APRIL, 1959 35 CENTS

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Bench Servicing New Sets

•

Room Air-Conditioner Maintenance

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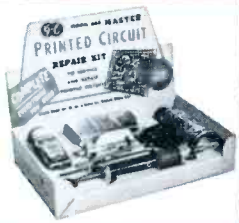

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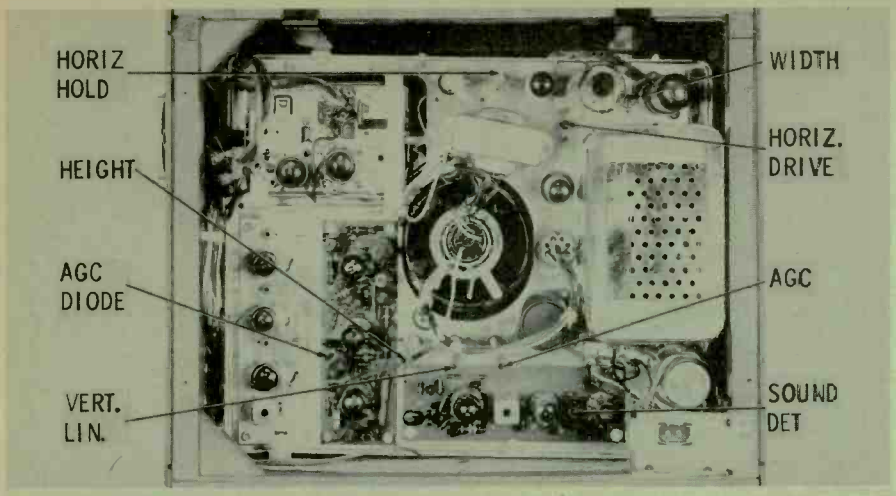
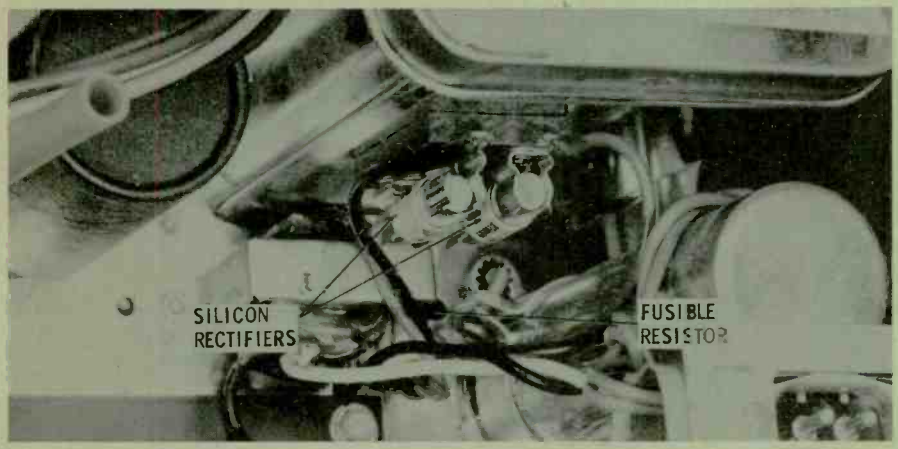
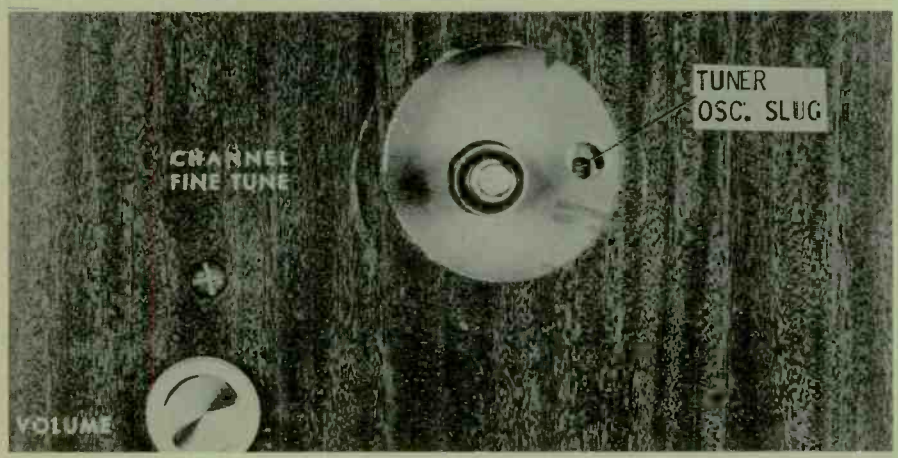
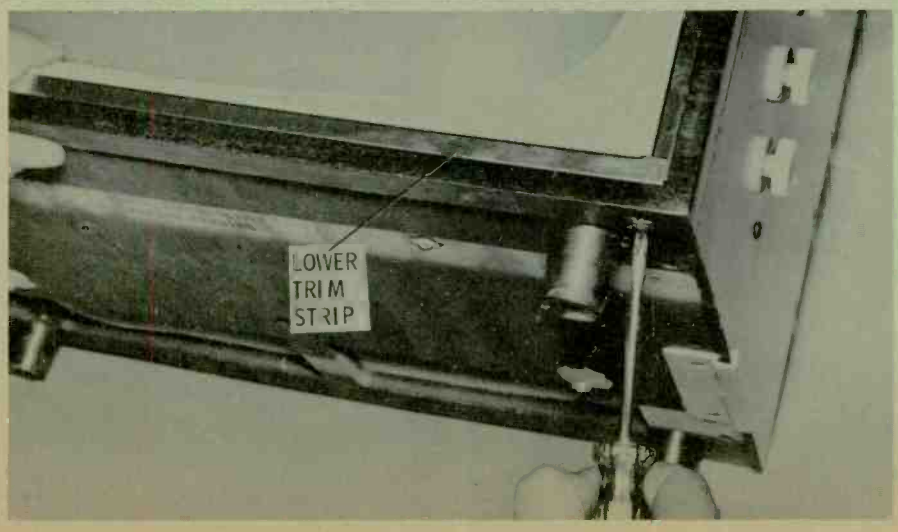
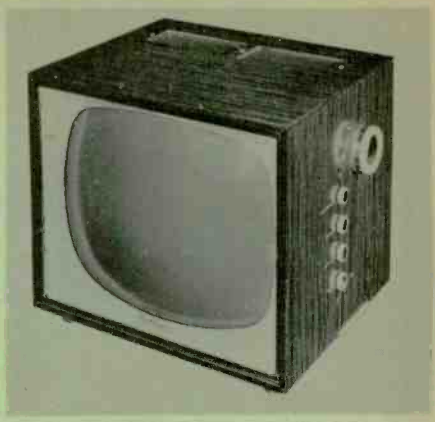
Hoffman











Hoffman Model M1277 Chassis 335

Pacoima is the trade name for this new 17" VHF portable, which features a short neck 110° picture tube. Two strips of printed wiring are used in the make-up of the vertically-mounted chassis—one for the sound section and the other containing the video, AGC, sync, and vertical-oscillator circuits. Tube heaters are all in series, and one side of the AC line is connected to chassis ground. A 6BJ8 dual-diode/triode is employed in the horizontal-AFC and sync phase-inverter stages. The remaining tube types are fairly conventional, except perhaps the 12DT5 output tube in the vertical circuit. The AGC diode pointed out in the rear cabinet photo is a small crystal used to clamp the AGC voltage for the RF amplifier. Since this component is found on the printed board containing the video amplifier stage, one might conclude that it functions as the video detector; however, the diode section of a 5AM8 is actually used for this purpose.

Powering the chassis are two silicon rectifiers mounted in polarized clips on the bottom side of the high-voltage cage. Connected in a voltage-doubler circuit, each unit is rated at 500 ma. The supply is protected by a 7.5-ohm fusible resistor located on the wiring side of the chassis directly behind the audio-output transformer. Chassis removal involves taking out two bottom bolts and two screws holding the brackets on the upper rear of the cabinet. After removing the interlock panel and disconnecting the necessary leads, the chassis slips out the back without the picture tube.

Adjustment of the RF oscillator is accomplished by removing the channel-selector and fine-tuning knobs and tuning each operating channel slug as the turret is rotated. The front of the tuner is covered with a fibre insulating board having a single adjustment hole as shown. Incidentally, you'll find that the control panel (mounted on the side of the cabinet) has long leads and will not necessarily require removal to work on the chassis.

To clean the screen on this model, remove the two Phillips-head screws securing the lower trim-strip under the front edge of the cabinet, pull the glass assembly out at the bottom and remove.

Magnavox Model 2MV-147L Chassis V30-05AA

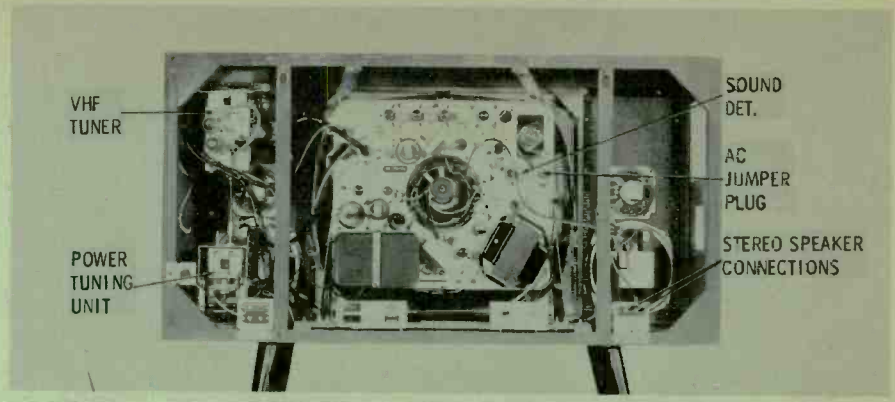
The vertical chassis in this console is powered by a transformer, and mounts in the center section of the cabinet with a 21" picture tube. On each side, an 8" woofer and a 4" tweeter reproduce sound (four speakers in all), while the tuner and power-tuning unit mount to one side as shown. Be careful not to mistake the AC jumper plug above the power transformer for a horizontal-AFC diode. The jumper, fashioned as a plug-in dual diode, is merely a connecting device used in the primary circuit of the power transformer. If line voltage is normal, the plug should be placed in the socket with its "117V" marking on top. If voltage is higher than normal, the "127V" marking should be up.

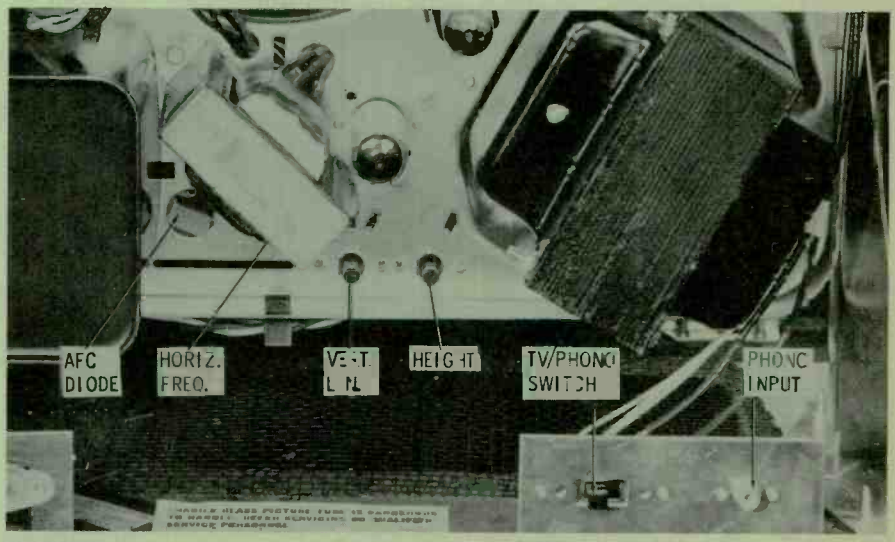
You'll find vertical-linearity, height, and horizontal-frequency adjustments near the bottom of the chassis pan between the high-voltage cage and the power transformer. Although the tube lineup is not revolutionary, the audio output stage employs a 6DG6GT (6W6GT), and a 6BF6 is used for half the vertical multivibrator and the AGC clamper. The other section of the multivibrator uses a 6DT5.

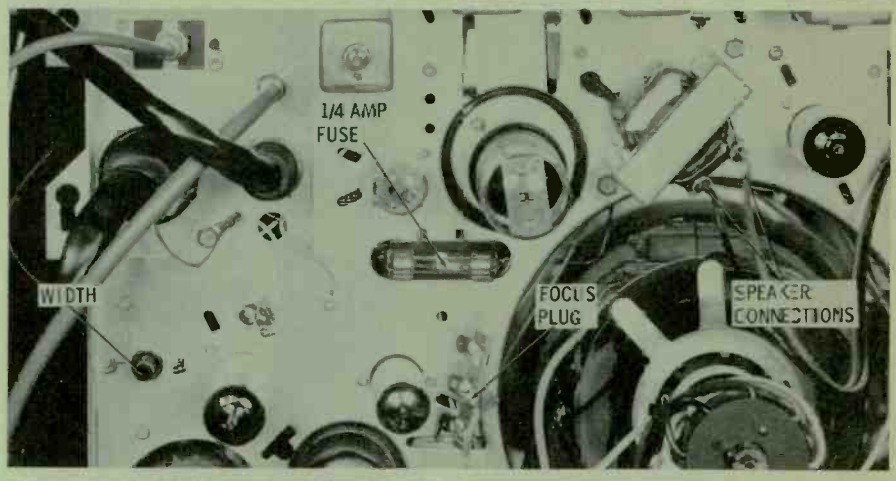
Positioned on the chassis just to the left of the yoke is a three-connection terminal strip. The lead from the focus anode of the picture tube should be connected to the terminal producing best picture focus. The ¼-amp fuse shown in the photograph is a slow-blow unit which protects the horizontal-output and flyback components. A length of #24 uninsulated wire fuses the filament circuit.

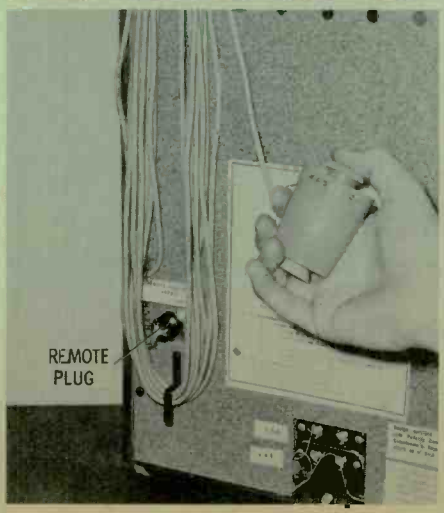
The remote hand unit is a small plastic case with a suction cup on one end and a combination pushbutton switch and volume control on the other. The switch enables the operator to select channels automatically and to turn the set on. If one channel of the tuner (such as the UHF position) is set up for automatic shut-off, power can also be turned off with this switch.

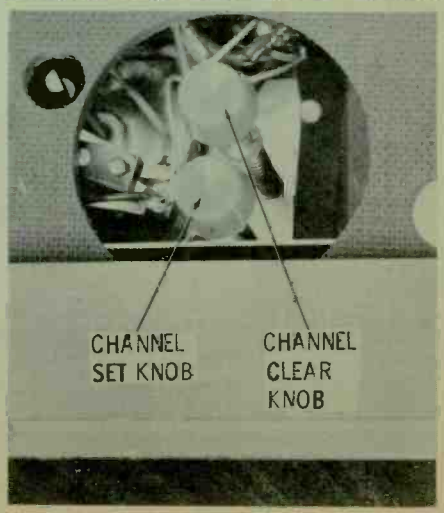
Set-up adjustments for indexing the powered tuner are located under the cabinet. The *set* control (nearest side of cabinet) selects channels for automatic tuning by pulling out or down on the knob. When this control is rotated clockwise in the *out* position, the associated channel is then set up for automatic shut-off. Pushing in on the *clear* control bypasses undesired channels.



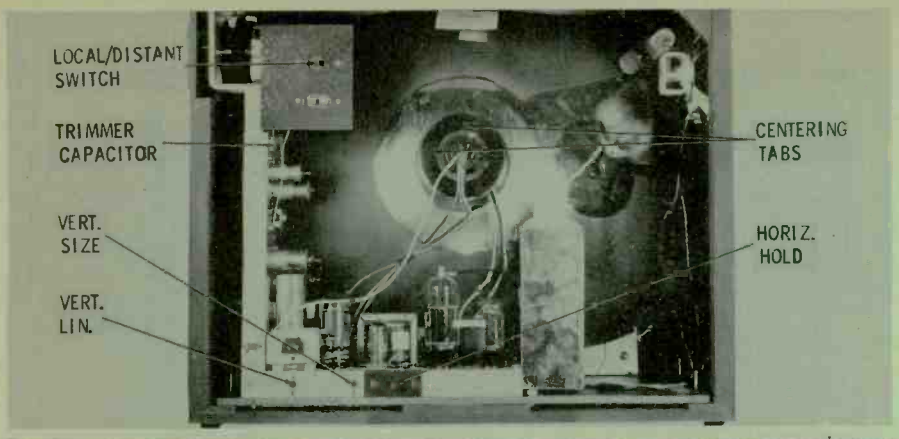


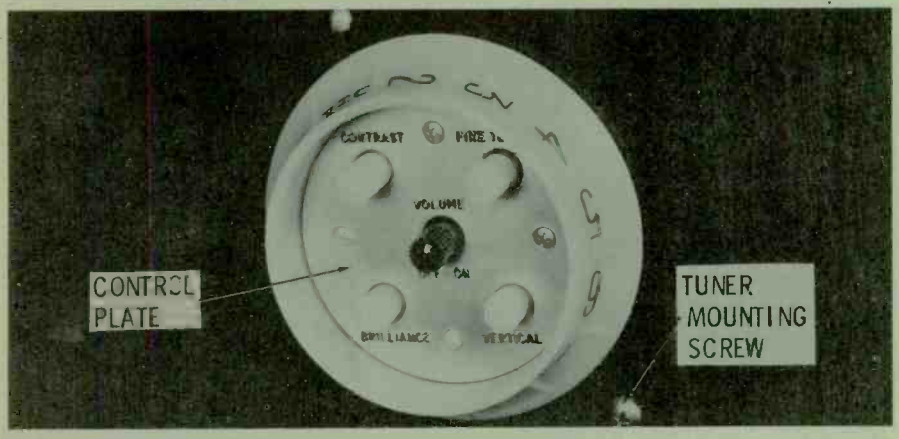


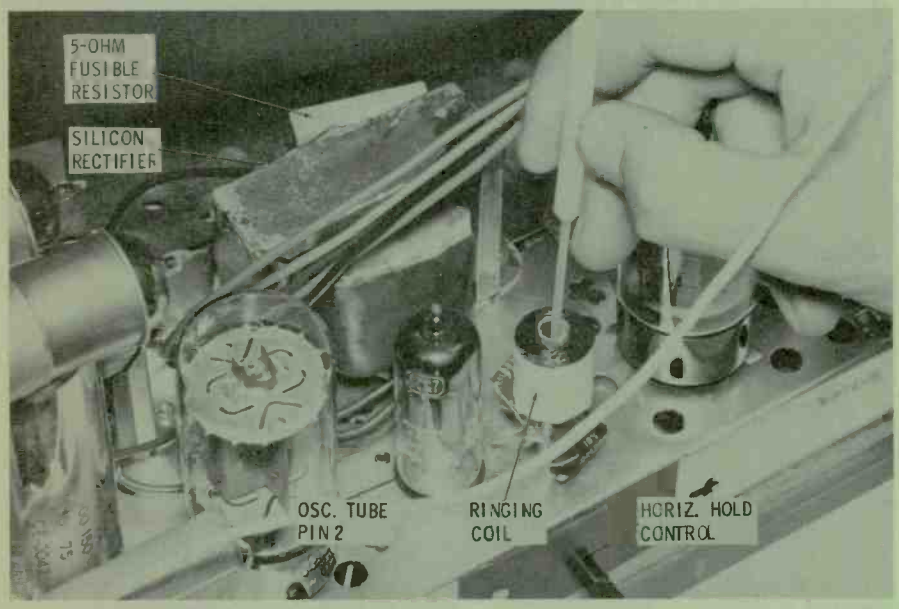


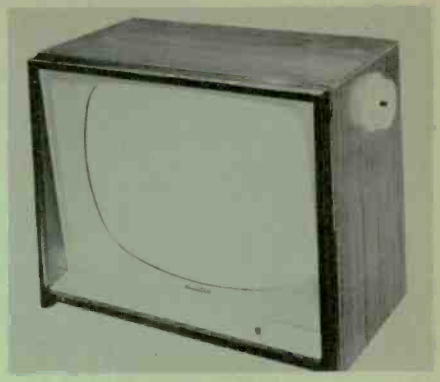


Muntz









Muntz Model 21TM Chassis "J"

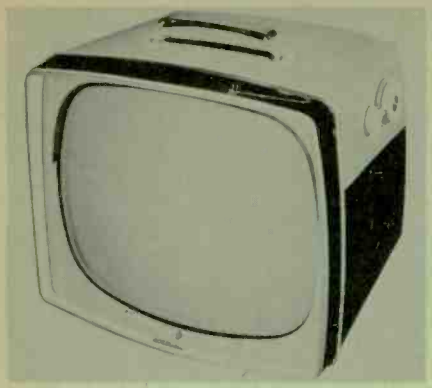
A little different from the Muntz portable design, this new table model has all its operating controls on the side. Also featured are a 21" 110° picture tube and a local-distant switch for selection of the proper AGC range.

When you remove the back cover, you'll find a narrow "L" shaped chassis with one of the new Sarkes Tarzian *Hot-Rod* tuners positioned on top of the vertical section. Incidentally, the tuner is not positioned directly behind the group of control knobs, but is offset and operated via a gear arrangement. The trimmer capacitor pointed out in the photo is an alignment adjustment located in the grid circuit of the first IF stage. Remember this so you won't mistake it for a horizontal-AFC or drive control.

Five separate operating controls, including contrast, fine tuning, brilliance, volume with on-off switch, and vertical hold, are confined within the large channel-selector knob. To remove the knobs prior to pulling the chassis, the circular control plate, which is held by four Phillips-head screws, must be removed. The large screw below and to the right of the controls is part of the mounting hardware for the tuner assembly. Chassis and picture tube are attached to a single mounting board, which is removable from the rear of the cabinet.

Alignment of the horizontal oscillator is accomplished by tuning in a normal signal, shorting out the ringing coil, grounding the AFC voltage at pin 2 of the 5BW8 phase detector, and adjusting the hold control until a single picture is obtained. Next, remove the jumper across the ringing coil and adjust the coil slug with a hex-ended tool. Screw the slug up into the winding until a single picture is again obtained. Then, turn it back about ¼ turn, remove the short from the AFC diodes, and observe the picture to see if it snaps into sync. To check AFC action, measure the voltage on pin 2 of the 6CG7 oscillator tube. A normal reading should be from 0 to .2 volts DC.

To take the safety glass out from the front, you'll find four Phillips-head screws under the lower trim-strip. With the strip removed as shown, tilt the cabinet forward until the glass swings out at the bottom; then slip it down and out of the top retainer.



RCA Model 21PT9095
Chassis KCS 117A

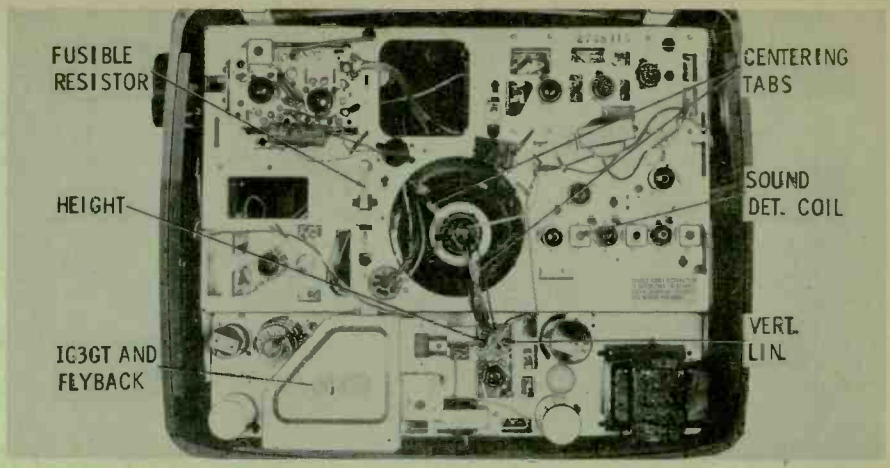
This large-screen portable has all operating controls on the side of its metal cabinet, with horizontal hold, brightness, and vertical hold in a small hidden compartment below the contrast, volume, and tuner knobs. Although not shown, the set also has a "V" or rabbit-ear antenna attached to the rear cover.

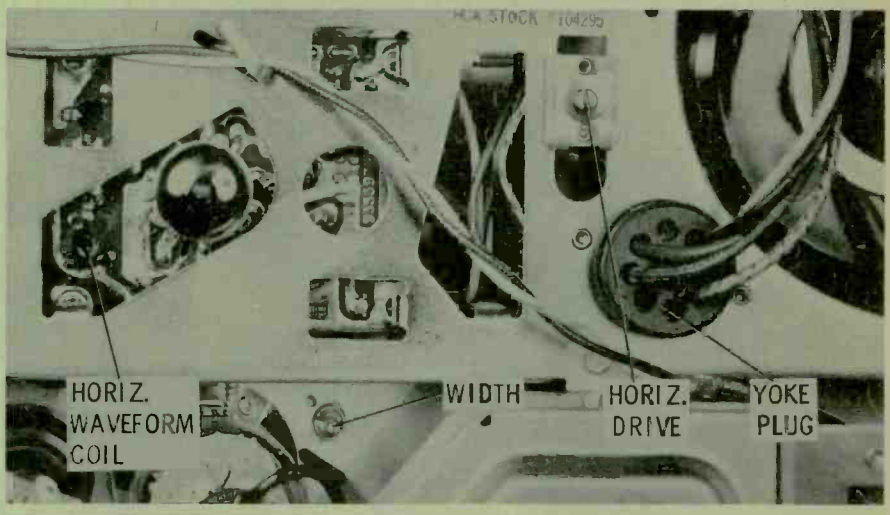
The chassis is of the vertical style positioned around the neck of a 21" 110° tube. A VHF tuner, which incidentally uses a 6CQ8 converter tube, mounts right on the chassis in the upper left corner. The transformer-powered set, featuring almost all printed wiring, introduces another newcomer to your tube caddy—a 6EM5 serving the vertical multivibrator-output section. The fusible resistor, located on the chassis just to the left of the yoke cut-out, is a special 9-ohm unit, and should be replaced by an original type. This component guards the B+ supply against damage from shorts, while three separate lengths of copper wire protect the heater circuits.

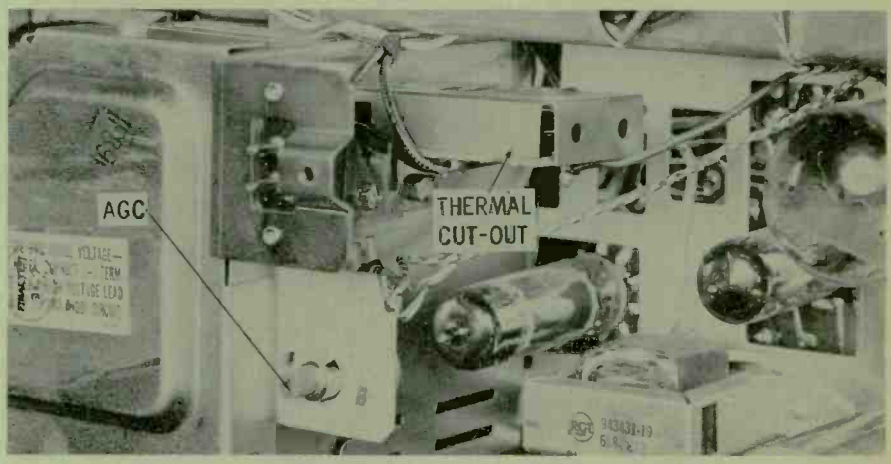
All tubes and service adjustments are easily reached, with the exception of the height and vertical linearity controls. These two pots are screwdriver adjustments mounted on a printed board recessed from the chassis surface. Horizontal adjustments (drive, waveform, and width) are near the left side of the chassis.

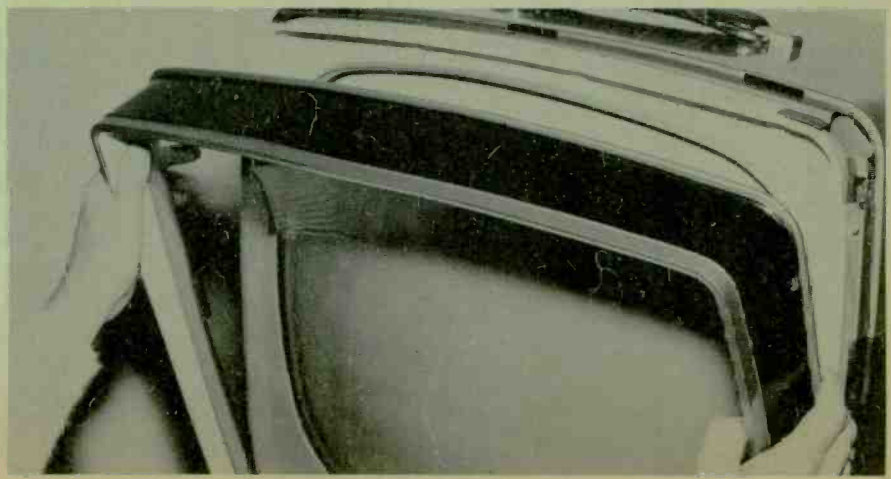
You'll find a thermal cut-out device fastened to the side of the high-voltage cage directly behind the AC interlock. This combination switch and resistive unit offers automatic protection for the low-voltage supply, breaking the circuit when current drawn by the receiver becomes excessive. The AGC control located below the interlock should be adjusted while the strongest signal is being received. If adjusted with a weak signal as a guide, the set may overload when a stronger signal is tuned in.

The picture tube and safety glass on this model can be separated for cleaning by removing the entire front mask assembly. To free the bezel, remove the two Phillips-head screws from each side of the cabinet, and two screws from the bottom. There are actually four screws under the front section of the cabinet, but you need only remove the two back ones.









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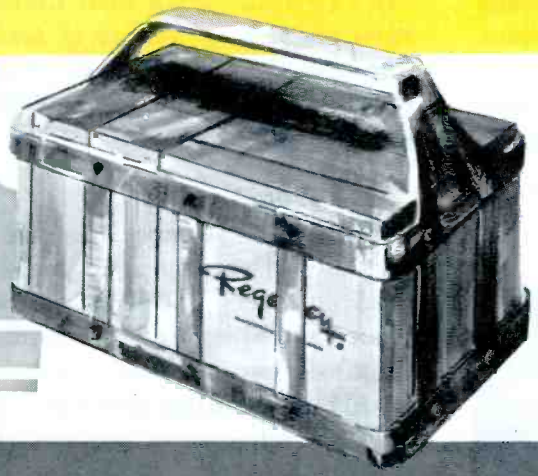

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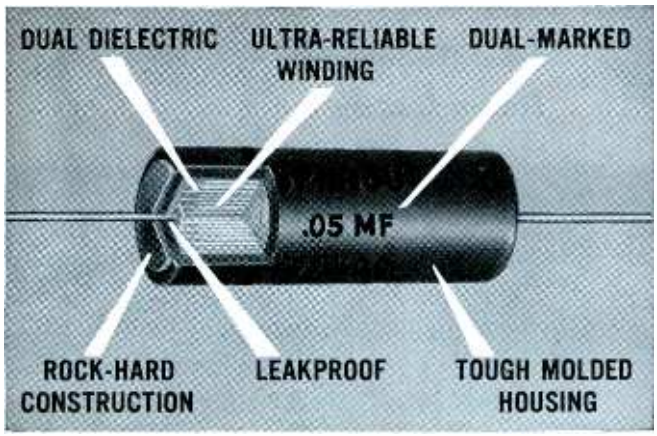

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NEXT MONTH

Aligning and Calibrating Communications Sets
Another "mecty" feature by expert Jack Darr, following up the "Getting Acquainted" article under his byline in the March issue. The title tells you what to expect.

