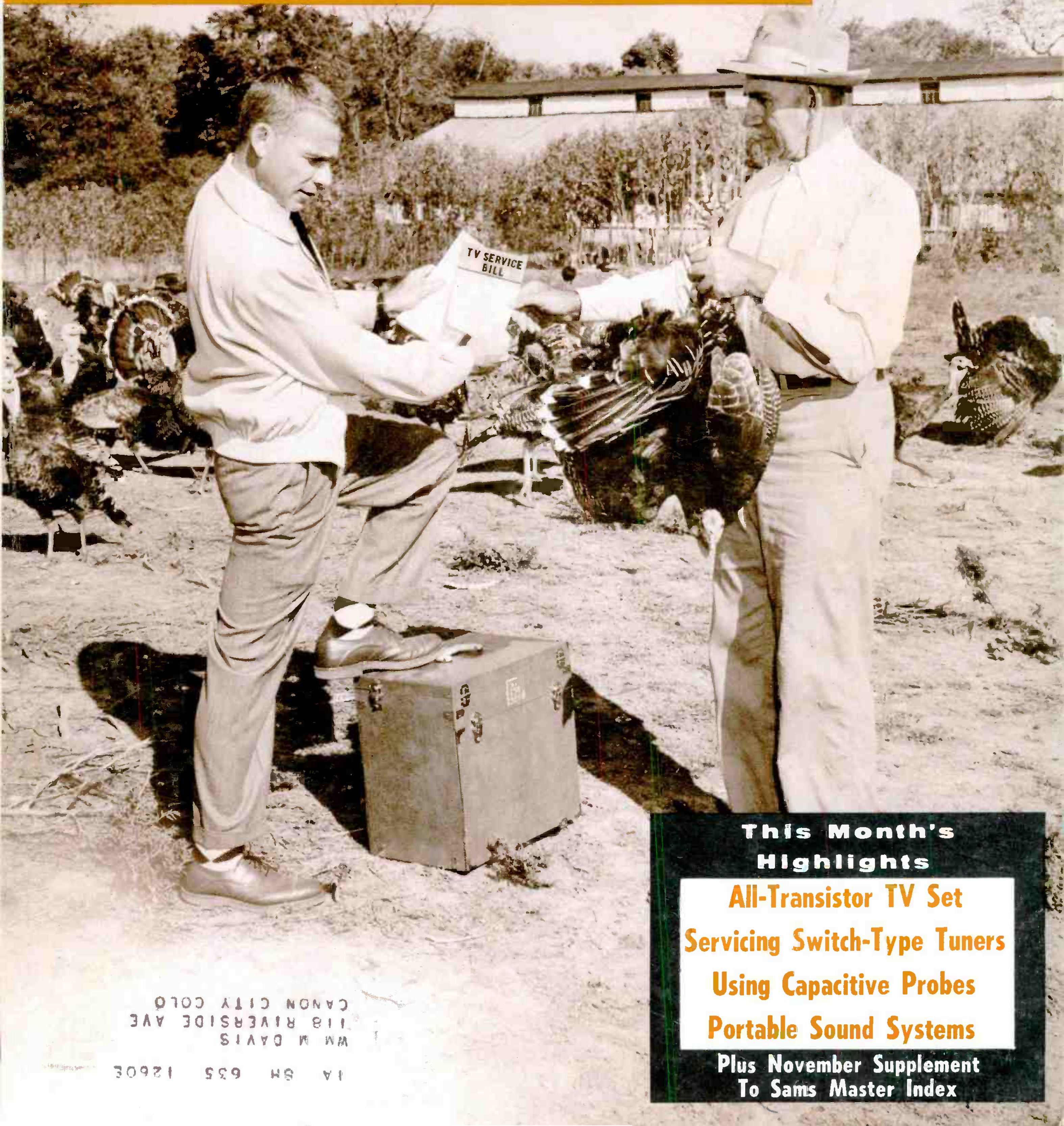
NOVEMBER, 1958 35 CENTS

PF REPORTER

PHOTOFACT

including Electronic Servicing



This Month's Highlights

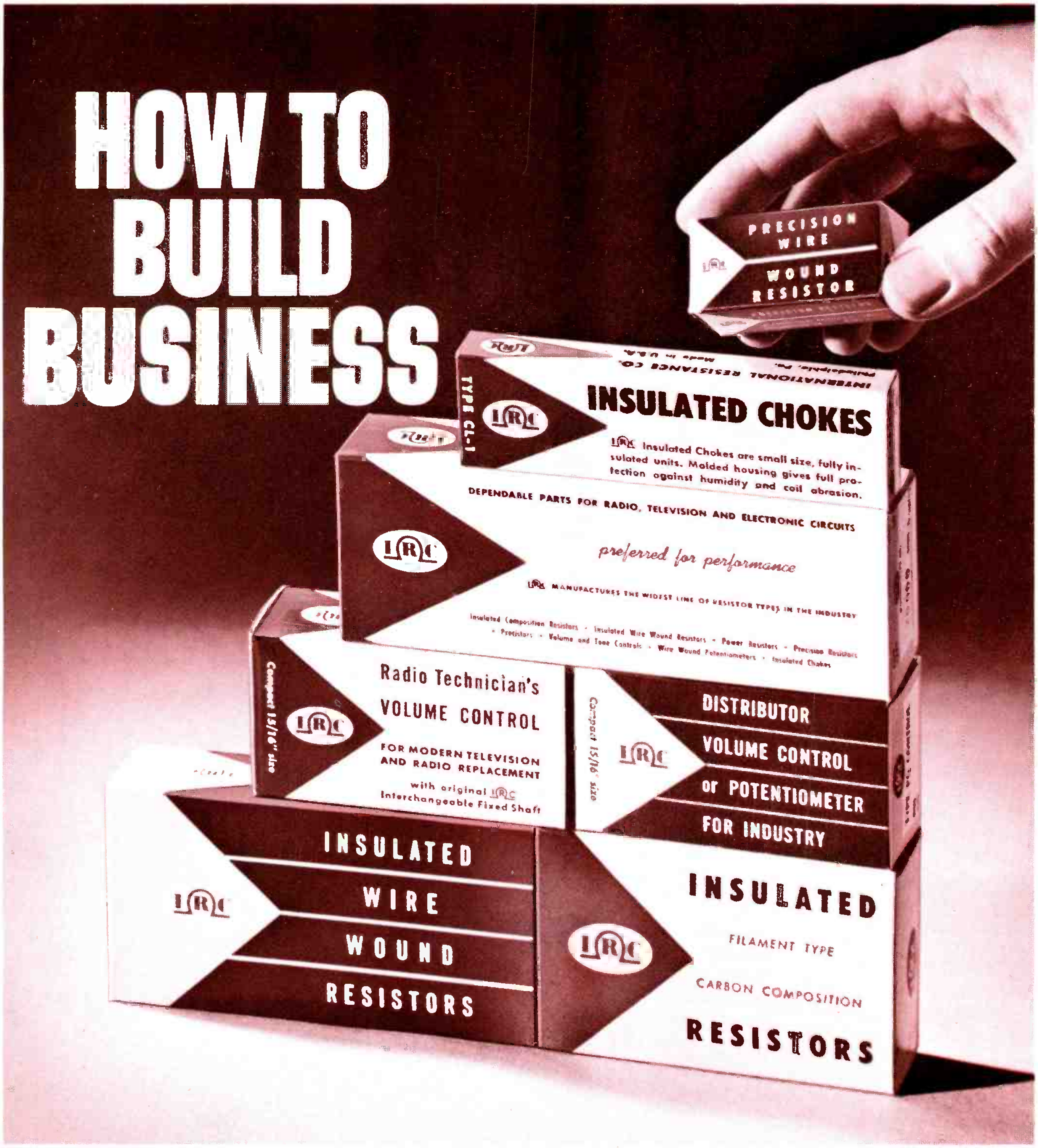
All-Transistor TV Set

Servicing Switch-Type Tuners

Using Capacitive Probes

Portable Sound Systems

Plus November Supplement To Sams Master Index



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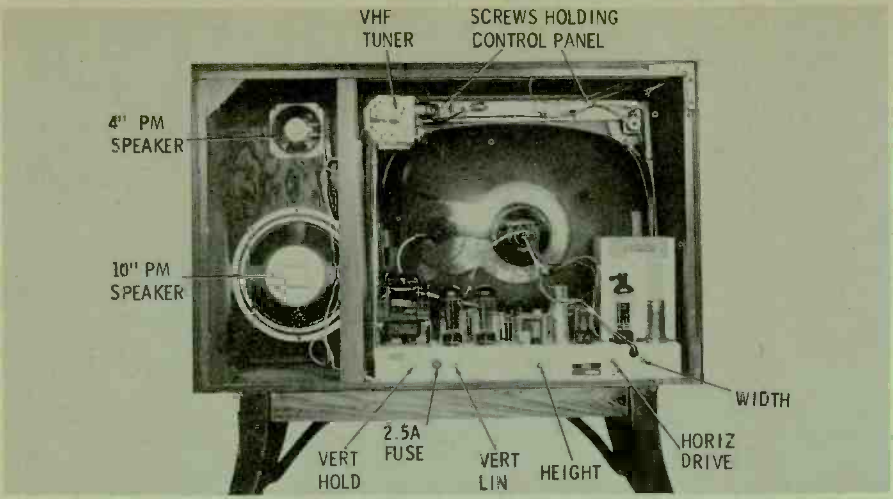
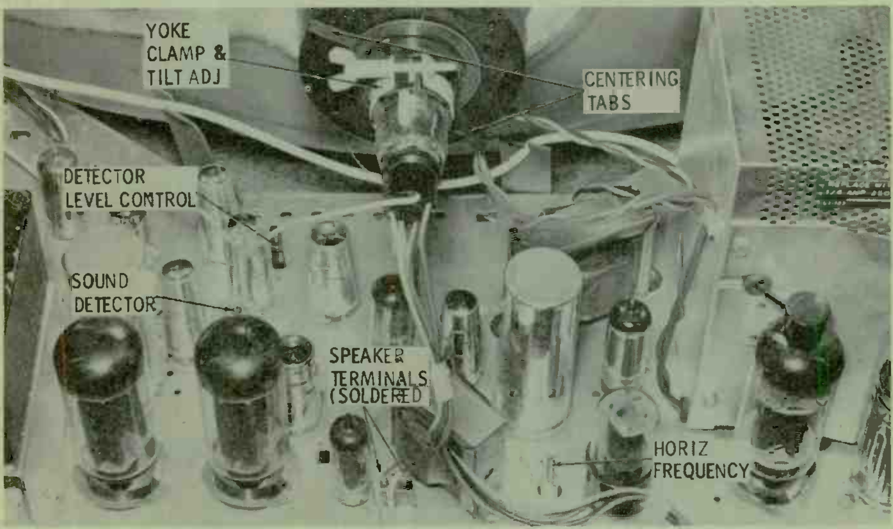
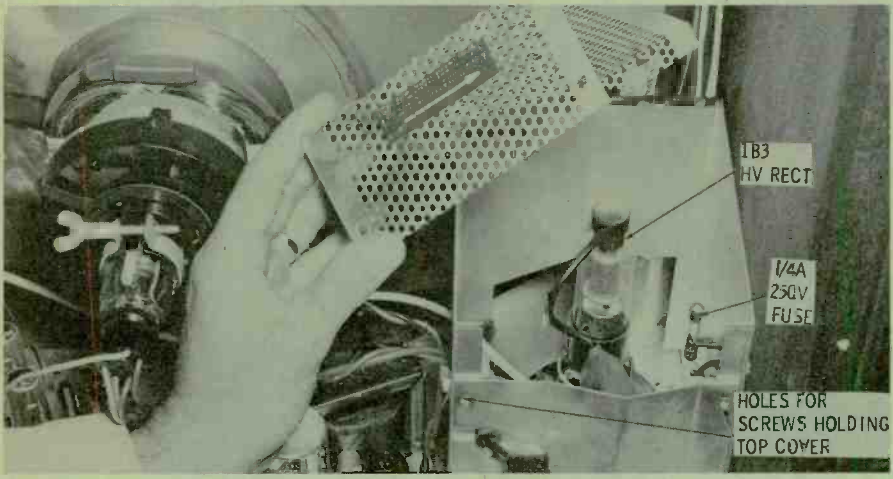






