated, this is the variation of the input capacitance in a tube as its grid bias is varied. Earlier, it was

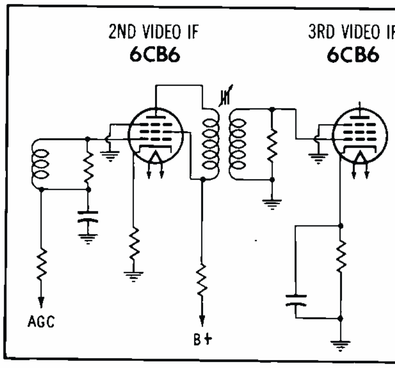
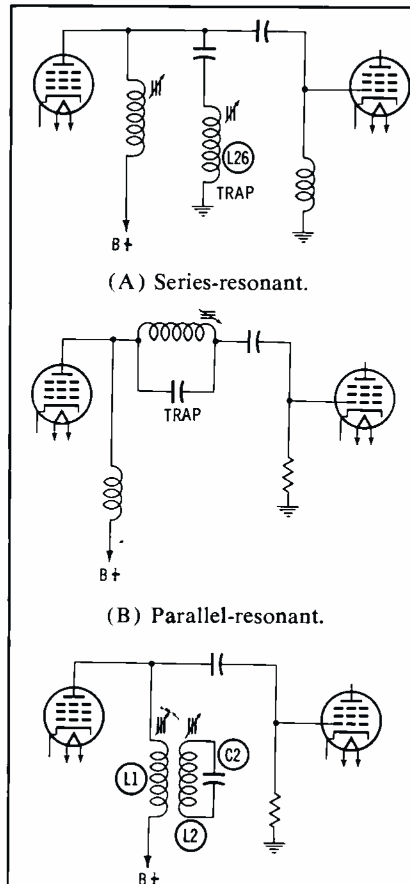


Fig. 10. Circuit using a bifilar transformer has a minimum of components.

pointed out that the resonant frequency of each IF stage was determined partly by the input capacitance of the tube. Since the amount of capacitance varies with bias changes, we may likewise expect the resonant frequency of the stage to vary. An IF stage controlled by AGC bias will change alignment when the strength of the received signal varies. In order to reduce this effect, a small amount of degeneration is inserted in each affected IF stage by inserting a low-value (39- to 47-ohm) unbypassed resistor in the cathode circuit.



(A) Series-resonant.

(B) Parallel-resonant.

(C) Absorption.

Fig. 11. Examples of the three basic types of trap circuits used in TV.

Some manufacturers make good use of the Miller effect by allowing the response curve to shift as Miller-effect capacitance varies. When low-amplitude signals are being received, the reduced AGC bias causes an increase in the input capacitance. This effect changes the IF response in such a manner that both carriers are moved up into a "higher-gain" position on the curve. Although some of the fine detail may be lost, snow is materially reduced. This reduction in snow content improves the picture more than a small loss of detail degrades it. DuMont employs this system in their RA-343 chassis, and so does Westinghouse in recent sets with "shifting IF."

Examples of Commercial IF Circuits

IF amplifiers in use today apply various combinations of the previously-described circuits to obtain the proper IF response curve. Fig. 12A shows part of the IF amplifier strip used in the Bendix T20 chassis. The input to V3 is through C26 and L20, which form a series-resonant circuit at 43 mc. A 12K resistor (R26) loads L20 to reduce the Q and broaden the response of the circuit. An absorption trap, resonant at 41.25 mc, is coupled to L20 to prevent excessive sound-carrier amplitude. Each successive stage is coupled with bifilar-wound coils which are stagger-tuned to produce the over-all response curve shown in Fig. 12B.

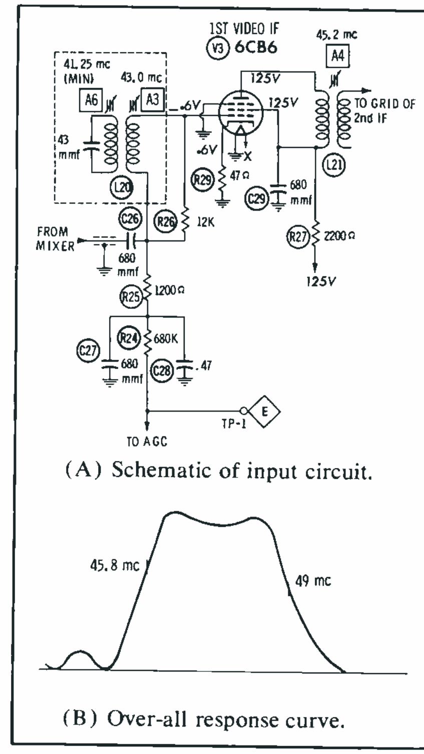
The same fundamental circuit is used in most types of recent-model sets, except for minor variations in resonant frequency, loading resistors, and trap circuits. The DuMont RA-365 differs only in the input to the first IF stage, as shown in Fig. 13. This set contains two traps which, at first glance, may appear to be parallel-resonant circuits and therefore not traps at all. However, careful analysis of the circuit reveals that, while the traps are parallel-resonant circuits at some frequency, each is effectively an inductance at either the sound IF or adjacent-channel sound frequency. Each inductance is in series with a small capacitor, thereby forming series resonant circuits at frequencies of 41.25 and 47.25 mc.