Question and Answers on Deflection Yokes
Are you lost when it comes to deflection problems? For answers to the most-often asked questions, along with numerous picture symptoms to help you isolate yoke troubles more quickly, be sure to read this down-to-earth presentation in the May issue.

Using a Crosshatch Generator to Align Chroma Circuits
This one is particularly for the numerous readers who have urged us to put in more color TV coverage, but it will also be a great help to those who want to cut a few corners and take on some color work.

PF REPORTER®
including Electronic Servicing

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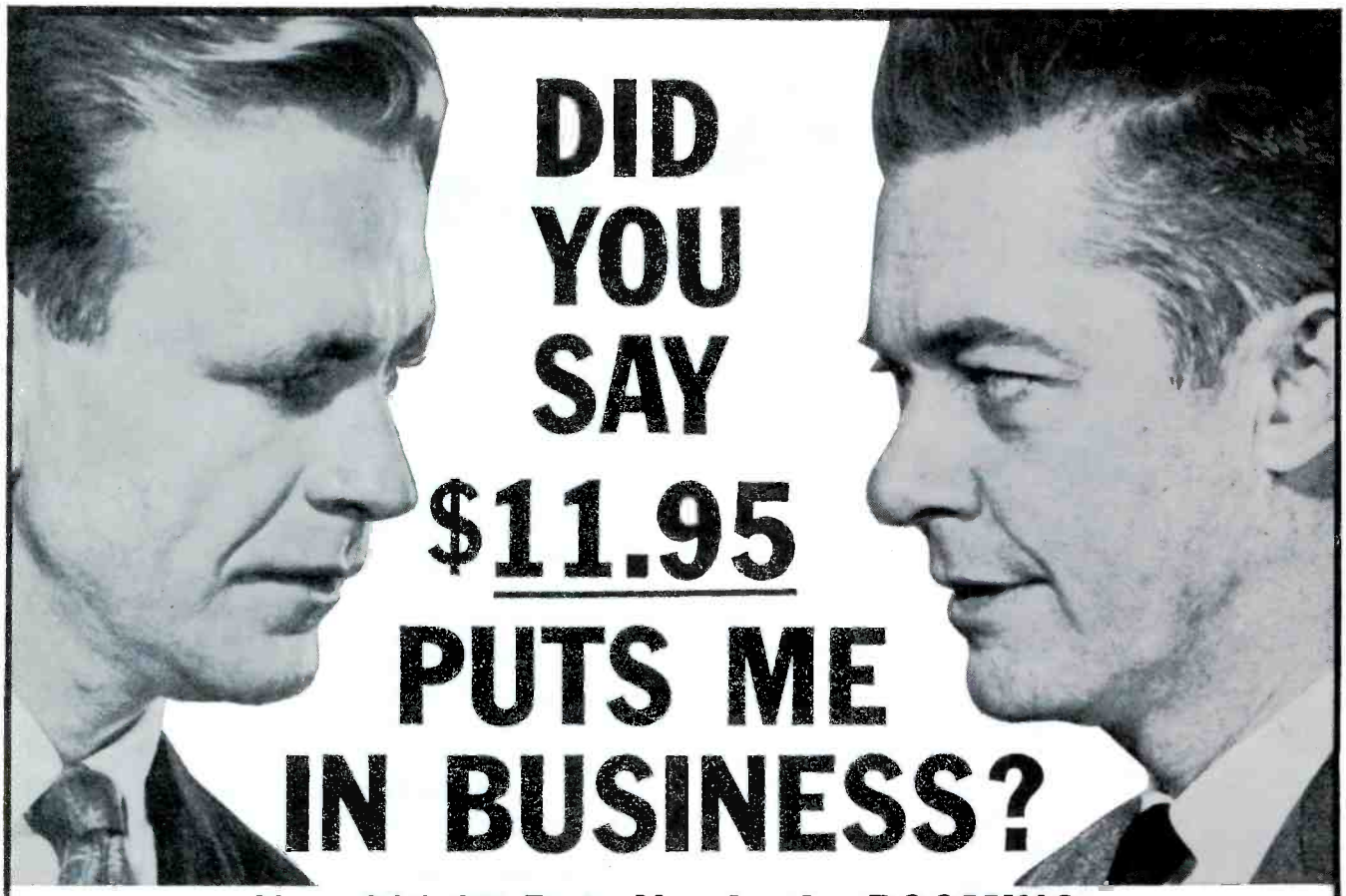
ABOUT THE COVER

Like so many of us, our cover serviceman has been too busy repairing sets to file his federal income tax report. Now he's scrambling to beat the midnight deadline. Doesn't look like April 16th will be a good day to have a set fixed.

USE HANDY CARD AT BACK TO ENTER YOUR SUBSCRIPTION



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1	TA360	GE, Hotpoint, Westinghouse	11.75
1	TA442	Emerson, GE, Olympic	10.95
		Total List	$58.10

1 1959 *catalog* of all Portable TV Sets by brand, model and JFD Exact Replacement Indoor Antenna.

1 "Exact Replacement Portable TV Antenna Headquarters" *streamer.*

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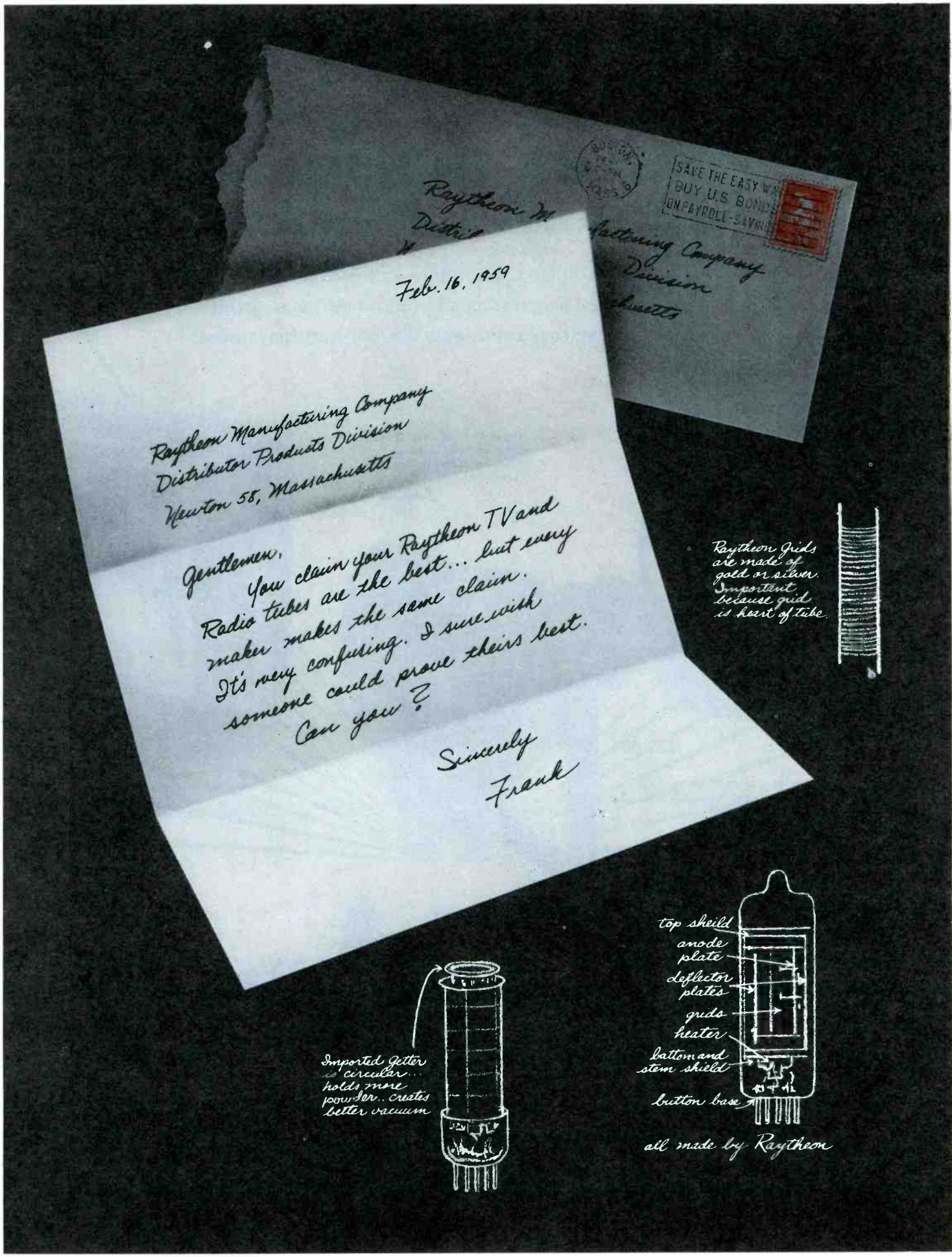

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DISTRIBUTOR PRODUCTS DIVISION

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Dear Frank:

How can I prove Raytheon Tubes are superior to all others? A good question and I'm going to try and give you an honest answer!

First, we believe that what we put in Raytheon TV and Radio Tubes . . . and the way we make them . . . are the real reasons why they are best. Pictures of quality control, manufacturing processes, might help convince you, but would they actually prove the end result is a quality product?

You still wouldn't be sure that the Raytheon replacement Tube you put in your customer's set was as good as or better than the original and would outlast it in saving you all those no-charge repeat calls.

To be sure, Frank, we could give you a long list of how we make all our own tube parts—use imported getters, special grids, ceramic insulated multiple fold heaters, and many, many others—but do you really care about these things?

You know, of course, that Raytheon is the world's largest exclusive manufacturer of Electronic Components. Raytheon Tubes and Components which go into 21 of our nation's missiles have to be better than normal. They don't just have to be good!

Honestly, Frank, maybe we can't prove superiority . . . but you can! You and thousands of men like yourself are proving it every day. I would suggest that as long as there is a doubt in your mind, why don't you find out for yourself by using Raytheon Tubes as others have done? I don't know of any other way.

Thanks for your letter . . . let's hear from you again real soon. I know you're going to be convinced.

Sincerely,

RAYTHEON MANUFACTURING COMPANY

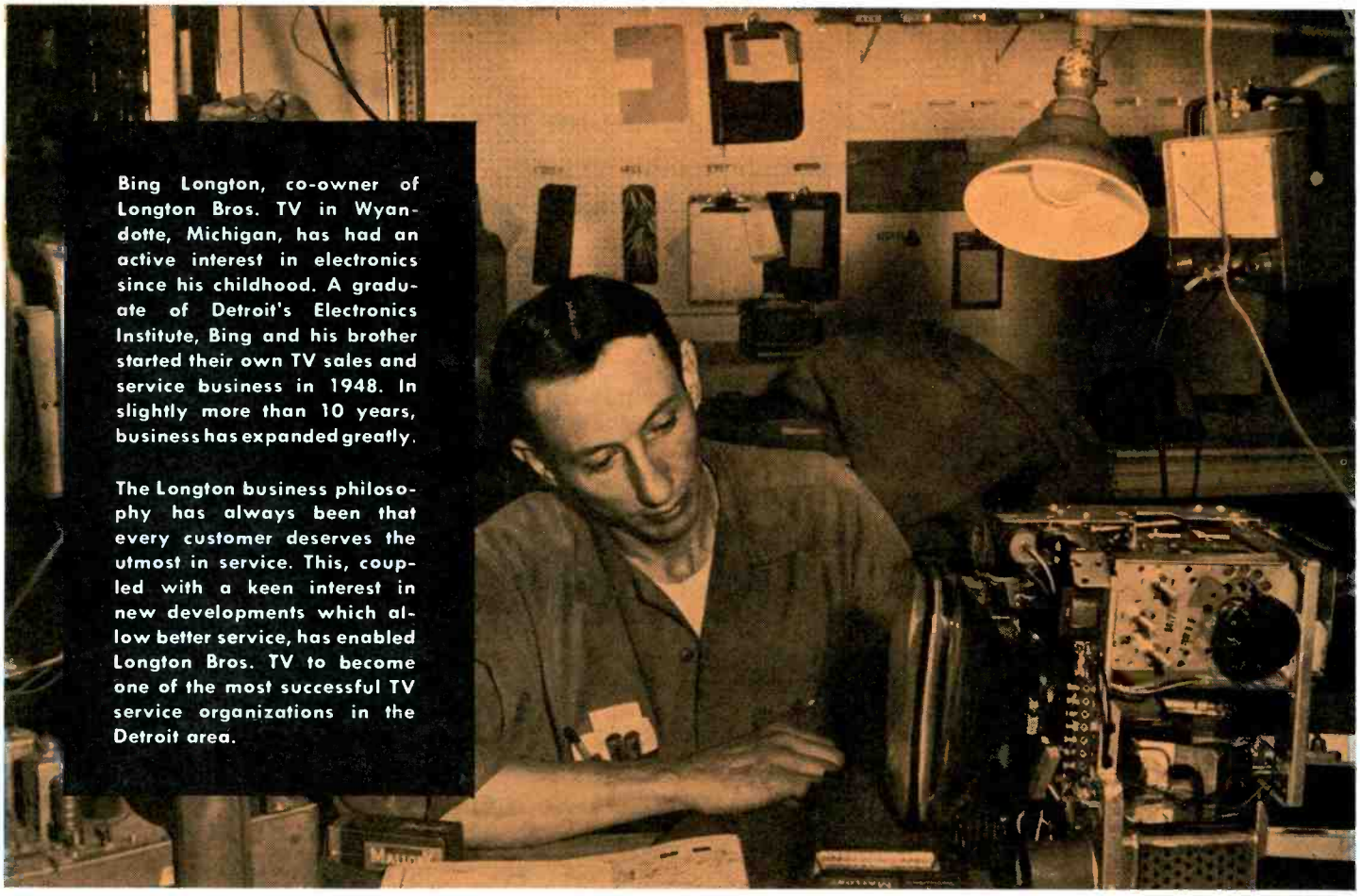
Ray Raytheon

P.S. I'll be talking to you again next month.

Excellence in Electronics

TV Technician Bing Longton says . . .

"We Can't Gamble With Customer



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

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

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

GEMS

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

RMC DISCAPS®

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

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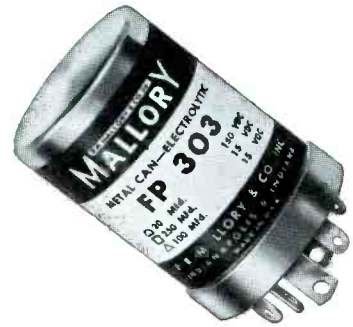

FP ELECTROLYTICS

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

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

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

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

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MALLORY

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

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**Trade Mark*

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

Letters to the EDITOR

Dear Editor:

Please enter our order for your "Homeowner's TV Antenna Handbook."

We have been anticipating setting up a special division for the sales and service of antenna systems, and are anxious to try out the handbooks. We feel they will help us gain a considerable amount of business.

E. W. THIESS

Livingston, N. J.

Dear Editor:

When I came across the "Homeowner's TV Antenna Handbook" in your February issue, I was very much impressed.

I plan to open a new TV service center on March 1st, and can't think of better direct-mail advertising material than the handbook.

Many thanks for your past help and the splendid articles on electronics.

VICTOR SAULTER

Bloomington, Ind.

We knew the "Handbook" was good, but we didn't know how good until orders started pouring in.

Please bear with us if your order is delayed slightly. We're doing our best to keep up with the demand.—Ed.

Dear Editor:

In your *Homeowner's TV Antenna Handbook*, I noticed no reference to the use of a preamplifier or amplifier for *improving* signals from a TV antenna. There is mention, and rightfully so, of amplifiers for use with *multiple outlets* or for distribution systems—but no mention of them as an aid to *single-set* reception.

SELMAN M. KREMER

Jerrold Electronics Corp.
Philadelphia, Pa.

Take heed, you guys out there in the fringe!—Ed.

Dear Editor:

The information you gave me about the puckered raster on a Westinghouse set (*Troubleshooter*, February) was very helpful. I'm writing to let you know how I made out.

I'd already tried changing the filter capacitors one at a time, without success; but, when I bridged all filters at the same time (two triple-section units and one double) the defect was cured.

Even after the filters were repaired, the set would receive only one station. I checked the tuner and found that lightning had damaged the set.

JIM PHILLIPS

Lavonia, Ga.

Always glad to help our readers with a "dog." Incidentally, Jim didn't have to wait until the data he wanted was published. A personal reply, with suggestions for curing the trouble, is given immediately in all such cases.—Ed.

Dear Editor:

To prevent squeals while servicing the Philco E670 series chassis, as discussed in the February *Quicker Servicing* column, I always connect a jumper from the minus terminal of the filter capacitor to the frame. I also make sure the volume control is secured to the frame with its own Parker screw. The set can then be serviced with the shield removed.

JOHN WIZEMANN

Jackson Heights, N. Y.

Good idea, John, but watch out for shock hazards! And don't forget to restore isolation between B minus and chassis before returning the set. We can't defend you in a lawsuit!—Ed.

Dear Editor:

While driving between Ottumwa and Bloomfield, Iowa, we saw a sight that startled us—a TV antenna already in place on what appeared to be the unfinished frame of a new house. When we drove on around to the other side of the hill, we could see that people were already living in the basement of the house.

R. L. KURTZ

Des Moines, Iowa

This incident serves to emphasize the sacrifices some people make to have TV. It should also point out that, as long as people feel this way, it isn't necessary to repair sets at cut rates.—Ed.

Dear Editor:

I'd like to get a copy of your "Cross Reference Guide on Fusible Resistors." Why don't the set manufacturers state the value of this resistor on the tube chart they mount inside the receiver cabinet? To me, that is just as important as the tube type numbers.

WALTER A. RINDY

Mayville, N. D.

Perhaps they haven't realized what a problem it's been, Walter. Let's hope publication of the "Guide" and knowledge of the tremendous demand we've had for reprints will serve as a gentle hint. Your copy is on its way.—Ed.

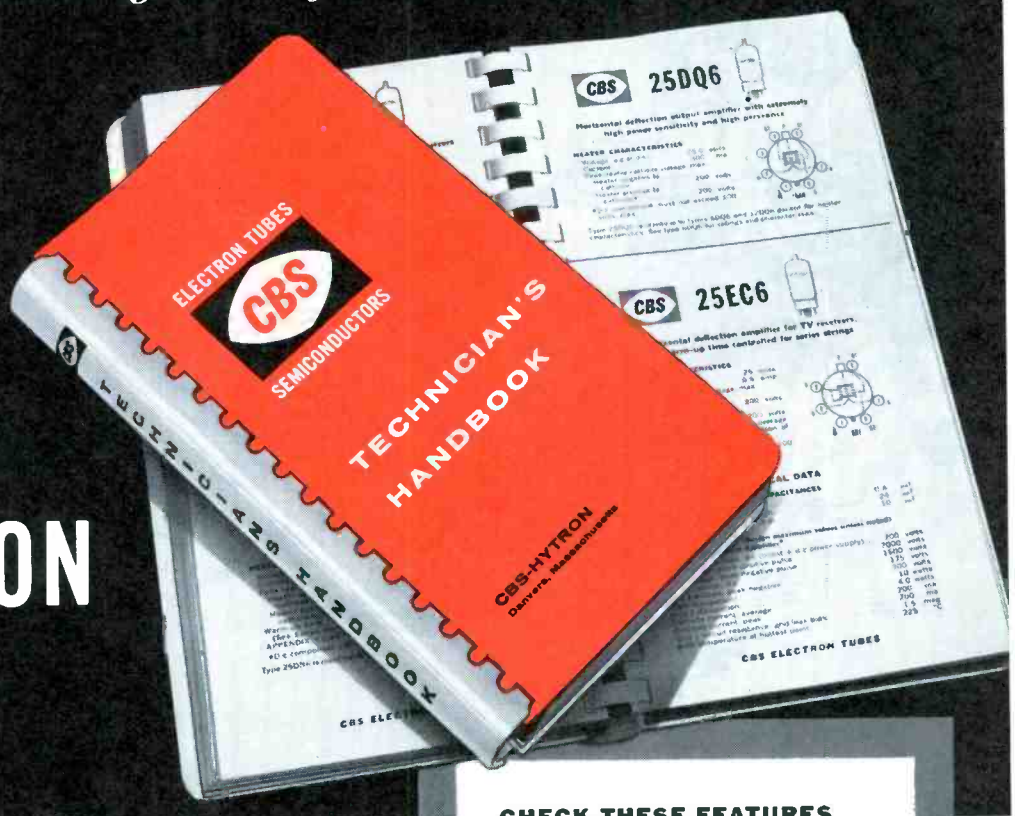
Dear Editor:

The absence of cartoons in your February issue makes me very, very unhappy.

Every month, after the men in our shop have read the PF from *kiver to kiver*, I am allowed to (1) file the "Previews of New Sets," (2) make note of the latest tube test data, and (3) send for the "literature circled below." Then, and only then, may I cut out the little cartoons and paste them on the walls of our shop. We and our customers are used to

designed by and for the technician

NEW 1959 EDITION $1.85



This new Handbook was designed especially for the technician. Planned for on-the-job use, it is compact, handy, rugged . . . lies flat when open. Its modern styling permits quick, easy reference. And, of course, it is up-to-the-minute, complete in one volume . . . with data for receiving, special and picture tubes as well as semiconductors. Get your copy today from your CBS-Hytron distributor.

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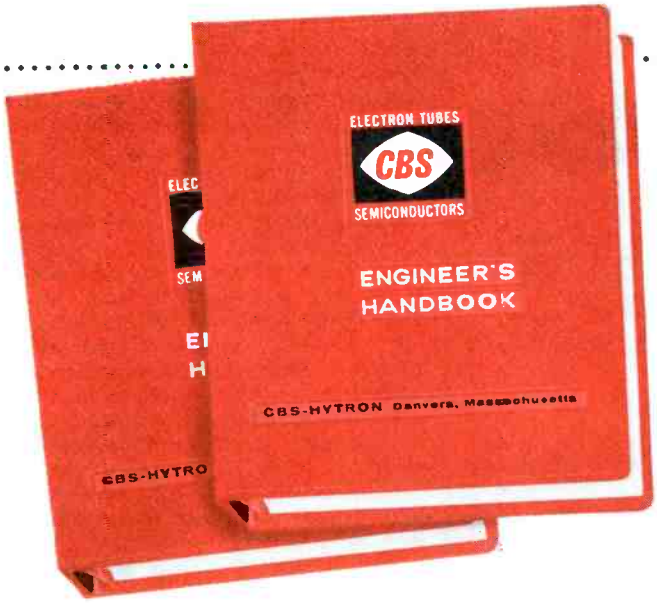

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this procedure, and YOU have upset our amusing way of life.

MRS. C. E. MANLEY
San Jose, Calif.

Cheer up! We have no intention of doing away with cartoons. It's just that we have to omit one here and there to make room for an article which runs a little longer than anticipated. We must, so to speak, finish all the "meat" before we can have any dessert. We're firmly committed to using cartoons, however, having built up a stockpile big enough to keep you chuckling for at least a year. —Ed.

Dear Editor:

I note with regret the discontinuance of the *Subject Reference Index* that used to be found at the bottom of the contents page. This was very useful for quickly locating data. In fact, I wish you'd carry this idea further and print a subject index on the *outside front cover* so that a serviceman could search a file of PF REPORTERS in a hurry for specific data.

J. J. HANCOCK
Keokuk, Iowa

Information in past issues can be located most quickly with our annual Subject Reference Index, *which has been published as a separate pamphlet for the last couple of years. Copies are free simply for the asking.*

If you'd rather refer to the cover, why not make appropriate notes as you read each issue. These can be neatly typed and pasted on the front of the magazine.—Ed.

Dear Editor:

I think your magazine is the best printed; you just can't beat it. Keep up the good work.

DONALD ELLWOOD
Detroit, Mich.

Thanks for the kind words, Donald (also, the 3-year subscription renewal). Modesty keeps us from saying more.—Ed.

Dear Editor:

The day after I received your December issue, I had a service call on a Sylvania Chassis 1-537-1, the same one you described in *Video Speed Servicing* that month. It had a complete loss of vertical sweep, and the trouble was a short in the .001-mfd capacitor from the oscillator grid to ground—just as described in your article.

Then, about a month later, I serviced a twin to this set. The trouble was exactly the same, and so I replaced the .001-mfd capacitor in this case also. To my astonishment, this did not remedy the trouble. I got busy with the VTVM. Checking pins 7 and 6 of the 10DE7 oscillator tube, I found no voltage at either place. Finally, I changed a .22-mfd capacitor wired from pin 6 (the oscillator plate) to ground; this replacement restored the raster and got the set operating normally again.

I thought this experience might be of interest to someone else who might run into the same thing.

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Schenectady, N. Y.

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in TV Trouble-Shooting

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AUDIO AMPLIFIER AND AUDIO OUTPUT Injection of 400 cycle tone signal simplifies trouble-shooting this section. Isolates the defect instantly.

CONVERTER

1st, 2nd, 3rd I.F. Signals available at 20 mc and 40 mc i.f. Checks A.G.C. action. Isolates trouble to individual defective stage, i.f. transformer, or other component.

VIDEO DET. **VIDEO AMP.** Reproduces test pattern on picture tube. Injects signals into video detector or video amplifier stage of TV receiver for fast, visual trouble-shooting and correction. Makes it easy to check bandwidth, resolution, shading and contrast.

R.F. OSC.

SYNC Composite sync signals available for checking of these stages.

VERTICAL — Provides separate driving pulse to isolate defect between vertical oscillator and vertical output stage.

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across the BENCH

by Stan Prentiss

In December and February, I described two series of receivers—the Capehart CX-33 and the RCA KCS47. A healthy percentage of these sets are still playing an important part in home entertainment, and since space didn't permit telling their stories completely, the remaining notes and waveforms for both these receivers comprise this month's column. As an added attraction, there are some waveforms taken between several points with rather large differences in DC potentials, demonstrating the practical use of DC amplifiers in an oscilloscope. In future installments, more instrument techniques will be described to help you make sure that "old TVs never die."

Updating the Capehart CX-33DX

Just recently, I obtained one of these excellent receivers for the modest sum of $25.00. It had a beautiful cabinet, but also some minor electrical defects that, confided the owner, consisted of merely a "bad vertical condenser in the tuner." Happily, the high and low voltage supplies were just what they should be. IF, sync, and AGC voltages were restored to normal by replacement of some resistors and capacitors, plus a tube. Handling of the horizontal-sync discriminator, horizontal-oscillator and discharge, damper, and horizontal-output circuits was routine; I simply replaced *all* the paper coupling and bypass capacitors and checked the values of individual resistors. This is the best way I know to insure that these highly critical circuits keep operating for a long, long time. I also checked tubes very carefully for Gm and leakage.

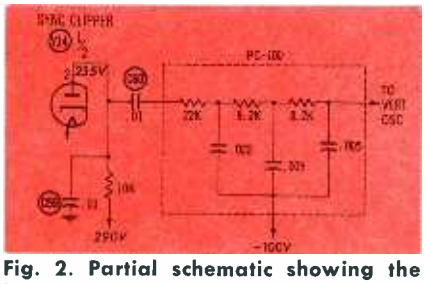

Fig. 2. Partial schematic showing the location of sync coupling capacitor C60.

When these circuits were all in good order, I turned to the task of tackling that "bad vertical condenser in the tuner." I first tested the RF and oscillator-mixer tubes, then removed most of the oscillator and RF channel strips and measured the value of the RF plate-load resistor. Following this, the tuner was carefully cleaned with pressurized *Hush* and *No-Noise*. Replacing the channel strips, I air-checked the receiver on all local stations. Response was uniform and there was signal strength to spare. After a few minutes of operation, however, there was noticeable vertical jitter in the picture. This, obviously, was the real difficulty. The only trouble in the tuner had been tarnished contacts.

Oscilloscope to the Rescue

With the receiver connected to the shop antenna, the first waveform I took (Fig. 1) was at the end of the PC-100 integrator network. Instead of the normal 25 volts peak-to-peak, its amplitude was hardly 6 volts. This meant the trouble was either ahead of or in the integrator circuit itself. Since the DC supply had already been inspected and found adequate, the signal circuits were obviously responsible. Switching the oscilloscope cable to the DC input, I compared the relative positions of the signals across capacitor C60 in Fig. 2. This initial check indicated a substantial DC level for the signal at the plate of sync clipper V14 (top waveform of Fig. 3); however, the difference in levels for it and signal on the integrator side of C60 (bottom waveform of Fig. 3) made me suspect that capacitor C60 was leaky. While replacing C60, I also replaced C59 (the .01 mfd to ground). Now, the DC-level separation between the two waveforms appeared as in Fig. 4.

The next point of inspection was on either side of C63, the coupling capacitor from the plate of the vertical multivibrator (Fig. 5) to the grid of the vertical output. Considering the differences in their DC potentials to ground (–85V and +275V), the spacing of the waveforms was again a little too close (Fig. 6), and their negative portions

• *Please turn to page 66*

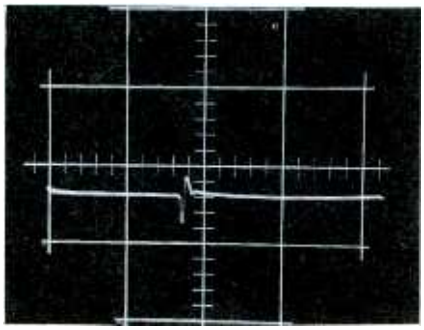

Fig. 1. Defective waveform at the output of the vertical integrator assembly.

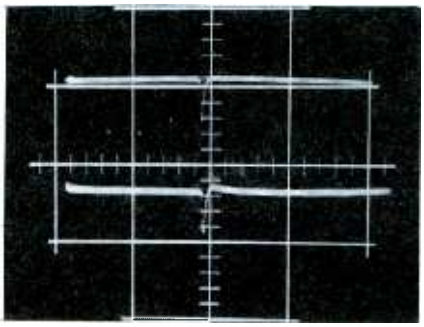

Fig. 3. Lack of separation between waveforms indicates leakage in C60.

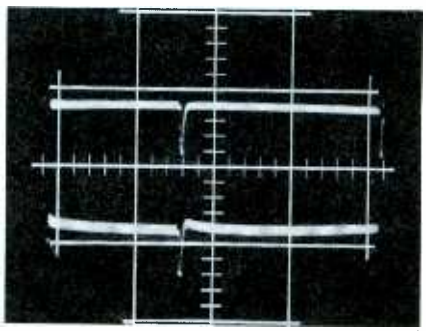

Fig. 4. Normal separation between the waveforms when C60 has no leakage.

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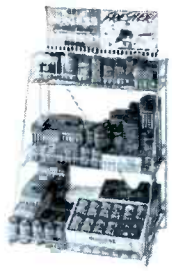

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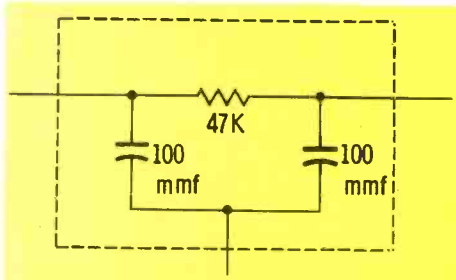
DIODE FILTER

By using the service scope and signal generator, components in a diode filter can be checked without unsoldering any leads. Set the scope to sweep at about 60 to 100 cps and connect the vertical input leads to the output of the filter. Apply a tone-modulated signal to the IF stage ahead of the filter and check for the presence of a detected signal. A signal indicates that the resistor isn't open and the capacitors aren't shorted. Switch off the modulation and change the scope's sweep frequency to 100-250KC. Also check for the presence of RF signal at the output of the detector. No signal means the capacitors are good. If the unit is out of the circuit and you desire to test the capacitors for value, simply connect the outer leads together and test for total capacity between this junction and the center lead.