Andrea Model MLB-VQ21 Chassis VQ21-110

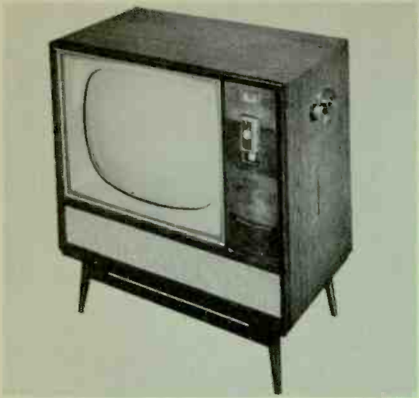
This new console employs a narrow horizontal chassis having conventional wiring, and driving a 21" 110° picture tube. The set also features both 10" and 4" speakers mounted beside the chassis in a separate compartment. The front panel controls, located across the top of the cabinet, include contrast-volume with on-off switch, tone, horizontal hold, picture fidelity, brightness, and channel selector with fine tuning.

Rear chassis adjustments can be seen in the photo. Transformer-powered, the set uses two 5U4GB rectifier tubes in parallel and a 1N60 crystal-diode in the video detector stage. The tube line-up is somewhat conventional and all are easily reached. Oscillator slugs for each channel are adjustable through a hole in the front of the tuner; however, to adjust them with the chassis in the cabinet, the entire front wood panel must be removed (as shown for cleaning of the safety glass).

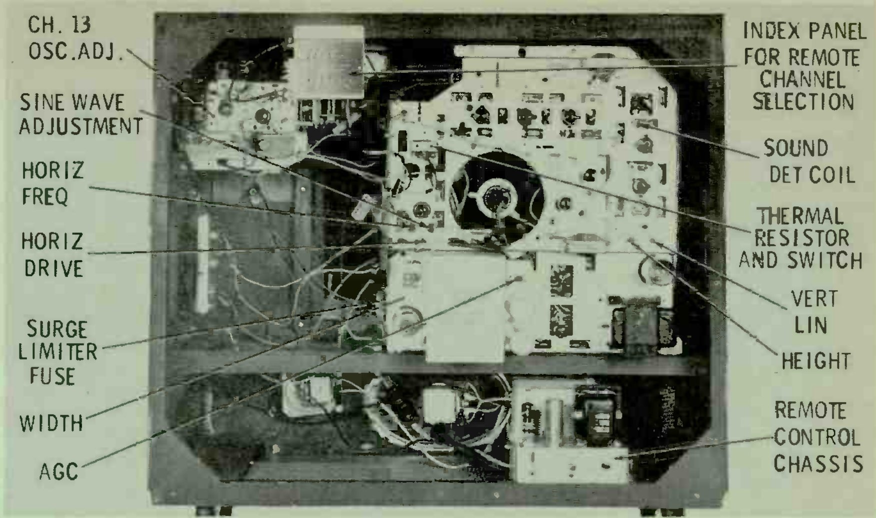
Service adjustments on top of the chassis are detector level control, ratio detector, and horizontal frequency. The speaker system connects to two terminals near the center-rear of the chassis. To remove speakers or chassis, merely disconnect the lead at the banana-plug contacts on each speaker. The detector level control, pointed out in the photo, is electrically located in the screen and control grid circuits of the AGC keyer tube—a 6AU6 just left of the control shaft. This adjustment sets the operating bias of the keyer and thus affects AGC action. Incidentally, if you are wondering what part the picture fidelity knob on the front panel plays, it is a two-position switch inserted in the cathode return of the video output stage and switches an RF bypass capacitor in or out of that circuit.

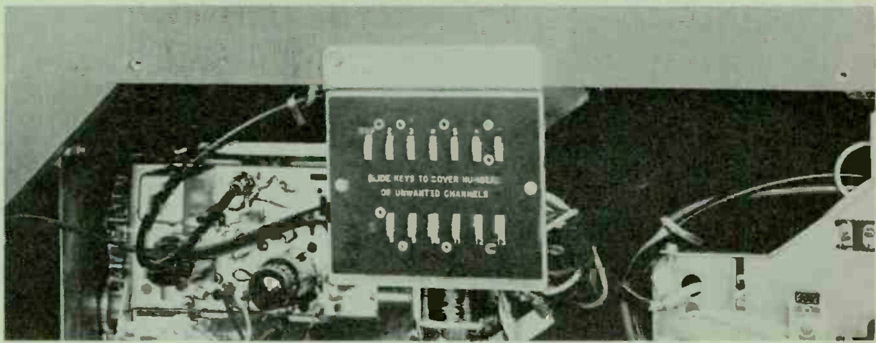
When you first look at the high-voltage cage, you might think the entire back side should be removed before getting to the 1B3, ¼-amp fuse, or flyback. All that's necessary, however, is to remove the two ¼" screws near the top, and lift the perforated section up and toward the front. The fuse is a slow-blow, pigtail type connected in the plate circuit of the 6AU4 damper tube.

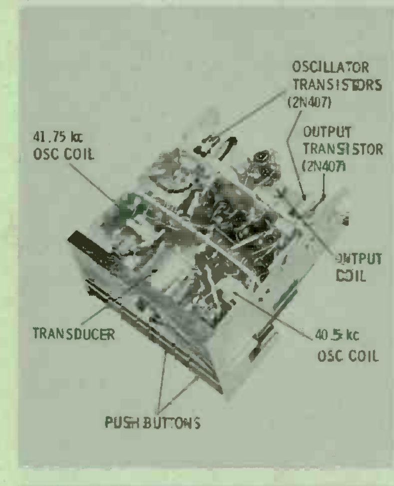
When a customer asks you to clean the screen on this model, you might like to know that the safety glass *will* come off the front. Remove all the front-panel control knobs and the two Phillips-head screws pictured. After removing the wood panel and tilting the glass outward at the top, lift it up and out.

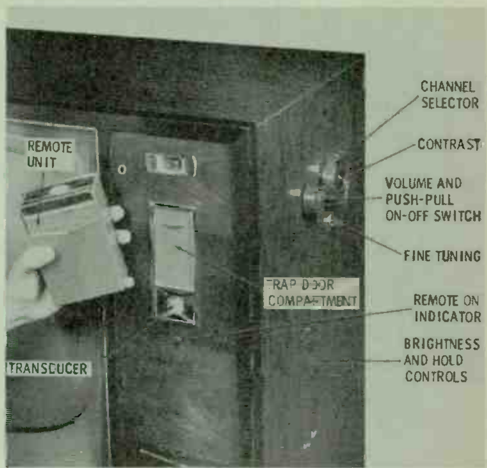


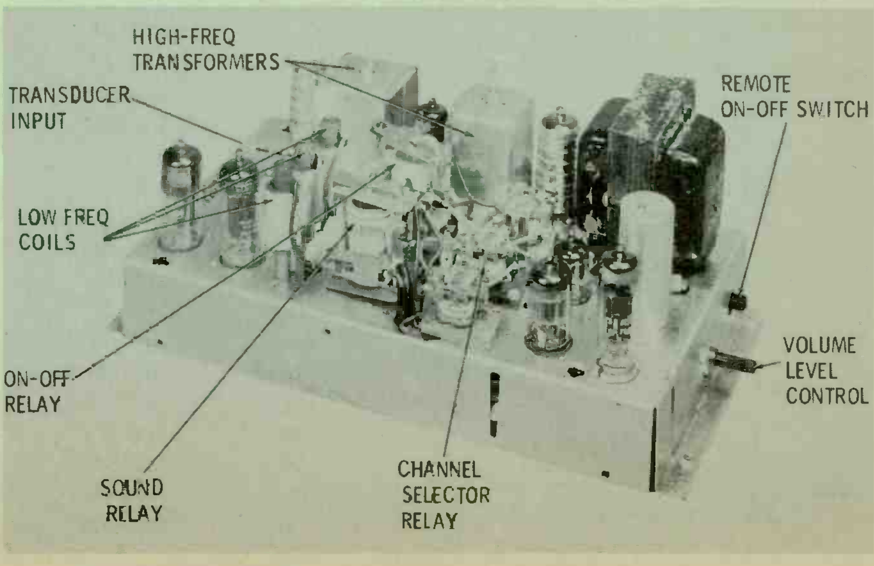
RCA Model 21RT9655 Chassis KCS122 BAB











This new 21" console, featuring a "Wireless Wizard," may be operated from remote or local positions. The front safety glass is removed by prying off the top and bottom channel strips with a small-bladed tool, and sliding the glass retainers to the right.

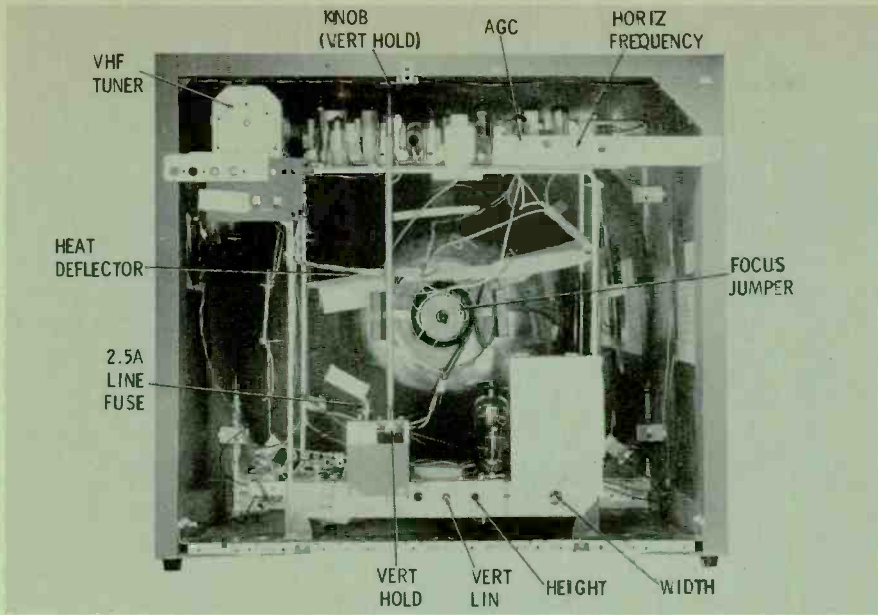
The transformer-powered vertical chassis has four individual printed boards. In addition to the main chassis, a separate remote subchassis mounts in the bottom of the cabinet with the speaker system. The surge-limiter fuse, positioned on the left side of the main chassis, is a special .3-amp plug-in unit (RCA No. 104295). All tubes are easily reached except perhaps two or three on the remote chassis. New tube types include a 6CQ8 converter, 6DS5 audio output, and 6EM5 vertical output.