An interesting variation—in reality, an application of an early radio circuit—is used in the Emerson reflex IF amplifier shown in Fig. 14. The second video IF amplifier (V4) also serves as a sound IF amplifier in the following manner. The 4.5-mc sound output is taken from the secondary of a special transformer in the video-detector output circuit, and is fed back to the grid of V4 through L8 and the secondary of L7. The plate circuit of V4 has two resonant circuits, L9A (tuned to the conventional frequency of 42.6 mc for the picture and sound) and L9B (tuned to 4.5 mc for the sound IF). The signal developed across L9A, a bifilar IF transformer, is fed to the following video IF stage, while the signal across L9B is fed to the 5U8 sound limiter (which functions as a second sound IF stage). Since the signals are of widely different frequencies, there is no significant interaction between them.

A Word About IF Servicing

If a part failure in the IF strip brings about a complete loss of video and sound, the trouble can usually be located without too much difficulty. Techniques such as tube substitution, signal tracing (or injection), and voltage or resistance checks of suspected stages are especially helpful. It is often much harder to solve service problems involving only a moderate distortion of the IF signal, because the IF trouble is likely to masquerade as a sync, video, sound, or AGC defect. To add to the confusion, a faulty AGC system can make the IF strip behave as if it were defective. In case you suspect IF signal distortion, here are two tests which should be made immediately: Check all IF amplifier tubes for grid-circuit defects as well as for transconductance; and try connecting an adjustable DC voltage source (bias box) to the AGC line in an attempt to override any faulty action of the AGC system.

In some cases, you will finally come to the conclusion that the IF strip needs realignment. With a little practice, you can recognize a misaligned receiver by observing the picture as you turn the fine tuning control; however, for a really positive indication as to whether or not the IF strip is properly aligned, nothing beats a quick check of the over-all IF response curve with a scope and sweep generator. It's well worth the short time it takes. ▲



(A) Schematic of input circuit.

(B) Over-all response curve.

Fig. 12. Video IF strip of Bendix T20.

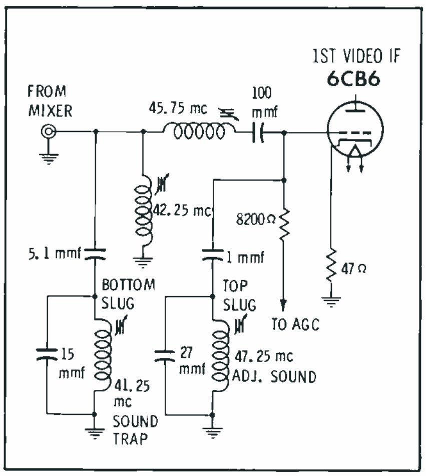


Fig. 13. Video IF input circuit in the DuMont RA-365 contains two traps.

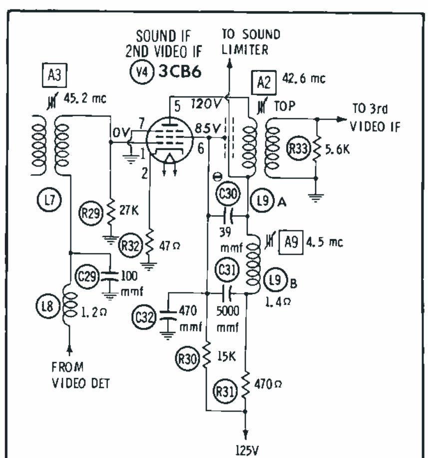


Fig. 14. Emerson 1138 employs a video IF stage also as a reflex sound IF.

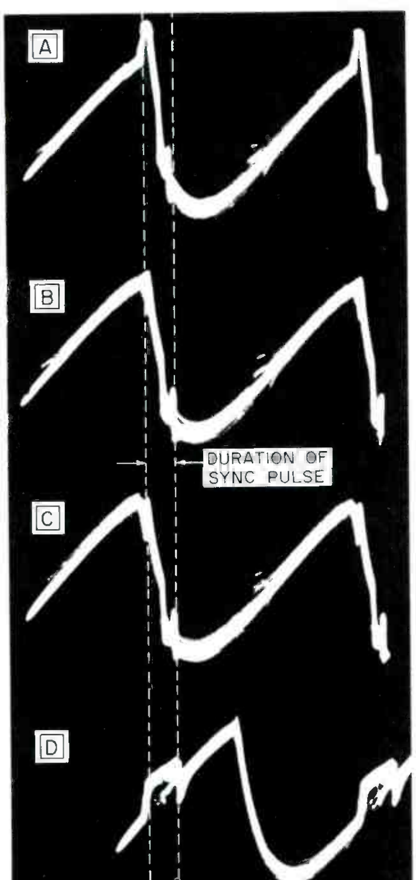
Streamlined Synchroguide

(Continued from page 35)

er-type circuit works in just the opposite manner. Its sinusoidal portion has just passed the negative peak and is positive-going at the end of trace time. The resulting steep increase in plate voltage of the triode oscillator tube helps to regulate the time at which tube conduction begins during each cycle, in addition to preventing early triggering by noise pulses.