AEROVOX	PA - 97
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PRINTED CIRCUIT COMPONENTS

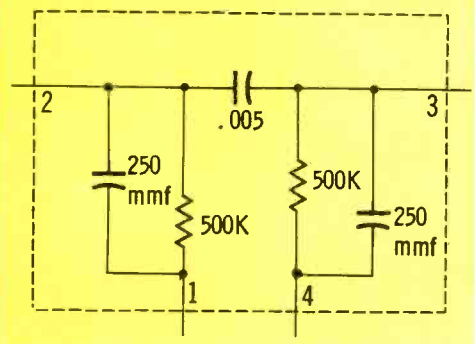
Assemblies of multiple electronic components, encapsulated in a thermo-setting plastic and equipped with either spear-like terminals or wire leads, are to be found in almost every radio and TV receiver manufactured in the past couple of years. Greater application of printed wiring boards has resulted in increased use of these assemblies; some TV receivers employ as many as 6 to 10. This pictorial coverage will acquaint the serviceman with the characteristics of the most often used units.

Generally speaking, resistors used in packaged units are rated at ⅛ to ¼ watt with value tolerances of ± 20%, while capacitors are rated at 500 WVDC with value tolerances of +50 and –20%. Some of the least critical capacitors, such as audio couplers, are rated +80 and –20%. When testing these units with ohmmeters or capacitance bridges, be sure to consider tolerance ranges.

TRIODE COUPLING

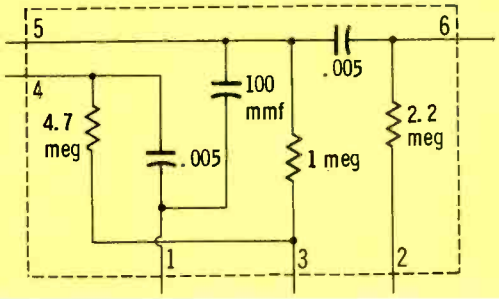
This four-lead network contains all of the components that link the audio-power and voltage-amplifier stages in many AC-DC radios. Checking this unit involves, in addition to the scope and signal generator, a VTVM plus duplicates of the tubes used at both ends. Lead 2 normally connects to the plate of the voltage amplifier, lead 1 to B+, lead 4 to B–, and lead 3 to the grid of the power amplifier. First of all, measure the voltage at leads 2 and 3. The reading at 2 should be lower than B+, while the reading at 3 should be 0 volts. If you get a reading at lead 3, replace the output tube and check the reading again. The presence of voltage indicates a leaky coupling capacitor or an open grid resistor—the ohmmeter section of your VTVM will quickly tell you which. A lack of voltage on lead 2 can be caused by a defective tube or an open plate resistor. Check the resistor with an ohmmeter to tell which. If open or increased in value, it can be replaced with an external unit of correct size, providing all other components check good. Apply an audio signal to lead 2 to test the balance of the unit. Sound from the speaker is a good sign; install the external plate-load resistor and check circuit operation. A check at lead 2 with the scope will tell you if the RF bypass capacitors are still doing their job.

AEROVOX	PA - 112 - 1
CENTRALAB	PC - 70
C D	112 TM1
ERIE	1406 - 01
SPRAGUE	T3
TOBE	112TM1



PENTODE COUPLING

This unit is used in a good many portable radios and is very similar to the triode unit. It has two more leads (6 instead of 4 for the triode unit) to accommodate the screen grid circuit of the pentode audio amplifier. The screen-grid bypass capacitor can be checked by applying an audio signal to the control grid of the pentode and checking for the presence of an audio signal at lead 4. No signal indicates a good capacitor. Check the balance of the network as outlined for triode units.

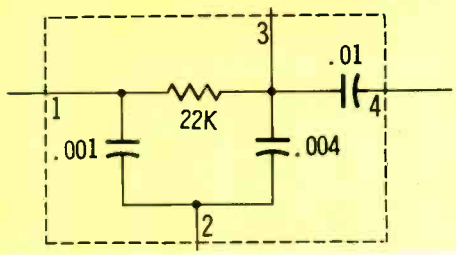


AEROVOX	PA - 117
CENTRALAB	PC - 91
C D	114TM2
ERIE	1407-03
SPRAGUE	P - 2
TOBE	114TM2

DE-EMPHASIS NETWORK

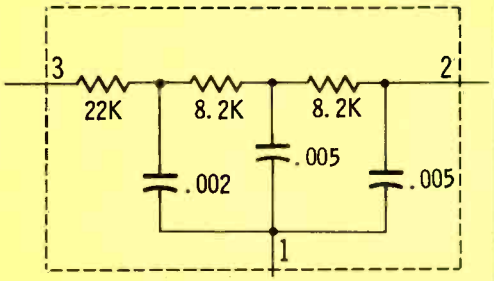
The de-emphasis network in the FM detector output circuit of a TV receiver frequently appears in encapsulated form. The original may be a three-terminal type (omit terminal 3) or in the form shown. Install the type shown if terminal 3 is used in detector alignment procedures. To test this network, apply a tone-modulated FM signal to a stage and check network as specified under "Diode Filter."

AEROVOX	PA - 425
CENTRALAB	PC - 186
SPRAGUE	V - 17



VERTICAL INTEGRATOR

This three-lead unit, having been used in at least 175 different models (well over 7 million sets), can be considered the standard of the industry. No shop should be without at least one in the stock room. To check these units, operate the set, disable the vertical oscillator, and check the output for a signal that is roughly ¾ of the amplitude of the signal applied to the integrator. To test the three filter capacitors and the DC blocking unit for leakage, remove power, disconnect lead 2 and measure from it to chassis. The reading should be infinite even on the highest range of your ohmmeter. If the DC blocking capacitor is in the output network, disconnect lead 3 and measure from there to chassis. Again, the reading should be infinite. A resistance check between leads 2 and 3 should produce a reading of 38.4K ohms ± 20%.

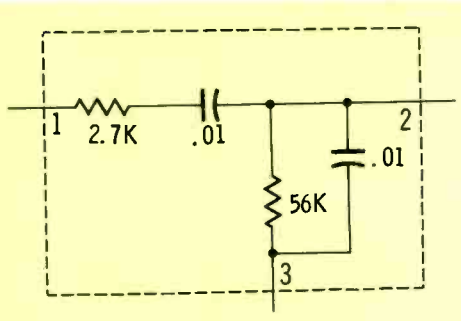


AEROVOX	PA - 110
CENTRALAB	PC - 100
C D	115TM1
ERIE	1405 - 01
SPRAGUE	V1
TOBE	115TM1

RETRACE SUPPRESSION

This is a familiar network to the serviceman working on Admiral sets—not that they are prone to fail too often, but simply because, outside of vertical integrators, this was about the first printed assembly used in TV receivers. Two quick checks with a scope and one with a VTVM can tell you all about this little unit. The signal at lead 2 should be about half that at lead 1 when checking with the scope. The VTVM should indicate zero volts on lead 2. Any voltage here indicates a shorted or leaky coupling capacitor. The checks just outlined should be made when you have high voltage but no raster, and they should be made before you try to sell the customer a new CRT.

CENTRALAB	PC - 314
SPRAGUE	RS - 3



AUDIO FACTS

servicing HI-FI equipment part 4

Equalizers and Preamps

The output signal of a magnetic phono cartridge is very low in amplitude, often no more than 6 to 15 millivolts. This low-level signal must be amplified considerably before it can be applied to a power-output stage. Because of noise considerations, the first stage of amplification must be a high-gain, low-noise circuit called a preamplifier. It is desirable to use a very short signal lead between this initial stage and the magnetic cartridge; for this reason, the preamp is sometimes built on a separate chassis complete with power supply and mounted in the same cabinet with the turntable or changer. However, because there are several controls which must be adjusted for optimum playback, the preamp stage is most often included with tone-control and equalization stages in a single unit called a *Preamplifier, Tone Control Amplifier, Master Audio Control,* etc.

Why Equalization?

Signal output from a phono cartridge is a function of needle velocity — the greater the velocity, the greater the output voltage. This means that for a given output, groove excursions must be greater at low frequencies than at high frequencies. If a record were cut so that low-frequency signals had the same amplitude as high-frequency signals, the width of record grooves would have to be much wider than they now are, and it wouldn't be possible to get several musical selections on a single 10″ or 12″ record. In addition, low-level, high-frequency signals are more prone than any other to noise pickup. It is desirable to increase the amplitude of high-frequency signals to overcome this tendency. Records are cut with reduced low-frequency groove excursions to conserve record space, and increased high-frequency groove excursions to minimize noise pickup. This is accomplished by decreasing the amplitude of low-frequency signals and increasing the amplitude of high-frequency signals before applying them to the recording cutter. For correct playback, therefore, the cartridge output signal must undergo a reversed version of this amplification difference. This is done by the equalizer circuits in the preamplifier stage.

All recording companies do not use the same amount of treble boost and bass attenuation. As a result, some form of variable equalizer must be used. The equalizer may be a separate unit inserted between the phono cartridge and the preamp, or it may be part of the preamp. It consists of resistors and capacitors, with a switch for the selection of various combinations. In every position, basic functions are the same—boost the lows and attenuate the highs. The only differences are in the degree of amplitude change and the frequencies at which the change starts.

Bass Boost

Bass playback equalizers boost the lower frequencies using a circuit resembling the one shown in Fig. 1A. R3 and C1 are selected by switching, and determine the frequency at which bass boost begins (called *turnover frequency).* The combination of R2, R3 and C1 determines the degree of boost. As signal frequency decreases, Xc increases, causing an increase in the output voltage and effectively giving bass boost. In some variations of the circuit, R1, R2, or R3 may be omitted. None of these changes, however, alter the basic action of the circuit.

If R1 or R2 is open, or if C1 is shorted, there is no boost. In the latter case, however, signal amplitude is decreased below its normal level. If C1 is open, the impedance across the output is considerably higher, resulting in greater voltage output, but there is a loss of bass boost. If R3 should open, boost will be excessive and hum level will increase.

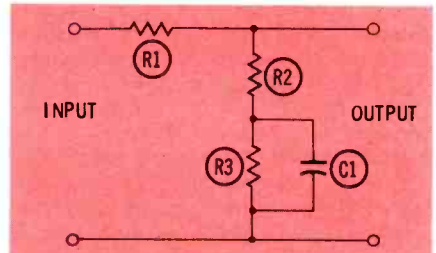


Fig. 1A. Typical bass-boost circuit.

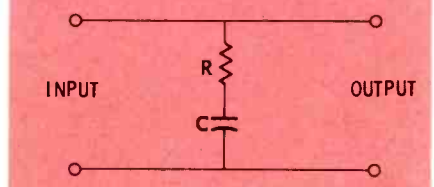


Fig. 1B. Circuit for treble attenuation.

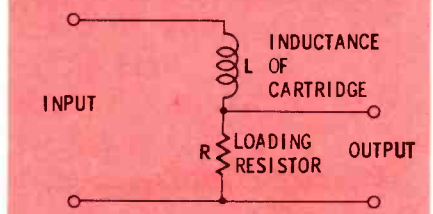


Fig. 1C. Roll-off provided by L and R.

Treble Attenuation

A basic circuit for treble attenuation (called *roll-off)* is shown in Fig. 1B. R and C may be in parallel, but results are similar. The value of C governs the frequency at which roll-off begins, and R determines the amount of roll-off. For each setting, R and C have different values.

• *Please turn to page 74*

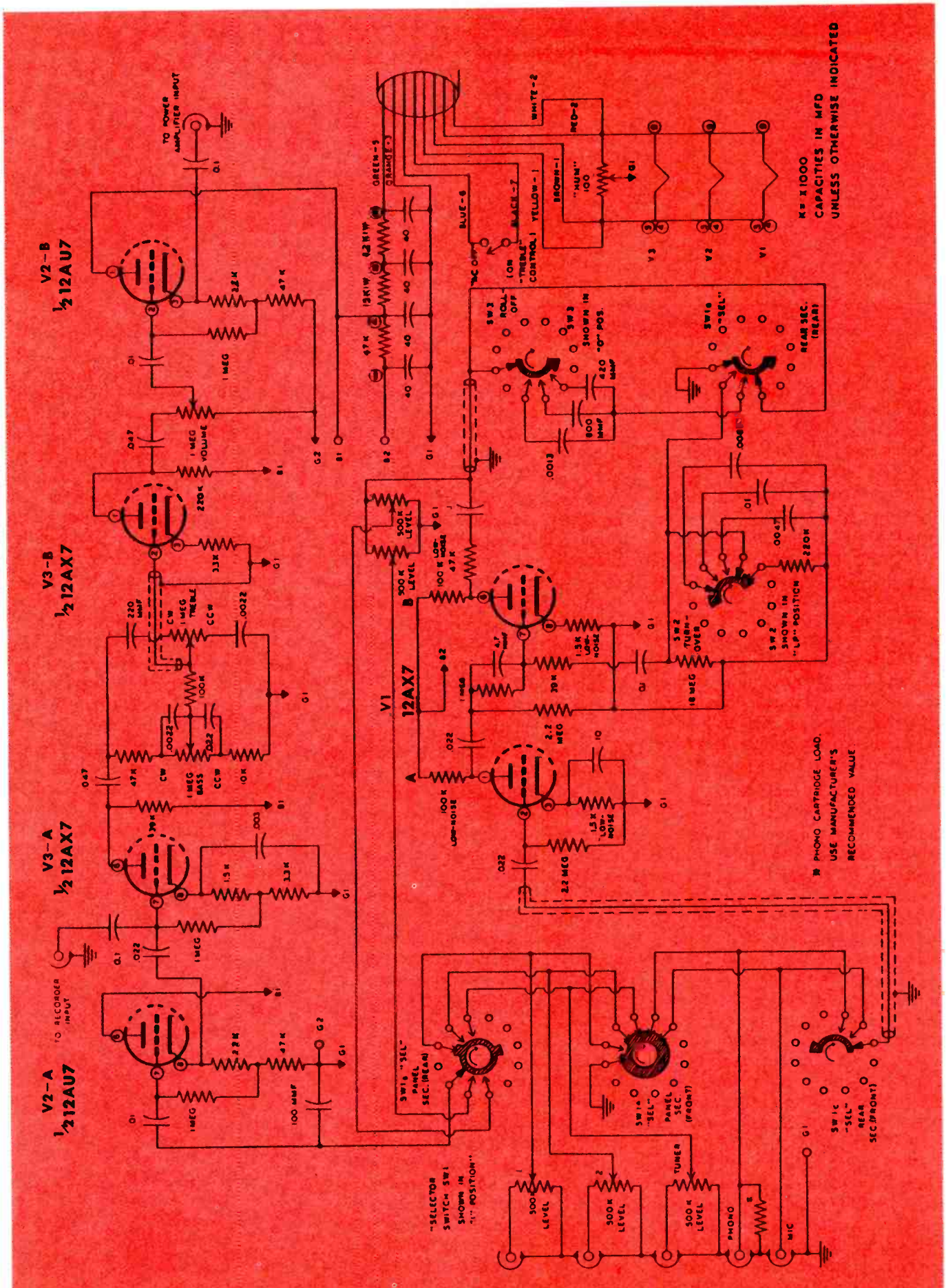


Fig. 2. Typical Hi-Fi preamp has switched inputs and cathode-follower output.

BENCH SERVICING NEW SETS

Fig. 1. *Predicta* table model has picture tube fastened to top of cabinet.

by Thomas A. Lesh

When you are disassembling an unfamiliar TV set and getting the chassis ready for bench work, it usually takes a certain amount of trial and error to figure out the answers to questions such as the following: Are there any unseen "catches" to cause complications while you are pulling the chassis? How should you place the chassis on the bench for maximum stability?

To save you some time in solving problems like these, we took a few of the 1959-model TV sets into the lab and put them through typical bench-setup procedures. This article reports the results of our analysis of one of the new Philco models; future articles will cover other new sets.

Philco Chassis 9L37

The Philco *Predicta* design, with the picture tube mounted outside the cabinet, represents the most drastic change in TV styling in many years. Servicemen are naturally curious to know how these sets compare with conventional receivers from a servicing standpoint. We'll provide many of the answers as we explore the table model shown in Fig. 1 (Chassis 9L37), reported to be the best-selling set in the *Predicta* series. Coverage on another model, the *Tandem* (with picture tube connected to chassis by a long cable) is scheduled for the May *Previews of New Sets* department.

With its 21" CRT looming above a small, fragile-looking cabinet, the receiver in Fig. 1 appears somewhat top-heavy — especially to someone who knows that a picture tube is a pretty hefty object. This impression is misleading. The set is actually quite stable because the cabinet is considerably heavier than it looks. If you approach this set from the front when lifting it, you'll find that it is easier to carry than many conventionally-styled table models.

If you have to do some shop work on this model, you'd be better off to bring in the whole set rather than to pull the chassis. It's not practical to use a substitute picture tube on the bench; standard 110° tubes and check tubes are not compatible with Philco's "semi-flat" 21EAP4 picture tube, which has a heater-voltage rating of only 2.35 volts.

Considering the shape of the cabinet, it should come as no surprise to learn that the chassis is horizontally mounted. The rear panel of the cabinet can be taken off to permit removal of the chassis. Only two screws are employed to fasten the chassis to the cabinet, and both are located just inside the rear cover; you'll find no bolts or screws underneath the set. To prepare the chassis for removal, pull off all control knobs; also, reach inside the cabinet and unfasten the retaining clips that hold two long leads against the right side. (One is for the front-mounted speaker and the other for video signal input to the CRT.) Once the wires are freed from these clips, all interconnecting leads will have ample slack to allow the chassis to be taken all the way out of the cabinet.

From reading preliminary descriptions of this receiver when it was first introduced, we somehow got the idea that the chassis might be mounted on rollers traveling in tracks or guides. No such arrangement is used, however; the chassis is simply hauled out of its resting place with a rearward pull, helped along by sled-like runners. Only one minor snag stands in the way—a length of plastic tubing, which serves as a socket for the built-in antenna, projects inward from the left wall of the cabinet, where the control panel on the chassis will run afoul of it. To cope with this situation, pull the antenna completely out of the socket; then the tubing will be flexible and can be bent out of the way.

After you have pulled the chassis, rest its front edge on the rear sill of the cabinet for greatest convenience in servicing topside components. (CAUTION! This is a "hot" chassis, and an isolation transformer should be used.) Power supply filters and other heavy-duty components underneath the chassis can be checked while the receiver is operating, if you carefully swing the chassis up into the position shown in Fig. 2. The chassis is not self-supporting

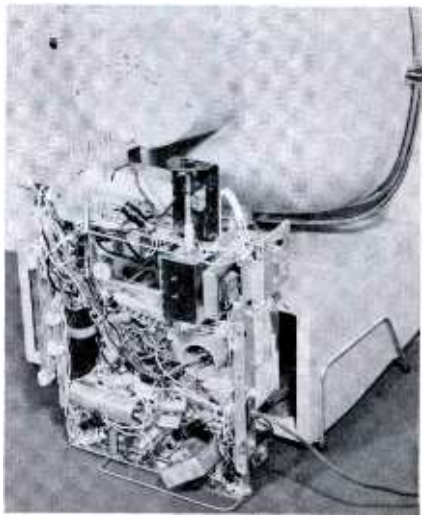


Fig. 2. Chassis can be operated while upended on bench behind the cabinet.

when raised up on end, but it can be safely leaned against the "dog-house" on the back of the CRT housing.

No extension leads are necessary to operate the receiver when it is arranged as in Fig. 2. Extensions *would* be required if you wanted to get the chassis into a position that would permit you to reach the top and bottom sides with equal ease—but there is no particular advantage to such a hookup. Recent Philco chassis are laid out so that trouble-shooting can be done with a minimum of back-and-forth neck-craning. For example, the printed wiring boards in *Predicta* sets are mounted above a solid metal chassis pan and are designed to be worked on from one side only. Parts such as resistors and capacitors should be removed by clipping the pigtail leads close to the component body, and then using the lead stubs that remain on the chassis as points of attachment for the leads of the replacement component. Printed-circuit components with multiple leads, which are widely used in the 9L37 chassis, can be removed by either clipping or heating the leads on the top side of the board. Leads on these parts are relatively easy to remove from above, since they are not crimped underneath the board.

One thing is clear: For efficient servicing of this chassis, the practice of disconnecting and testing individual parts must be held to an absolute minimum. This means you'll have to *use your noodle* and obtain most of the needed information by analyzing the results of in-circuit checks such as voltage and waveform readings. Philco has attempted to make these tests as convenient as possible. A number of lugs around the edges of the wiring boards serve as handy test points; in addition, all tube sockets on these boards are constructed so that the tube pins can be reached with a test prod from the top side. The latter feature, in particular, is extremely helpful—as long as you remember that the pin numbers run *counterclockwise* around the socket when you are looking at it from above.

Some of the most important test points on top of the chassis are indicated in Fig. 3. The colors of the attached leads are listed to help you locate the correct points on an actual

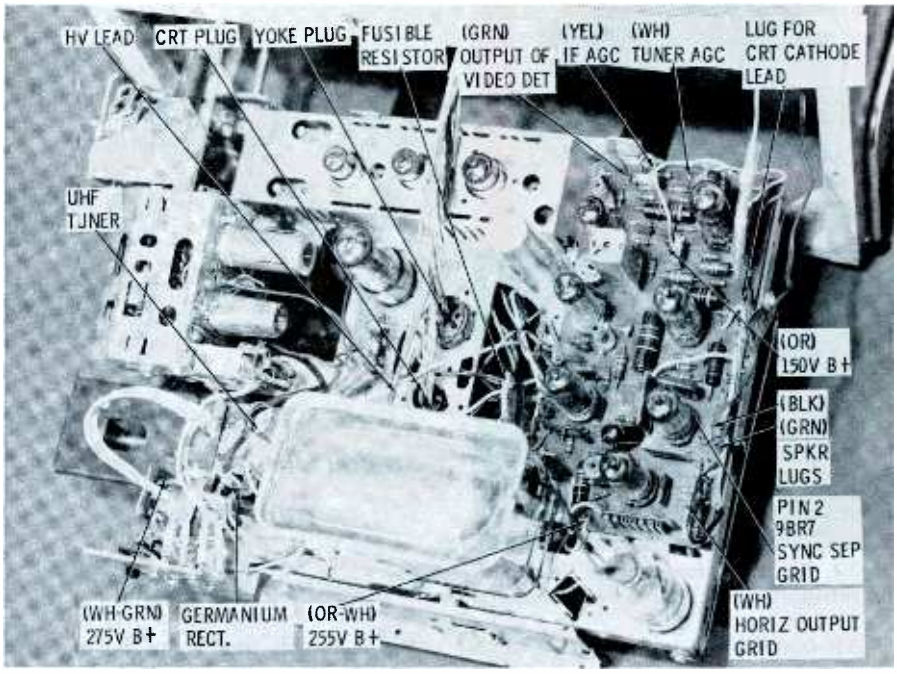


Fig. 3. Topside view of Philco Chassis 9L37 showing important test points.

chassis.

If you are familiar with other recent Philco models, you will recognize the 9L37 chassis as being practically the same as the 9L35 used in the "Advanced '59'er" receivers. This earlier chassis was mounted vertically inside a more-or-less conventional cabinet. When adapted for use in the *Predicta* table model, the VHF tuner and operating controls were moved to new locations and the "doughnut hole" in the center of the chassis was covered with a metal panel to provide for yoke and CRT socket mountings.

Voltages and waveforms on the base pins of the picture tube can be checked by inserting a sharp-pointed prod into test jacks in the CRT base socket. Boost B+ can be conveniently measured at the accelerating anode (pin 6), and the vertical retrace-blanking pulses can be viewed at the control grid (pin 3). The tube base is accessible when a small trap-door in the rear cover of the CRT housing is removed.

The high-voltage anode lead is plugged into a hole on the top side of the high-voltage rectifier tube socket. To gain access to this plug-in connection, pry off the "cocoa can" lid of the high-voltage cage.

The IF strip is hidden under a shield at the front of the chassis. To perform service work (other than alignment) in this section of the receiver, remove a half-dozen ¼" hex-head screws from the shield and lift it off. To reach the screws at the end of the shield, you must first remove two ¼" mounting screws from the control panel and swing it out of the way as demonstrated in Fig. 4.

Note the white plastic grommet in the photo. There are two of these on the front edge of the chassis; their purpose is to mate with two projections on the inside front wall of the cabinet, thereby anchoring the chassis in the correct position.

Lead Dress Precautions

Before reinserting the *Predicta* chassis into the cabinet, make sure that everything on the underside is in its proper place. A number of long leads pass below the chassis pan—some across the full width of the front border, and others diagonally across the chassis to the area-selector switch on the rear of the set. If these leads are allowed to hang below the bottom edge of the chassis, they are likely to become

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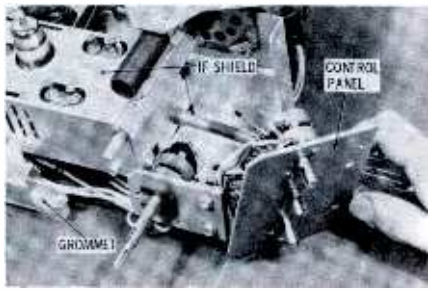


Fig. 4. When removing IF shield, loosen control panel for access to screw.

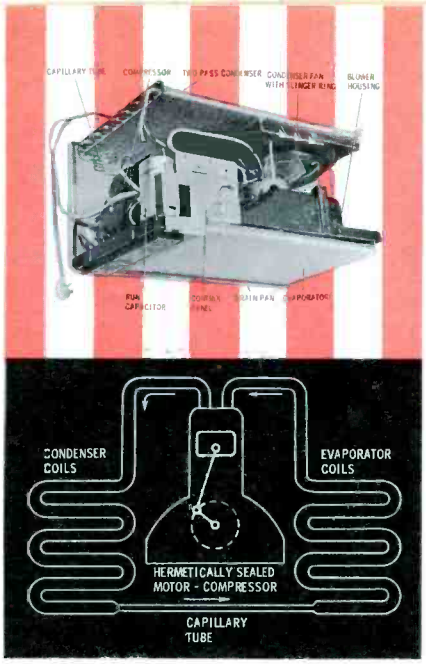


Fig. 1. Diagram showing the flow path of refrigerant used in air-conditioners.

ROOM AIR-CONDITIONER MAINTENANCE

The first of a two-part series on installing and repairing self-contained units

by Joseph Derman and Harold Seaman

Air-conditioning is assured of a permanent place in our modern electronic-appliance industry. To the consumer, air-conditioning represents a basic requirement for everyday physical comfort; to the technician, it is an opportunity for profitable service.

This article is the first of a two-part series on the operation, repair, maintenance, and installation of the room air-conditioner. Incidentally, the room air-conditioner, or the so-called window unit, is a self-contained, factory-assembled, packaged piece of equipment. It requires only an external electrical supply to be able to cool, dehumidify (remove moisture), circulate, and clean the air in a confined space. Complete air-conditioning may require the addition of heat and/or moisture; however, we will touch on these items only briefly, since air-conditioning has primarily come to mean the practical manipulation of summer air to achieve personal comfort.

How It Works

Cooling is achieved because a chemical, called *Freon,* flows around a mechanical circuit. Briefly, the action is as follows (see Fig. 1): A restrictive element, called the capillary tube, permits liquid *Freon* to vaporize (and expand) at a preassigned rate in the evaporator, which is located in the room or output side of the air-conditioner. During this evaporation process, room heat is absorbed by the *Freon.* The compressor, which is driven by a direct-coupled induction motor, draws the *Freon* vapor from the evaporator, compresses it, and directs it to the condenser. The condenser is located *outside* the space to be conditioned; thus, the gas, hot and compressed, liberates its heat outdoors and thereby becomes a liquid again, completing the cycle. In the succeeding article, we will develop this phase in greater detail.

The Electrical System

Most air-conditioning units are furnished with power cords having plugs that use a ground connection, as shown at bottom left in Fig. 2. It is recommended that a licensed electrician provide a suitable wall receptacle if one is needed. Some local communities permit the use of an adapter between the three-prong plug and the standard two-element wall outlet. In this case, the ground

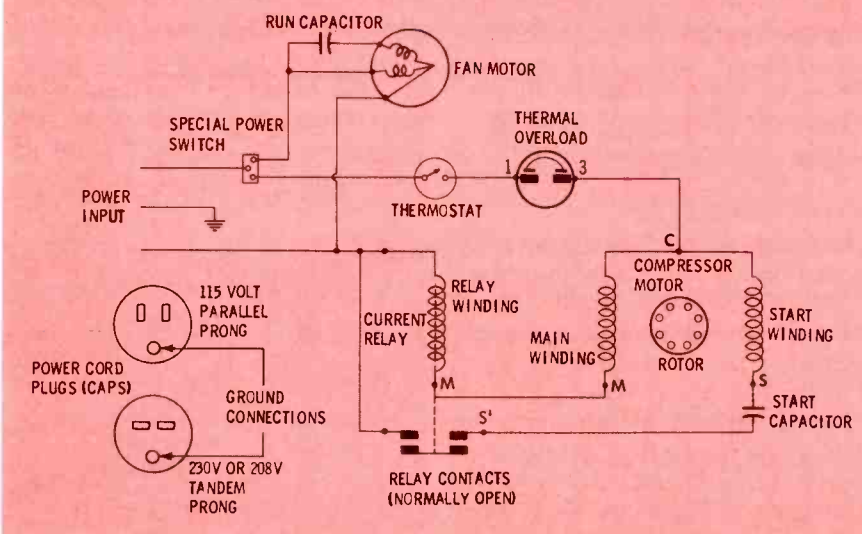


Fig. 2. Electrical circuit for a conventional room air-conditioning unit.

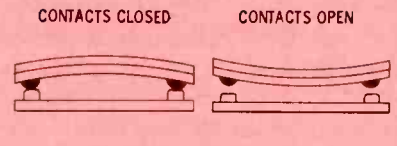


Fig. 3. Thermal overload uses a temperature-sensitive, bimetal-disc breaker.

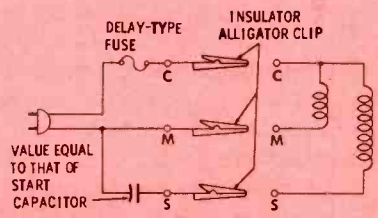


Fig. 4. Test harness for use on standard capacitor start and run circuits.

wire of the adapter must be electrically connected to the wall receptacle. (Be sure to scrape the paint from the screw that secures the adapter wire to the receptacle!)

Obviously, if the prongs of the power plug do not make contact at the receptacle, or the plug is otherwise defective, power will not reach the unit. A voltmeter check at a point beyond the plug is conclusive evidence that power is available. Make sure you have a good ground connection at the receptacle.

The Thermostat

As the drawing in Fig. 2 indicates, the thermostat is a make-and-break device. Action depends on the pressure in a vapor-filled tube called the sensing element. If room (ambient) temperature is high, increased pressure will close the contacts, thus causing the compressor to operate. Conversely, when ambient temperature drops, the contacts will open.

Most thermostats are designed so that the customer can control the actuating temperature and choose his own comfort level. In addition, the serviceman can also set the low-temperature operating point by adjusting a screw on the mechanism. (Do not give this screw more than a few turns.) NOTE: It is possible to set some thermostats for "continuous operation"; that is, to keep the contacts closed irrespective of ambient temperature. This position must be used with care, however, as will be explained in the second article.

A simple continuity check (with power cord removed) can show the effectiveness of the thermostat. Note, however, that the unit must call for cooling before the contacts of the thermostat are actually closed. Grasp the sensing element (bulb) in your hand; body heat will then simulate room temperature and the contacts will close. Make sure the sensing element is in a free air stream and not up against any metal members of the chassis.

Thermal Overload

Every compressor is protected against current overload by an automatic resetting device (located on the compressor shell). Fig. 2 illustrates use of the two-terminal, disc-type overload (also see Fig. 3). At a predetermined current level, depending on the particular compressor, the bimetal curved disc will alter its curvature to open the contacts and break the circuit. After the disc cools (and the overload condition has been removed), it assumes its original position with contacts closed. Of course, if the disc continues to break the circuit again and again, the cause of such cycling must be determined.

The compressor should never be operated for any length of time without the thermal overload device. Normally, the thermal overload should show continuity and permit power to reach the compressor. Every time the contacts open, the compressor is being safeguarded against excessive current; if there is no continuity across the overload, it must be replaced.