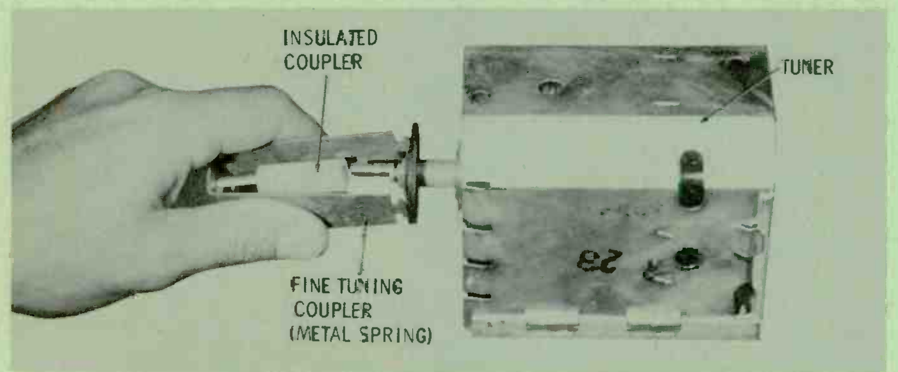
The index panel for setting up automatic channel selection from the remote-control mechanism is attached to the rear of the cabinet as shown. Small, slide-type buttons or keys represent channels 2 through 13 and a UHF position. Numbers of desired channels should be visible, but those unwanted should be covered by the index keys. The VHF tuner, which mounts separately in the cabinet, features a "one set" fine tuning adjustment. The tuning knob on the side of the set must be pushed in for each channel setting. Once the adjustment is made, a small gear-and-cam arrangement will automatically set the fine-tuning trimmer to its proper position when the channel is again selected.

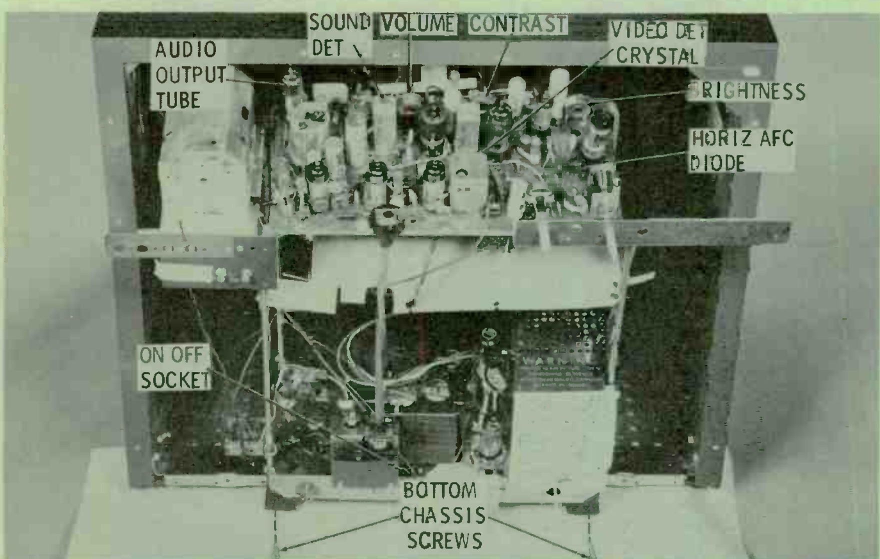
When not in use, the remote control unit, housed in a relatively small plastic case, fits conveniently in a trap-door compartment on the front of the set. The transducer or pickup mike is positioned directly beneath this compartment.

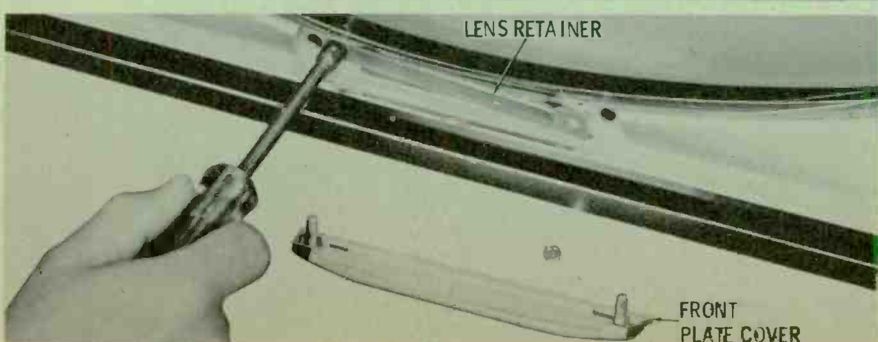
The remote transmitter employs three 2N407 transistors and is powered by a single 13.5-volt battery having a 9-volt tap (RCA No. VS 304). An AC voltmeter, connected across the output coil, can be used to check transmitter operation. Under normal conditions, the RMS value should be about 35 to 55 volts when any one of the push-buttons are held down.

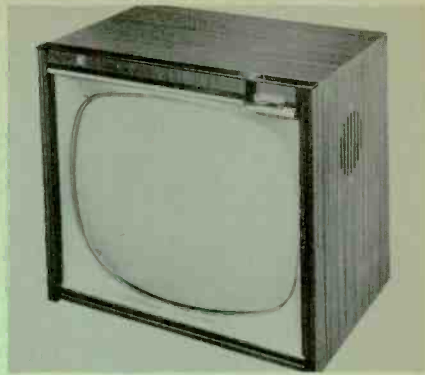
The remote-signal receiver employs 8 tubes, a power transformer, and several relays. The input high-frequency circuits are tuned to 40 kc, which is the signal picked up by the transducer on the front of the set. Only one control and an on-off switch is found on this chassis. The control sets maximum remote volume level, and the slide switch turns the remote system on and off.











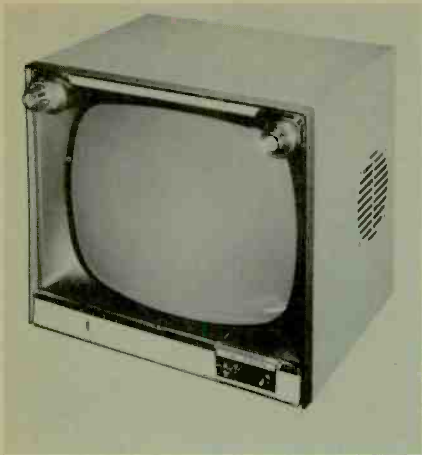
Sylvania Model 21T218 Chassis 1-542-3

Removing the back from this new table model reveals somewhat of a step-shelf chassis built around a 21" 110° picture tube. Tube filaments are connected in series, and the hot chassis is powered by two 450-ma selenium rectifiers. The upper shelf beside the tuner consists entirely of printed wiring, while the lower deck, housing the low-voltage, sweep, and high-voltage sections, features conventional wiring. When servicing this unit, remember not to remove the heat deflector located between the two chassis; it serves to protect the upper board. The neutrode tuner employs a 2CY5 RF amplifier and a 5U8 converter. Channel oscillator adjustments are accessible by removing the selector and fine tuning knobs. The slug for channel 13 is located at about 7-o'clock on the circular hole pattern around the tuner shaft.

Replacing tubes on the lower chassis is relatively easy, but those positioned on the upper board may give you some trouble. If you have a fairly small hand, you should be able to replace all tubes on this board, except the 6AQ5 audio output. This tube is rather tall and has a permanent-type shield, so it's practically impossible to remove without at least tilting the chassis backwards. To accomplish this, remove the Phillips-head screw securing the vertical hold-control bracket at the top of the cabinet, reach in and compress the sides of the fine tuning coupler, and disengage it from the tuner as shown in the photograph.

After removing the two ¼" hex-head screws from the bottom feet of the chassis, loosen the speaker leads, raise the chassis slightly and tilt it back as shown. Shaft couplers for the volume, contrast, and brightness controls will disengage automatically as the chassis is tilted toward the rear. With the unit in this position, all components on the top board are within easy reach. When substituting tubes, remember to exercise care to avoid damaging the somewhat delicate printed board. To completely remove the chassis, disconnect speaker and high-voltage leads, picture tube socket, and the power lead to the ON/OFF socket. Take off the yoke clamp and remove chassis with yoke from the cabinet. When operating the chassis with the plug removed from the ON/OFF socket, a jumper must be used as a substitute for the on-off switch, which remains in the cabinet.

The safety glass of this receiver is lens-shaped, and covers only the picture tube screen itself. To remove for cleaning, pry off the front cover plate at the bottom center of the mask, remove the two ¼" hex-head screws holding the retainer, pull out slightly and then down on the glass.



Zenith Model B2330 EUD
Chassis 19B20UD

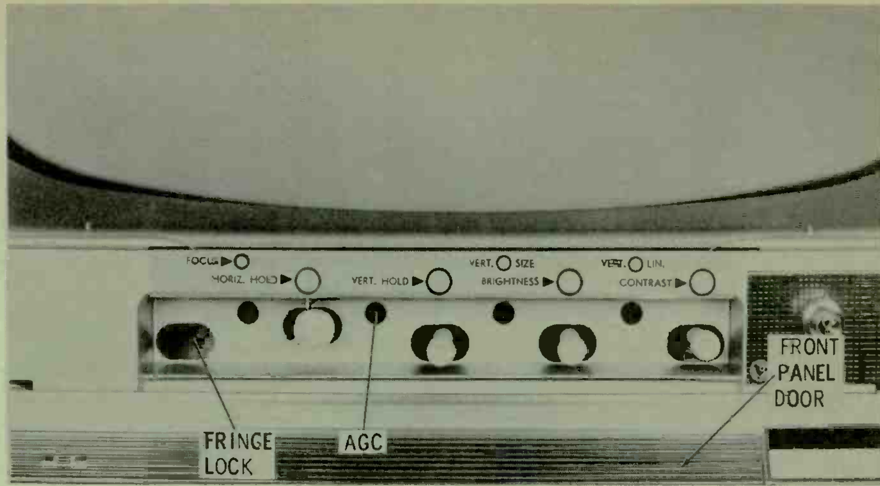
When you're called upon to service this particular TV, you'll find that it features a 21" picture tube, metal cabinet, and both VHF and UHF reception. The tuners are mounted on opposite sides of the cabinet and their tuning knobs are in the upper front corners. The push-pull on-off switch is located in the center of the UHF tuning knob on the left side of the cabinet.