Going on to the AFC tube, we shouldn't expect to find any significant waveform at its cathode (pin 3) because of the bypassing action of C2 and C3. The plate (pin 1) will likewise be free of signals because it is tied directly to B+. However, a conventional "pulse-width AFC" waveform (W5) will be produced at the grid when the input sync pulse W6 combines with an integrated sawtooth wave fed back from the oscillator circuit.

The waveform sequence in Fig. 7 shows graphically what happens in



(A) Oscillator slow, but in sync.
(B) Oscillator at correct frequency.
(C) Oscillator fast, but in sync.
(D) Out-of-sync condition.

Fig. 7. AFC grid waveforms (W5).

the grid circuit when the feedback signal undergoes a phase shift with relation to the sync-pulse signal. Waveforms A, B, and C were taken with the receiver in sync and the oscillator running under the following conditions: (A) At the "slow" end of the hold-control range; (B) very close to the center of the range; (C) at the "fast" end of the range. Waveform D corresponds to a condition in which the picture slips out of sync and a horizontal-blanking bar appears in the center of the screen.

As you will note, the sync pulse normally arrives while the feedback signal is passing through the steep negative-going portion of its cycle. If the oscillator tends to run too slow, the pulse occurs relatively early in each cycle of the feedback signal. It then "rides high" on the crest of the modified sawtooth wave (as in waveform A) and drives the AFC tube into heavier-than-normal conduction. Cathode current of this tube, flowing through R3, R5, R6 and R1 in series, produces a positive bucking voltage which decreases the bias on the oscillator tube in order to speed up the operating frequency.

Whenever the oscillator tends to run too fast, the sync pulse arrives abnormally late in the feedback signal's cycle. It then serves to increase the negative voltage on the grid of the AFC tube—thereby slowing down the oscillator and keeping it in sync.

The AFC stage can maintain control over oscillator frequency only as long as the sync pulse occurs within the retrace period of the sawtooth wave. Sometimes, just past the end of the lock-in range, the picture tends to assume an out-of-phase condition in which a horizontal-blanking bar is displayed in mid-screen. This symptom corresponds to D in Fig. 7, where the sync pulse occurs midway in the positive-going slope of the feedback signal.

Voltage Readings

Let's take a round of DC voltage measurements with a VTVM to see what the normal readings should be in this new *Synchroguide* circuit.

E1, the output-tube grid voltage, may be conveniently measured at lug E of the printed-wiring board. The reading between this point and ground will be about -25 to -35 volts, depending on drive-trimmer setting and condition of the receiver. Note that the total bias on the output tube will actually be greater than the grid-to-ground voltage, since a small positive potential will be developed across the cathode resistor of the 6DQ6A.

E2 (oscillator plate) remains constant at about 120 volts.

E3 (oscillator grid) varies by only a couple of volts over the entire range of the hold control. The nominal value is about -55 volts.

E4 (oscillator cathode) is only about a quarter of a volt above ground, since very little voltage is developed across the low resistance of the coils which form the ground-return path for the cathode.

E5 (AFC grid) is a tricky voltage to measure, since even a VTVM will load the circuit and may knock the oscillator out of sync. If it does this, E5 will be close to zero. At some settings of the hold control, an attempt to measure E5 will just cause the picture to shift slightly, and a reading of more than +5 volts will be obtained. By rotating the hold control while keeping the meter connected to the grid, you should be able to keep the picture synchronized over a grid-voltage range of approximately −2 to +8 volts.

E6 (AFC cathode) is highly positive—much more so than in the older - type *Synchroguide* circuit. Therefore, the meter should be placed on the +75-volt or higher scale to check E6. Placing the test probe on the cathode may detune the oscillator, but this situation can be corrected with the hold control. You should be able to vary cathode voltage from about +45 to +65 volts between the "oscillator fast" and "oscillator slow" ends of the hold-in range.

Alignment and Adjustment

Now that the horizontal frequency slug has been eliminated, alignment of the *Synchroguide* oscillator consists mainly of adjusting the waveform slug for maximum picture stability. During this process, the horizontal hold control is placed within the correct portion of its range.

In the earlier-type circuit, proper setting of the waveform slug was determined by direct observation of the waveshape of the oscillator-plate signal (Fig. 4). Since none of the signals in the new circuit give such a clear-cut indication of proper alignment, the slug-adjustment procedure is now carried out by watching the effect on the picture. Since no scope is required, the horizontal section can be aligned without removal of the chassis from the cabinet.

Here is a quick run-down of the alignment sequence: Short out the waveform coil by placing a jumper between the two lugs indicated in Fig. 2. Disable the AFC stage by grounding its grid; the easiest way to do this is to stick a soldering-aid tool into the test jack at pin 2 of the 6CG7 socket, and then ground the tool to chassis with a clip lead. Next, adjust the hold control for a reasonably steady picture—or for a sort of "horizontal roll" effect with an absence of diagonal tearing. Disconnect the jumper from the waveform coil, and adjust the slug to restore the steady or "rolling" condition. Finally, remove the short from the AFC grid and lock in the picture by means of the hold control.