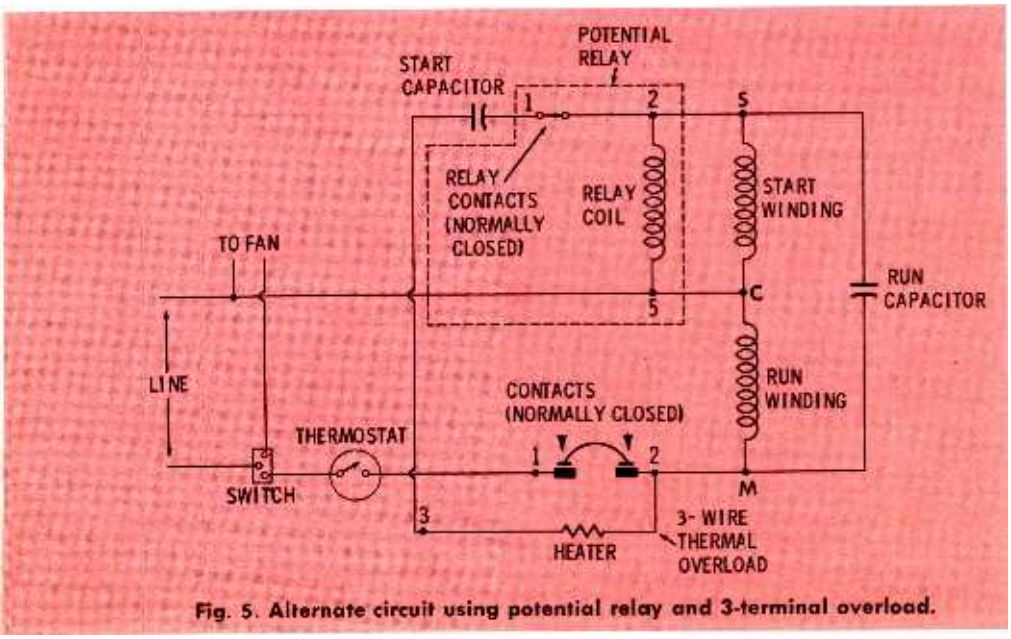


Fig. 5. Alternate circuit using potential relay and 3-terminal overload.

Compressor Motor

The compressor motor is perhaps the most critical, and is certainly the most expensive item in the air-conditioner. It is directly coupled to the compressor and, as previously stated, forces the *Freon* about the mechanical circuit. As seen in Fig. 2, the compressor motor has a main-winding circuit and an auxiliary (start) circuit which includes the start capacitor. The magnetic field of the main winding and the out-of-phase magnetic field developed by the start circuit are both required for sufficient torque to initiate motor operation. (AC power is connected directly to these stationary or stator windings.) When the rotor reaches a certain speed, current in the relay winding will have decreased sufficiently to permit the start-circuit relay contacts to open. The main winding alone then maintains rotation.

Fan Motor

The fan motor may be of the shaded-pole or the permanent split-capacitor type used in Fig. 2. The shaded-pole type has no capacitor; starting is achieved by special internal construction. The motor shown is the induction type and operates in practically the same manner as the compressor motor; there is no relay, however. The fan motor will function if the windings and the capacitor are satisfactory and suitable voltage reaches the motor.

Power Source Requirements

The full load voltage *must be* within *±10% of the rated nameplate voltage*. This is most important because, if the voltage is insufficient, the compressor motor will start up too slowly or not at all. In such a situation, current drain will be excessive, the overload device will be actuated and/or the line fuse will blow.

In most dwellings, one or more convenience (wall) receptacles are supplied by a single branch circuit. Each branch has a very definite current limitation, usually 15 amps, or 20 amps if the wiring is more recent. The air-conditioner load (operating, not surge) plus other loads on the same branch circuit must not exceed this limitation. Where the air-con-

• *Please turn to page 79*

QUICKER SERVICING

By Calvin C. Young, Jr.

Improve Your VTVM

If your VTVM is one of the older models (before uniprobes) and employs pin or banana jacks for common and AC-ohms leads, you probably find yourself reinserting the leads in the jacks more often than you care to admit. Worn banana plugs seem to pop out of their jacks at the slightest provocation. This situation can be remedied in a very simple way — replace the banana jacks and plugs with miniature microphone connectors such as Amphenol 75-1 and 75-3 or Switchcraft 5501F and 5501MF — the latter unit being the male panel connector.

Installation details are shown in Fig. 1. The fiber shoulder washer originally used with the banana jacks can be reused in most cases. The leads that previously soldered to each of the banana jacks must be connected to the center terminals of the new connectors. The finished job should look as shown in Fig. 2.

Negative Temperature Coefficient

If your experiences have been like mine, you haven't had too much luck obtaining capacitors with special temperature characteristics from your local distributor. About the only ones I've been able to get consistently are zero and N750 types.

While plowing through a maze of capacitor catalogs, I came across a system for combining zero and N750 units to produce any negative characteristic that might be required. The method is simple, involving only the parallel connection of a zero type and a N750 type. To determine the value of the N750 unit, divide the product of the desired capacity and the desired temperature coefficient by 750. To determine the value of the zero unit, subtract the value of the N750 unit from the desired capacity.

Thus, if you wanted to assemble a 220-mmf unit with a N220 temperature coefficient, you would calculate the value of the N750 component as follows:

$$\frac{220 \times 220}{750} = \frac{48{,}400}{750} = 64 \text{ mmf}$$

Since 62 mmf is the nearest standard value, subtract 62 mmf from 220 mmf, and you'll find you need a 158-mmf capacitor with zero coefficient. The nearest standard

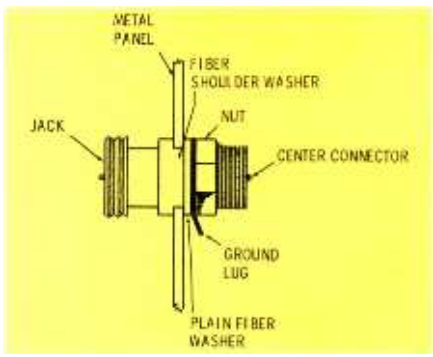


Fig. 1. Installation of miniature microphone connectors improves VTVM value.

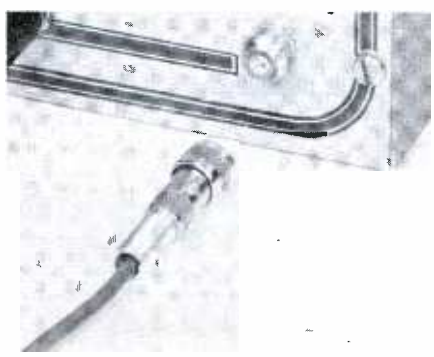
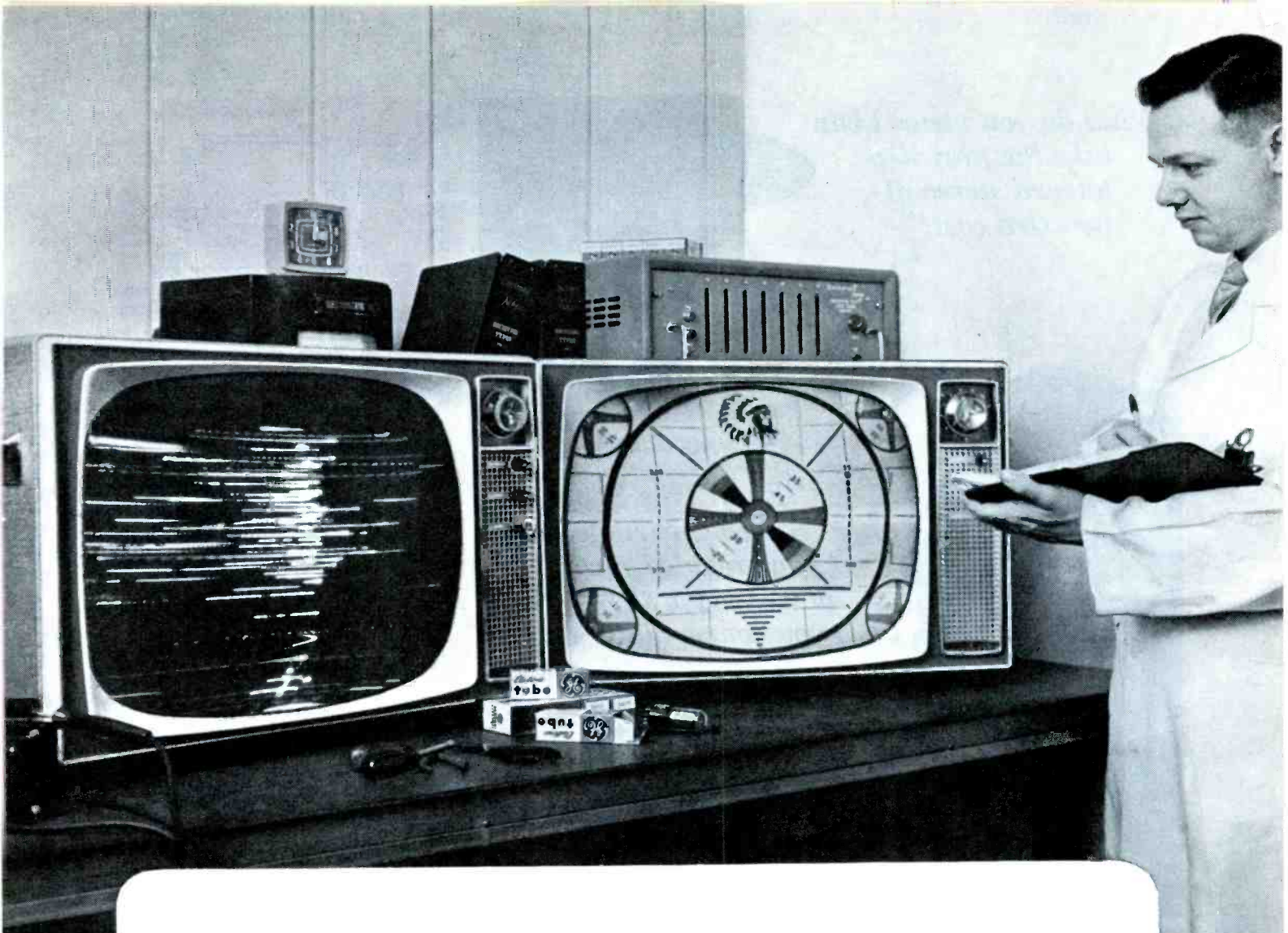


Fig. 2. Finished installation on VTVM showing the AC-OHM lead connectors.



CUT DAMPER-TUBE ARCING!

Have steady, dependable pictures with the new Service-Designed General Electric 6AX4-GTA (right)!

Side-by-side receiver tests show how prototype horizontal-damper tube occasionally will arc, cathode-to-plate (screen at left), whereas the new General Electric 6AX4-GTA continues to do its job reliably. The reason: a new, 15% larger cathode, with more emission area, consequently a lower operating temperature requirement.

New 6AX4-GTA also has faster warm-up, tapered pins, other improvements. Install this advanced tube to promote customer satisfaction, reduce call-backs. Service-Designed quality through and through! See your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Co., Owensboro, Ky.*

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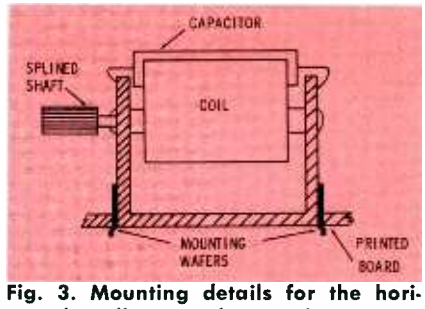


Fig. 3. Mounting details for the horizontal-oscillator coil in Sylvania TV.

value is 150 mmf; thus, you would use this value and select a higher value for the N750 unit, say 68 mmf. Connected in parallel, these two values give you a total capacity of 218 mmf at very near the desired temperature characteristic (within 10% and close enough for all practical purposes). Other values and characteristics would be calculated in the same manner.

Service Hint on Sylvania 21P101A

The customer had originally complained that this set was completely dead. None of the tubes had open filaments, and the AC switch wasn't defective, leaving as the only suspect a large dropping resistor in the filament circuit. In the shop, a 51-ohm, 30-watt resistor cured the trouble. Everything seemed okay, so the set was placed in the outgoing rack.

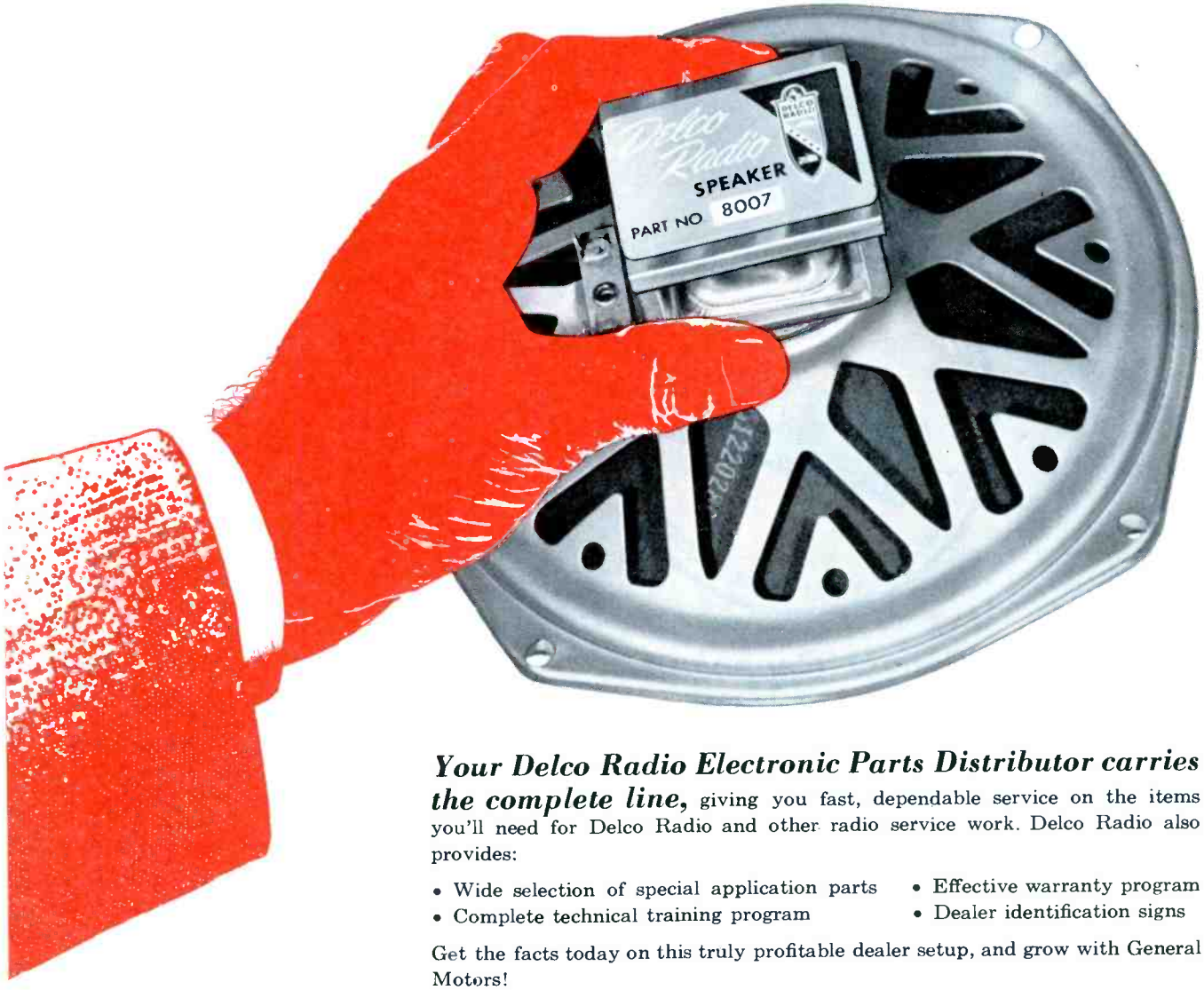
Even though it was below zero the next day, the serviceman checked with the customer and made arrangements to deliver the set. In the customer's home, with the chassis back in the cabinet and all the knobs in place, the serviceman found he couldn't get the horizontal oscillator to lock in. In fact, the hold control didn't seem to have any effect at all. In the course of events that followed, the serviceman found that tapping the shaft of the control (connected to a slug in a coil) would cause the picture to pop in and out of sync.

Because the set had already been shop-tested and the balance of the circuits were operating nicely, the chassis wasn't pulled again. Instead, only the suspected coil was removed. A vigorous shake confirmed the previous suspicion; the core was definitely broken, so it was taken to the shop to serve as a guide in obtaining a replacement.

Checks with local parts distribu-

Use Delco Radio Service Parts!

8-inch "Hi-Fi" speaker, No. 8007 offers the most highs, the most lows, the most watts in a medium-price speaker. Designed for replacement use and high fidelity audio systems.



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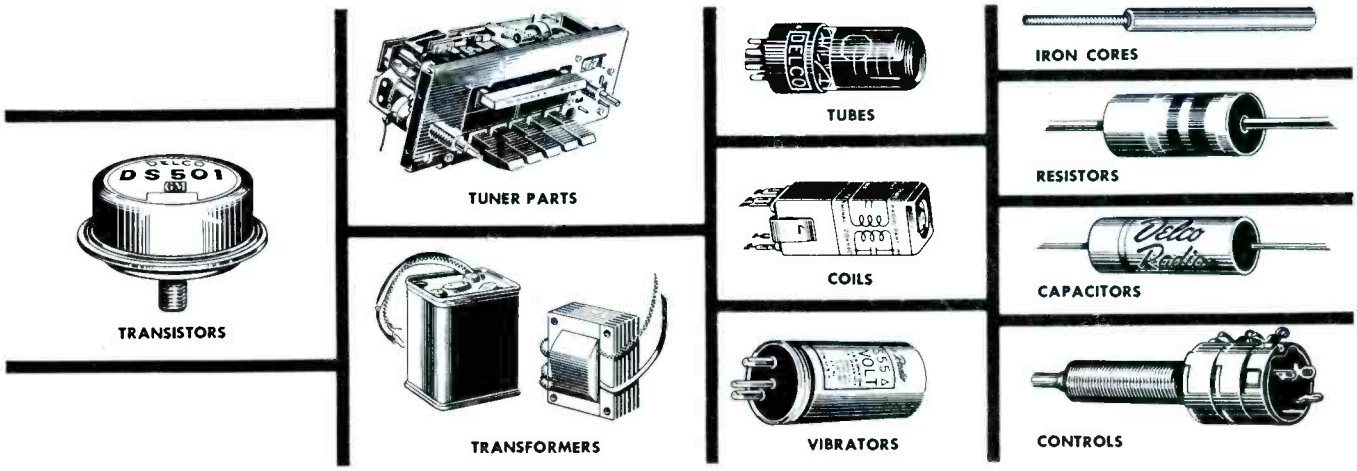


Fig. 4. "Electro-Sub" provides 10 popular capacitance values at 450 WVDC.

tors failed to locate a suitable replacement; therefore, a man was dispatched to the Sylvania distributor to obtain the correct part which, by the way, was 132-0019. The capacitor pointed out in Fig. 3 was transferred to the new coil which was then installed. This restored the set to normal operation and helped produce another satisfied customer.

Since the chassis had been operated in various positions while it was in the shop, the technician was sure the defect had developed after the set left the shop. The only possible explanation for the broken core is that the relatively warm core, when taken outside into the frigid weather, had broken due to the rapid temperature change.

Shop Service Aid

The Sencore Model ES-102 Electro-Sub shown in Fig. 4 not only provides ten of the most-often-needed capacitance values at 450 WVDC, but also includes a 3-position switch and a 500-ohm resistor for capacitor surge protection and automatic discharge. Red and black test leads are permanently connected into the test switch circuit as illustrated in Fig. 5.

The three-position switch is spring-loaded for automatic return to position 1. As the switch is moved

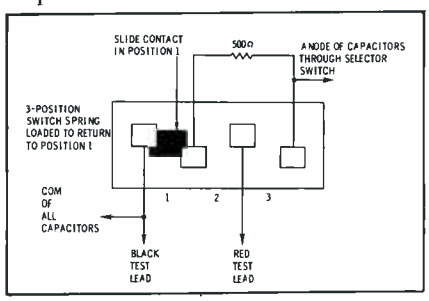
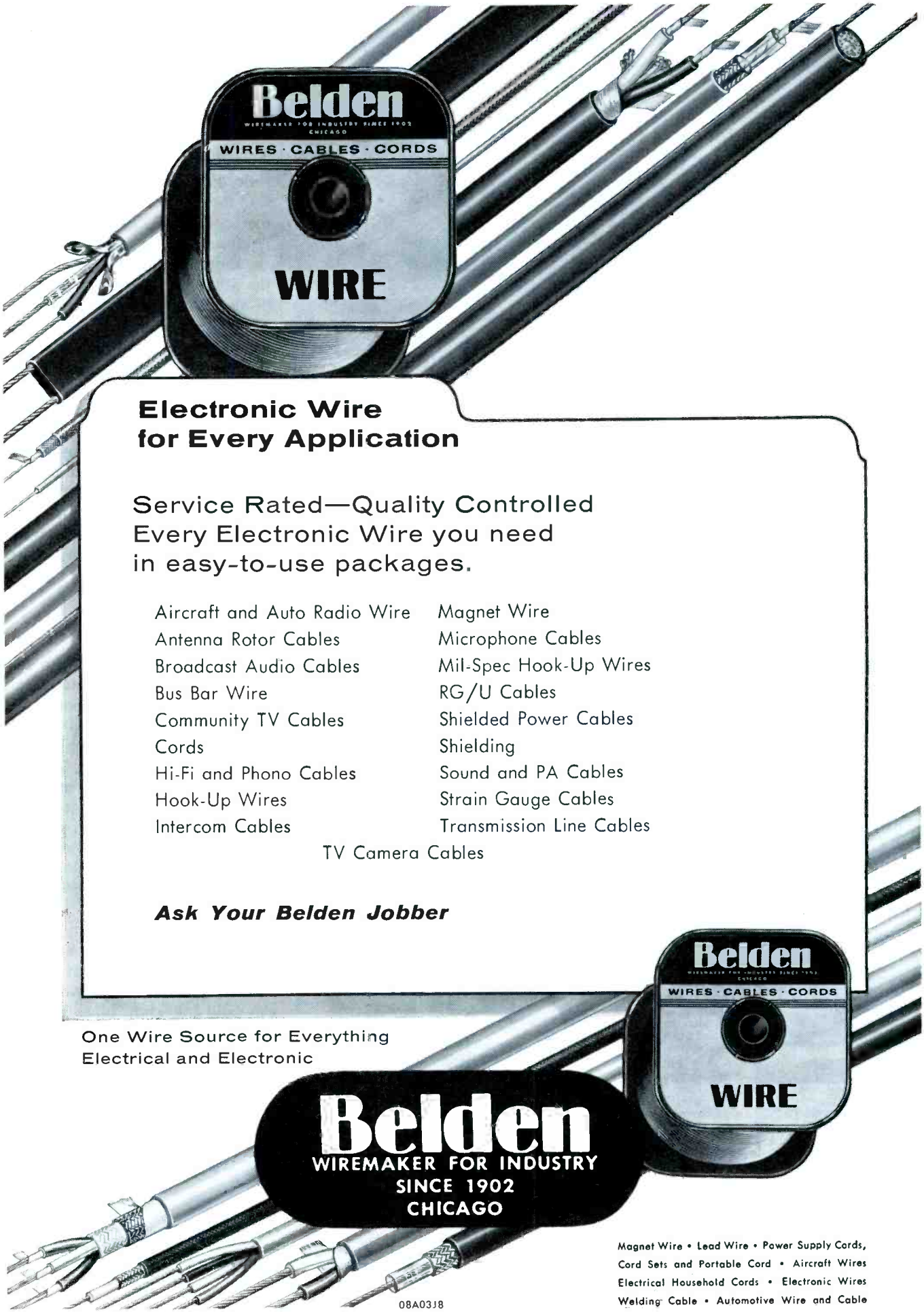


Fig. 5. Slide switch automatically provides surge protection for capacitors.



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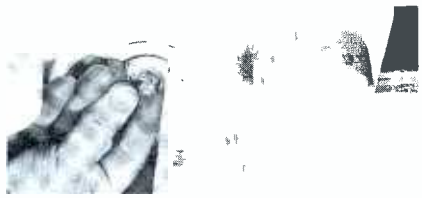


Fig. 6. Installing an auto snack tray on the underside of the servicing bench.

away from its resting position, the slide contact connects the red test lead through the 500-ohm resistor to the anode of the capacitor previously chosen by the rotary selector. As the slide connector is moved further, the 500-ohm resistor is dropped out of the circuit and the red test lead is connected directly to the anode of the capacitor. Releasing the switch labeled "Surge Protector — Push to Test" automatically removes the red test lead from the circuit and discharges the capacitor.

Capacitances offered by this unit (as seen in the photo) are 4 through 350 mfd in 10 steps and, while the voltage rating of all units is 450 volts, any of them can be used at lower voltages without any effect on capacitance value.

"Autotray" Becomes Service Aid

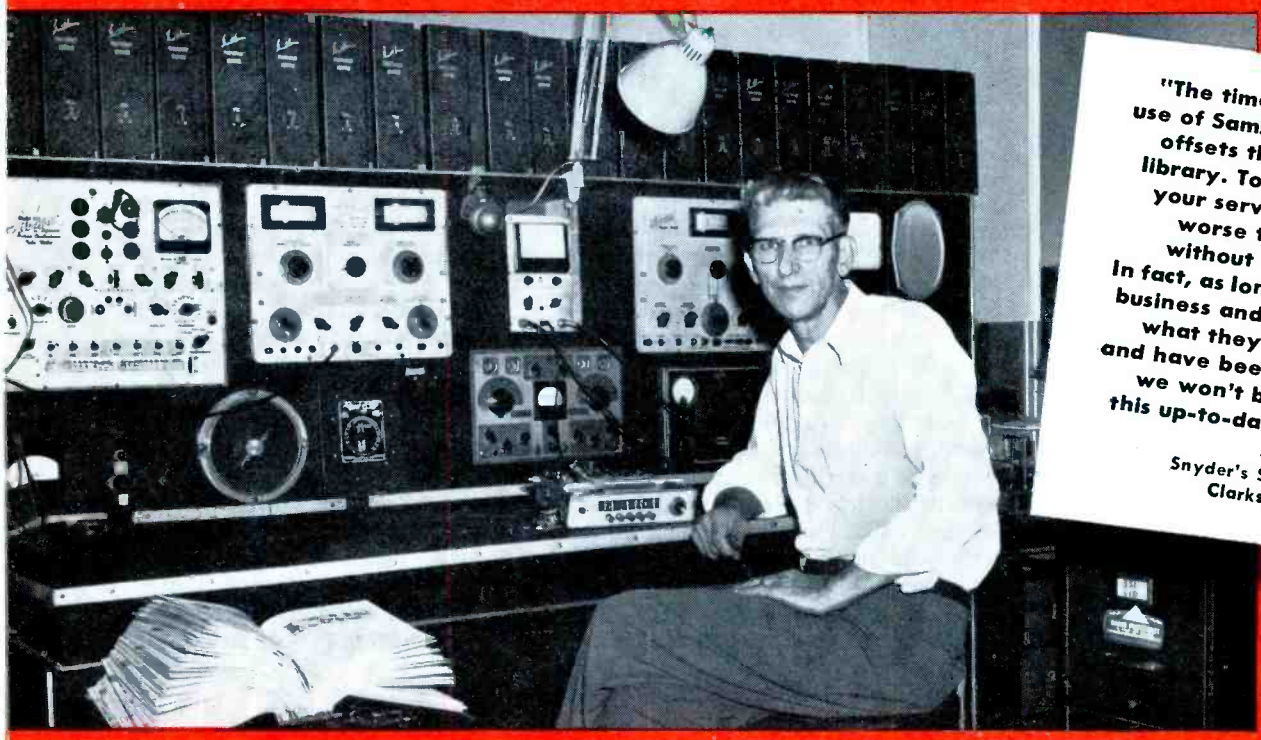
Are you troubled with small screws, washers and nuts falling to the floor — not to mention a miniature tube sometimes rolling off the bench? If so, a suggestion sent in by H. Leeper of Canton, Ohio, may save you time and trouble. The *Autotray* shown is designed to swing under a car's dash when not in use. It may be attached to the underside of your bench or table with the bracket furnished (see Fig. 6.)

The tray is about 12" x 6½" and has two openings which are about 3" in diameter and about 2" deep. Paper drinking cups may be placed in the openings as shown in Fig. 7 to hold miniature tubes taken from a radio or TV being repaired. The tray can be swung out of sight and out of the way when not in use. ▲

Fig. 7. Paper cup holders are handy for holding stray tubes used at the bench.

ownership of a PHOTOFACT SERVICE DATA LIBRARY SPELLS SUCCESS FOR SERVICE TECHNICIANS

here's actual proof from the men who know



"The time saved by the use of Sams more than offsets the cost of the library. To do without your service would be worse than operating without a V.T.V.M. In fact, as long as we are in business and Sams remain what they are today and have been in the past, we won't be without this up-to-date service."

—Frank Snyder,
Snyder's Sales & Service,
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HERE'S MORE PROOF...FROM COAST-TO-COAST

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"I would not take anything for my valuable collection of Sams PHOTOFACT."
—Charles S. Coot,
Winslow, Arizona

IDAHO
"My PHOTOFACT library is an indispensable source of service information on the...TV sets serviced in our shop. Without this information, the time required to complete many repair jobs would be prohibitive."
—Richard Huntley,
Craigmont, Idaho

WISCONSIN
"With the PHOTOFACT file to back us, we have complete confidence that we can handle any service problem brought to the shop."
—Howard R. Olds,
Darlington, Wis.

TEXAS
"I don't see how anyone can run a shop without a set of PHOTOFACT. I would be lost without mine. They are a must on any bench job. You can do a faster job with the information in PHOTOFACT."
—T. A. Hopkins,
Quanah, Texas

OHIO
"PHOTOFACT speeds up my service on repairs and the file cabinets help dress up the shop."
—Ed Rahm, *Toledo, Ohio*

SOUTH CAROLINA
"(With PHOTOFACT) I have a lot less time on the bench and I can do a more complete repair job on a customer's set and have less come-backs because of a perfect repair job."
—Glen Stewart,
Pickens, S. Car.

MASSACHUSETTS
"PHOTOFACT has been one of the mainstays in my service business. The PHOTOFACT library has cut my service time well in half and has more than paid for itself already. In the best words—PHOTOFACT kept my new business in the black."
—Benjamin L. Hall,
Edgarton, Mass.

PENNSYLVANIA
"They are just great. Cuts service time to a minimum."
—Virgil Franceschini,
Barnesboro, Pa.

These are just a few of the hundreds of "Success with PHOTOFACT" letters in our files. Service Technicians everywhere are enjoying the profit-making advantages of a complete PHOTOFACT Library. If you're not among them, see your Sams Distributor today, or write direct to Howard W. Sams for full details. Use coupon below.

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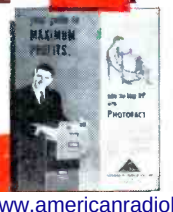

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☐ Send me Free booklet "Your Guide To Maximum Profits"
☐ I'm a Service Technician: ☐ full-time; ☐ part-time

My Distributor is: _____

Shop Name _____

Attn. _____

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City _____ Zone _____ State _____

Greetings. As a means of expanding your customer list, have you ever thought of spending some of your ad budget for participation in a local *Welcome Wagon* service? You might introduce yourself to every new family in the neighborhood by offering to check their TV set (without charge) to make sure it survived moving day without damage. Another appropriate offer would be a credit of so many dollars toward the labor charge on the first service call. This invitation, along with your name and address, could be printed on a card and slipped into the basket of gifts that the *Welcome Wagon* delivers to newcomers.