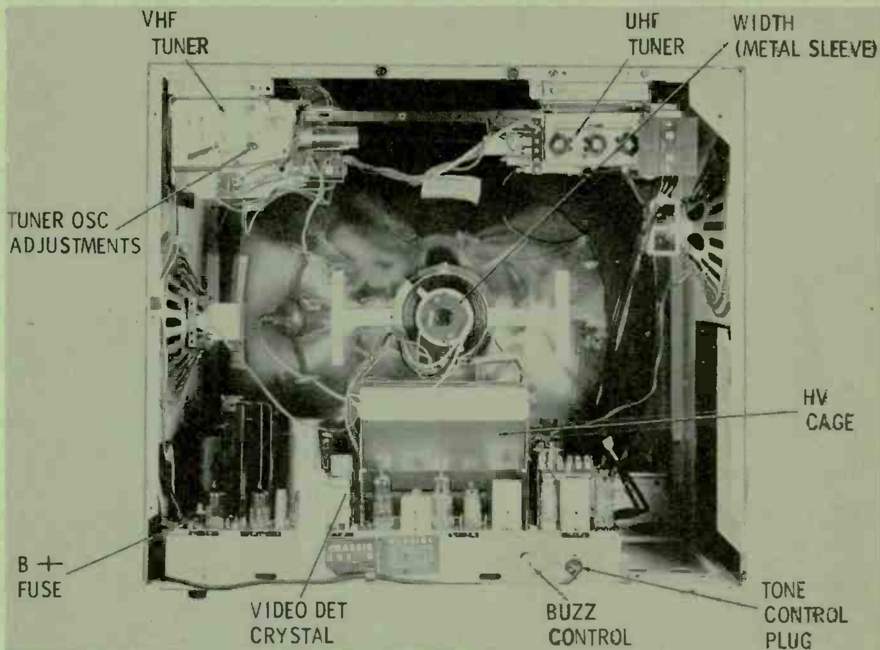
The remaining operating controls and a few service adjustments are accessible by opening the lower front panel door as shown in the photo. Just to the right of this group of controls, you'll find two "high fidelity" knobs used to actuate bass and treble tone controls.

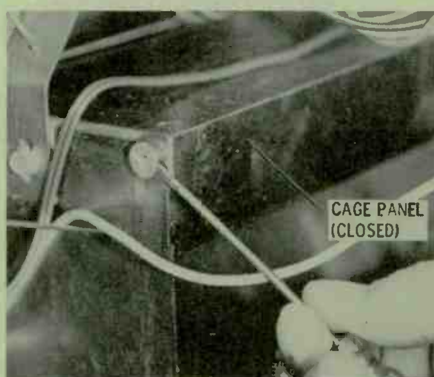
Looking in from the rear of the cabinet, you'll notice a transformer-powered horizontal chassis with conventional wiring. Both tuners are positioned directly above the chassis, and the speaker system consists of two units—one on each side of the cabinet. The fuse, located near the power transformer, is a .7-amp slow-blow unit connected in series with the entire B+ supply. If you service this set in the home, check your tube caddy to make sure that you have the following types; 12BV7 video output, 6BQ5 audio output, 6CK4 vertical output, and 1J3 high-voltage rectifier. In addition, you'll find a 6EA8 converter tube in the VHF tuner. The latter is a near match to the 6U8, and can be replaced by such in most cases. Chassis removal is not much of a problem; however, the volume control and switch located on the UHF tuner bracket may give you a little trouble. To remove, loosen the screw on the rear of the nylon shaft-coupler and slide the shaft forward. Slip off the "C" type washer holding the control, and slide the rubber grommet from the shaft.

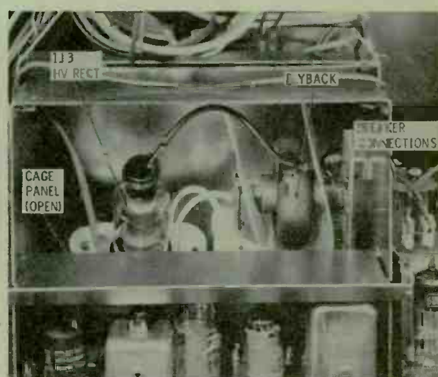
To get into the high-voltage cage, positioned in the center of the chassis under the neck of the picture tube, remove two small tri-mounts from the top rear corners of the cage as shown. The cage panel will then drop down and you can easily reach the 1J3 rectifier tube. Don't look for a fuse in the cage because the flyback circuit has no protection other than the B+ line fuse. The set is also without horizontal-drive or horizontal-linearity adjustments.

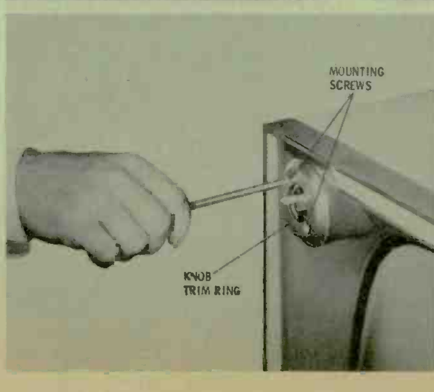
To clean the screen and safety glass on this model, remove the top push-on type control knobs and the two Phillips-head screws securing each trim ring. Tilt the top of the glass forward and lift it out.

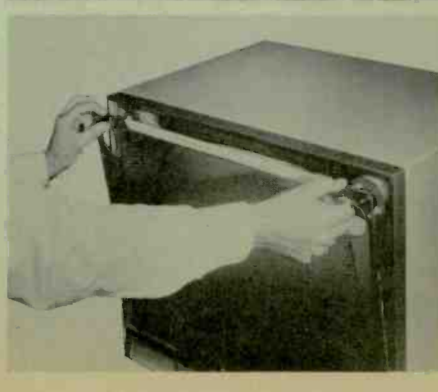












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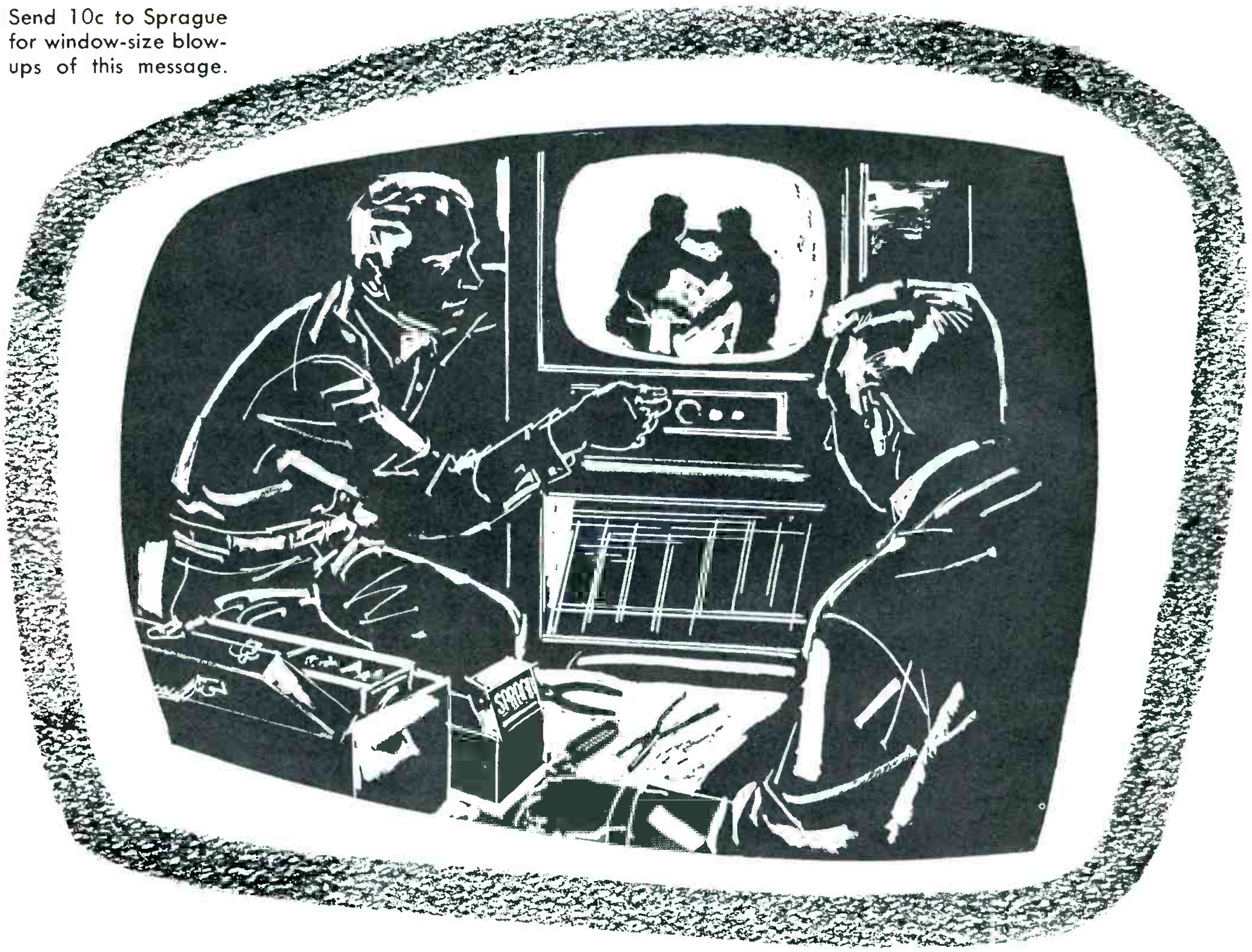

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YOUR INDEPENDENT TV-RADIO TECHNICIAN

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Troubleshooting by Waveform Analysis

How to spot circuit defects and performance deficiencies with the use of a scope and signal generator.

Audio Facts

Points to consider when evaluating performance of a hi-fi system, plus localizing faults to specific units.

Hints for PC Servicing

Practical suggestions for tracing circuits and replacing components on printed boards, exemplified by this report on a serviceman's actual experiences.

ABOUT THE COVER

It looks as though our serviceman this month is about to get the "bird" for his latest efforts in repairing a TV set. One thing is for certain, however — he's obviously learned to "talk turkey." Thinking ahead a bit, we wonder how he plans to get friend "turk" home — and who'll have enough nerve to wield the axe?

USE HANDY CARD AT BACK TO ENTER YOUR SUBSCRIPTION

Letters to the EDITOR

Dear Editor:

In the September *Dollar and Sense Servicing* column, you stated that service dealers might have success in promoting sales of a timer mechanism that could be inserted between a TV receiver and the power line. A good item for this purpose is a timer similar to those used in photographic work. It will shut the set off after a preset period (say 30 minutes), giving a person a chance to watch TV awhile before going to sleep.

ALLAN W. SEELY

Danvers, Mass.

Good idea, Al — only thing is, it won't turn it on in the morning.—Ed.

Dear Editor:

Now that you have taken over *Electronic Servicing* and extended my PF REPORTER subscription, I would like to bring my records up to date regarding the time when my subscription expires. The address label on the latest issue reads:

1A BH 114 1074 DE

Does this mean that my subscription expires with the October, 1974 issue?

MICHAEL HADAY

Camden, N. J.

Yes, you can look forward to 191 more issues of PF REPORTER, *ending with the October, 1974 issue. Yours is one of the longest subscriptions we now have on our books, so you're assured of being kept up to date on future electronic developments which have yet to be discovered. Who knows — inter-planetary travel may be an everyday occurrence by then, and we'll be mailing copies to you on Mars!—Ed.*

Dear Editor:

As time goes by, we accumulate more and more TV cabinets because so many traded-in sets are good for nothing but dismantling. I am sure that something useful can be done with them, but what? Surely someone else has given this problem some thought.

MRS. GABRIEL M. FOUASNON
(a serviceman's wife)

Bay St. Louis, Miss.

Considering the picture-tube cut-outs, they might serve as simple speaker enclosures. Anyone "Have chassis—want cabinets"?—Ed.

Dear Editor:

Ever since I started taking PF REPORTER, I've been hoping you would put troubleshooting hints in a special section that could be clipped out and filed without tearing up the magazine. Your new *Video Speed Servicing* fills the bill very nicely. In order to get the most out of this section, I'd like to know if it is meant to be filed in any special way. Are the facts basically production change information, or what?

PHILIP O'NEILL

Los Angeles, Calif.