Of course, adjusting the drive trimmer is part of any good horizontal sweep alignment. Instructions usually tell you to tighten the trimmer until a "wrinkle" or vertical white line appears through the middle of the picture, and then to back off until this drive line just disappears. Sometimes, however, this indication is not sufficiently clear to let you make the drive adjustment with complete confidence. In such cases, try hooking up a scope and viewing W1 (Fig. 1) while you turn the trimmer. Tighten down the screw until the positive peaks of the waveform become noticeably more flattened; then back off until the distortion disappears. After completing this adjustment, check the cathode current of the output tube. A normal value for these 110° sets is 125 ma. If current seems excessive, try tightening the trimmer slightly. Suspect trouble if the trimmer adjustment does not bring the cathode current down to the prescribed level without putting a drive line in the picture.

Service Pointers

Since the revised *Synchroguide* circuit works fundamentally the same as the previous version, trouble-symptom analysis is similar for both designs. For example, the picture distortion known as "hunting" or "pie-crust effect" is most often produced by defective components in the AFC cathode circuit; random-frequency operation or "Christmas-tree effect" is commonly due to leaky or off-value capacitors in the oscillator stage; and drifting of oscillator frequency is usually caused by leakage or gas in the 6CG7 or by a heat-induced change in the value of some associated component.

Judging from the parts lists of the newest RCA receivers, the capacitors in the horizontal section have been chosen with an eye toward protecting the oscillator against frequency drift and other subtle defects. In the future, this should minimize the need for a serviceman to resort to the "shotgun blast" repair technique —wholesale replacement of all capacitors in the oscillator circuit.

The latter method can cause more trouble than it cures, if replacements are not selected with care. Here are a few capacitors which you may not have in stock, but should obtain if the need arises: A highly stable .01-mfd tubular unit (C6) with Mylar and styrene dielectric; two 1000-volt types (C5 and C8) with 5% and 10% tolerance ratings; and an N750 ceramic disc capacitor (C4) with a negative temperature coefficient to counteract drifting of oscillator frequency during warm-up. ▲

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Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis, Ind.; Alan S. Brengle, 28423 Kendalwood Dr., Farmington, Mich.; Jean B. Eldred, Redwood Drive, Franklin, Ky.; Paul F. Grubbs, 925 N. Audubon Rd., Indianapolis, Ind.; Edward D. James, 122 E. Michigan, Indianapolis, Ind.; Harold Knox, Zionsville, Ind.; J. A. Milling, 7905 Morningside Dr., Indianapolis, Ind.; Mrs. Lucile Overbay, 5768 Washington Blvd., Indianapolis, Ind.; Raffensperger, Hughes & Co., 20 N. Meridian, Indianapolis, Ind.; James R. Ronk, 6160 Primrose Ave., Indianapolis, Ind.; Howard W. Sams, 414 Kessler W. Dr., Indianapolis, Ind.; Donald B. Shaw, 3419 N. Pennsylvania, Indianapolis, Ind.; Benjamin T. White, 120 E. Market St., Indianapolis, Ind.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)
Armer F. Ahlstrand, 335 Wilty Ave., Rockford, Ill.; Associates Life Insurance Co., 111 Monument Circle, Indianapolis, Ind.; Ad Auriema, 89 Broad Street, New York, N. Y.; Charles R. Barker, P.O. Box 384, Fredonia, N. Y.; John D. & Ruth E. Baur, 3239 Sutherland, Indianapolis, Ind.; Mary M. Benham, 215 N. Senate, Indianapolis, Ind.; Bertha & Frieda Binninger, 3510 Watson Rd., Indianapolis, Ind.; Ralph T. Brengle, Potter & Brumfield, Princeton, Ind.; Bruce & Lorraine Cumming, 6029 W. Belmont, Chicago. Ill.; Glen Dial, 812 Truman St., N. E., Albuquerque, N. M.; Herbert J. Farr, Jr., 3297 Enderby Rd., Cleveland 20, Ohio; Paul F. Grubbs, 925 N. Audubon, Indianapolis, Ind.; Elmer C. Hodges, 1100 Union St., San Francisco, Calif.; Joconat & Co.-Dept. 551, 3911 Prairie Lane, Prairie Village 15, Kansas; M. S. Kiver, 900 Fairview Rd., Highland Park, Ill.; Grace Knox, 505 W. Oak St., Zionsville, Ind.; Harold S. Knox, Zionsville, Ind.; Michelle Fern Koplow, 7035 N. Meridian, Indianapolis, Ind.; Robert J. Lewis, 5800 Lawrence Dr., Brendenwood, Indpls. 26, Ind.; Fernanda D. Milling, 7905 Morningside Dr., Indianapolis, Ind.; Margo Milling, 7905 Morningside Dr., Indianapolis, Ind.; Jack B. Moore, 128 W. Worth St., Worthington, Ohio; Melvin R. Moser, 864 McGill St., Orrville, Ohio; Frieda & Harold Neil, 5026 N. Hillside, Indianapolis, Ind.; Lucile Overbay, 5768 Washington Blvd., Indianapolis, Ind.; Mrs. Norman A. Perry, Sr., E. Shore Dr., Culver, Ind.; Edward E. Petri, Guaranty Bldg., Indianapolis, Ind.; James R. & Phylis M. Ronk. 6160 Primrose, Indianapolis, Ind.; O. T. Smith, W. 918 Long Point, Culver. Ind.; Kenneth Swan, 4243 Broadway, Indianapolis, Ind.; Typographic Service Co., Inc., 215 N. Senate St., Indianapolis, Ind.; Charles W. Vandenbark. P.O. Box 55266, Indianapolis, Ind.; The Estate of Lynne Ann Wavering, Continental-Illinois Bank & Trust Dept.; 231 So. LaSalle, Chicago, Ill.; Benjamin T. White, 120 E. Market, Indianapolis, Ind.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