You are charged a small fee (exact sum varies) for each such call made. In a medium-sized city, this organization visits hundreds of families per month — drumming up more potential business than you could ever handle. Fortunately, they are willing to offer partial coverage; for example, they might present only 50 or 60 of your cards per month to families who have moved into your immediate locality.

$ & ¢

They're In The Bag. *Electrotex,* a parts distributor in Texas, imprints common paper bags in two colors with a message headed, "Your Troubles Are In The Bag." These are offered to service technicians at a low bulk rate for use in delivering bad parts to customers after completion of shop jobs.

This jobber reports the bags have been a rousing success in his area. Perhaps an idea along this line would work well for you, too.

Returning defective parts along with the set is recognized as a wise practice, since it lets the customer see what he's getting for his money. However, he will accept a loose collection of grimy TV tubes and diseased-looking tubular capacitors about as eagerly as a handful of dead bugs. Hand over the decrepit parts in a neat bag, however, and the average customer will follow a simple three-step procedure: Read the good-will message on the outside, peer gingerly inside, and then fling the whole mess into the trash can. This last gesture signifies he is satisfied with the job you've done.

Besides its usefulness as a neat bit of public relations, the bag also helps you keep track of all parts removed from the set during repair. This cuts down on the number of capacitors and resistors absentmindedly donated to the cause of getting the set in proper working order.

$ & ¢

Limping Along. We'll bet that you are putting up with a number of nagging little defects in things which belong to you — for instance, a lock on one door of your truck that can't be operated from the outside, or a zipper on your jacket that won't zip up all the way. It seems to be human nature to live with such faults as long as the object can still be used. Why don't you get them fixed? Simply because you never get exasperated enough to fix them yourself or to hunt up a professional repairman. Yet, if someone came along and convinced you that he could take care of these little things with minimum cost and inconvenience, you'd most likely be willing to let him do it. You might even agree to have your storm windows repaired in July.

People have the same sort of minor defects in their radio and TV sets—burned-out dial lights, broken contrast-control knobs, dirty safety glass, or minor circuit defects which don't prevent use of the set. These annoyances will frequently be tolerated until some major trouble develops, unless some considerate serviceman takes the trouble to correct them. Like so many of life's

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COMPLETE
10-WATT POWER RESISTOR
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POCKET CASE!

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With the new IRC
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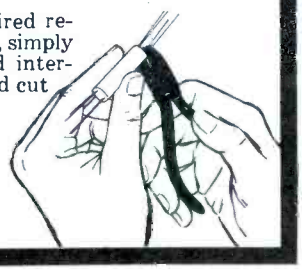
Only 10 basic terminal interconnections . . . all with axial leads. Connection diagrams in each Handy-Pak.

For the required resistance value, simply solder desired interconnection and cut off unwanted terminals.



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CONTAINS **5** HANDY-PAKS
10 Type MR Resistors
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Here's super-convenience on power resistors. Have complete 10-watt coverage right at your fingertips . . . in a stock so compact it fits in the palm of your hand. No delays for odd values . . . no costly inventories of slow-movers.

- Kit gives complete 10-watt coverage of 200 values.
- Contains 5 Handy-Paks—2 of each Type MR resistor—10 Multi-Range units.
- Rigid, clear-plastic box with hinged lid.
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small comforts, these little improvements are really appreciated; so they're well worth performing as routine "extras" on your calls. You could even work up a direct-mail or radio-spot advertising campaign to let people know that you take care of small repair needs.

$ & ¢

More Sets—More Business. The theme. "Two or More TV Sets in Every Home," is expected to appear often in TV manufacturers' advertisements during the coming season. The consumer products division of EIA is currently cooperating with individual manufacturers to build a coordinated program of new-set promotion around this idea.

The multiple-set campaign should be regarded as more than just an effort to sell new TV sets. It will also serve to increase the total number of sets in use, thus providing opportunities for the ambitious serviceman to increase his volume of business. Besides creating more service work, an increase in multiple-set homes will open up new chances to install antennas, two-set couplers, and antenna distribution systems.

Here's another encouraging note: If the average customer warms up to the suggestion that he should own an extra TV set or two, dealers may be able to solve the problem of what to do with trade-ins. After all, the second or third set in a home doesn't have to be new! Perhaps this year's new-set buyer will be more easily talked into keeping his old set instead of having the dealer haul it away. Sales of reconditioned used sets may perk up, too.

$ & ¢

Edible Resistors. Ohm's Law has been put to use for cooking hot dogs! In a new "Dog-O-Matic" appliance, electrodes are attached to wieners at both ends — thus literally "plugging them in" across the AC line. The electrical resistance of a hot dog is high enough to prevent blowing a line fuse when the current is turned on. Like an ordinary resistor, however, it will heat up; in about 90 seconds, it's cooked to perfection.

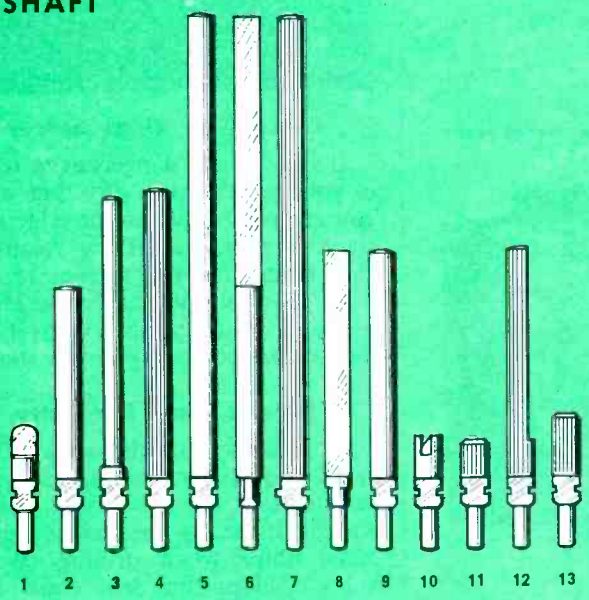
Need an expendable power resistor for an electronic experiment? Don't rummage around in your parts box — raid the refrigerator! Then enjoy a snack afterward, too!

Quick as a Wink!

THE RIGHT CARBON CONTROL COMBINATION

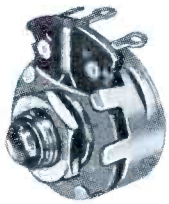
There's no fuss, no muss, when it comes to getting the **exact** carbon control you want—when you ask for Clarostat. You get your choice of shaft—13 types to select from—and with just a light tap, the shaft is permanently attached. Also, pick your switch, and in a moment you have the **exact** combination you need. Ask your Clarostat distributor for the new, bigger, 1958 Catalog.

SHAFT



1 3/8" long male for female fitting.
2 2" round shaft.
3 3" round shaft, 3/16" dia.
4 3" knurled split shaft.
5 5" round shaft.
6 5" flatted shaft.
7 5" knurled split shaft.
8 3" flatted shaft.
9 3" round shaft.
10 1/2" double-flatted Philco-type shaft.
11 1/4" fine knurled shaft.
12 3" knurled flatted shaft.
13 1/2" fine knurled flatted shaft.

CONTROLS



Series A 47: 1/2-watt, 15/16" diameter controls. 500 ohms to 10 megohms.

Series A 47F: 1/2-watt, 15/16" diameter controls, with taps located at 30%, 50% or 70% of rotation, depending upon resistance value. 50K to 3 megohms.

Series AD 47: 1/2-watt, 15/16" diameter dual controls for audio, radio, TV and industrial uses. Various taps available. 50K to 5 megohms.

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Choice of five switch types including SPST and DPST, for various power ratings. UL approved.

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TIPS for TECHS

Carry Guy Rings Safely

It's downright dangerous to reach in your pocket for a guy ring when you are poised out on the edge of a slanting roof, but it's a relatively easy matter for you to remove one from your belt loop as shown. Hook a supply of rings on a convenient loop before you go up on the roof.

Service Uses for Putty

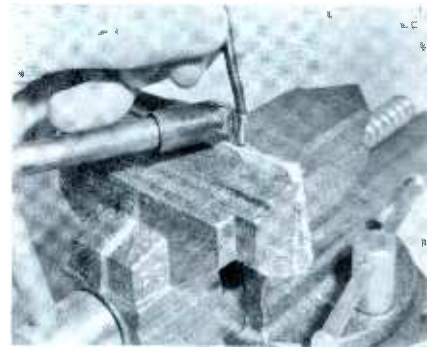
Extra-sticky calking-strip putty (available at hardware stores) is a helpful item for the service bench. Among its many uses are catching metal chips when drilling chassis holes, picking up drill chips and small bits of solder, removing metal filings from pole pieces of PM speakers, or holding parts on the bench when soldering or testing.

Shockless AC-DC Servicing

Have you ever received a jolt while servicing an AC-DC set on the bench? Chances are, you completed a circuit between the chassis and a grounded object. If you want to avoid such unpleasant shocks, cover an area about 2′ square at one end of your bench with a piece of fine-mesh copper screen or sheet metal and ground it through a neon lamp. Place the AC-DC set on the screen or plate and turn the set on. If the lamp lights, just reverse the line plug in the outlet.

Ladder Measures Lead-In

To simplify the measurement of lead-in wire used on antenna installation jobs, mark the length of your service ladder with different-colored daubs of paint at foot and half-foot intervals. Then you can charge the customer for exactly the amount of wire used.



Asbestos Facilitates Soldering

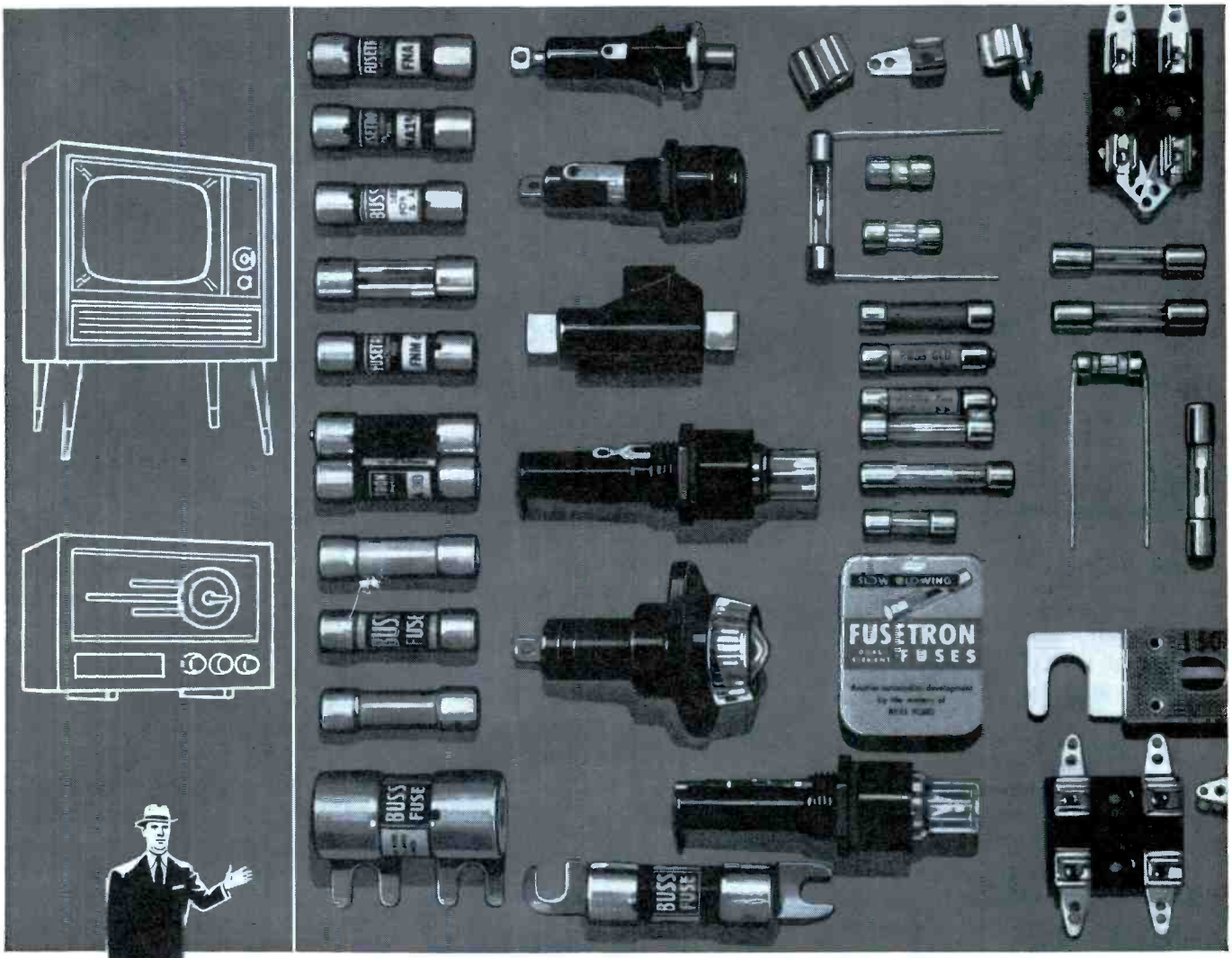
Ever try soldering small parts while they are clamped in a vise? Chances are you found the task a difficult one because the heavy metal jaws dissipated the heat so rapidly that you had to resort to some other way to hold the work. Next time this happens, pad the jaws with some pieces of asbestos. This will eliminate the undesirable heat dissipation and make efficient soldering much easier.

Magnetic Schematic Holder

Do Your PHOTOFACT service folders lay around on your bench and become torn by tools and soiled with solder and dirt? This can't possibly happen if you keep the folder you are using attached to the wall near the service bench. Fasten a magnetic knife rack (or a strong magnet from a PM speaker) to the wall, put your service folder up to it, and lay a small piece of iron such as a flat file against the folder. This will hold it securely in place without harming it in any way. You can turn it over easily to view the opposite side, too.

Parts Bin for Shop

If you have some vacant space on your shop wall that isn't being put to good use, why not take a few spare moments to build a wall-mounted parts bin? If you keep most-often-needed pieces of hardware or parts in a bin made from some 6½" three-quarter discs and a length of 6" stovepipe, parts selection will be fast and efficient. In case you don't have enough space left on your shop wall for such a bin, mount it on one end of the bench.



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BUSS fuses stay sold—customers stay satisfied because, BUSS fuses are made to protect, not to blow needlessly.

Every BUSS fuse you sell or install is tested in a sensitive electronic device that automatically rejects any fuse not properly constructed, correctly calibrated and right in all physical dimensions.

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The ready acceptance of the BUSS trademark as standing for fuses of unquestioned high quality is built upon the millions upon millions of BUSS fuses that have provided dependable protection in homes, farms and industry over the past 44 years.

Selling and installing KNOWN, 'trouble-free' BUSS fuses, saves you time and trouble and helps protect your reputation for service and reliability.

For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders, write for BUSS bulletin SFB.

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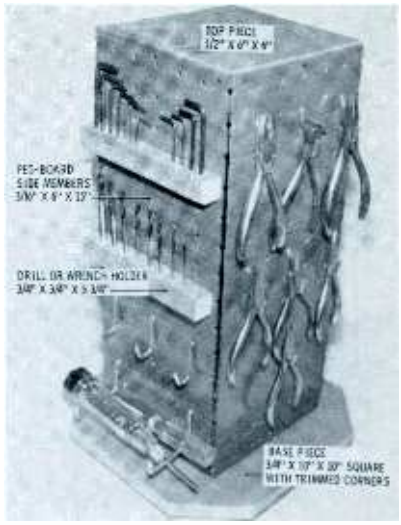
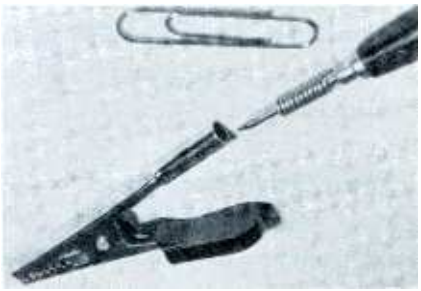


Tool "Tree"

A convenient and orderly arrangement of tools on the service bench contributes much to the efficiency and money-making ability of any electronic service shop. This tool "tree" puts your most often needed tools within arm's reach. It should take you only a little longer than an hour to build. The four side members are cut from Marlite prefinished pegboard and attached to the top and bottom pieces with small nails. A bolt with two washers, inserted through holes drilled in the middle of the bottom and base pieces, serves as a pivot and allows the tree to be rotated "Lazy-Susan" fashion. The threaded end of the bolt is recessed into the base piece and the nut locked in place with solder.

The tool fasteners are of the type normally used with pegboards. The holders for hex and spline wrenches and drill-bits are simply blocks of wood with holes drilled in them.



Prod Adapted To Fit Clip

To adapt a pointed test prod to fit the sleeve of an alligator clip, wind a medium-size paper clip into a small, tight-fitting coil and place it around the prod as shown. Now, whenever you need to clip one prod to chassis ground or to a terminal, merely slip the coil over the prod and insert it into the barrel of the clip.

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The set a serviceman can recommend to his best friend

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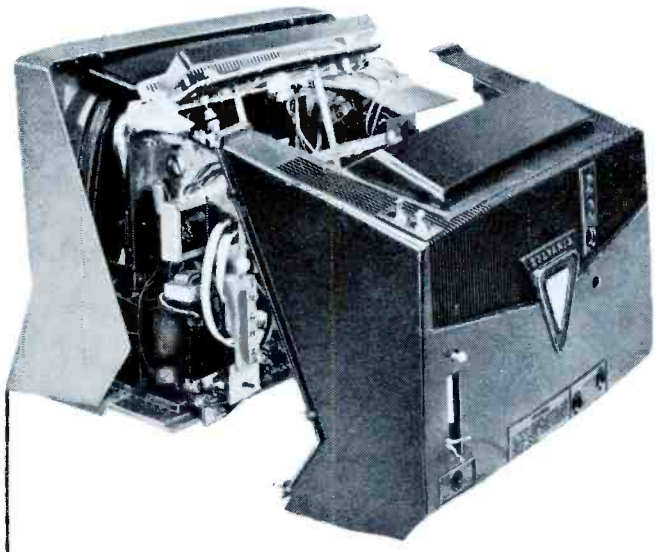
- long-life GERMANIUM OR SILICON RECTIFIERS
- exclusive "LIFETIME ENGRAVED CIRCUIT"
- shockproof, HIGH IMPACT STYRENE CABINET

for years of dependable reception

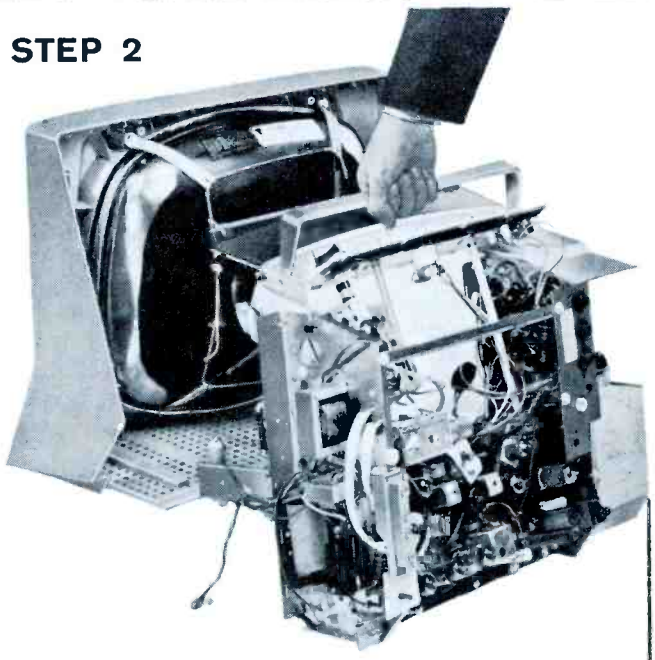
And, if service is ever necessary
TWO QUICK STEPS OPEN THE DOOR FOR ALL SERVICE JOBS

STEP 1



Take out only 8 screws to remove the back cover! All check points and tubes are accessible. A burned-out tube can be located in seconds! 90% of all service jobs and adjustments can be made without even removing the chassis!

STEP 2



Just two more screws remove the entire chassis! If it ever becomes necessary to pull the chassis, simply remove two more screws and lift it out. The dualette carrying handle becomes a carrying handle for the chassis!

Recommend SYLVANIA TV
—every set has a "LIFETIME ENGRAVED CIRCUIT"

NOTES on test equipment

informative reports from the lab

by Les Deane

New Radio Troubleshooter

Keeping pace with the ever-expanding electronic servicing field, Hickok Electrical Instrument Co. of Cleveland has recently introduced a new bench instrument specifically for troubleshooting transistor radios. Doing one of the jobs it was designed for in Fig. 1, the Model 810 Transistor-Radio Tester is actually a signal generator, an AM receiver substitute, and a transistor checker all rolled into one neat package.

Applications of the tester are not necessarily limited to transistor radios, however, and it may also be used in servicing tube-type receivers as well as auto radios.

Specifications and features are:

1. Power Requirements—105/125 volts, 50/70 cps; power consumption approximately 25 watts.
2. RF Output—audio modulated or unmodulated frequency ranges of 200 to 600 kc and 500 to 1600 kc; output impedance 180 ohms.
3. Radio Substitute—tuned receiver covering an IF band of 500 to 1600 kc; and an RF band of 500 to 1600 kc; cathode-follower prove provided; input impedance 5 megohms shunted by approximately 4 mmf; sensitivity 200 uv.
4. Audio Output — 600-cycle sawtooth, variable from 0 to 2 volts p-p across 180-ohm load; modulation switch provided on panel.
5. Audio Substitute—AF amplifier with cathode-follower input and built-in speaker; input probe resistance 5 megohms.
6. Transistor Test — checks both p-n-p and n-p-n transistors for leakage and relative gain when used with low-range milliammeter.
7. Size and Weight—9" x 11¼" x 7", 11¼ lbs.

One can probably visualize many uses for the Model 810 from the specifications alone, but to really become acquainted with a new instrument of this type, you should understand its operating principles. When I first examined this piece of equipment and took a look at the function selector, I immediately wanted to find out how it worked.

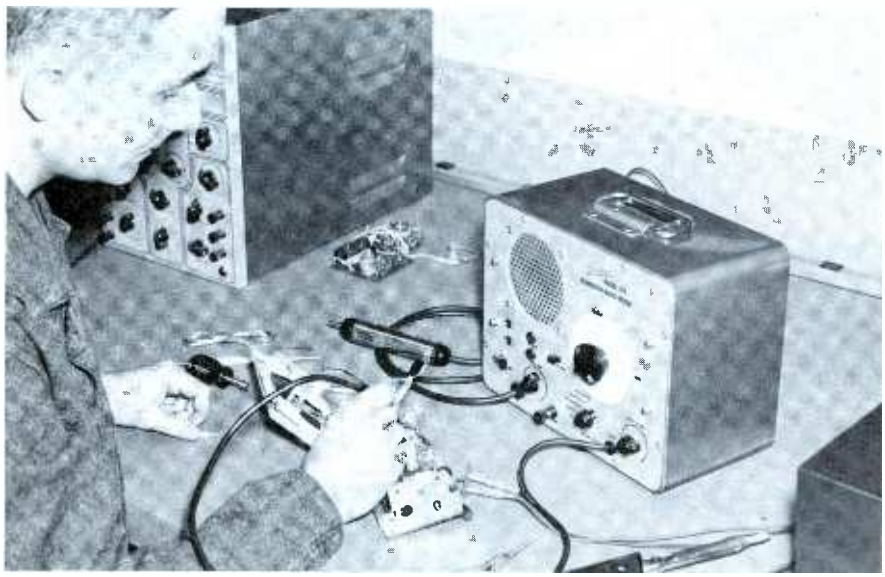


Fig. 1. Signal-tracing, substitution, and alignment of transistor radios is easy with Hickok's Model 810, which also featuers a test circuit for transistors.

Although the tester is basically a service instrument for transistorized equipment, its circuitry employs four vacuum tubes — one 6AB4, two 6AU8's, and a 6X4 power rectifier. This complement represents six separate stages; however, certain stages are used for more than one application, depending on the setting of the function selector.

The function switch has six positions. In one, labeled 500-1600 KC REC., the instrument operates as a complete AM radio, covering the standard broadcast band and reproducing sound on a built-in 4" speaker. Stages involved in this arrangement are shown in the block diagram of Fig. 2A.

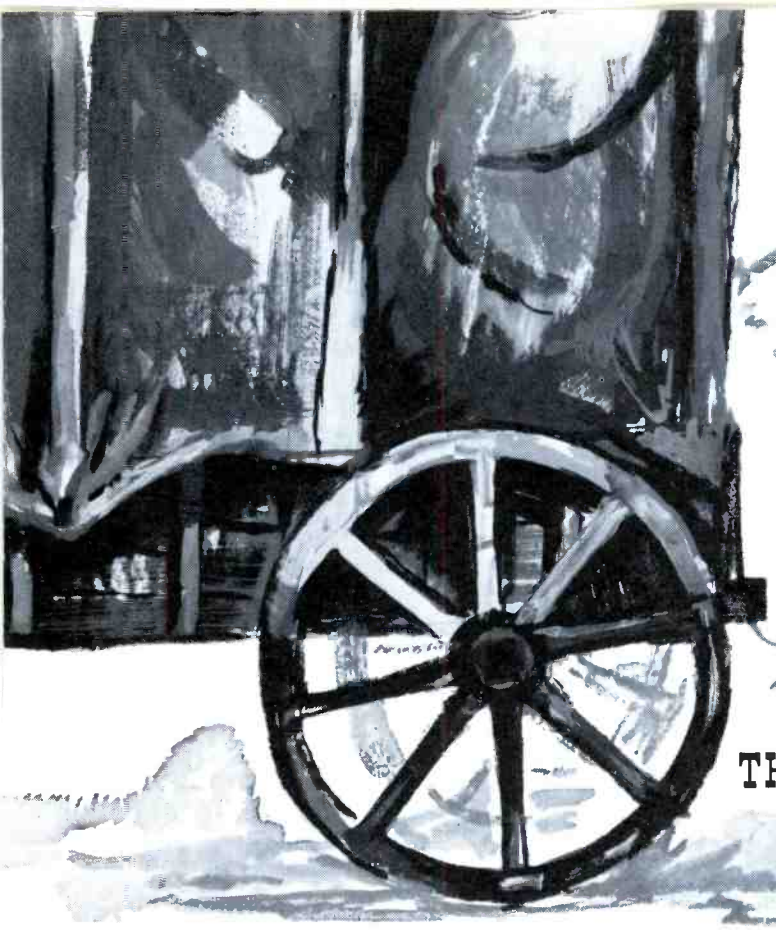
The input to this substitute receiver consists of a cathode-follower triode stage housed in a probe at the end of the input cable. The probe may be connected to the RF circuits of a radio under test or, with the use of a 3′ length of wire, used as an antenna itself. A gain control is also found in the output of this first stage.

The two RF amplifiers (V2A and V3A) are plate-tuned over a range from 500 kc to 1600 kc by varying the tuning dial on the front panel. Since an intermediate frequency is not used, the circuit operates as a simple TRF receiver.

Audio detection is accomplished by a 1N34 crystal diode which, in turn. supplies a grid signal to the AF amplifier V3B. In the final stage, an attenuator control located on the front panel varies the output signal to the tester's built-in speaker. For this function, the modulation switch is placed in its off position, automatically connecting the speaker across the output circuit.

Turning the function switch to the position marked 200-600 KC REC., the instrument is again operated as a TRF receiver, except that the plate circuits of V2A and V3A (Fig. 2A) are tuned to a range covering the two common IF radio frequencies of 262 kc and 455 kc. Incidentally, with the tester operating in this manner, you can also pick up aircraft weather signals, which are transmitted in this frequency band.

Selecting another function of the



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BLUFFTON, OHIO

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Model 810, I placed the switch in its 500-1600 KC OSC. position, operating the unit as an RF generator. Making use of the stages shown in Fig. 2B, tube sections V2A and V3A form a multivibrator-type RF oscillator. The output frequency is made variable by employing the same tuned circuits used in the TRF receiver setup. The dial on the panel thus selects the generated signal, which is then coupled to the output cable by way of the cathode follower V2B. If desired, the RF output can be modulated with a 600-cycle tone by merely flipping the MOD. switch to its on position. I will describe this modulation source presently.

With the function selector in the position designated as 200-600 KC OSC., the generator circuit of Fig. 2B automatically falls into a tuning range covering the intermediate radio frequencies. This signal, too, can be modulated or unmodulated and used for either signal injection or IF alignment purposes.

The block diagram of Fig. 2C represents operating circuits of the tester when set up as an audio amplifier. In this case, the function switch is in the AUDIO AMPL. position, and the modulation switch is turned off. This functional arrangement is used for complete signal tracing of the audio section of a radio, or as an auxiliary amplifier in itself. An input signal of 10 millivolts or more will normally produce a good aural indication from the instrument's speaker.

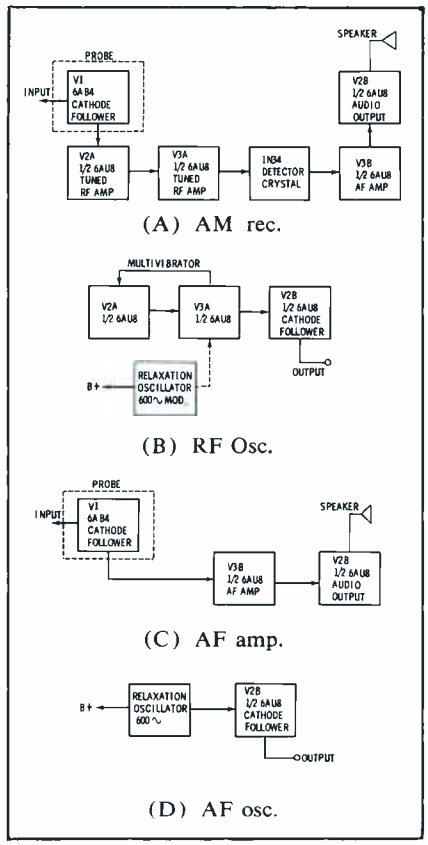


Fig. 2. Block diagrams of Model 810.

Placing the function switch in its one remaining position, namely 600 CPS AUDIO, I discovered that the unit operated as a simple audio oscillator or generator. The stages involved are shown in the block diagram of Fig. 2D. The relaxation oscillator, operating from the B+ supply, consists basically of an NE2 neon bulb, a .002-mfd charging capacitor, and a 5.6-megohm limiting resistor. The fixed frequency of the oscillator is 600 cycles, and its out-

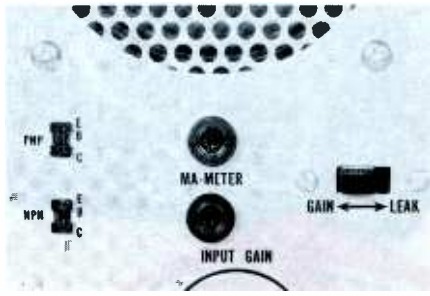


Fig. 3. Front panel provisions of the Hickok tester for checking transistors.

TV TIPS FROM TRIAD

NO. 2 IN A SERIES

The voice on the phone was painfully familiar. "No picture again," it said. The PTM (short for Professional Television Man) realized he was indeed on rather intimate terms with this particular receiver. Since installing a power transformer 8 months ago he had put in three 6CU6's, and two "exact replacement" flybacks.

"This is a blot on my escutcheon," said the PTM, who always used big words when talking to himself. "I'll fix it or buy it."

On the bench, the receiver revealed one flat 6CU6 and one flyback cooked to a turn.

First the PTM checked out the low voltage B+. Finding it excessive by 40 volts, he referred to the secondary rating and found it normal (660 volts where schematic called for 650).