The Video Speed Servicing sheets are designed to be torn out and punched for insertion in loose-leaf binders. Since all six items on a sheet refer to the same chassis, the easiest way to file the information is to insert the whole sheets alphabetically by manufacturer.

Although some items describe production changes, the rest are gleaned from a variety of field service information. Certain items announce field changes that are recommended after an entire model run has been completed; still other items warn technicians to be on the lookout for particular components that tend to have an unusually high failure rate.

If you want to bring your VSS file up to date, Vol. I, in loose-leaf binder, is available at $4.95; Vol. II, paper-bound, for only $2.95.—Ed.

Dear Editor:

I would like some more information on European tube types besides that given in the September issue. Are the following European and American types interchangeable? EBC90 — 6AT6; EF93 — 6BA6; EF95 — 6AK5; EK90 — 6BE6; EZ35 — 6X5; ECC81 — 12AT7WA, ECC82 — 12AU7A, 5814, 6189; ECC83 — 5751; ECC85 — 6BQ7A (if worse comes to worst!).

ROBERT C. HARP

Detroit, Mich.

The first five pairs are so similar that you should have no trouble interchanging them. The American types paired with the ECC81,-2, and -3 are all "ruggedized" industrial versions of the 12AT7, 12AU7, or 12AX7. As such, they should be better than their prototypes for replacement use; however, we cannot assure you that they will be trouble-free in audio applications. If you need a high-quality replacement for the 12AX7, try a 12DT7. This brand-new American type was especially engineered for better performance in audio preamp stages.

You're right in surmising that a 6BQ7A should be tried in place of an ECC85 only " if worse comes to worst." This

Statement of Advertising Policy

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CARDIOID (UNIDIRECTIONAL) MICROPHONES, so named because their polar pattern is heart-shaped, pick up sound arriving at the front and reject sound arriving at the back. Proper placement of cardioid microphones reduces pick-up of ambient noise and echoes, minimizes risk of feedback.

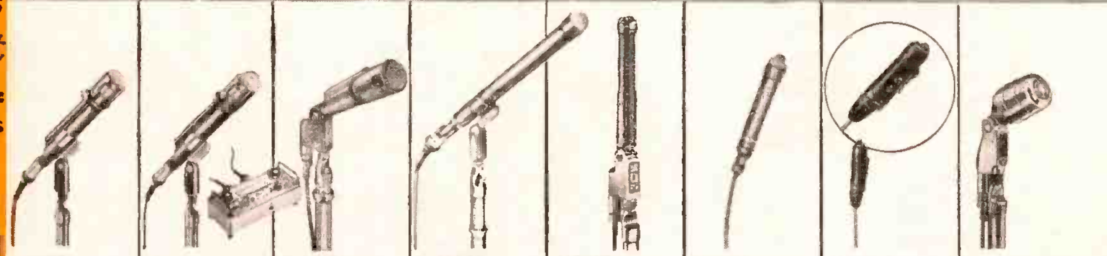
DIFFERENTIAL MICROPHONES have a noise cancelling pick-up pattern. Sound waves originating from a point more than a few inches away from the microphone enter both sides of the case at the same time and cancel each other. When sound source is close to microphone, the sound waves do not cancel. Differential microphones are ideal for use in areas of high surrounding noise.

ACOUSTALLOY DIAPHRAGM IN ALL DYNAMIC MICROPHONES. Acoustalloy—the virtually indestructible diaphragm material—gives peak-free response, prevents popping as commonly experienced by explosive syllables "B" and "P" in ribbon-type microphones. Because Acoustalloy gives improved response, operators can work with confidence under [illegible] conditions.

ELECTRO-VOICE MICROPHONES FOR EVERY PURPOSE

MODEL NUMBER	667	666	665	655C	654	649A	646	635	664	636	530	647	623	611	605	615	911	926	920	715	727	974	912	951	622SKK	625SKK	606	648	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	205STCKK
PICKUP PATTERN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BROADCAST—TV																																			
Television	●	●	●	●	●	●	●																												
Radio	●	●	●				●	●	●			●																							
Remote		●	●				●	●	●	●	●	●	●															●							
PUBLIC ADDRESS																																			
Auditorium	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●		●											
Outdoor		●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	●		●					●		●				
High noise																										●	●				●				
Mobile																●													●	●					
Broad Coverage	●	●	●	●	●				●	●	●													●											
Lectern—Stage	●	●	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●											
Paging									●	●	●		●	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●			
Church Pulpit		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●				●							
COMMUNICATIONS																																			
Railroad																										●	●		●	●	●	●		●	
Emergency—Fixed									●	●	●	●	●	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●			
Emergency—Mobile																				●					●	●	●		●	●	●	●	●	●	
Marine															●	●					●				●	●	●	●	●	●	●	●	●	●	
Aircraft—Ground Station									●	●	●		●		●										●	●	●	●	●	●					
Aircraft—Airborne																															●	●		●	●
Business—Mobile																									●	●			●	●	●	●	●	●	
Inter Communication										●	●		●	●	●	●	●	●	●	●	●			●	●	●	●	●							
Amateur—Fixed									●	●	●		●	●	●	●	●	●	●	●	●		●	●	●			●	●						
Amateur—Mobile																●				●	●								●	●	●	●	●	●	
[illegible]																									●	●									
RECORDING																																			
Studio Recording	●	●	●	●	●			●	●																										
Disc—Professional	●	●	●	●	●			●	●																										
Tape—Professional	●	●	●	●	●			●	●																										
Tape—Home									●	●	●		●	●	●	●	●	●			●	●	●	●											
DICTATING MACHINES																●				●	●		●		●				●						
SOUND LEVEL MEASUREMENT				●	●			●		●	●																								
OPERATING ELEMENTS																																			
Dynamic	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●									●	●	●	●	●	●	●	●			
Crystal																	●	●	●			●	●	●											
Ceramic																				●	●														
Carbon																																	●	●	●

BROADCAST AND TV MICROPHONES



Model 666
Dynamic, Cardioid
Rejects unwanted sound—doubles the working distance—wide range. Floor or desk stand and boom mount available.

Model 667
Dynamic, Cardioid
Variable response—low noise—transistorized—shockproof. Controls compensate for varied acoustic conditions found in TV, broadcast, recording

Model 665
Dynamic, Cardioid
Economical—high value—top performance. Similar to 666 but designed for less exacting conditions.

Model 655C
Dynamic, Nondirectional
Widest range—to 22KC for TV, broadcast and recording. Can be hand-held or mounted on floor or desk stand.

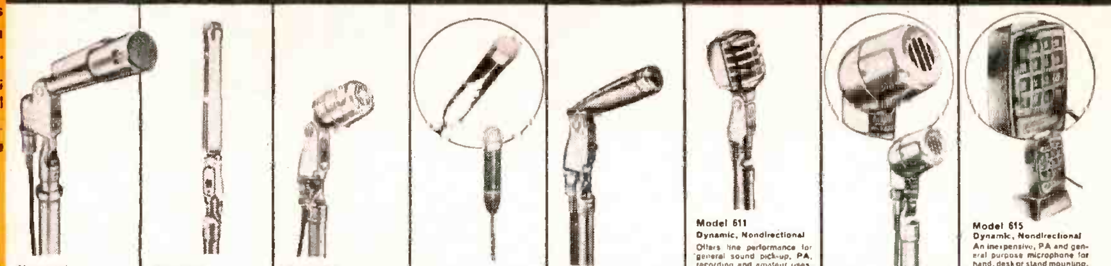
Model 654
Dynamic, Nondirectional
Similar to 655C except designed for all-around use: economical

Model 646
Dynamic, Nondirectional
Compact lavalier for chest, desk or hand use. Designed for broadcast, TV or PA use.

Model 649A
Dynamic, Nondirectional
Exceptionally small highest quality lavalier that can be easily concealed anywhere for chest or hand use.

Model 635
Dynamic, Nondirectional
For TV, broadcast, recording; ideal for remote use—rugged. May be hand held or mounted on desk or floor stand.

PUBLIC ADDRESS, RECORDING AND GENERAL PURPOSE MICROPHONES



Model 664
Dynamic, Cardioid
Designed for rugged use in any PA, recording or communications situation. Doubles working distance—minimizes feedback.

Model 636
Dynamic, Nondirectional
World's finest for wide range PA, recording and general purpose. Slim style does not hide entertainer.

Model 530
Dynamic, Nondirectional
Favorite for years in PA, with recording, amateurs and broadcast applications.

Model 647
Dynamic, Nondirectional
A versatile PA lavalier for chest, desk or hand use. Indoors or outdoors.

Model 623
Dynamic, Nondirectional
Handsome modern styling. Designed for PA general use or recording

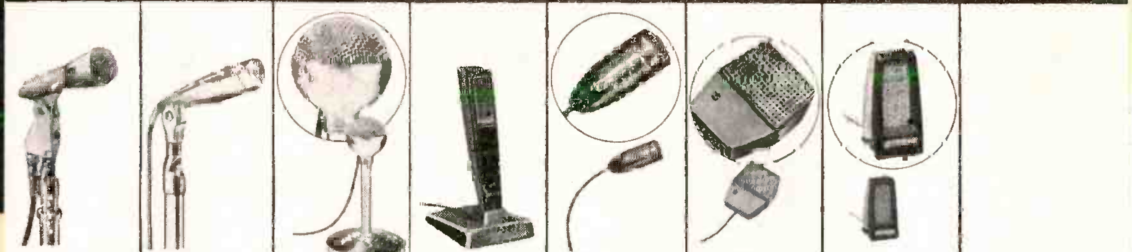
Model 611
Dynamic, Nondirectional
Offers fine performance for general sound pick-up, PA, recording and amateur uses

Model 911
Crystal, Nondirectional
For economical PA, home recorders, amateur uses. Desk or floor stand mounting.

Model 605
Dynamic, Nondirectional
A small, convenient microphone for PA, general purpose, or paging. Desk or floor stand mount

Model 615
Dynamic, Nondirectional
An inexpensive, PA and general purpose microphone for hand, desk or stand mounting.

Model 715
Ceramic, Nondirectional
An inexpensive microphone for general PA, home recording and amateur uses. Hand held, or mounted on desk or floor stand.



Model 951
Crystal, Cardioid
[illegible] general purpose and amateur uses. Increases working distance—retards feedback.

Model 926
Crystal, Nondirectional
[illegible] for PA, general purpose, paging, home recording and amateur use.

Model 920
Crystal, Nondirectional
All direction pickup for conferences, discussions, home recording and PA.

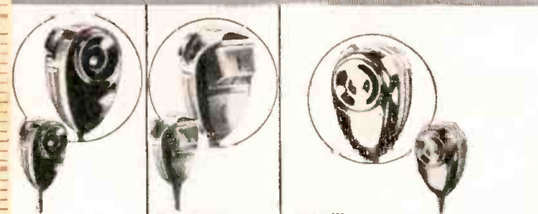
Model 727
Ceramic, Nondirectional
Designed for PA, paging, recording and amateur uses. Hand held, desk or stand mounted.

Model 914
Crystal, Nondirectional
Small lavalier for chest or hand use, home recording, PA and amateur applications.

Model 912
Crystal, Nondirectional
An inexpensive microphone for general PA, home recording and amateur uses. Hand held

Model 718
Ceramic, Nondirectional
Suitable for paging, home recording and amateur use. Can be hand held or desk mounted.

COMMUNICATION MICROPHONES



Model 210KK
Carbon, Nondirectional
Single button microphone for general replacement and amateurs

Model 600D
Dynamic, Nondirectional
A rugged mobile microphone. Offers flat response and light weight.