(Signed) MAL PARKS, Jr., Bus. Mgr.
Sworn to and subscribed before me
this 30th day of September, 1959
(Seal) Mary Helen Whipp, Notary Public

PRODUCT report

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

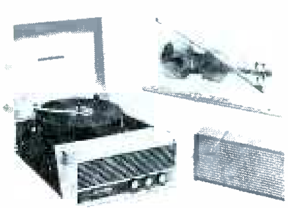
Soldering-Gun Heat Control (43J)

Tip temperature of a soldering gun can be made low enough for safe use on printed wiring boards, if line current is fed to the gun through the *Gunchoke* manufactured by Electric Soldering Iron Co., Inc. The device can be adjusted to produce a tip temperature of either 500° or 600°. Models are available for use with all popular types of guns.

Tuner and Control Cleaner (44J)

A tuner and control cleaner called *Rx*, manufactured by Superex Electronics, contains a "detergent - lubricant" which coats the contact surfaces and provides a cleaning and lubricating action each time the contacts are actuated. The net price of $1.19 per 6-oz. aerosol can includes a detachable injector-type applicator.

Portable Phonographs (45J)



CBS Electronics announces a new *Harmony* line of portable phonographs, to be marketed exclusively through the company's parts distributors. Model 220 (shown) is a stereo unit with four-speed changer and twin 5" speakers; its list price is $79.95. Two other stereo and two monophonic models are also available in a price range of $24.95 to $99.95.

CRT Brightener Deal (46J)

A special promotional package offered by Perma-Power includes 12 *Vu-Brite* picture tube brighteners and a windproof cigarette lighter, all packed inside a bag made of heavy-gauge clear plastic. The cost is $9.95—the regular net price of the 12 brighteners. The serviceman may choose units for either series-string or parallel-filament operation.

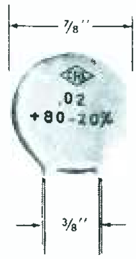
$100.00 CASH REWARD

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

Admiral, serial Nos. 7-147559, 7157997, 7231556, and 6-782330; General Electric, serial Nos. 256754, 256852, 256967, 257983, and 258239; Philco, serial Nos. BC-5008, 549813, and 7152708.

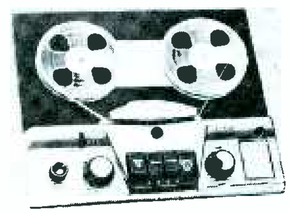
Contact by phone or wire, Carl C. Schmidt, Inspector of Detectives, Indianapolis Police Dept., Indianapolis, Ind.

High-Value Ceramic Capacitors (47J)



Centralab "DD" Series *Hi-Kaps* (ceramic disc capacitors for bypass, coupling and filter applications) are now being supplied in three new values of .03, .04 and .05 mfd, all rated at 600 WVDC. Measuring 7/8" in diameter and 15/64" thick, the new units are impregnated with high-melting-point wax, and are sealed in a coating of *Durez* resin.

Stereo Tape Deck (48J)



The Arkay / Harting MS-5 tape deck provides stereo recording and playback at either 3¾" or 7½" per second. Metal guards prevent vertical movement of the tape as it passes over the heads. Other specifications include a ½" diameter capstan, push-button controls, dimensions of 12 3/16" x 14½" x 6¼", and a price of $129.95.

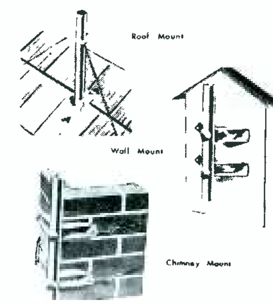
Miniature Electrolytics (49J)

Fifteen electrolytic capacitors, comprising five of the most popular values used in current models of transistor radios, are packaged in the Pyramid No. 515 *Transistor Radio Maintenance Assortment.* Contents include four 6-mfd, four 12-mfd, three 25-mfd, two 50-mfd, and two 100-mfd units, all rated at 12 WVDC. Net price, complete with clear plastic box, is $7.70.

Silicon Power Rectifiers (50J)

International Rectifier has introduced a new series of seven silicon rectifiers designed as exact plug-in replacements for vacuum-tube rectifiers. Of special interest to radio-TV servicemen are Type ST-1 (which replaces the 6X4 and 12X4); the ST-2 (which replaces the 5Y3GT, 5U4GB, 5AW4, etc.); and the ST-3 (which replaces the 6X5, 0Z4, and similar types).

Antenna Mounting Feature (51J)



All models in the Clear Beam line of do-it-yourself antenna kits are equipped with *Miracle Mount* brackets which are adaptable to many different types of installations. They may be used as a base for a roof-mounted antenna, fastened to a wall, or adjusted to form right-angle braces which serve as firm points of attachment for straps or cables in chimney-mount installations.