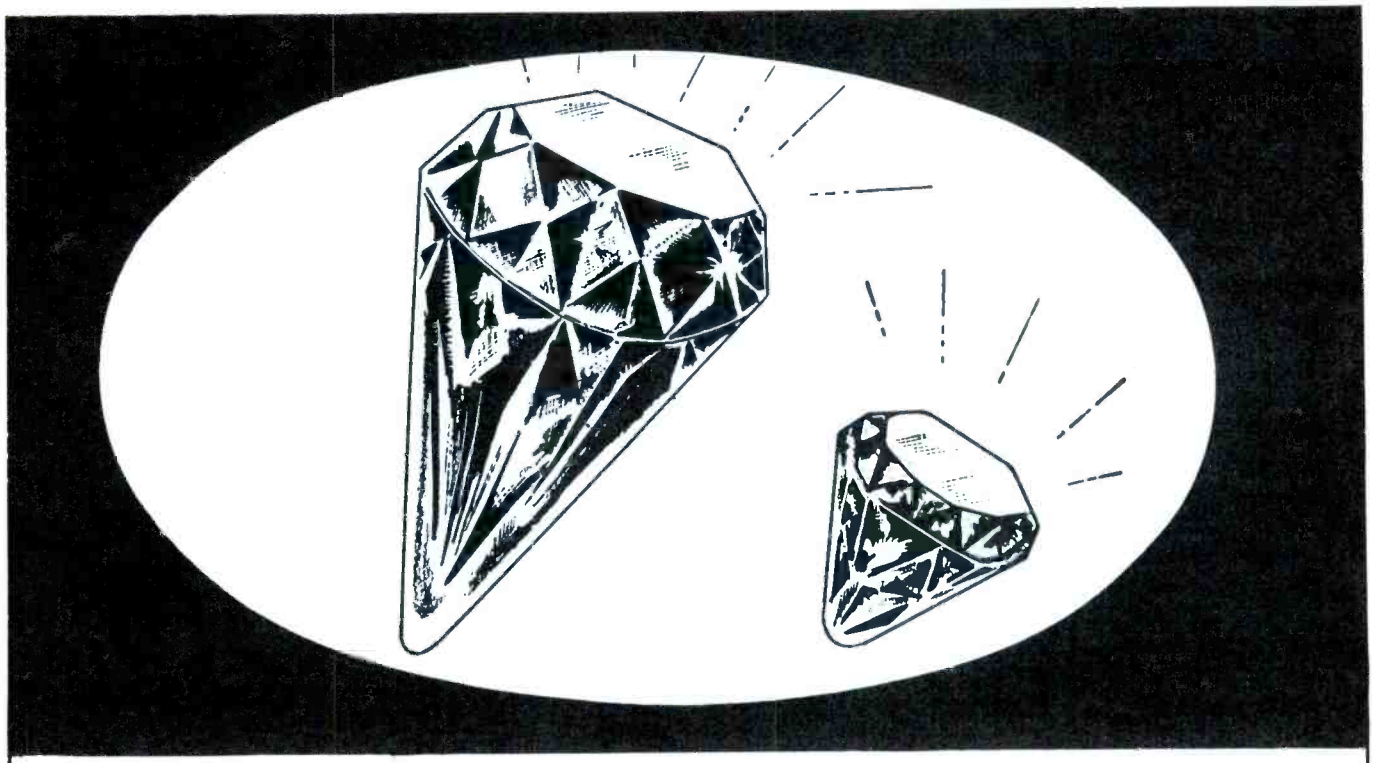
"This can't be," he said, among other things. An outside salesman, attracted by the picturesque language, immediately presented the PTM with Triad's new Replacement Guide. "Check page 15," said the salesman, who was apparently blessed with total recall.

Here they find the rating that counts for the serviceman is the B+ he gets under actual conditions in the receiver; whether the set has one or two 5U4's; and, regardless, how fully loaded the circuit is. Actually the same power transformer can vary from 340 volts at 70% load with two 5U4 rectifiers to 285 volts with one 5U4 at 100%.

A Triad Service Aid called "Taking The Heat Off Flybacks" provides some additional information: "An increase of only 20 volts B+ can shorten tube and flyback life by 80%."

Better to fix the cause of the trouble than keep fighting the results. So the PTM looked up the current and voltage rating and selected the item that delivered it from his rectifier system. The picture was just as good but the whole set cooled down well below the boiling point.

MORAL: Too little information is a dangerous thing. Extra specifications—such as those you get from Triad—avoid callbacks. If you'd like to receive Triad Service Aids, communicate with **Triad Transformer Corp.**, 4055 Redwood Ave., Venice, Calif.



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There are two kinds of diamond needles now on the market. One is the *whole* diamond; the other is a diamond chip welded on a steel shaft. The overall length of both is the same. With the welded chip diamond the entire amount of diamond is visible on top of the steel shaft, and should there be a bubble resulting from heat or gas during the welding, the slightest jar can result in instant loss of the diamond. With the *whole* diamond needle, only ⅓ of the total diamond is visible and the remaining ⅔ is deeply embedded, crimped and cemented into the metal holder — thus making it impossible to shear off the point by any jarring or dropping of the tone arm.

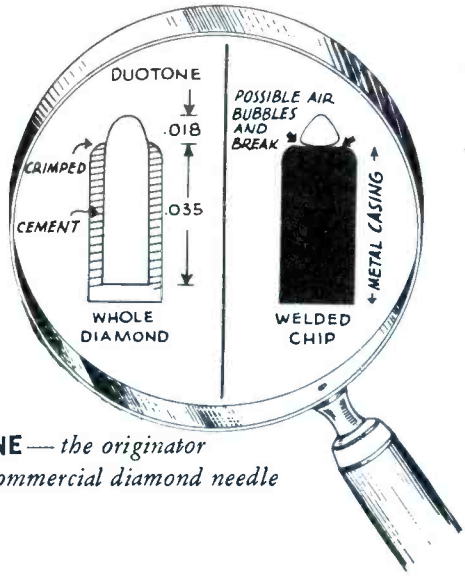
What are the additional advantages of a Duotone Diamond Needle?

All Duotone diamond tips are hand ground and polished to a mirror finish, hand radiused to the exact required specifications, and hand set in perfect alignment to the record grooves. None of these delicate hand operations can weaken a weld that does not exist in a *whole* diamond. The constant observance under microscopic inspection plus Duotone's exacting quality standards eliminate every possibility of imperfection — permitting Duotone's 100% guarantee of the diamond needle itself, better reproduction and longest life possible for the needle.

One more important feature of your Duotone Diamond Needle.

No diamond needle will last forever. Only Duotone Diamond Needles give you the "needle that remembers" service and warns you when the Company Technicians know that needle wear is getting dangerous for your record collection.

All this at no extra cost over ordinary diamond needles.



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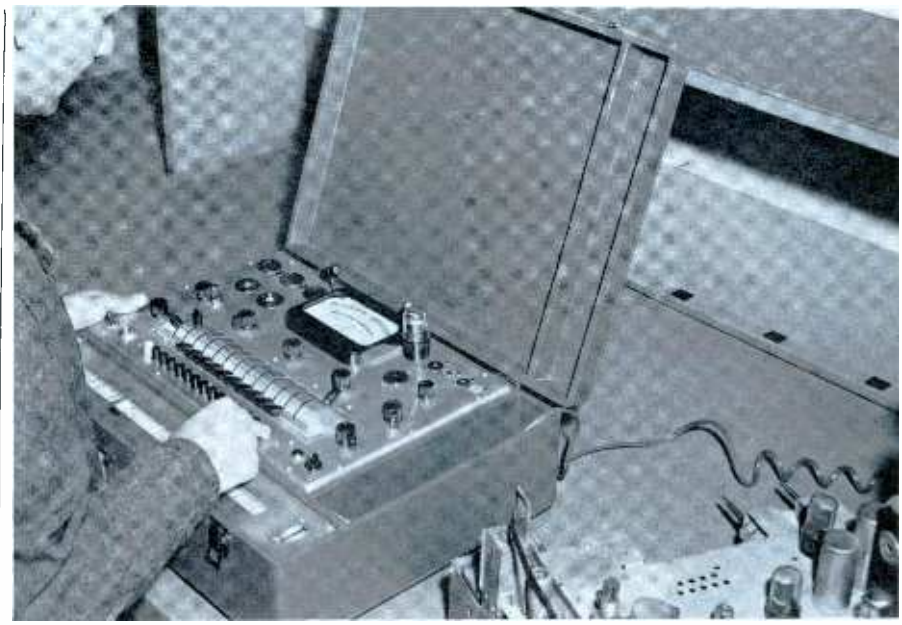

Fig. 4. Making use of Precision's *Electronamic* tube tester in the laboratory.

put waveform is sawtooth in nature.

For this phase of operation, I also found it necessary to place the MOD. switch in its "on" position, thus applying B+ to the oscillator circuit and shorting out the instrument's speaker at the same time. As shown in Fig. 2B, this same relaxation oscillator is used to modulate the output frequency when the instrument is used as an RF or IF signal generator. The cathode follower V2B offers a low-output impedance, which makes it suitable for driving transistor circuits.

Aside from the signal-tracing and signal-injection functions of the Model 810, it also provides a test circuit for transistors. As shown in Fig. 3, two test sockets, a positive and negative meter jack, and a leakage-gain switch are located on the front panel directly below the speaker grille. In addition to the test circuits, a separate milliammeter must be plugged into the panel jacks and used as an indicating device. The instrument's manual gives step-by-step instructions for checking transistors, as well as general hints on servicing transistor receivers.

"Electronamic" Tester

Pictured in Fig. 4 is the new Model 10-40 *Electronamic* Tube Tester developed by Precision Apparatus Co., Inc., Glendale, L. I. Featuring a special quality test for all amplifier tubes, the instrument is designed to meet the realistic needs of today's radio and TV service profession.

In addition to checking all receiving tubes for shorts, quality, and gas, the Model 10-40 can also be used to test picture tubes with the use of special accessory adapters. As you can see in the photo, the instrument comes in a leatherette carrying case with side compartment for adapters

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or tools and a detachable lid.

Specifications and features are:

1. Power Requirements—110/125 volts, 50/60 cps; power consumption approximately 15 watts in stand-by condition; all test circuits isolated from line.
2. Shorts Test—shorts indicated by neon bulb on front panel; individual push buttons provided for each tube element; test rapidly made before setting up lever switches.
3. Quality Test — separate loads and voltages applied to each tube element; indications given directly on 3-colored meter scale labeled REPLACE-?-GOOD; linear scale provided for comparison purposes.
4. Gas Test—VTVM measurement taken in grid circuit of tube; meter gives direct indication on special 0 to 20 ua scale.
5. CRT Test—shorts and beam current testing of all picture tubes with use of adapter cables; separate quality scale provided on meter.
6. Other Tests — voltage regulators, diodes, gas rectifiers, thyratrons, tuning eyes, certain foreign tubes, ballast units, pilot lamps, and a special contact potential test for 12-volt auto radio tubes.
7. Panel Features—built-in pin straighteners; 11 test sockets; large double-jeweled meter, accuracy within 2%; filament selector providing 24 individual voltages; roll chart with 3 viewing windows; line fuse and ON indicator.

In checking out one of these new tube testers in the lab, I first read over the operating instructions and then proceeded to test all of the tubes in both an old and a new TV chassis. Although the two chassis are generally kept in good working order for experimental purposes, I still ran across one tube that checked weak, and another that indicated excessive gas content. I then compared readings of the Model 10-40 with those obtained on an elaborate lab-type tester, and confirmed my findings.

Referring to the front panel shown in Fig. 5, you'll notice that the test sockets include standard octal; 7- and 9-pin miniatures; loctal; 7- and 8-pin subminiatures; 4, 5, 6, and 7-prong types; and also a special 12-prong socket for direct access to all twelve tube-testing circuits. The position of switch A selects the load and plate voltage applied to the tube under test. Switch B is used to complete the heater circuit. Control C, in the center of the panel, varies the input grid potential for different tubes. The control labeled D is adjusted to a precise value given on the roll chart, and accurately calibrates

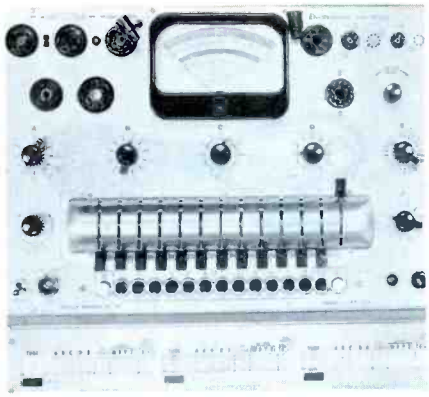

Fig. 5. Model 10-40 panel has easy-to-read meter and 3-window roll chart.

the meter for the particular tube tested. Switch E, on the far right, selects any standard filament voltage from .75 to 117 volts.

The bank of lever switches across the center of the panel enables the operator to connect individual tube elements into the test circuit. With the numbered levers in row "W", the tube element is open; in row "X", it's in the screen grid position; in "Y", the plate circuit; "Z", as control grid; and in "Normal", the element remains at a reference test potential. The line of pushbuttons just above the roll chart are used when checking for shorts and leakage as well as for a rapid continuity test of tube filaments. It's interesting to note that both these and the lever switches are numbered to represent the tube pin numbers standardized by EIA.

Switch F and the control knob opposite it on the far left are used for gas and picture tube testing. A line-voltage adjustment is located above switch E, while the neon short indicator is down in the lower left section of the panel. Leads for both grid- and plate-cap tubes are found at the top of the instrument on each side of the meter.

Operation of an amplifier tube depends on a number of characteristics such as electron emission, amplification factor, plate resistance, mutual conductance, plate current, power output, etc., and this instrument is designed to sum up these characteristics in a single quality test.

Examining the test procedure, I found that the instrument evaluates tube performance by monitoring output voltage or power while the tube input signal is dynamically swept over a wide range of characteristic curves. The results of this *Electronamic* test are integrated and

(A) Mod. PTA

(B) Mod. PAA

Fig. 6. CRT adapters for Precision unit.

expressed in terms of REPLACE—?—GOOD on the plate-circuit meter. With an output indication resulting from a sinusoidal voltage applied to the control grid, one can see that the test is actually based on more than emission or mutual conductance alone.

Adapter cables for testing picture tubes on the Model 10-40 are shown in Fig. 6. To check standard-base tubes having a deflection angle up to 90°, the Model PTA adapter of Fig. 6A is used; for the newer 110° types, the adapter pictured in Fig. 6B is also required. This latter cable (Model PAA) features two separate sockets on one end. The one visible in the photograph accommodates 110° tubes having a miniature base designated as the *small button Eightar* style. The one on the other end of the dual-socket is employed on 110° tubes having the medium-size base designated as the *small Seven Pin* type.

The plug end of the Model PTA cable fits into the octal test socket on the panel of the tester. The plug end of the Model PAA cable, on the other hand, attaches to the standard base socket of the Model PTA. Using the VTVM indicating circuit of the instrument, picture tubes are tested by measuring beam current. This has a direct relationship to picture brightness, and is usually preferred over standard emission tests. ▲

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10	5U4GB	3	6AU6
10	6SN7GTB	3	6U8A
8	6CB6A	2	6BZ7
6	6BQ7A	3	6AX4GT
3	12AU7A	2	1B3GT

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Electronic Tube Division Elmira, New York

STOCK GUIDE for tv tubes

The tube types listed on this page should account for at least 95% of your tube stock requirements. Figures in the chart indicate the number of tubes of each type that you might expect to find among a group of 1,000 tubes taken at random from all TV sets now in service. A figure "1" is listed if the frequency of usage is at least 1 in 2,000. If a tube is used less often than this, but is found in at least one out of every 4,000 sockets, the type number is listed with a dash in place of a figure.

About 75 of the rarest types, with a frequency-of-use figure of less than 1 per 4,000, have been omitted from the chart. Most of these are new designs that have not yet become well established. A forthcoming article will list the circuit applications of these tubes and the brands of receivers in which they are used.

The information in the chart is purely statistical, so it should not be considered as a recommendation to stock a specific number of tubes of each type. However, you can combine the statistics with your own experience and come up with information tailor-made to your own needs.

Be sure to consider the following:

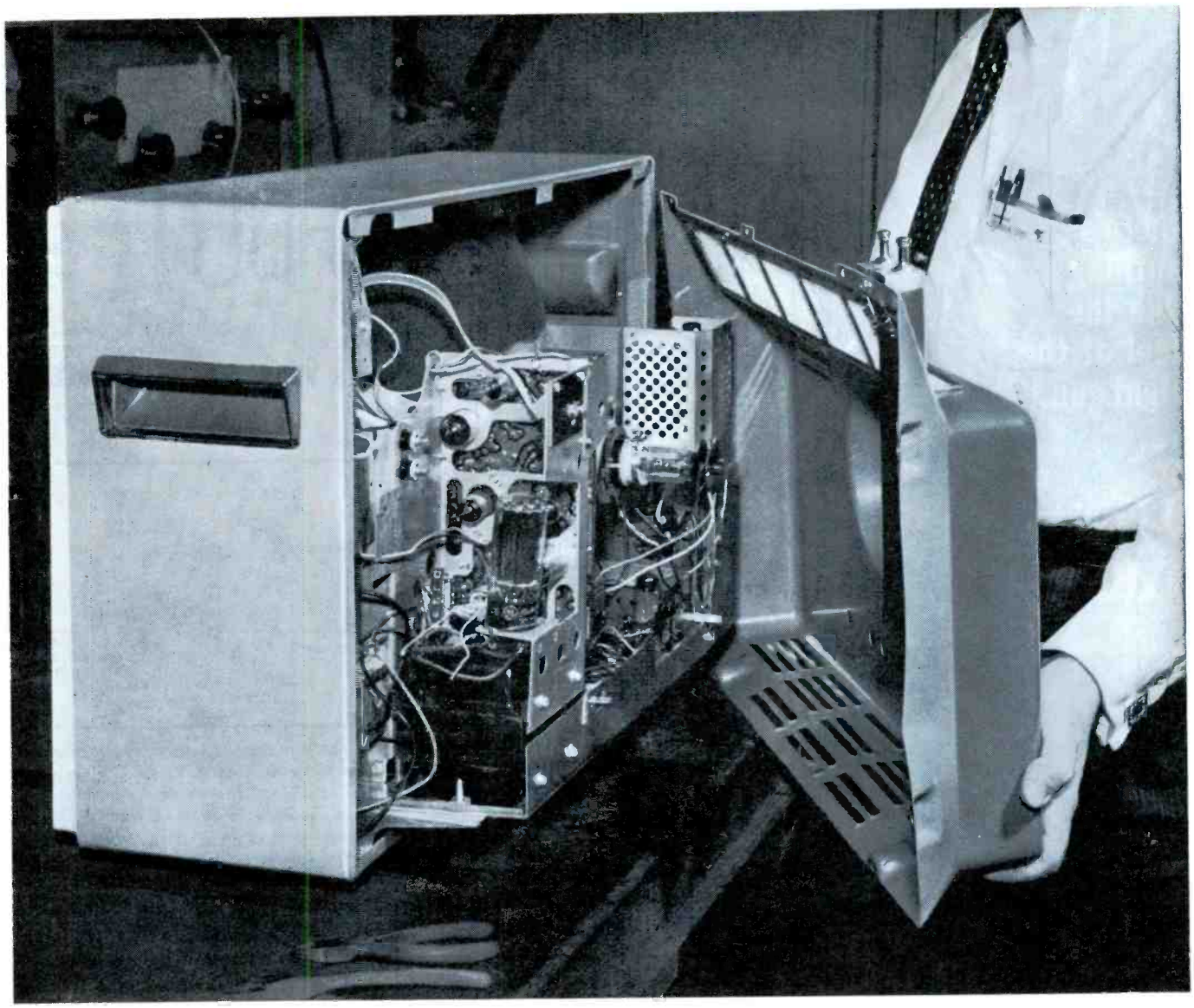
1. Relatively high failure rate of certain types such as RF amplifiers and power output tubes, requiring that larger stocks of these types be kept than a literal reading of the chart would indicate.
2. Specialization in particular makes of sets, such as regionally-popular brands. As a national publication, PF REPORTER necessarily gives nationwide averages based on all brands of receivers.

It's much easier to maintain an up-to-date tube stock when you are well informed about trends toward increased or decreased use of particular tube types. Keep posted on this subject by comparing the current Stock Guide chart with previous editions. The most recent ones were published in the April and October, 1958 issues.

Notes on Using the Chart:

1. Redesigned "A" and "B" versions of tubes can almost always be used in place of their prototypes.
2. All type numbers (or "A" or "B" suffixes) marked with an asterisk are 450-ma series-string tubes.

TUBE TYPES	NO. OF UNITS	TUBE TYPES	NO. OF UNITS	TUBE TYPES	NO. OF UNITS	TUBE TYPES	NO. OF UNITS	TUBE TYPES	NO. OF UNITS
1AX2	—	5CG8	2	6BA8A	2	6CS6	3	*8AW8A	1
1B3GT	39	5CL8	2	6BC5	4	6CS7	1	8CX8	1
1G3GT	3	5CQ8	—	6BC8	2	6CU5	1	10DE7	1
1J3	2	5CZ5	1	6BE6	5	6CU6	2	12AT7	7
1K3	—	5DH8	—	6BF5	—	*6CU8	1	12AU7/-A	25
1V2	1	5EA8/5U8	1	6BG6GA	3	6CX8	1	12AV5GA	1
1X2A/-B	9	5J6	1	6BH8	2	6CY5	1	12AV7	2
2BN4	2	5T8	2	6BK4	—	6CY7	1	12AX4GTA	8
2CY5	2	5U4GB	40	6BK5	2	6CZ5	2	12AX7/	
3A3	1	5U8	5	6BK7A/-B*	6	6DA4	—	ECC83	4
3AL5	1	5V3	1	6BL7GT	5	6DB5	—	12AZ7	1
3AU6	4	5X8	1	6BN4	2	6DC6	—	12B4A	1
3AV6	—	5Y3GT	1	6BN6	7	6DE6	4	12BH7A	10
3BC5	1	6AB4	1	6BN8	1	6DE7	—	12BK5	—
3BN6	3	6AC7	3	6BQ5/EL84	1	6DG6GT	1	12BQ6GTB	1
3BU8	2	6AG5	4	6BQ6GTB	15	6DK6	1	12BR7	—
3BZ6	9	6AG7	1	6BQ7A	14	6DN7	1	12BV7	—
3CB6	11	6AH4GT	2	6BS8	1	6DS5	1	12BY7A	11
3CF6	—	6AH6	4	6BU8	2	6DQ6A	9	12C5/-CU5	2
3CS6	1	6AK5	2	6BW8	—	6DT6	3	12CA5	1
3DK6	1	6AL5	48	6BX7GT	—	6EA8/6U8A*	1	12CU6	1
3DT6	3	6AM8/-A*	4	6BY6	3	6EB8	—	12D4	2
4BC8	1	6AN8/-A*	5	6BY8	1	6EW6	—	12DB5	1
*4BN6	—	6AQ5/-A*	19	6BZ6	11	6J5	2	12DQ6A	6
4BQ7A	2	6AR5	—	6BZ7	3	6J6	17	12DQ7	—
*4BU8	—	6AS5	3	6C4	5	6K6GT	5	12L6GT	3
*4BZ6	1	6AS6	—	6CB5A	—	6S4A	1	12R5	—
*4CB6	—	6AS8	1	6CB6/-A	100	6SL7GT	1	12SN7GTA	3
5AM8	2	6AT6	2	6CD6GA	2	6SN7GTB	51	12W6GT	1
5AN8	1	6AT8/-A*	2	6CF6	3	6SQ7	2	*17AX4GT	—
5AQ5	4	6AU4GTA	6	6CG7	21	6T8	12	*17DQ6A	—
5AS4	1	6AU6/-A	77	6CG8/-A*	2	6U8/-A*	16	19AU4/-A	2
5AT8	1	6AU8	3	6CK4	—	6V3A	2	25AX4GT	1
5AV8	—	6AV5GA	2	6CL6	2	6V6GT/-A*	11	25BK5	—
5AU4	—	6AV6	12	6CL8/-A*	1	6W4GT	14	25BQ6GTB	3
5AW4	—	6AW8A	11	6CM6	1	6W6GT	8	25CD6GB	1
5B8	1	6AX4GTA	15	6CM7	4	6X8	6	25DN6	1
5BK7A	—	6AX5GT	1	6CN7	2	6Y6G	—	25L6GT	3
5BR8	1	6BA6	5	*6CQ8	3	7AU7	3	25W4GT	1



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JOB	G-E "Designer"	Set A	Set B	Set C
Replace most resistors	yes	no	no	no
Replace most capacitors	yes	no	no	no
Replace deflection yoke	yes	no	no	no
Replace video detector	yes	yes	no	no
Replace audio detector	yes	no	no	yes
Replace horizontal phase detector	yes	no	yes	yes
Replace power rectifier	yes	no	no	yes
Adjust tuner oscillator	yes	no	yes	yes
Replace inter-stage transformers	yes	no	no	no
Replace size and linearity controls	yes	no	yes	yes

General Electric Co., Television Receiver Dept., Syracuse, N.Y.

THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

Danger — Tube Out!

I am studying TV repair and have acquired a Bendix Model TS-17C for experimentation. One thing puzzles me about this set: When I remove the sync clipper-vertical oscillator tube (a 6SN7) while the set is on, the 2200-ohm, 2-watt plate load resistor of the vertical output tube overheats and begins to smoke. What causes this condition?

PAULMER L. WILLIAMS
Trout, W. Va.

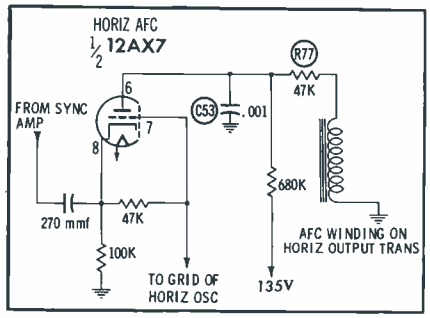
The resistor gets hot because the output tube draws excessive plate current. The reason for this behavior is that the grid of the output tube receives no drive signal when the oscillator is disabled. As a rule, both horizontal and vertical output stages of TV sets depend on the presence of a normal input signal from their respective oscillators in order to maintain sufficient bias for operation at safe plate-current levels. "Loss of drive" usually has more severe consequences in the horizontal section, where it can cause the plate of the output tube to glow red from excessive current; but, as you have discovered, the same condition can also cause trouble in the vertical output stage.

Resistor With a Fever

I recently serviced a Mirrortone Chassis 9034A which had no raster or high voltage. The AFC feedback resistor R77 was burned to a crisp. I replaced it with a 1-watt unit; this restored the raster, but the new R77 runs quite hot. The DC voltage drop across it is 8 volts, and I measure 450 volts AC across the coil to which R77 is connected. B+ voltage on the 135-volt line measures only 115 volts. Even though the receiver has been running OK for more than 100 hours, I wonder if there is still some trouble which might be causing the resistor to run abnormally hot.

A. V. ROUSE
Tonawanda, N. Y.

R77 couples a feedback signal from the flyback transformer to the horizontal AFC stage, and it also works in combination with C53 to reshape the signal into sawtooth form. Under normal conditions, R77 will run relatively hot because considerable pulse voltage is developed across it. You stated that the amplitude



of the signal at the transformer winding was 450 volts p-p. R77 and C53 in series act as a load across this winding; and, since the impedance of C53 at 15,750 cps (in ohms) is equal to only about one-fifth of the ohmic value of R77, about four-fifths of the pulse voltage will appear across the resistor.

A leaky condition in C53 would tend to make R77 run hotter than normal, besides pulling down the voltage on the 135-volt line. Just to be sure that the repair is completed to your satisfaction, you might replace this capacitor.

Record Changer Shutoff

With the rising interest in stereo, I have been called on to convert several hi-fi installations to stereophonic operation. This sometimes calls for a new four-pole motor to reduce hum pickup in the magnetic stereo cartridge which I prefer to use. As a result of these modifications, a problem has cropped up. The automatic shutoff at the completion of a stack of records makes a loud snap in the speakers, and this is a source of great annoyance to my customers.

This problem may be shared by other servicemen doing stereo conversion work. Has anyone come up with a squelching circuit to eliminate this switch snap?

FRED A. SIEBOLD
Portland, Ore.

You are probably aware that the "pop" in the speakers is due to a transient pulse voltage of high peak amplitude which is produced when the contacts of the automatic shutoff switch are opened. This pulse interference reaches the audio amplifier by way of the power-supply circuits. One simple way to reduce or eliminate the snapping noise is to connect a .01-mfd, 1-kv capacitor across the con-

tacts of the shutoff switch in order to suppress the transients. This sort of arrangement is used in several commercial phonographs, and capacitors are sometimes connected across TV components such as damper tubes and silicon rectifiers for a similar purpose.

A high - voltage ceramic capacitor should be well suited for this application. Wire it directly to the switch terminals if possible; in any event, try to place it as close to the switch as you can.

Vertical Foldover

A white bar appears at the bottom of the raster on an Admiral Chassis 21F1 when the height control is adjusted to fill the screen. I was able to remove it by changing the vertical oscillator and output tubes, but it returned after about a month. I have been informed that several servicemen have worked on this set for the same trouble.

L. J. KELLER

Chicago, Ill.

The white bar indicates you have vertical foldover, a condition appearing when the vertical output tube is driven into saturation on positive peaks of the vertical sweep signal. This symptom could be caused by driving the output stage too hard or operating it with insufficient bias.

In a great many cases, the 100-mfd cathode bypass capacitor is the source of the trouble. If this unit loses capacitance, the gain of the stage is reduced. This makes it impossible to obtain normal raster height unless the input signal at the grid is made strong enough to cause foldover.

You may find that the grid voltage is not as negative as it should be; if so, the coupling capacitor between the oscillator and output stages may be leaky.

Another conceivable cause of your trouble is abnormally low plate voltage, which could be due to a faulty plate-load circuit.

Persistent Burnout

What causes the 12BY7A video amplifier tube in a Westinghouse Chassis V-2342-24 to develop an open filament? I've replaced three of these tubes (besides the original one) in less than three years, the latest one lasting only five weeks.

BEN DIGENNARO

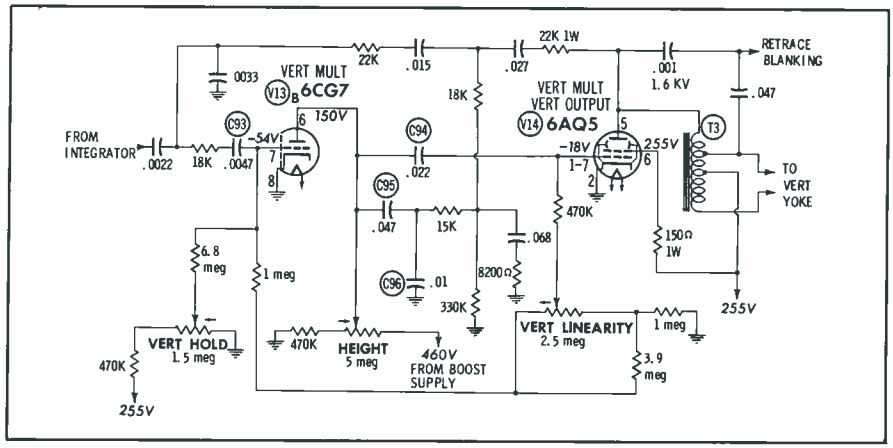
Willow Grove, Pa.

We have a Westinghouse TV Model H-950T24, Chassis V-2343, which repeatedly burns out 12BY7 tubes. We're unable to find the trouble.

WARREN L. GLENN

Burley, Idaho

We're receiving an unusually large number of reports from the field about this particular trouble. A Westinghouse field service technician informs us that the 12BY7A tube socket in the above-named chassis tends to develop leakage between the heater pins and ground as the receiver ages. Because of the series-string hookup used in these chassis, this leakage places enough voltage across the heater of the 12BY7A to burn it out. Replacement of the socket is reported to be the only effective cure.



Vertical Circuit Short Story

Although I know the vertical sweep circuit of the RCA Chassis KCS96 is a form of multivibrator, I don't quite understand its operation. Can you explain which components make up the frequency-determining time-constant network, why B+ goes to the grid of the oscillator, and how the linearity components fit into the picture?

CONDE L. BENOIST

Dickinson, Texas

The KCS96 chassis uses the same basic type of vertical circuit found in most of today's sets — a plate-coupled multivibrator whose second section serves also as an output stage. Unlike earlier forms of multivibrators, this circuit is set up so that the second section (V14) conducts during trace time and the first section (V13B) during retrace.