Model 205KK
Carbon, Differential
Noise canceling close talking microphone for Private Aircraft or any noisy vehicle. Discriminates against all noise from any direction

Model 205STCKK
Carbon, Differential
A noise cancelling microphone for commercial aircraft. Has CAA type certificate 1040.

Model 602
Dynamic, Differential
Noise cancelling, hand held, microphone for mobile or fixed station use

Model 600TR
Dynamic, Nondirectional
Same as 600D but has built-in transistor amplifier. Works in carbon microphone input to give high quality sound.

Model 602TR
Dynamic, Differential
Same as 602 but has built-in transistor amplifier. Works in carbon microphone input.

SPECIAL PURPOSE MICROPHONES

Model 606
Dynamic, Differential
Noise cancelling microphone for stand use under high ambient noise.

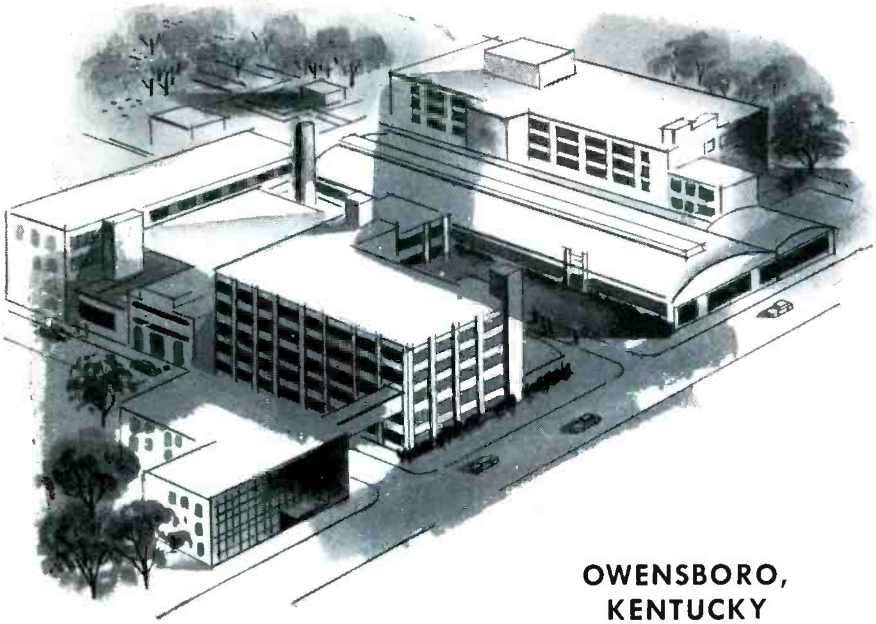
Model 648
Dynamic, Nondirectional
For intercom, paging or PA. Mount on stand, boom, gooseneck or Model 448 boom.

Model 622SKK
Dynamic, Nondirectional
Handset type microphone for paging, intercom and communications uses.

Model 625SKK
Dynamic, Differential
Noise canceling handset for use under high noise conditions.

Model 805
Crystal, Contact
Mounts directly on body of guitar, banjo, mandolin, violin or any vibrating musical instrument.

BROAD NEW CUTS



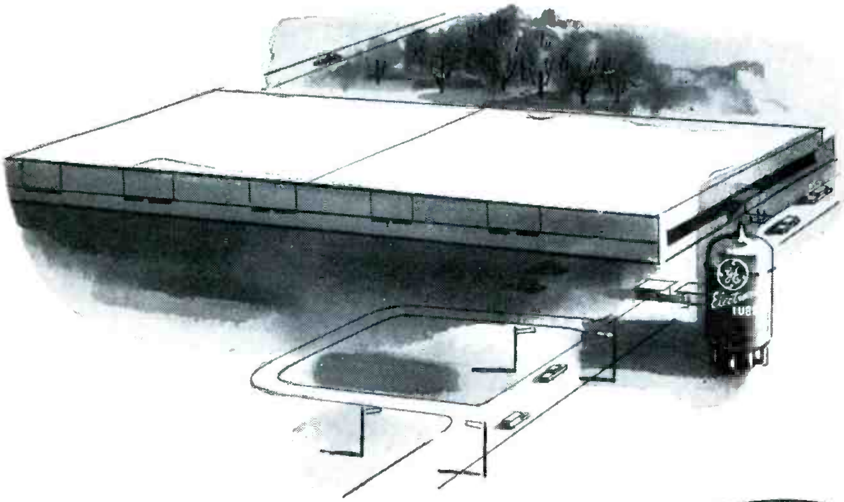
OWENSBORO, KENTUCKY

FIRST IN TUBE MANUFACTURING FACILITIES!

General Electric's four large and ultra-modern receiving-tube plants back up your replacement sales with a product that is uniform in high quality.

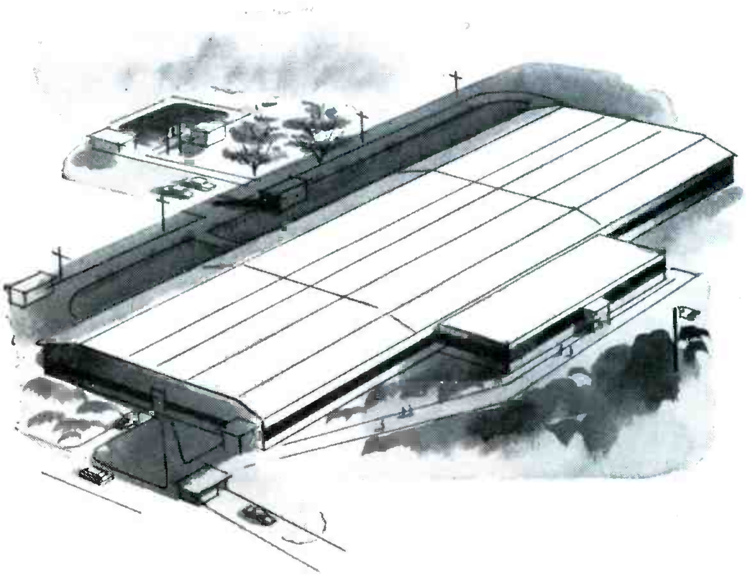
Pace-setting General Electric tube research and design go hand in hand with manufacturing and test facilities that are the most advanced in the industry.

"Snow White" cleanliness is found throughout. Lint-free workers' garments; filtered and conditioned air; floors cleaned many times daily—these help to make G-E Service-Designed Tubes the best, most dependable you can install.

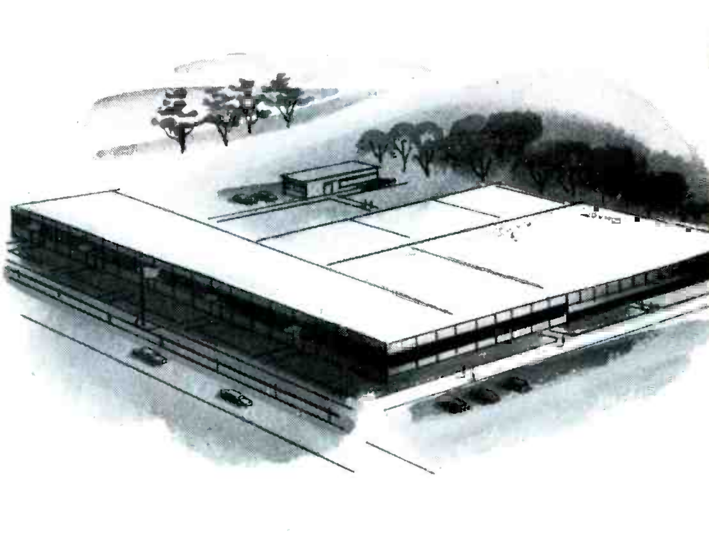


OPERATION up turn
Buy now for extra values
GENERAL ELECTRIC

ANNISTON, ALABAMA



TELL CITY, INDIANA



substitution will often work in a pinch, but there are also cases in which it won't. If you are in a hurry for a temporary ECC85 replacement, and none of your 6BQ7's will work, you might get better results if you use a "hotter" tube such as a 6BS8.—Ed.

Dear Editor:

The description of the Aerovox Model 97 LC Checker on page 64 of your September issue is very good. However, you overlooked the most important feature; that is, capacity can be measured in-circuit.

CHARLES GOLENPAUL
Vice-President,
Aerovox Corp.
New Bedford, Mass.

You are right; this point was not specifically mentioned. However, in the photograph of Fig. 5, the author is shown testing a capacitor in the circuit — and, as they say, a picture is worth 1000 words. —Ed.

Dear Editor:

In "Video Speed Servicing" for September, card GE-M3-5 refers to integrator network part RED-025. The correct catalog number is REK-025, or to use our new system of numbering, WT33X18.

D. V. ROSSMAN
General Electric Co.
Syracuse, N. Y.

We traced the error to our proofreader. Do you think 20 lashes will be enough?—Ed.

Dear Editor:

I am having trouble with a push-pull audio amplifier I am building. The design calls for a feedback resistor from the secondary of the output transformer to the phase inverter stage. The amplifier sounds OK until I hook up this resistor, but then I get a high-pitched noise no matter where on the secondary I connect the resistor.

L. B. ROMERO
New York, N. Y.

Since the amplifier works normally without the feedback resistor, the trouble is undoubtedly due to incorrect phasing of the feedback signal. To cure the trouble, reverse the connections from the transformer to the plates of the 6V6 audio output tubes.

Sorry we couldn't reply to you personally, Mr. Romero, but you neglected to give us your street address.—Ed.

Dear Editor:

Which one of your past issues carried information about the B+ boost circuit? I recall seeing such an article, but I can't seem to find it again.

J. H. GOURLEY
Sioux Falls, S. Dak.

A full description of B+ boost was included in "Operation of Damper Circuits" in August, 1956. One point is likely to be confusing at first: The boost voltage is not pure DC but contains a 15,750-cps AC component with a roughly parabolic waveshape. The various feed lines from the boost supply to the verti-

cal oscillator, etc., contain RC networks that filter out the AC in about the same manner that ripple is removed from the regular B+ supply voltage.—Ed.

Dear Editor:

Being the only technician in a large music store in a relatively small city has its advantages and disadvantages. One of the latter is that I find myself working on electronic organs with which I have had no previous experience. Having no musical training, I find it necessary to service an organ from a strictly technical standpoint.

Therefore, I wholeheartedly second Mr. Lee Ruetz's motion that you run a series of articles on electronic organs. Even a few hints on good service procedure would help.

ERNEST POWER, JR.

El Centro, Calif.

For music-minded technicians, we've just obtained a very concise manuscript on the subject and plan to publish it later this year.—Ed.

Dear Editor:

Thank you for "The Troubleshooter." It is the finest section of its kind in current technical publications. The fundamental purpose of such a section is to educate the reader. "The Troubleshooter" does this in a thought-provoking style and starts the cogs grinding in the right direction.

C. S. DOYLE

Denver, Colo.

Dear Editor:

I would like to see an article on practical scope signal tracing in RF-IF circuits using a demodulator probe but without use of signal-generating equipment. The article should deal primarily with interpreting waveforms, both normal and abnormal.

ELVIN SPINKS

Baton Rouge, La.

As we do in almost every issue, we'll continue to present material dealing with the use of oscilloscopes and probes in making waveform analyses; however, depending on transmitted station signals is not often practical. We prefer to use controlled, closed-circuit signal-generating equipment for reasons of accuracy—but station signals can be substituted with no change in procedure.—Ed.