Phono Cartridge Display Rack (52J)

A dispenser rack with a gold, white and blue finish, accommodating 35 phono cartridges and 29 needles, is being offered to dealers by Sonotone. The unit can be employed as a free-standing counter display, or else mounted on a wall; in addition, two or more racks can readily be stacked to provide greater storage capacity. Furnished with the dispenser is a reference chart of Sonotone stereo cartridge replacement data.

Controlled Pickup Arm (53J)

The *Connoisseur* stereo tone arm, imported from Britain by Ercona, features "cushioned control"—a system in which the arm is gently lowered or raised by rotation of a knob. Arm length is 10¼"; stylus force is 3 gm. The unit comes equipped with a ceramic pickup having a .6-mil diamond stylus and an output of 20 mv (into a 50K-ohm load). Price is $59.50.

Rechargeable Batteries (54J)

Hermetically - sealed nickel - cadmium batteries, which can be repeatedly recharged, have been announced by Burgess Battery Co. Basic 1.25-volt cells are stacked together (using a conductive silver wax) to form various battery types. These "building block" cells are made in six sizes having different current capacities. Single-cell batteries are also available in Sizes AA and D.

Four-Track Tape Heads (55J)

A set of heads for conversion of dual-track tape recorders to four-track stereo operation is available from Robins. The new record-playback head, Model 5Q8, which is electrically and mechanically interchangeable with Robins M/M B&L Series heads, has a list price of $30. A companion unit, the four-track Model 9QE3 erase head, is priced at $14.

Parts Storage Cabinet (56J)

Akro-Mils storage cabinets for small parts are fitted with clear plastic drawers 2" high and 11" deep. Two drawer widths, 3" (M3 Series) and 4" (M4 Series) are available. Features of individual drawers include a stop tab at rear, full-length runners, label slots, and adjustable inner partitions. The welded steel cabinets are made in various sizes holding from 6 to 60 drawers.

Stereo Styli (57J)

An improved Mk II version of the Pickering *T-Guard* stylus, for Model 371 Stanton *Stereo Fluxvalve* cartridges, offers higher output (now 12 mv per channel) and thus a better signal-to-noise ratio. A built-in shock-absorbing feature also provides *controlled* (i.e., self-regulating) compliance. Model D3707A, with a tracking-force range of 2-5 gm for transcription arms, and D3707C, with a range of 3-7 gm for changers, have .7-mil diamond tips; Model S3727 MkII has a 3-mil sapphire.

INDEX TO ADVERTISERS

NOVEMBER, 1959

Latest Jackson Tube Test Data

TUBE TYPE	MODEL 648 FIL.	CIRCUIT D.	CIRCUIT E.	PLATE TEST	MODEL 49 SEC.	A.	B.	C.	D.	CATH. SHORTS	E.
3EA5	3.0	A234	AC156	18X2	P	3.0	3	2X	156	7	30
6DE4	6.3	234	6	14W	D	6.3	7	-	5	3	4
12BZ6	12.6	AC1234	567*	16WY	P	12.6	3	X	1567	2	30
6085	12.6	127	A89	25YZ	T	6.3	9	-	67	8	8
	12.6	123	A45	25YZ	T	6.3	9	-	12	3	8
6686	6.3	A1236	B579	90W	P	6.3	4	-	278	3	4

TUBE TYPE	MODEL 658 SEC.	HEATER	CIRCUIT H-K	CIRCUIT P-G	PLATE	GRID TEST	HEATER CURRENT
3EA5	P	3.0K	124	ac356	32R	10WY.	
6DE4	D	6.4L	234	6	18U	V	
12BZ6	P	13.6E	1247	ac356	35R	15WY.	
6085	T	13.6G	127	a89	25Q	25WY.	
	T	13.6G	123	a45	25Q	25WY.	
6686	P	6.4J	1236	b579	45Q	20VY.	

Latest Chart Form 648-22, 49-5, 658-2

CATALOG AND LITERATURE SERVICE

ANTENNA SYSTEMS

1J. *ANTENNA SPECIALISTS* — 16-page catalog plus data sheets on complete line of communications antennas and accessories, including stationary, mobile, and portable types.

2J. *CLEAR BEAM*—Information on *Miracle Mount* "do-it-yourself" antenna kits. *See ad page 63.*

3J. *JFD* — New 24-page catalog of UHF, VHF, FM and indoor TV antennas and accessories, plus hi-fi speakers and TV accessories. *See ad page 12.*

4J. *JERROLD*—16-page booklet on the 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 75.*

5J. *TACO* — Revised price list and catalog sheets on antennas, accessories, and FM promotion kit. *See ad page 74.*

AUDIO & HI-FI

6J. *ASTATIC*—Catalog 33-3 containing complete listing and descriptions of cartridges, microphones, pickups, and needles. *See ad page 9.*

7J. *CLAROSTAT*—Form 75177301C, with data on line of sound system controls, including T- and L-pad combinations, constant-impedance attenuators, etc., plus diagrams showing typical applications and wiring instructions. *See ad page 21.*