In many circuits of this type, the output stage has a cathode bias network which includes a linearity control, and the grid is self-biased by a simple RC arrangement. However, the KCS96 circuit employs grounded-cathode operation for V14, with a linearity network connected to the grid. Sufficient operating bias is maintained by feeding a negative voltage to the grid of V14 from the grid circuit of V13B. The actual source of this voltage is a charge maintained on C93 by grid-leak action. (Grid current periodically charges this capacitor on positive peaks of the grid signal, and the charge leaks off very gradually through the network of grid resistors.) A resistive voltage divider, connected between this negative source and ground, includes a linearity control which allows selection of the proper bias for V14 in order to produce a linear yoke-current waveform.

As you have noted, the hold control is part of another voltage divider connected across the B+ power supply. A variable positive voltage, picked off at the arm of the control, neutralizes some of the grid-leak bias on V13B and thus determines the operating point for both tubes. Effectively, this control accomplishes the same thing as the more common type of hold control which merely varies the RC time constant of the grid circuit.

C93 and its associated components determine the exact instant V13B comes out of cutoff to begin each retrace interval, but numerous other components have an influence on the natural frequency of the oscillator. To understand their importance, consider the part played by the output stage in maintaining oscillation. The plate current of V14 increases throughout trace time, and thus the plate voltage steadily decreases. As a result, a negative feedback voltage is applied to the grid of V13B through the components shown along the top edge of the schematic. This feedback keeps V13B cut off. Sooner or later, however, plate current reaches a point where T3 becomes saturated; then the feedback voltage dwindles away and allows V13B to begin conducting.

The component network between the two halves of the multivibrator is mainly concerned with shaping the drive waveform for normal raster height and linearity; but, since these components will

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(Similar types available with Peak Inverse Voltages ranging from 50 up to 500)

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Continuous D. C. Reverse Working Voltage	400 Volts
Average D. C. Output Current	500 mAdc
Peak Recurrent Forward Current	5 Amps.
½ Cycle Surge Current	30 Amps.
Full Load Voltage Drop @ 25°C	1.1 Volts
RMS Input Voltage	130 Volts
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affect the time it takes for plate current to reach saturation, they will have some bearing on oscillator frequency. Be especially wary of defects in C94, C95 and C96. In addition, a breakdown in the transformer or feedback network can also throw the oscillator off frequency.

Vertizontal Hold

The picture on a Silvertone Model 5160 rolls vertically whenever it is locked into horizontal sync. The rolling can be stopped by counterclockwise rotation of the horizontal hold knob, but then the horizontal sync is lost!

Realignment of the pulse-width AFC and oscillator circuit improved the horizontal stability but did not affect the vertical trouble. Replacement of sync and video tubes made only a slight improvement. Voltages and waveforms in the sync and sweep circuits all seem to be within tolerance, except that the vertical sync pulses are lacking from the input and output waveforms of the sync amplifier at times when the picture is in horizontal sync.

LEE A. HUTCHINS
Cape Porpoise, Maine

At first thought, it might seem logical to blame this trouble on the coupling circuit between the sync amplifier and the horizontal AFC stage; but experience with similar cases leads me to suspect that the horizontal hold control may be affecting vertical sync by a more roundabout route.

For instance, we might start by assuming that a lack of AGC voltage is the cause of the vertical trouble. Considering that this receiver has a keyed AGC system, we can reconstruct a logical series of events to explain the whole situation.

As you know, the AGC tube will produce a normal output only when the keying pulses applied to the plate coincide in time with the horizontal sync pulses arriving at the grid. If the plate pulses were either speeded up or delayed for any reason, the keying tube would conduct less heavily than normal, and the AGC output voltage would be reduced. This would tend to cause overloading of some IF or video stage, which is a common cause of compression or clipping of the vertical sync pulses.

The most probable reason for incorrect timing of the AGC pulses would be a shift in the phase of the horizontal sync signal at some point between the horizontal oscillator and the flyback transformer. You can compensate for this phase shift by slightly adjusting the horizontal oscillator, but then you lose horizontal sync!

To test this theory, you might try checking the DC voltage on the AGC line. If it changes in a negative direction when you adjust the horizontal oscillator for good vertical sync (!) the keying tube is likely to be receiving improperly-timed pulses for the reason described.

You might expect the horizontal AFC circuit to be capable of compensating for any phase shift in the sweep signal. However, the pulse-width AFC circuit in this

receiver gets most of its feedback from the input side of the horizontal output tube rather than from the flyback circuit itself; therefore, some phase shifting could be taking place in the output stage without affecting the AFC. A gassy output tube has been known to produce symptoms similar to those you have described.

Shades of 15,750!

Picture contrast on a Philco Model 53T1827 is normal along the right edge of the screen, but becomes progressively lighter toward the left and washes out almost completely at the extreme left edge.

Tubes have all been checked and several bad ones replaced.

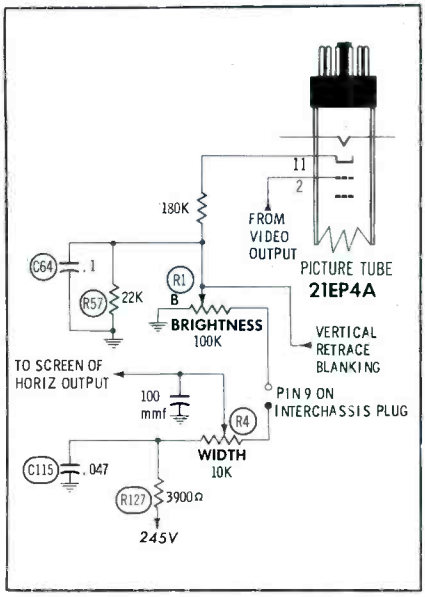
ERWIN WHITE

Clare, Mich.

A spurious 15,750-cps sawtooth signal is evidently modulating the electron beam of the picture tube. It is probably being fed into the CRT cathode circuit from the screen grid of the horizontal output tube through the series-connected brightness and width controls (see schematic). The purpose of this unusual hookup is to counteract the raster's tendency to decrease in width when the brightness is turned up.

Higher brightness is obtained by moving the arm of R1B closer to ground. As a result of this action, a smaller proportion of R1B is shunted by R57; thus, the total resistance between the top of R1B and ground becomes greater. This change in resistance produces an increase in the voltage drop across R1B, with a consequent increase in the positive voltage at the arm of R4. A higher screen voltage is then applied to the horizontal output tube, and raster width increases.

Since the screen grid is bypassed by only 100 mmf, proper filtering of the voltage in the width-and-brightness circuit depends mostly upon the condition of C64 and C115. One of these capacitors—especially C64—could well be the root of your trouble.



Across the Bench (Continued from page 22)

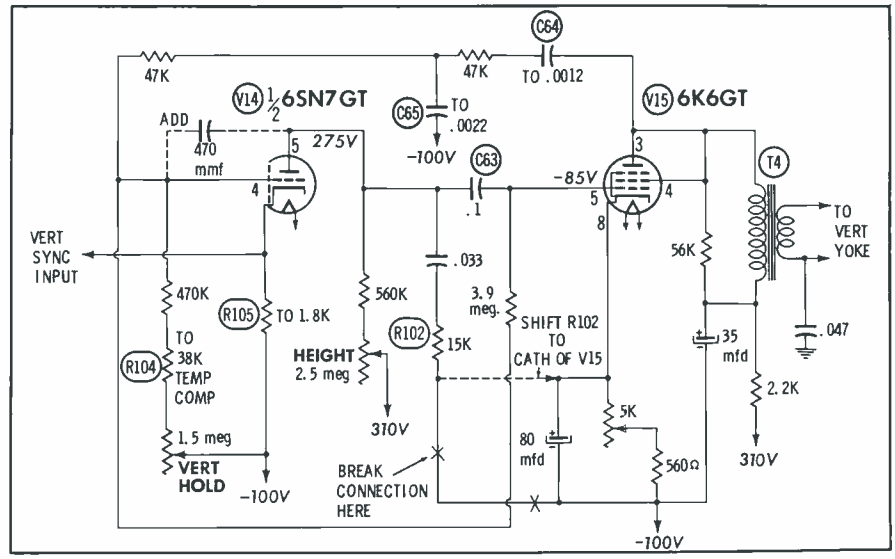


Fig. 5. Schematic of the vertical oscillator and output circuits showing the various changes that should be made to improve operation of the vertical circuit.

were oddly shaped. A capacitance checker showed C63 to be leaky.

Circuit Improvements

If you're really conscientious, like to have steady customers, and want that extra buck, here's the *pièce de resistance*! Bring this vertical circuit up to date by including all the changes made in the final production run. Add a 470-mmf mica capacitor between the plate and grid (pins 4 and 5) of vertical multivibrator V14, change the value of C65 from .0047 to .0022, change R105 from 2.7K to 1.8K, disconnect the end of R102 (15K) from the -100V line and connect it to the cathode (pin 6) of the vertical multivibrator, change C64 in the plate circuit of V15 to .0012 mfd, 1,000V, and make sure that R104 is a 38K temperature-compensating resistor. These changes will produce both better vertical interlace and more stable vertical sync lock. The new

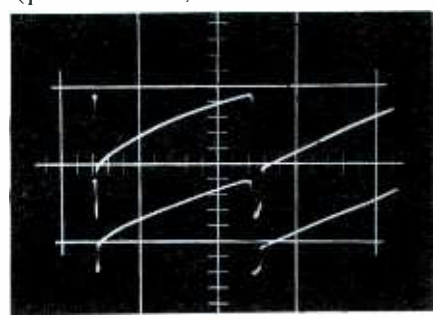


Fig. 6. Spacing of waveforms on either side of C63 indicate leakage in C63.

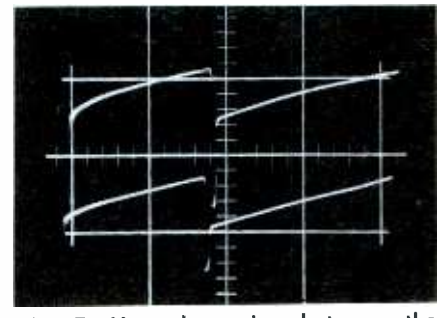


Fig. 7. Normal spacing between the waveforms when C63 has no leakage.

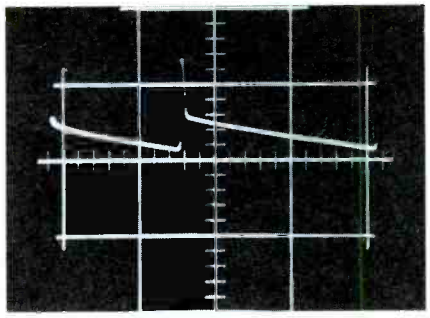


Fig. 8. Vertical-output plate signal should be 1200 volts peak-to-peak.

waveforms—DC amplifier and all—will appear on either side of the new C63 as in Fig. 7. The plate waveform of the vertical-output tube should have an amplitude of 1,200 volts as shown in Fig. 8.

If you aren't weary by this time, here's a bit more you might do. On receivers with the pentode RF stage (production run 2), the following changes will improve its over-all performance:

To cancel background "hiss", remove C50, C52, and R48 (Fig. 9) in the plate circuit of the AF amplifier and AGC clamper V9. Replace with a .0047 mfd (tied to the plate) in series with an 18K, ½-watt resistor to ground. C51 is still the coupling capacitor to the audio output and remains in the circuit. Change capacitor C53 from .0022 mfd to .01 mfd.

To remove IF harmonic feedback in the video detector, add a 2.7-uh choke between the secondary of L13 and the –100V supply (see Fig. 10). Disconnect C39 from ground and reconnect it to the junction of the new choke and the secondary of L13. Completely remove C40 from the circuit.

Should your customer be fortunate enough to have a receiver with a cascode 6BQ7 RF amplifier (production run 4 or 5), you might check the following changes to be sure it's completely up to date:

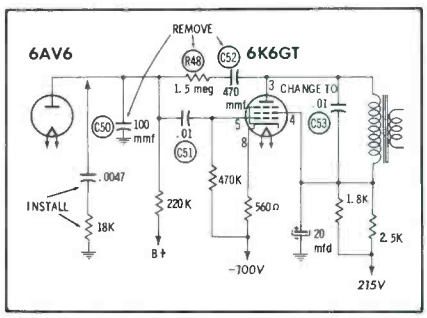


Fig. 9. Schematic of audio circuit showing changes to remove background hiss.

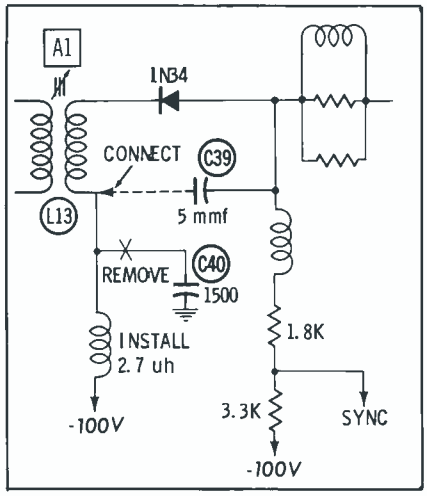


Fig. 10. Video-detector circuit showing changes to prevent harmonic feedback.

To remove bends (flagwaving) at top of pix, connect a 10K, ½-watt resistor in series with a .22-mfd capacitor between the junction of C70 and C71 in the cathode circuit of the horizontal-sync discriminator and ground (see Fig. 11).

To improve sync stability, a 47K, ½-watt resistor is now connected between the screen grid (pin 6) of V11, the 1st sync amplifier, and the 115V line as shown in Fig. 12. Also connect a 10-mfd, 450-WVDC electrolytic capacitor (+ terminal) to the screen of V11 and (— terminal) to the –100V line. Resistors R54 and R55 should be changed from 100K to 47K each. Also, change R66 and R67 in the plate circuit of the 2nd sync amplifier to 100K, 1-watt units.

In the AGC circuit (Fig. 13), C56 should be changed to .047 mfd and R58 to 470K. Also, in the cathode network of the AGC amplifier, R65 is changed to 8.2K, R63 and R64 are deleted, and R61 and R62 are changed to 220K, 1 watt.

What does a job like this cost? All right, here are the figures: It

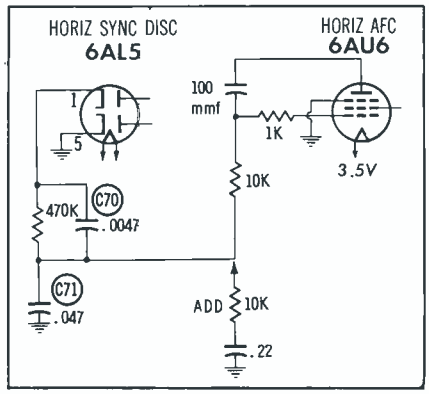


Fig. 11. Horizontal-AFC circuit showing changes to prevent bend in picture.

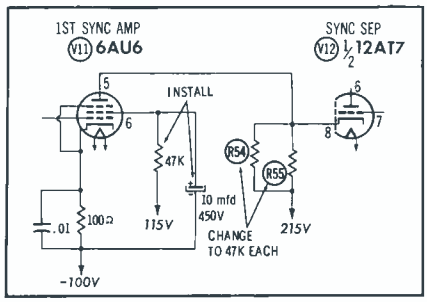


Fig. 12. Schematic showing sync-circuit changes to improve picture stability.

took approximately 10 hours of labor, a new 17BP4-B aluminized picture tube, 28 capacitors (8 of which were OK and within tolerance, 14 leaky, and 6 out of tolerance), 8 resistors (only 4 were actually defective), 6 receiving tubes, and one set of tuner strips. Cash money (net), about $45. Results? One of the prettiest pictures in television!

More on the RCA KCS47

Beginning with the 8TV321 RCA manufactured in 1947, the pulse-width AFC system survived almost unchanged through the KCS60A originated in 1950. With only slight modifications in the value of some components and a revamping of the horizontal-output stage, it is still a very popular circuit.

An oscilloscope with a low-capacitance probe is an absolute must for troubleshooting this sort of circuit. In fact, I also recommend using a 10 to 1 low-capacitance probe when investigating video amplifier, AGC, or sync circuits. It adds to the scope's input impedance, is welcome isolation between receiver and test instrument, and permits almost unlimited use of the scope's DC amplifiers.

Pulse-Width Horizontal Sync System

This system was developed so

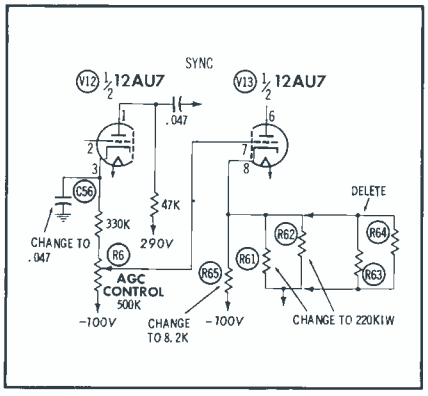


Fig. 13. Schematic showing the changes necessary to update the AGC circuit.

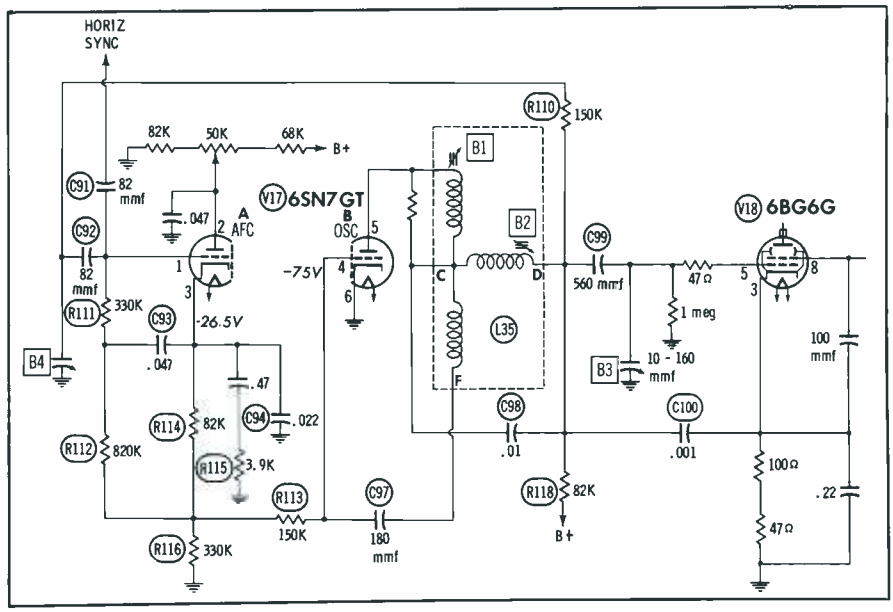


Fig. 14. Schematic of the pulse-width AFC and blocking-oscillator circuits.

that a single 6SN7 (now 6CG7) might develop a corrective voltage from comparison of the sync and horizontal - oscillator frequencies, and also act as the oscillator itself. The windings of L35 (Fig. 14) constitute a blocking-oscillator transformer. It operates in conjunction with the B section of V17 which, in its free-running state, oscillates at approximately 15,750 cps.

A sawtooth signal from the oscillator is fed back to the control grid of horizontal - AFC tube V17A through R110 and C92. Simultaneously, horizontal sync pulses are applied to the grid of the AFC stage through 82-mmf capacitor C91. Horizontal lock-in capacitor B4 is adjusted so that the peak of the sawtooth voltage is just below the cutoff point of V17A. Neither sawtooth nor sync-pulse signal alone is strong enough to cause the tube to conduct. However, when both reach their positive peaks simultaneously, V17A conducts and a proportionate amount of voltage is developed across cathode-load resistors R114 and R116.

In order to understand how AFC action occurs, you must first know the factors which influence oscillator frequency. Using the simplest possible explanation, let's say that oscillator frequency is determined by the time it takes the charge on C97 (accumulated through grid conduction of the oscillator tube) to leak off through R113 and R116. Further, if the voltage on C97 is increased or decreased, its discharge time will increase or decrease proportionately.

The AFC and oscillator circuits are designed so that the oscillator will operate at the correct frequency when horizontal sync and feedback signals at the grid of the AFC tube coincide, as shown at the top of Fig. 15. If, however, the frequency of the oscillator tends to be lower

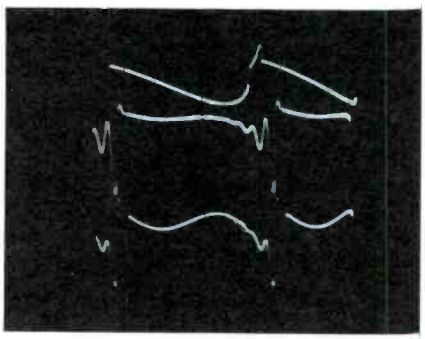


Fig. 15. Simultaneous display of signals in horizontal-AFC and oscillator stages.

than that of the incoming sync pulses, more of each sync pulse will ride high on the sawtooth, causing the AFC tube to conduct for a longer period. This increases the charge across C94 and C95 and the voltage across R116. In turn, the bias on the oscillator is decreased, so it begins conducting a little earlier. Oscillator frequency is thus increased. If, on the other hand, the oscillator is running too fast, most of the sync pulse rides down the steeper slope of the sawtooth, thus reducing the period of AFC tube conduction. This reduces the voltage across R116 and increases the bias on the oscillator. Oscillator frequency decreases because C97 will have to discharge to a lower level before a new cycle can start.

Capacitors C94 and C95, along with resistor R115, filter the AFC tube's current pulses, providing a DC control voltage proportional to conduction time. C95, along with R115, also has another duty, that of providing an "anti-hunt" circuit to prevent overcontrol of the oscillator. Incidentally, if C95 or R115 fails, you'll notice a "flagwaving" at the top of the picture. Should the grid-to-cathode capacitor C93 short, you'll have a narrow picture and lose horizontal sync. The values of all resistors in the AFC circuit are quite critical; they should be disconnected

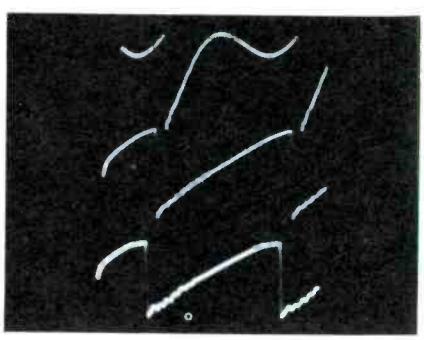


Fig. 16. Key waveforms at oscillator transformer and output control grid.

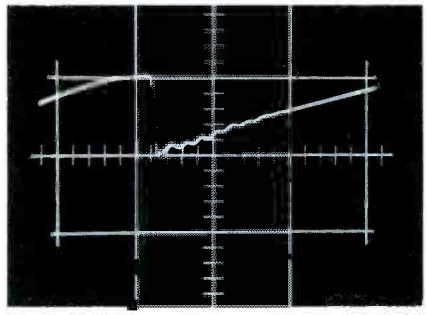


Fig. 17. Expanded waveform at grid of horizontal-output tube shows transients.

from the circuit during value checks.

Horizontal Oscillator

Each time the oscillator tube conducts, the oscillator transformer is pulsed. The familiar sine-wave portion of the waveform (Fig. 16A) is generated at point C of L35 by the resonant circuit comprised of coil section C-D and C98. The required sawtooth signal (Fig. 16B), is developed at terminal D of L35 because of the charge and discharge of C100. Feedback to sustain oscillation is furnished by coil section C-F and is coupled through C97 to the oscillator grid. Oscillator frequency is affected primarily by the values of C97, R113, R116, C98, C99, C100, and R118. Leakage in C98 is often the cause of instability; C97 is the usual culprit when the oscillator goes wild (Christmas-tree effect). Proper circuit operation can be obtained only if B1, B2, B3, and B4 are properly adjusted.

Horizontal System Transients

Now, let's discuss the waveform at the grid of the horizontal-output tube (Fig. 17). Frankly, this is about the worst drive signal I've ever seen; but, believe it or not, there are no bad components in the circuit. It's simply that this receiver has developed more oscillatory transients than usual. Look at the waveform in Fig. 18 and you'll have much of the answer before you. This

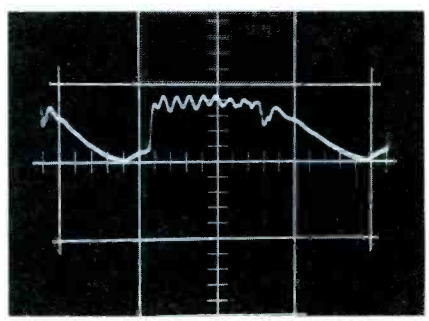


Fig. 18. Transients in the signal at screen grid of horizontal-output tube.

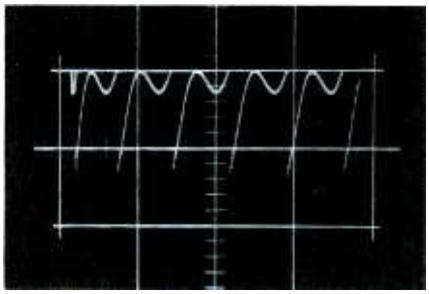


Fig. 19. Setting of the hold control must not affect waveform at terminal C.

is the screen waveform of the horizontal output tube. Varying the width control changes its amplitude almost 100 volts.

Take comfort, however, in several convenient conditions. Of the 63-microsecond trace and retrace period, 10 microseconds are utilized for blanking the return trace. This, coupled with the fact that 5 to 10% overscan is usually employed, results in most of the transients not being seen because they occur during blanking, or when the beam is past visible portions of the screen. In addition, the output tube doesn't begin significant conduction until approximately half way up the positive portion of the rising sawtooth waveform.

What To Do

In a situation like this, where there are no defective components, you can reduce the condition by carefully selecting a new horizontal-output tube, and by carefully adjusting the width and drive controls. But whatever you do, don't forget that for proper alignment of the horizontal - oscillator transformer, the waveform at junction C *must* look like Fig. 19, and must not change even when the horizontal-hold control is varied across its entire range. Only then will you have successfully repaired the horizontal oscillator of these pulse-width television receivers! ▲

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Audio Facts

(Continued from page 26)

As signal frequency increases, the reactance of C decreases, giving a smaller total impedance and hence lower output voltage.

If either component opens, signal amplitude increases, giving too much treble and excessive scratch noise. If C shorts, the entire signal will be greatly reduced in amplitude.

For variable - reluctance cartridges, the inductance of the cartridge and the loading resistor provide roll-off as shown in Fig. 1C; bass boost is provided elsewhere. As frequency increases, inductive reactance increases, leaving less signal across R, thus providing proper roll-off. A load resistor which is open or increased in value would cause excessive treble and surface noise. It is imperative that the load resistor have the correct value for the cartridge being used.

Frequency response troubles often originate in the equalizer, in which case switch contacts are the most likely suspects. These should be checked if the fault is traced to the equalizer. Poor switch contacts and cold solder joints comprise virtually all equalizer troubles.

The Preamplifier Unit

The preamp unit is not too different from other audio amplifiers. It uses single-ended amplifier circuits, RC coupling, and in some cases feedback and cathode followers. However, preamps do have circuitry not found in other audio equipment; i.e., switching circuits, equalizers, and tone controls. In addition, they are designed to handle extremely low-level signals. We will concentrate on these in our tests and measurements.

Fig. 2 is the complete schematic of a typical hi-fi preamp. Five separate inputs are available through selector switch SW1. Three of these are for signals greater than 0.1 volt, and can be used for tuner, tape recorder, TV, etc. The other two are for magnetic phono cartridge and microphone, which have smaller signal levels. Each input has its own 500K level control.

Low-level input signals are first amplified by stages V1A and V1B, then by the other four stages. High-level signals bypass the first two stages. The output signal is taken from the cathode-follower stage V2B, providing a low-impedance output and allowing the use of almost any length of connecting lead. B+ and heater voltages are obtained from the power amplifier chassis. In addition to bass, treble, and volume, front-panel controls include input selector switch SW1, SW2 for selecting the turnover frequency, and SW3 for roll-off.

Should preliminary tests indicate trouble in the preamp, it can be localized by the methods described in previous installments of this series. If the trouble exists for all inputs, one of the last stages in the preamp must be at fault. Trouble for phono input, however, does not necessarily mean that the phono is at fault, because stages V1A, V1B, or the equalizing circuits could be defective.

It is important to remember that in the low-level stages of a preamp, even a trivial fault can be serious. Shielding, lead dress, component replacement, and soldering are just as

critical as in TV tuners.

Because signal level is so low, even small amounts of hum or noise are objectionable. Suppose, for example, that 1 millivolt of hum were introduced at the preamp input. If the input signal is 10 millivolts, hum is down only 20 db. This same amount of hum or noise introduced in a later stage would not be nearly as objectionable. If signal level were 10 volts, the difference between it and 1 millivolt would be 80 db. For proper results, signal and hum levels should be at least 60 to 70 db apart.

Switching

Switching troubles in preamps are not uncommon, especially when the switches are handled roughly. The major troubles encountered are open and dirty contacts. A certain amount of signal tracing is usually required to find the trouble.

In Fig. 2, the input selector switch SW1 is shown in the No. 1 position, connecting the top high-level input (as seen in the diagram) to the input of V2A through the top portion of the switch. The middle section of SW1 grounds the unused inputs. The bottom section is used only to apply phono or microphone signals to the first low-level stage V1A.

Usually, several input devices (phono, tuner, microphone, etc.) are connected to the various input jacks. When operating the system on phono, an extra signal coming through is due to an ungrounded contact on the middle section of SW1. When signal is not getting to the amplifier stages at all, check the signal path through SW1 with an ohmmeter. Open contacts can usually be remedied by bending the stationary sections so that normal contact again occurs. Noisy switching is caused by dirty contacts, which can be cleaned with carbontet or other suitable contact cleaner. Hum and noise can be caused by open or partly open contacts; for locating the guilty ones, the schematic diagram is a most valuable aid.

Frequency Response

Frequency response limits are largely determined by the preamp. If the customer complains of low-end or high-end distortion, be sure to check the preamp first. As a first step, make sure the customer is using the controls properly. Misadjusted tone and/or equalizer controls could be responsible for all the trouble.

In measuring response of preamplifier circuits, it's wise to apply the audio signal to the phono or microphone jack to check all stages at once. Naturally, tone controls and equalizers should all be set to *flat*. The simplest way to measure response (described in a previous article) is to vary the input frequency over the audio range and check the output voltage across the range. A more accurate method of checking frequency response is shown in Fig. 3. Here, the same VTVM is used to measure both input and output signal voltages, thereby reducing errors due to meter inaccuracy.

The calibrated attenuator is a variable resistance which can be adjusted to provide a wide range of attenuation. It is designed so that, at any setting, the input and output re-

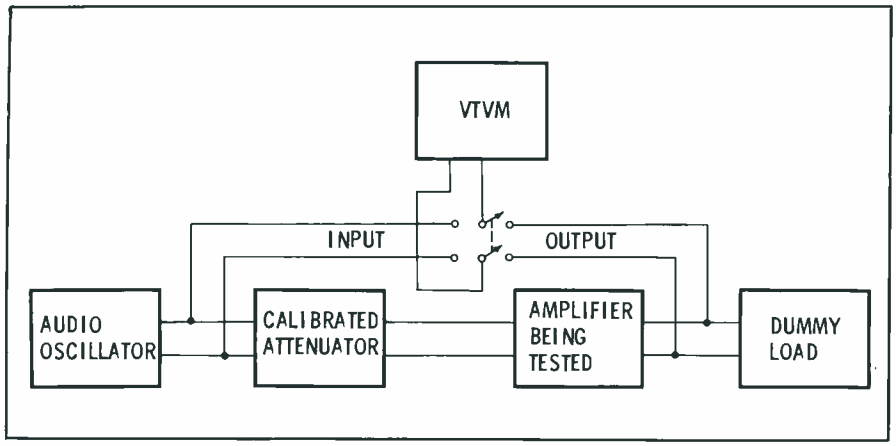


Fig. 3. Setup for testing frequency response employs a calibrated attenuator.

sistances of the unit are the same. One such unit gives attenuation from 0.1 to 100 db. The amount of attenuation is easily read from the front-panel control.