Dear Editor:

In "Servicing New Designs," you have twice described the EIA base type 7FA used on some 110° picture tubes. (See the April, 1957 and May, 1958 issues.) Different pin connections for this base were given in the two different articles. Would you mind clearing up this point?

ORVILLE TAFT

Morgantown, W. Va.

We goofed! Not once, but twice — and your sharp eyes caught both errors in our descriptions of this base. To set the record straight for once and for all, the proper pin connections are: 1—blank, 2—cathode, 3, 4—filament, 5—control grid, 6—focusing anode, and 7—accelerating anode.—Ed.

Shop Talk

MILTON S. KIVER

Author of . . .
How to Understand and Use TV Test Instruments and Analyzing and Tracing TV Circuits

As of now, there are no transistorized television receivers commercially available, but considerable work toward this end is being carried out by applications engineers of receiver and transistor manufacturers. Much of the development work is secret, but the circuit of a transistorized television receiver developed by Texas Instruments, Inc. is available to the industry for study.

Since Texas Instruments is a transistor manufacturer, only their units are utilized in the receiver. Other firms, however, have comparable transistors.

The transistorized television receiver shown in Fig. 1 contains 24 transistors, 13 semiconductor diodes, and one high-voltage rectifier tube to perform all of the functions required to develop a high-definition picture and accompanying sound. For reasons of economy, a 1V2 tube is employed instead of a high-voltage semiconductor diode to develop anode voltage. When a suitable high-voltage semiconductor does become available, however, it will replace the 1V2 and thus complete the shift to semiconductor devices.

Power for the set is furnished by a ten-cell nickel-cadmium battery providing 12 volts at an average current of 700 ma. The picture tube is a 9QP4 with a filament modified to operate at 12 volts, 150 ma. This particular tube was selected because the 70° deflection angle requires reasonably low deflection power.

From the block diagram shown in Fig. 2, note that the sequence of stages is the same as for conventional vacuum-tube receivers. The major variations that do exist will be found either in the number of stages per section or in the addition of auxiliary stages because of the differences between tubes and transistors. Thus, the video IF system possesses five stages, whereas three are common in vacuum-tube systems. In the sound section, there are two 4.5-mc IF amplifiers, a ratio detector, an audio driver, and a push-pull class-B output amplifier. In addition, the second IF stage functions as a reflex audio amplifier. The audio output of the ratio detector is fed to the base of the second sound IF, the volume control is connected in the emitter circuit, and the amplified audio obtained from this point is transferred to the audio driver.

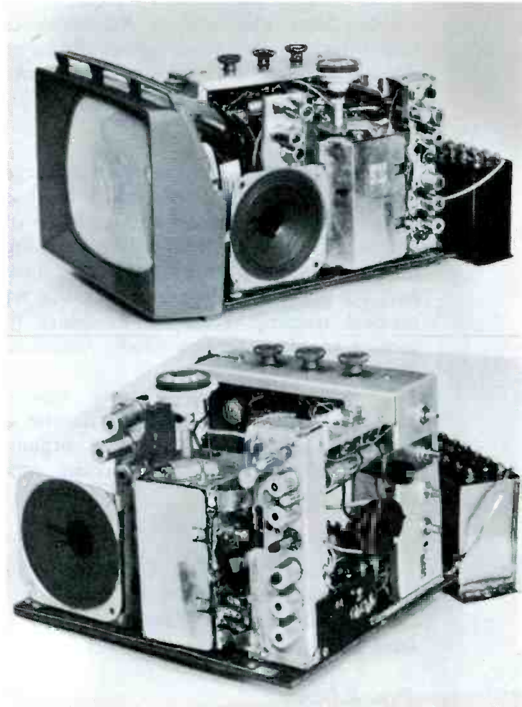


Fig. 1. Experimental transistorized TV set built by Texas Instruments, Inc.

Another section of the receiver that differs from conventional TV design is the horizontal system. The difference is not to be found so much in the block diagram as in the actual circuit, which will be examined as part of the following section by section analysis.

Tuner

Two tuners were developed for this set; the more sensitive one (Fig. 3A) uses three tetrode transistors—one each for the RF amplifier, mixer and local oscillator—and provides a gain of 20 to 22 db on channel 13. Unfortunately, the noise figure is 14 db (also on channel 13), and this is poor compared to a vacuum-tube tuner. Another disadvantage of the

• *Please turn to page 64*

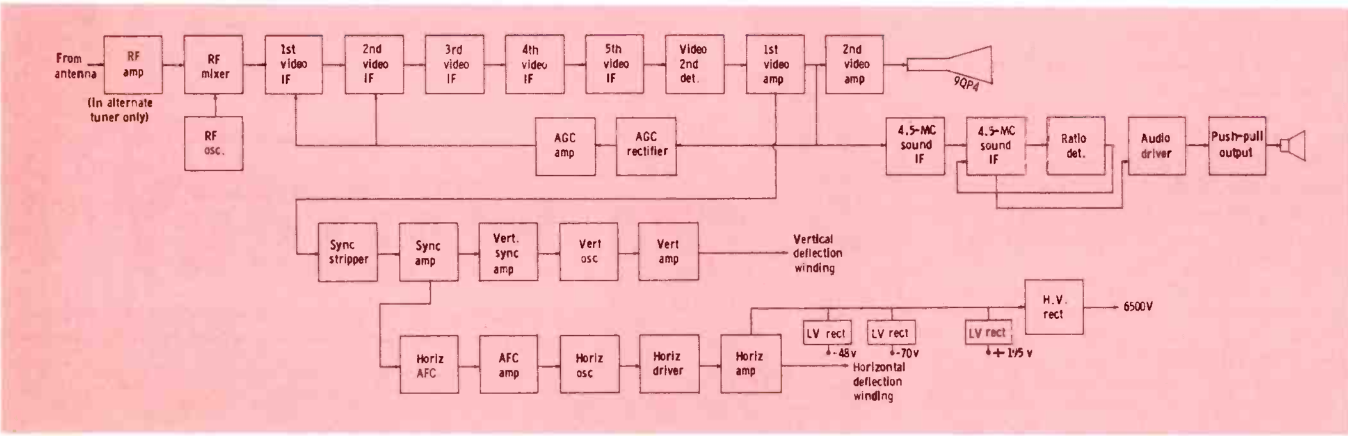


Fig. 2. Block diagram of transistorized TV receiver shows it has more stages than a vacuum-tube set.

Sylvania consumer advertising points out—

The big difference in Picture Tubes!

Take it from Bill Shipley: "'Silver Screen 85' consumer advertising makes it easy to *sell-up* to 'first line' picture tubes."

New TV Campaign dramatizes test results . . . *sells consumers up* to "first line" picture tubes . . . builds more profitable sales and satisfied customers for dealers everywhere.

Sylvania's fabulous new family, "The Real McCoys," is one of the top new television shows of the season. Critics label it the "Sleeper of the Year." Week after week, on the "Real McCoys" Sylvania is making millions of set owners aware of the big difference in picture tubes as revealed by direct comparisons of a nationwide sample of cut-rate off-brand picture tubes against Silver Screen 85 standards.

New commercials like the "Brightness Test" are pre-selling consumers on the "first line" performance of Silver Screen 85.

For dealers everywhere it means more and more customers asking for "Silver Screen 85"—Pre-sold customers make satisfied customers—strengthening your business reputation and building long-range profitable growth.

Sylvania has designed this powerful new selling tool for you. Get behind it and *sell-up* to "first line" Silver Screen 85 picture tubes.

Highlights of Sylvania's TV "Brightness Test."

"Don't be fooled by picture tubes that look alike — they don't act alike."

Sylvania's Silver Screen 85 is over twice as bright as this "off-brand" tube.

"Insist on a nationally known 'Silver Screen 85'—there's one to fit every make TV."

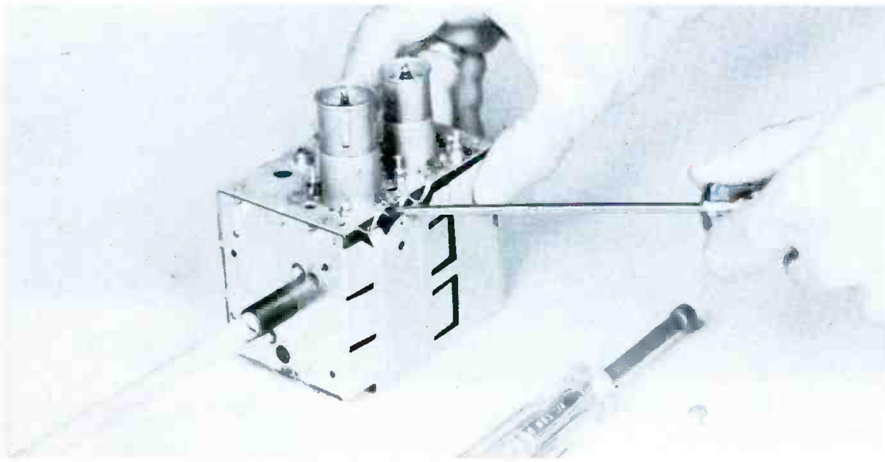
SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., Montreal

LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY

servicing SWITCH-TYPE TUNERS

The tuner is the most complex single unit in a TV receiver. Not only are a multiplicity of components employed, but their physical configuration with respect to each other is critical. The relative complexity of a tuner does not preclude servicing, although it does mandate that extreme care be employed because tuned-circuit components are exposed and can be easily disturbed. Ideally, tuner repairs should be followed by realignment; however, with the proper precautions, realignment can often be avoided. On completion of any tuner repair, check operation on all received channels, making sure that performance has not been impaired.

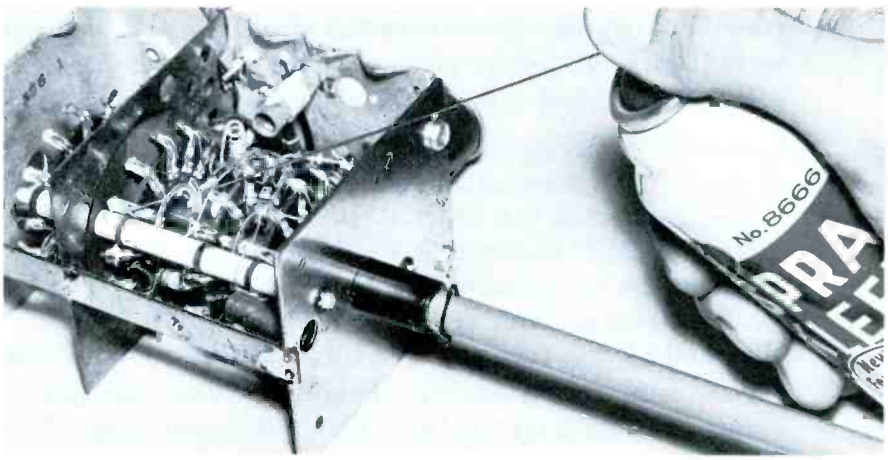


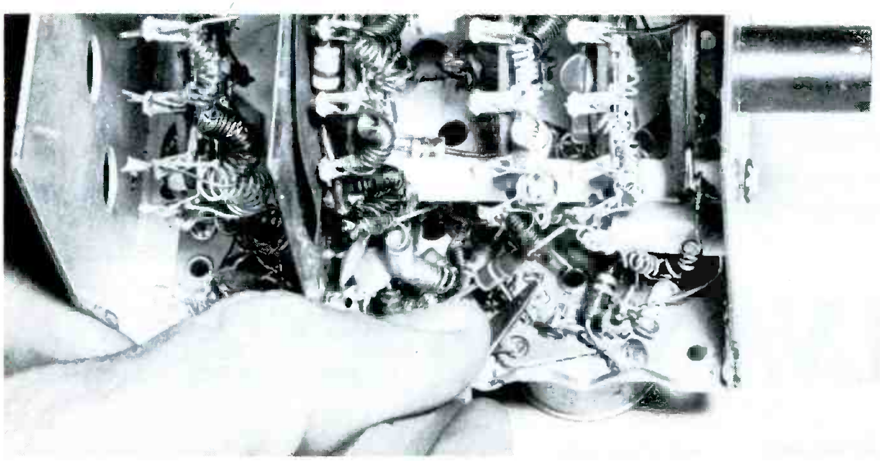
Getting at the Trouble

The first step toward gaining access to the circuitry involves removal of the "U" shaped cover. It may be secured by one or more self-tapping screws in addition to tension fastening at both sides. Do not mangle or bend this piece—a tight fit is necessary to avoid spurious radiation and pickup of undesired signals.