8J. *ELECTRO-VOICE* — Catalog #136 for 1960 in a new two-section binding. Section one covers hi-fi products; section two describes microphones, commercial sound (public address), RME communications equipment, and replacement phono cartridges. *See ad page 25.*

9J. *PHILCO*—Catalog for full line of new speakers covering every application. *See ad page 44.*

CAPACITORS

10J. *MALLORY*—New 28-page capacitor catalog in step-down wall-chart form. *See ad pages 26-27.*

11J. *SPRAGUE* Large, 2-color *Ceramichart*, with circuit diagrams showing typical ceramic capacitor applications in radio and TV, plus color-code specifications for ceramic and molded mica capacitors. *See ad page 10.*

CARTRIDGES & NEEDLES

12J. *ERIE* — Brochure with description and full technical specifications on the *StERIEo* cartridge, plus literature on the "PAC" audio amplifier kit for converting any record player to stereo. *See ad page 93.*

SEMICONDUCTORS

13J. *INTERNATIONAL RECTIFIER*—Bulletin SR-208 describes 2E4 and 5E4 silicon diode rectifiers; also, Bulletin JB-510, which describes silicon TV replacement rectifiers and hi-density selenium stacks. *See ad page 61.*

14J. *SAMPSON* — Component catalog and transistor literature. *See ad page 53.*

FUSES

15J. *BUSSMANN*—Completely new television fuse chart describing proper fuses to use, how they are mounted, and which circuits they protect. *See ad page 47.*

SERVICE AIDS

16J. *CHEMTRONICS* — Flyers describing complete line of electronic servicing chemicals, including *No-Arc* high-voltage insulator. *See ad page 80.*

17J. *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 91.*

18J. *YEATS* — Literature describing aluminum-alloy appliance dollies and padded appliance delivery covers. *See ad page 95.*

SPECIAL EQUIPMENT

19J. *ACME*—New catalog entitled, "Variable Voltage Adjustors," discusses high and low line voltage problems, and tells you how to select the right Voltage Adjustor for the job. *See ad page 70.*

20J. *ANTRONIC CORP.*—Literature on Anchor *NEV-A-BREAK SOC-KIT*, the replacement socket for CRT testers.

21J. *ATR* — Brochure describing customized *Karadios* for small import cars and compact American cars. Eight models available. *See ad page 14.*

22J. *BULLDOG* — Literature on *Electrostrip*, the new multi-outlet assembly that lets you position AC line outlets as needed. *See ad page 52.*

23J. *PERMA-POWER* — New catalog sheet illustrating and describing the Automatic Voltage Regulator and its uses in eliminating picture flutter, shrinking, flopover, loss of brightness and other similar TV troubles. *See ad page 46.*

TECHNICAL PUBLICATIONS

24J. *GERNSBACK*—Descriptive literature on Gernsback Library books. *See ad page 91.*

25J. *HOWARD W. SAMS* — Literature describing all Howard W. Sams publications covering servicing of radio, TV, hi-fi, etc. Includes data on "Tube Location Guide," "Printed Circuit Diagnosis Made Easy," "Servicing Transistor Radios, Volume 4," "101 Ways to Use Your Audio Test Equipment," and "Tape Recorder Manual, Volume 5." See ads pages 57, *76, 77, 80, 90.*

TEST EQUIPMENT

26J. *B & K*—Bulletin ST24-R gives helpful information on how to save time and work, and make money with point-to-point, signal-injection, direct-viewing Model 1075 Television Analyst, Models 550 and 650 dynamic mutual-conductance tube testers, Model 675 automatic tube tester, and Model 440 CRT cathode-rejuvenator tester. *See ads pages 43, 54.*

27J. *DOSS*—Information on the latest in test equipment, including the *Pioneer 250* Horizontal Systems *Quantalyst. See ads pages 60, 70, 90.*

28J. *EICO*—20-page 1959 2-color catalog describes 65 models of professional test instruments, hi-fi, and "ham" gear in both kit and factory-wired form. Shows how to save 50%. Also, 4-page 2-color stereo hi-fi guide. *See ad page 87.*

29J. *HICKOK* — Literature describing new transistor checker, Model 850. *See ad page 67.*

30J. *JACKSON*—2-color folder showing complete line of "service-engineered" test equipment. *See ads pages 40, 96.*

31J. *SECO* — New 2-color folder describes latest low-priced tube tester Model 78, Dynamic Transistor Checker Model 100, and all other Seco test equipment. *See ad page 38.*

32J. *SENCORE*—4-page brochure on complete line of time-saver instruments. *See ads pages 79, 81, 83, 85.*

33J. *TRIPLETT*—New test equipment catalog No. 39-T describes and illustrates many VOM and VTVM models; signal, sweep, dot-bar, and color-bar generators; appliance, tube and transistor testers; plus wide-band, high-sensitivity 5" oscilloscope. *See ad pages 18-19.*

34J. *VIS-U-ALL* — Catalog #59A contains complete description of business-building test equipment. *See ad page 92.*

TOOLS

35J. *BERNS*—Data on the 3-in-1 picture tube repair tool that crimps pin and element lead to make a solid electrical connection and also serves as screwdriver and channel selector, plus data on the new "Audio Pin-Plug" crimper that lets you make pin-plug and ground connections for shielded cables. *See ads pages 66, 91.*

36J. *CHAMPION*—Folder on line of specially-designed *Channellock* pliers and cutters for electronic servicing.