To measure frequency response, adjust the oscillator output to a predetermined voltage level as indicated on the VTVM (about two-thirds the maximum voltage output of the amplifier). Then, insert maximum attenuation, switch the meter to measure output, and adjust the attenuator so that the meter reads the same as the input. Gain of the amplifier is then equal to the loss offered by the attenuator. To make the test more accurate, it is wise to take readings at several different signal levels, and to observe the output on a scope. Good frequency response is not of much value if the output signal is distorted.

Testing Tone Controls

Separate bass and treble controls (both one megohm pots) are located between stages V3A and V3B. In testing these controls, a frequency response curve can be plotted. Applying an input signal to one of the high-level input jacks, the tone controls are adjusted until gain is the same at three different frequencies —50, 1,000 and 12,000 cycles can be used for most amplifiers. Equal gain at these frequencies corresponds to flat response — zero boost and zero droop in both bass and treble circuits. Without changing the bass control setting, response at the high end can be checked with the treble control at maximum, then at minimum. Returning the treble control to the previously determined *flat* position, response curves can be observed with the bass at maximum, then at minimum. By converting the voltage changes to decibels, the differences can be compared with published values. In this preamp, the bass control should have a total deviation of about 30 db (± 15 db), the treble control about 32 db (± 16 db). If interaction between controls is suspected, curves can be run with both controls at maximum, then with both at minimum. These can then be compared to the curves run previously.

Locating troubles in these circuits is easier when you understood the purpose of the components. The

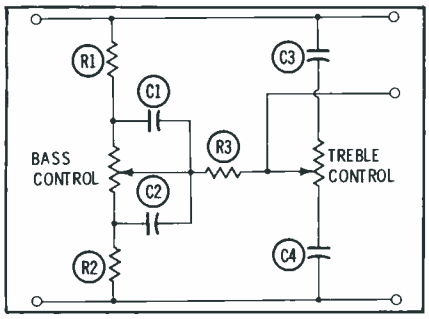


Fig. 4. Tone control circuit provides bass and treble boost and attenuation.

tone control circuit shown in Fig. 4 is very often used. R1 and R2 limit the range of the bass control, C1 controls bass cut, C2 bass boost. R3 provides isolation and prevents interaction between bass and treble controls. C3 controls treble boost, C4 treble cut. Troubles can usually be traced to one of these four capacitors, or to dirty controls.

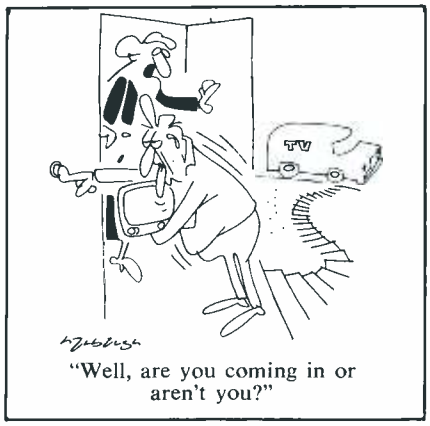
Suppose, for example, that there is no boost, and over-all gain is increased. It is likely that C3 is shorted, or else quite leaky. However, if gain was not changed appreciably, then C4 would probably be open. Similar troubles could occur for the bass-circuit capacitors.

Signal Tracing

That the audio generator can be very useful in signal tracing is illustrated by this typical service case. The complaint is "excessive distortion" at any volume level for any input source. This places the trouble in the sections handling all signals and rules out stages V1A and V1B. Tube replacement does not remedy the trouble, and measurement of the high B+ (at B1 in Fig. 2) shows it to be close to the published value of 180 volts, so other tests must be made. The signal generator is set to 1,000 cps, and about one volt of signal is applied to a high-level input. Touching the oscilloscope lead to the grid terminal (pin 7) of stage V2A reveals that a sine wave exists at that point, as well as at pin 8 of the same stage. However, at the grid of V3A (pin 7), a slight flattening of the positive portion of the signal is noticed. A check at the plate of the same stage shows the negative alternation clipped. Evidently the distortion is being introduced between the cathode of V1A and the grid of V3A.

Voltage measurement shows +8 volts at pin 7, whereas +2 volts is normal. This points to a leaky coupling capacitor between pins 8 of V2A and pin 7 of V3A; its replacement cures the trouble. In signal tracing this amplifier, notice that the cathodes of V2A and V2B are signal elements, while the plates of these stages are not.

This same test can be used to locate hum, noise, or the point at which the signal is lost entirely. The use of systematic servicing procedures, along with intelligent application of test equipment, should eliminate most of the problems in preamp servicing. ▲



"Well, are you coming in or aren't you?"

Bench Servicing

(Continued from page 29

snagged or pinched during installation. Runners on both sides (Fig. 3) normally serve to protect the under-chassis components from being struck or scraped by the rear sill of the cabinet while the chassis is being removed or replaced.

Electrically, the most important lead-dress problem concerns the CRT cathode lead. This long wire, which conveys a signal from a conventional high-impedance video output circuit to the base of the picture tube, is carefully routed to avoid spurious signal pickup from the yoke leads and other sources. When the chassis is returned to the cabinet after a service job, all slack in this lead should be gathered up and tucked under the retaining clip on the right wall of the cabinet.

Picture-Tube Replacement

One man can safely replace the CRT without separating the support assembly from the cabinet. The first step in taking apart the picture-tube housing is the removal of a small ornamental plate just under the tube face. (Incidentally, the entire housing is designed to pivot on its base so that the picture tube can be rotated up to 45° in either direction from the straight-ahead position.) When the trim has been removed, you can pry off the strip of metallized plastic that encircles the rim of the housing. This is held in place by a tension spring at the bottom—like a dial cord spring, but larger and stronger. Your best bet is to pry the plastic strip outward and slip it off to one side, as in Fig. 5. Start near the bottom and work all the way around. The whole process is something like removing an automobile tire from a wheel.

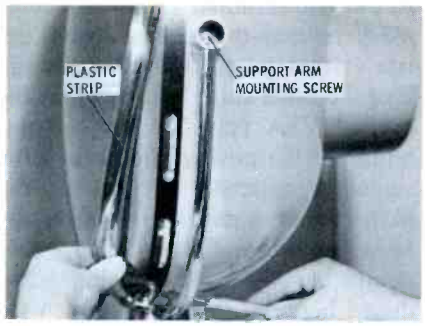


Fig. 5. To disassemble CRT housing, pry off plastic strip around its rim.

Underneath the plastic is a metal band which grips a series of cleats on the two halves of the housing, thus fastening them together. Release the band by taking out two screws at the base; then lift off the front of the housing. To free the rear section, remove the ornamental support arm from each side as follows: Take out the screw indicated in Fig. 5, give the arm a quarter turn downward, and pull it loose. (These arms are mainly "appearance items" and seem to furnish only a minor amount of bracing.) As a final touch, remove two small screws along the bottom inside border of the housing —and there's your picture tube, like a hickory nut fresh out of the shell.

The tube is fastened to the swivel base by metal straps. Unfasten these at the sides, peel them off, and take away the tube. You'll find a small supporting cradle underneath it. This is equipped with two sturdy projecting tabs that will help you to hold the replacement tube steady while you retighten the mounting straps. To put the housing back together, follow the disassembly procedure in reverse order. ▲

Air Conditioning

(Continued from page 31)

ditioner load is more than 7½ amps, it is not wise—in fact, usually not permitted—to have any other outlet on the same branch circuit.

A most significant current characteristic of the induction motor is that the initial current surge is four to six times the steady or running current requirement. The line fuse used to protect the air-conditioner must, therefore, have similar delay characteristics, such as the thermal-delay type (*Fusetron* or equal).

Servicing

It is a simple matter to check the current relay. An open coil, for example, would give no indication of continuity when checked with an ohmmeter. The relay contacts are normally open, but close when the coil is energized. A jumper placed *momentarily* across the relay contacts will energize the start circuit. If the compressor starts, the relay is defective. When checking the relay off the unit, orient it as originally mounted to permit gravity to act on the plunger. It is wise to replace the start capacitor when changing the relay.

If the supply voltage is proper (within ± 10% of rating); if the selector switch, the overload, and the relay are satisfactory; if the thermostat calls for cooling and if there are no breaks in the wiring, then the compressor motor should operate. If it doesn't, either the main (also called the run) winding or the start winding may be defective. Check continuity of the windings by connecting an ohmmeter across the compressor terminals. The resistance values are low—on the order of 2 ohms for the run winding, 10 ohms for the start winding. An open or shorted start capacitor will prevent motor operation because the out-of-phase starting current is not developed. An ohmmeter test will usually provide a pretty fair indication of the capacitor's condition; direct substitution should be tried if there is any doubt.

Another defect that would keep the motor from operating is a short between the compressor shell and either winding. There must be no indication of continuity between any compressor terminal and the compressor shell. Be sure to unplug the power cord when testing for this condition.

Another possibility, although infrequent, is a stuck compressor, which in turn prevents the rotor from turning over. Such a compressor must be removed—an operation which cannot be performed in the customer's home.

The test harness shown in Fig 4 can be used to make a straightforward test for compressor operation. In putting it to use, disconnect all wires from the compressor terminals, apply *main* and *common* connections, and then—only momentarily (one or two seconds)—apply the *start* lead. Use a start capacitor having the exact value required for the motor under test. If the compressor motor is satisfactory, the power applied to the main winding will be sufficient to keep the compressor operating. We will see in the next article that the compressor may operate and yet be ineffective.

Circuit Variations

The use of the three-terminal

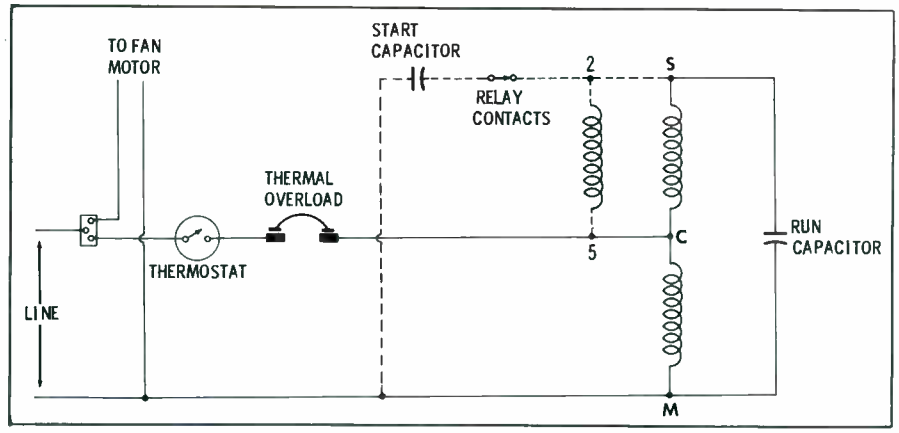


Fig. 6. Permanent split-capacitor motor does not need special start circuit.

thermal overload and a potential relay are shown in Fig. 5. Operation is as follows: The overload uses the disc contacts to protect the motor as described above. In addition, to afford extra protection for the start winding, the heater element assists in promoting disc action. Initially, the relay contacts are closed, enabling the starting components to develop the out-of-phase field for motor starting. During motor operation, an increasing voltage is induced across the closed circuit consisting of the start winding and the relay coil. At rated speed, current through the relay coil is great enough to hold the relay contacts open, effectively removing the start capacitor.

The run capacitor and the start winding are in series across the line (connected in the same manner as the start capacitor); consequently, the run capacitor aids in creating the initial starting torque. The run capacitor also improves the power factor of the air-conditioner, which means the same work is done with less current drain on the line.

Fig. 6 illustrates the use of the PSC (permanent split-capacitor) type of compressor motor. Normally, this more recently engineered unit utilizes only the motor windings and a permanently connected external capacitor. No start capacitor or relay is necessary.

Occasionally, however, either because of manufacturing tolerances or because of lower line voltage, the PSC motor will fail to start. It will then be necessary to use the additional components shown by the broken-line circuit in Fig. 6. The air-conditioner manufacturer will recommend the necessary component values.

Trouble Checks

1. The line voltage under load at point of use must be within ± 10% of rated voltage for the line fuse not to blow. Use a delay-type line fuse (*Fusetron* or equal) rated for the recommended line current.

2. If the fuse blows repeatedly, check to see if the branch circuit is not otherwise loaded excessively. Is there a short in the unit? Is start-circuit action satisfactory? Does the

compressor start?

3. If voltage reaches the fan motor but the motor does not operate, check associated start and/or run capacitors; also, check for continuity of windings or a short to chassis. (Note: If capacitor is shorted, the fan will operate in either direction when started by hand.) With the power cord removed, examine for physical obstruction of fan blades. Is the shaft frozen? Does the motor need oil? Is the capacitor wired properly?

4. If the compressor is dead, is the selector switch satisfactory? Does the thermostat call for cooling? Is the overload defective? Test continuity of the windings directly, first removing all terminal wires. Use the test harness on standard compressors as previously explained. On PSC types, no start capacitor is to be used. Place the run capacitor across the main (or run) and start terminals, and apply line voltage across common and main terminals. Note: Sealed-system failures, such as defective compressors, cannot be replaced or repaired in the home.

5. If compressor operation is satisfactory, but does not start properly, the relay and/or start capacitor may be defective. These, or any other components, may be tested by the direct substitution method.

6. The run capacitor aids in starting the compressor motor and reduces the current drain of the entire unit. Where a wattmeter is available, its use will indicate that the capacitor may be defective if current drain of the unit is excessive.

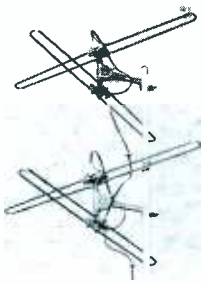
In the June article, we will see how purely mechanical conditions can cause electrical trouble symptoms. The final summary will interrelate all causes and effects. ▲

"I'll get a call from him 5 minutes before closing time."

PRODUCT report

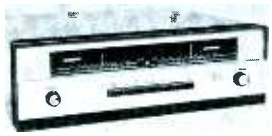
For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

Offset-Mounted FM Antenna (No. 41C)



An omnidirectional "turnstile" antenna for FM radio reception, the Winegard Model FM3T, is equipped with an offset-type mounting bracket for convenient clamping to the mast of an existing TV antenna. Up to four bays can be stacked together using standard 300-ohm line. Elements are of gold-colored anodized aluminum. List price is $11.95 per bay.

Stereo Radio Tuner (No. 42C)



The Harman-Kardon *Madrigal* high-fidelity tuner (Model ST350) has completely separate AM and FM sections to permit stereo simulcast reception. If a multiplex adapter (MA350) is added, the unit can receive stereo signals transmitted by the Crosby multiplex method. All switches are operated by push buttons. Price is $199.95.

Dual-Heat Soldering Gun (No. 43C)

The latest addition to the Weller line of soldering guns is the 8200K, a dual-heat model rated at 90 and 125 watts. Features include a trigger-type switch, single spotlight, and a copper tip plated with iron for greater durability. The new gun is sold as part of a $7.95 kit that also includes a soldering aid, a wire brush, and a spool of solder.

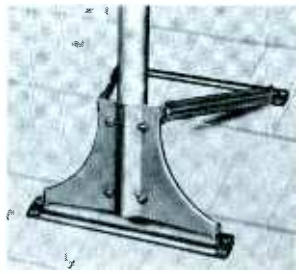
Speaker Systems (No. 44C)

The new Audio Component Div. of JFD has announced a *Mardi Gras* line of high-fidelity loudspeaker systems to be marketed from distributors through service dealers. The speakers require a driving power of 5 to 15 watts and are equipped with 4-, 8-, and 16-ohm impedance taps. Two versions are available: Model ALC1 (18" x 10" x 10"; $45 audiophile net), and Model ALC2 (14" x 10" x 10"; $30 audiophile net).

12" Woofer (No. 45C)

An input of 4 watts at 16 cps produces a voice-coil excursion of 1" in the Cletron Model C-12-RW woofer. The ceramic *Indox* magnet of this 12" speaker weighs 2 lb. and has a strength of 10,000 gausses. The "flex-edge" peripheral portion of the cone is made of specially treated cloth, and the gasket ring is of a composition cork material ½" thick. Peak power is 35 watts, and impedance is 16 ohms.

Antenna Mount (No. 46C)



Vokar, a well-known maker of auto radio vibrators, has branched out into antenna accessories with a new *Fast Mount* steel base for roof installations. Fastened in place with self-tapping screws, it can be mounted at any convenient point on the roof — regardless of pitch. This bracket will securely hold antenna masts up to 6' tall without guy wires. List price is $4.95.

Tube and Transistor Tester (No. 47C)

A new portable tube tester of the dynamic mutual conductance type, Hickok Model 800, is similar to an earlier model (600A) but has several new features including circuits for leakage and gain tests of transistors and crystal diodes, a quick heater-continuity check, and improved tests for interelement leakage and grid current in tubes. Price is $159.50.

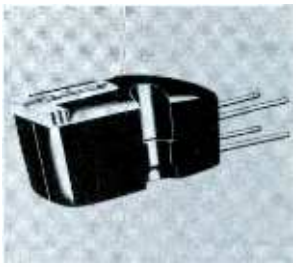
Stereo Channel Isolation (No. 48C)

A ground loop is created in a stereo system if the two amplifier channels have a common ground at any point and a three-wire cartridge is used. Objectionable feedback often results. The Triad A-210P, an isolation transformer with a 1:1 impedance ratio, remedies this problem when connected in series with the signal lead from the cartridge to one preamp. List price is $16.50.

Tone Arm With Cartridge (No. 49C)

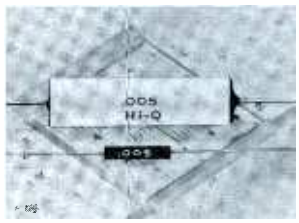
The Shure *Studio Dynetic*, a combination of a moving-magnet phono cartridge and a transcription-type tone arm, is now being supplied in a stereo version priced at $89.50. Tracking pressure is adjustable between 1½ and 2½ gm. Output voltage at 1000 cps is 5 mv per channel across the recommended load impedance of 50K ohms. Compliance is 8.0 x 10^{-6} cm/dyne in both vertical and lateral directions.

Stereo Cartridges (No. 50C)



A new Pickering magnetic cartridge, the *Stanton 45X45 Stereo Fluxvalve* (Model 371) is designed for a tracking force of 3 to 6 gm. Frequency response within the stereo recording range is flat within 2 db when a load resistance of 27K to 47K ohms is used. The unit fits tone arms with ½" mounting centers. Price, including .7-mil diamond stylus, is $29.85.

Tiny Ceramic Capacitors (No. 51C)



Ultra-miniaturized Aerovox *Cerafil* ceramic capacitors are available in capacitance values from 10 to 100,000 mmf at working voltages of either 30 or 100 WVDC. The photo illustrates the comparative size of one of the new units and an ordinary-sized ceramic tubular *Hi-Q* capacitor.

Stereo Amplifier (No. 52C)

The Arkay CS-28 incorporates dual 14-watt stereo amplifiers and a pair of control preamplifiers, all on a single chassis. A reverse-stereo switch (for interchanging channels) and a balance control are included. Output taps are provided for speaker impedance of 4, 8, 16 and 32 ohms. Price is $64.95 (kit) or $99.95 (wired).

Transistorized Intercoms (No. 53C)

1500 Series Fanon intercom systems are fully transistorized, and can be powered by either batteries or AC line current. Master stations are available with a choice of 6 or 12 connections for remote stations. A two-station, all-transistor system is also available, listing at $74.95 including 50' of connecting cable.

Automatic Antenna Rotator (No. 54C)

The Alliance Model U-98 *Tenna-Rotor* is an automatic unit that shuts itself off after turning the antenna to the direction indicated on the dial. Although similar in design to an earlier automatic model (the U-83), the new rotator includes numerous new features to eliminate arcing and insure more positive action of the escapement mechanism.

Stereo Record Changer (No. 55C)

A built-in gauge on the United Audio *Dual-1006* four-speed stereo record changer shows stylus pressure in grams. Records of all sizes from 5" to 12" can be intermixed. Noise produced by spurious vertical stylus motion during monophonic operation is suppressed by the STEREO-MONO switch circuit.

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ANTENNA SYSTEMS

1C. CLEAR BEAM — Complete information on how you can profit by stocking and selling antenna kits. *See ad page 55.*

2C. CORNELL-DUBILIER — Catalog and brochure entitled "All About Antenna Rotors." *See ad page 61.*

3C. TACO — Catalog on UHF antennas including the new *Translator* models. *See ad page 72.*

AUDIO AND HI-FI

4C. ARKAY—16-page booklet entitled "Let's Talk About Stereo" gives practical information about stereo, including recommended home installations. *See ad page 66.*

5C. SONOTONE—"Stereo Simplified" completely explains stereo reproduction for the layman; also, new catalog page on *Ceramike*, adaptable to existing tape recorder and PA systems. *See ad page 34.*

CAPACITORS

6C. ILLINOIS CONDENSER — Literature on all types of capacitors, including radio, TV, motor start, Philco flash, miniature, subminiature, military, computer, paper, audio crossover network, and tantalum. *See ad page 54.*

7C. SPRAGUE — M726 *Cerami-Chart*, large wall chart of standard ceramic capacitor color codes with circuit application data for various types. *See ad page 10.*

8C. TOBE DEUTSCHMANN — Capacitor catalog No. 5701. *See ad page 71.*

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9C. ELECTRO-VOICE — Bulletin No. 267 features new totally-compatible stereo cartridges. Offers two series—the *Magneramic* for magnetic inputs and the standard ceramic for ceramic inputs. *See ad page 13.*

10C. GENERAL ELECTRIC — 16-page booklet entitled "Application Considerations in the Use of Stereo Cartridges." *See ads pages 33, 59.*

11C. JENSEN INDUSTRIES — 1959 cross-reference booklet on phono needles. *See ad page 46.*

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12C. AMPEREX — Condensed catalog including a list of all company products. *See ad page 40.*

13C. CLAROSTAT — Catalog No. 59 of resistor and control products. *See ad page 43.*

14C. GENERAL CEMENT — Catalog sheet for *Sav-A-Tube* unit. *See ad 2nd cover.*

15C. IRC—Catalog on S505 *Handy-Pak* carbon composition resistors. *See ad page 41.*

16C. MALLORY — Capacitor catalog, Form No. 9-140; silicon rectifier catalog, Form No. 9-152. *See ad pages 16, 17.*

17C. J. W. MILLER—Data sheet gives schematic and base layout on IF transformer replacement for two GE models. *See ad page 81.*

18C. TRIAD — Data on new series of transformers for transistor power supplies; 6, 12, or 28 volt DC mobile supply inputs provide wide range of DC outputs. *See ad page 50.*

19C. UNITED CATALOG PUBLISHERS — List of distributors who have the 1959 edition of The Radio-Electronic MASTER, 1536-page standard parts catalog containing descriptions of over 150,000 items. *See ad page 54.*

FUSES

20C. BUSSMANN—Bulletin SFH-6 describes new space-saving fuse and fuseholder combination for circuit protection at 300 volts or less. *See ad page 45.*

POWER SUPPLIES

21C. ATR—Descriptive literature on battery eliminators, DC-AC inverters, tube protectors, and other products. *See ad page 18.*

SERVICE AIDS

22C. BERNS — Circular on the perfect pin-crimping picture-tube repair tool that eliminates hard soldering jobs. *See ad page 54.*

23C. 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 72.*

24C. SERVICE INSTRUMENTS — Mailer describing the 10 most popular *Sencore* timesavers. *See ads pages 52, 62, 66, 75, 79, 80.*

TECHNICAL PUBLICATIONS

25C. CBS-HYTRON—Catalog sheet No. PA-528 describing 1959 editions of "Technician's Handbook" and "Engineer's Handbook." *See ad page 19.*

26C. PHILCO — "1959 Service Dealer Handbook" covers the business side of service and provides a day-by-day business record. *See ad page 53.*

27C. HOWARD W. SAMS—Descriptive literature on all Howard W. Sams books covering servicing of TV, radio, hi-fi, etc. Includes data on latest books, "101 Ways to Use Your Oscilloscope" and Volumes 3 and 4 of the "Hi-Fi Servicing" series. *See ads pages 39, 62, 81.*

TEST EQUIPMENT

28C. AEROVOX—Literature on Model 97 LC checker for in-circuit capacitor tests. *See ad page 36.*

29C. DOSS—Flyer describing latest trouble-shooting instruments. *See ad page 32.*

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

31C. JACKSON — Catalog sheet on hi-fi, stereo, and audio test equipment. *See ads pages 76, 84.*

32C. SECO—New 2-color folder showing complete line of test equipment and service aids. *See ads pages 38, 79.*

33C. TRIPLETT—Flyer on new true dynamic mutual conductance tube tester, Model 3444. *See ad page 49.*

TOOLS

34C. HUNTER — Literature describing complete subminiature tool bar—first ever offered. *See ad page 81.*

35C. KEDMAN — Catalog sheet describing 4 screwdriver displays and specifications on 14 kinds of screwdrivers in company's line. *See ad page 72.*

36C. WELLER — Bulletin No. 017 describes new soldering kit combining dual-heat 90/125-watt gun for the tool kit with temperature-controlled 40-watt *Magnastat* iron for the bench.

37C. WEN — Free 50c 32-page booklet, "101 Ways to Use Small Electric Power Tools." *See ad page 60.*

38C. XCELITE—Latest catalog on complete line of tools for the electronic serviceman. *See ad page 75.*

TUBES

39C. TUNG-SOL — 30-page flip-style chart supplies electrical and physical characteristics for most important industrial, special-purpose and military tubes. *See ad page 63.*

40C. WESTINGHOUSE — Colorful comic book, "A Rescue Job for Tony," describing details of tube manufacturing. *See ad page 57.*

RCA pre-sells for you ...with these hard hitting ads!

How to make sure you get what you pay for in TV Picture Tubes!

If the time ever comes to replace the picture tube in your TV set, you should know these important facts:

All Tubes Are Not New!

One out of every two replacement picture tubes sold are made of used or reconditioned parts. In fact, many *rebuilt* picture tubes are sold as *new*. Until now, you and even many TV Technicians could not tell the difference.

RCA Takes the Guess-Work Out of It!

With RCA, you know what you're getting...and you get what you pay for. For all RCA [illegible] Tubes are now clearly labeled ALL-NEW or RE-BUILT—righ[illegible]

Both tub[illegible] card. Ch[illegible] virtually

How can you be sure you're getting a brand new picture tube?

Do you know that many TV picture tubes are made with reconditioned materials? Can you tell the difference between a new and a rebuilt picture tube? How can you be sure you are getting what you ask and pay for?

The answer is simple! RCA now manufactures two lines of picture tubes—*all-new* Silverama and *factory-rebuilt* Monogram. Each is clearly labelled as either new or rebuilt. Each is warranted for one full year. Each is priced accordingly. And *both* fit virtually every make and model TV set.

All guess work is eliminated. You're sure you're getting an all-new factory-fresh TV picture tube when you ask for RCA Silverama—or the finest rebuilt picture tube made when you ask for RCA Monogram.

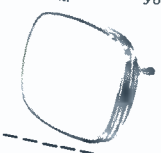
All-New Premium

RCA Silverama®

Finest picture tube made!

Completely new, glass and all parts. For the brightest, sharpest, clearest picture your TV set can deliver!

$49.00*



Factory-Rebuilt

RCA Monogram

Finest rebuilt picture tube made!

A picture tube for the budget-minded. Reprocessed and tested in the same factory as RCA's premium picture tubes.

$36.00*

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

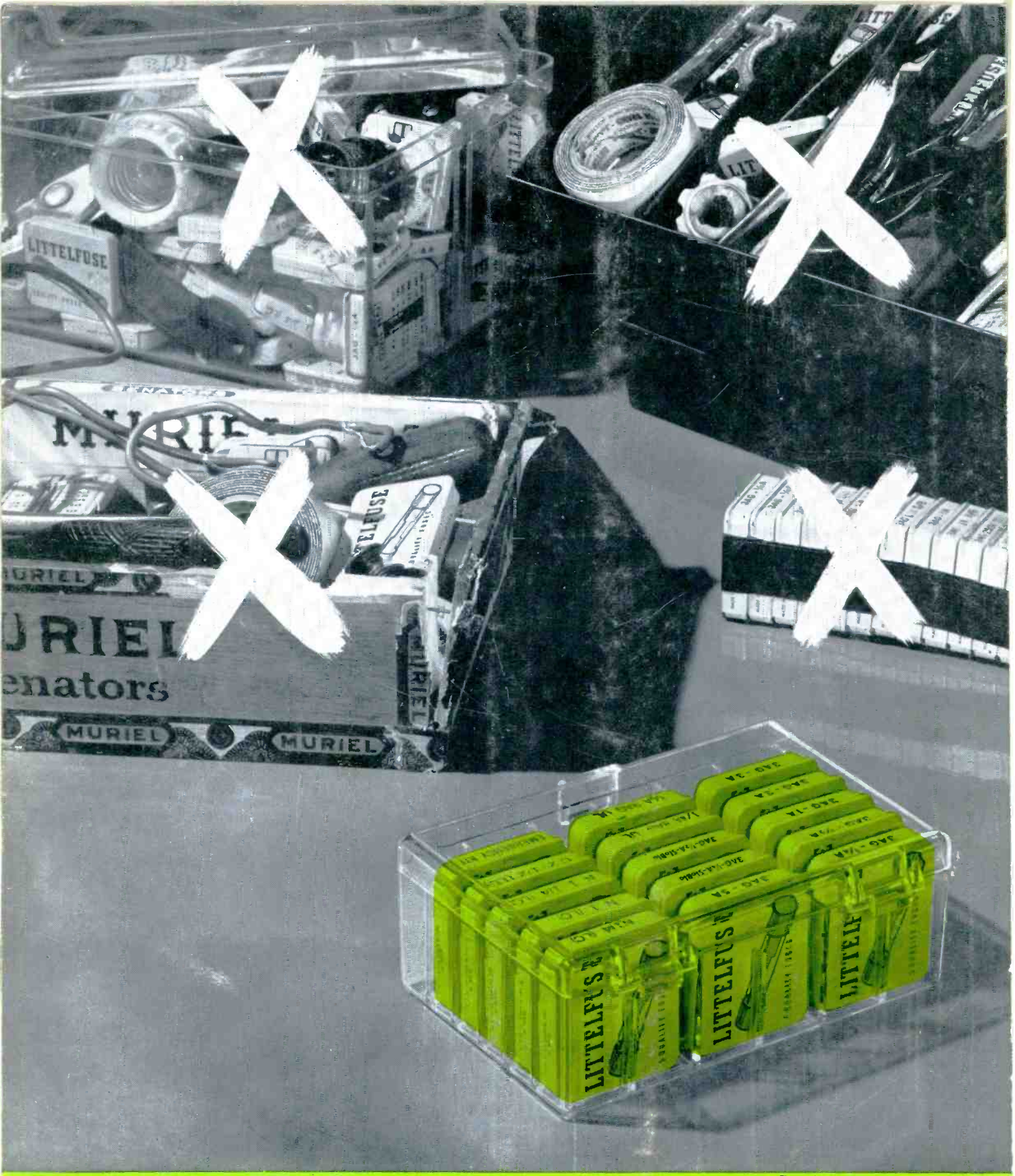
*Optional list prices for a popular 21" tube. Monogram prices slightly higher for West.

These ads are typical of the big advertising program for RCA SILVERAMA and RCA MONOGRAM Picture Tubes. You'll see these messages in TV GUIDE, LIFE, and the SATURDAY EVENING POST... on such leading TV shows as Steve Allen, Dave Garroway's Today, and Jack Paar.

Cash in! Make sure you're identified with this program. Your authorized RCA Distributor will tell you how. Contact him today!

RADIO CORPORATION OF AMERICA

Electron Tube Division ***Harrison, N. J.***



Burton browne advertising

THERE'S ONLY ONE RIGHT WAY

A *fuse caddy* for your *tube caddy*: 18 individual compartments for fingertip selection. The fuse caddy is complete with the 15 boxes of fuses required to service 93% of all TV sets. Three spare compartments are provided for additional fuses of your own selection.

LITTELFUSE *Des Plaines, Ill.*