37J. *ESICO* — Information on the *GUN-CHOKE*, a simple and inexpensive device that reduces tip temperature for soldering on printed-circuit or laminated boards. *See ad page 66.*

38J. *VACO*—Catalog pages on new insulated solderless terminals, plus special offer on new service tools. *See ad page 95.*

39J. *WELLER* — Catalog sheet describing complete line of soldering equipment and power tools. *See ad page 89.*

40J. *XCELITE*—Latest catalog on complete line of tools for radio, TV, and electronic servicemen. *See ad page 62.*

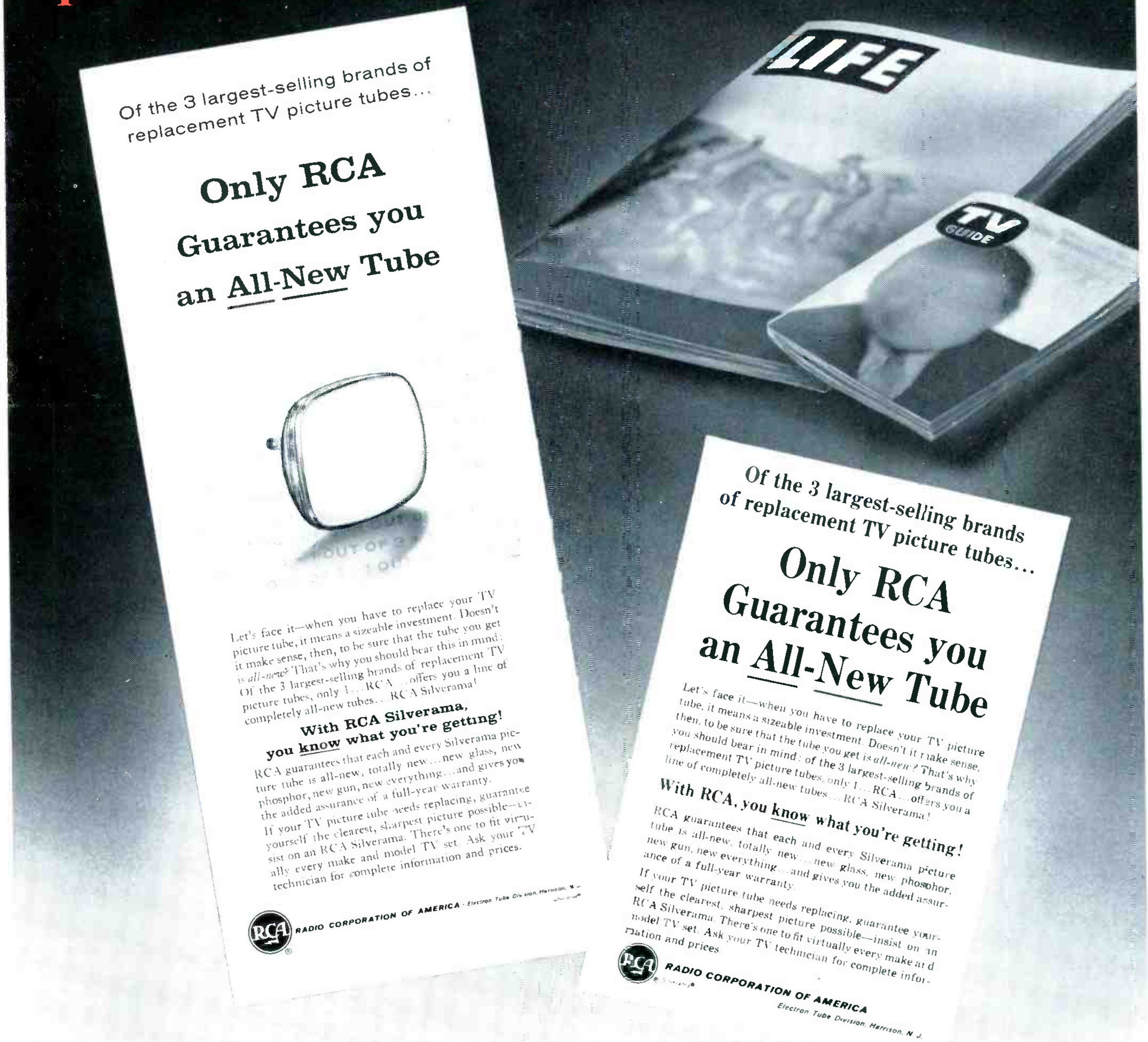
TRANSFORMERS

41J. *CHICAGO STANDARD* — New 36-page 1959-60 catalog containing detailed specifications on replacement transformers for radio, TV, industrial, and hi-fi equipment. *See ad page 82.*

TUBES

42J. *CBS*—New picture tube wall chart, PF-288, lists mechanical and electrical characteristics for more than 360 tubes and popular replacement types. *See ad pages 15, 16-17.*

For top customer value... top dealer profits... promote RCA Silverama Picture Tubes!



Ads like these in Life and TV Guide are pre-selling millions of TV-set owners on RCA Silverama Picture Tubes. Cash in!

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

Silverama ®