Cleaning Contacts

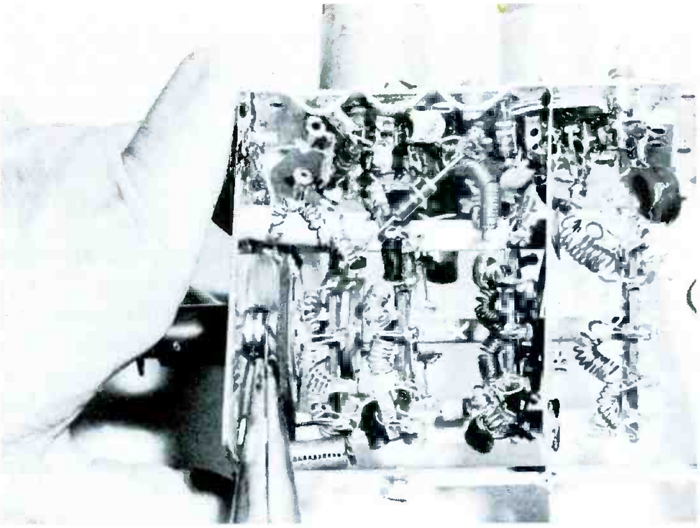
Noisy and intermittent operation due to dirty tuner contacts is a frequent complaint. In cleaning, apply cleaner or combination cleaner-lubricant directly to the contacts. Avoid contaminating components and tube sockets, or you may introduce new troubles. A light oiling of the cleaned contacts with a dripless, conductive-type lubricant will insure longer trouble-free operation. This step isn't necessary if a combination cleaner-lubricant is used.





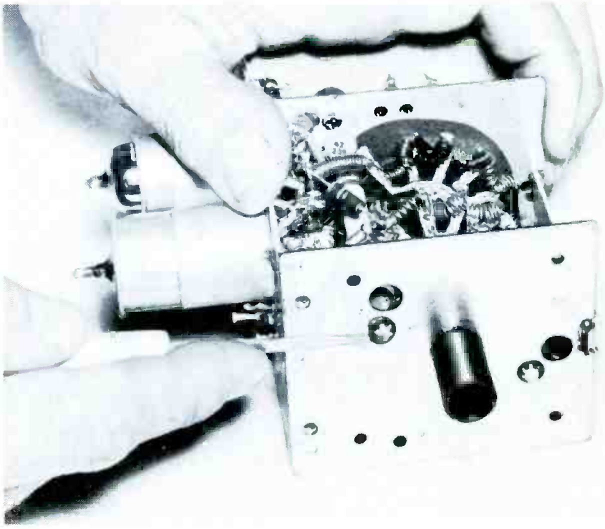
Tube Socket Contacts

Contacts on wafer-type sockets must be tightened from below. After removing the tubes, press the contacts together, using either a soldering aid or small screwdriver. Be extra careful not to disturb any of the circuit components during this procedure.



Removing Shaft

Extracting the detent-shaft assembly is a most desirable step when component replacement is necessary, since it provides access for the soldering iron and tools. Simply remove the "C" clip behind the front panel and pull the shaft assembly forward. Mark both the shaft and tuner body so that the shaft can be correctly reinstalled.

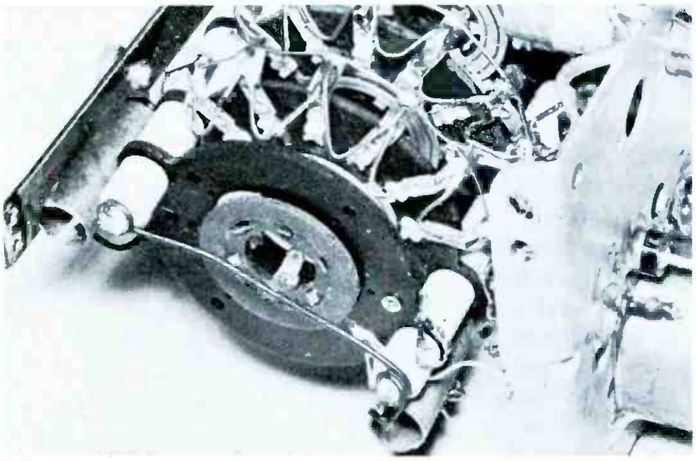


Removing Front Cover

After the shaft is out, the front cover can be taken off by removing two 1/4" hex-head screws plus two grippers that secure the wafer support rods. Then, the front plate is unsoldered from the bottom bracket, fine tuning assembly and main tuner body. Incidentally, it's a good idea to use new grippers when reassembling the tuner.

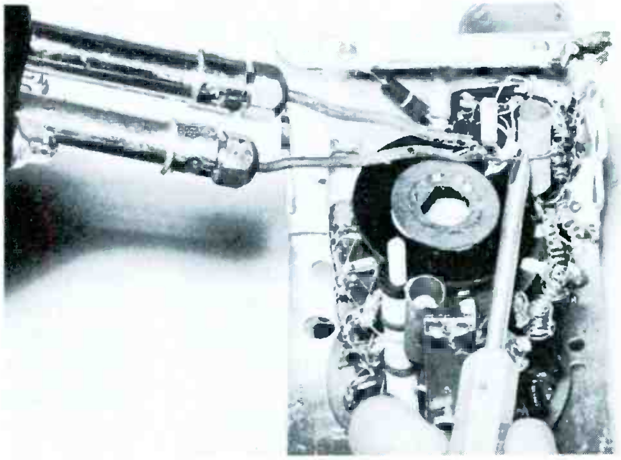
Heavy Duty Soldering

Because of the large surface area, chassis work requires a soldering iron with a large tip. An iron with a tip diameter of at least 1/2" and 200-watt minimum rating is satisfactory. A smaller iron might eventually unsolder the front plate but would not be suitable for resoldering. Also, a chisel tip is better than a pyramid, because it provides more surface contact and thus a better transfer of heat.



Secure the Support Rod

After removing the front cover plate, wire the support rods together to prevent them from falling out during servicing. From this point on, extra care must be exercised to avoid bending or moving any of the coils. An alternate method of securing the support rods is to install a small block or wedge between the rods and the rear cover.



Fine Tuning Assembly

If it becomes necessary to remove the fine tuning assembly, unsolder the remaining connections. To reassemble the tuner, reverse the process used to take it apart. Carefully check for shorts or displaced components before firing the unit up for test. Make an operational check on all channels received in your area and readjust as required.

servicing NEW DESIGNS

by Thomas A. Lesh

"Double-Barreled" Hi-Fi Tuner

Recently introduced stereo versions of AM-FM tuners feature completely separate AM and FM circuits. This design permits the simultaneous reception of both AM and FM stations, a feature not possible with earlier combination units. The output signals are applied to both channels of a stereo amplifier system for operation.

Although such reception would usually sound like a barroom brawl, the two programs do merge into stereophonic sound on the occasions when a pair of stations (one AM, one FM) join together to broadcast the dual tracks of a stereo recording. Some of the cities where this type of operation has been conducted on a regular schedule are New York, Pittsburgh, Washington, San Francisco, and Waltham, Mass.

When no stereo shows are being broadcast, a monaural program can be received on either channel in the conventional way. It is also possible to leave both sides of the tuner in operation and feed the separate AM and FM signals to speaker systems in different rooms.

An example of a stereo tuner is the Madison Fielding Series 330 (Fig. 1). The chassis is laid out into two distinct sections, unlike the usual AM-FM design in which numerous components are shared by both signal channels. Two independent dial scales, both featuring flywheel tuning, are placed side by side. The tuning eye at the center of the front panel has separate AM and FM wedges that operate individually, as shown in Fig. 2. When either an AM or FM station is tuned to the exact center frequency, the associated wedge will close. This dual operation is accomplished by using a 6AF6G tuning-eye tube which has two control grids.

The AM section includes an RF stage (6BA6), a feature which is often omitted even in high-fidelity tuners. Other stages are a 6BE6 converter, 6BA6 IF, 6AL5 detector-AVC, and an audio cathode follower using half of a 12AU7. The FM circuitry is similar to that found in high-sensitivity monaural tuners. Two 12AT7's are used in the front end—one as a grounded-grid RF amplifier and mixer, the other as oscillator and AFC. The balance of the system consists of three 6AU6 IF amplifiers, a 6AL5 ratio detector, and the other half of the 12AU7 used as an FM cathode follower.

Both AM and FM detected signals are fed to twin cathode followers through independent level controls, which should be adjusted so that both input signals are approximately equal in amplitude. Levels should be adjusted before a stereophonic program begins, since they will not necessarily remain equal after it starts. (The relative amplitudes will vary according to program content.)

A wafer-type selector switch with AM, STEREO and FM positions, ganged with an off-on switch, determines how the output signals shall be fed to the two output jacks. As shown in Fig. 3, jack J1 is used for all monaural signals as well as for FM output during stereo reception. It is normally connected to the left-channel audio amplifier. J2, the right-channel jack, is generally used for AM stereo signals only.

If you trace the switch circuit in the AM position, you will notice that an FM-channel signal reaches J2 through contacts 6 and 7. Thus, the AM position is also a stereo-reverse position. Many stereo preamps or

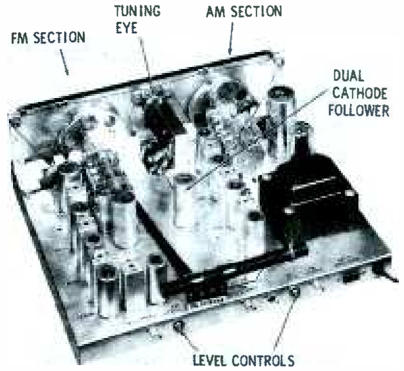


Fig. 1. Madison Fielding stereo tuner has fully separate AM and FM sections.

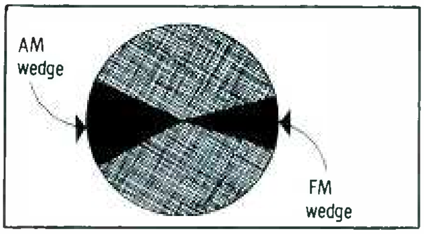


Fig. 2. Tuning-eye tube with two grids produces two independent indications.

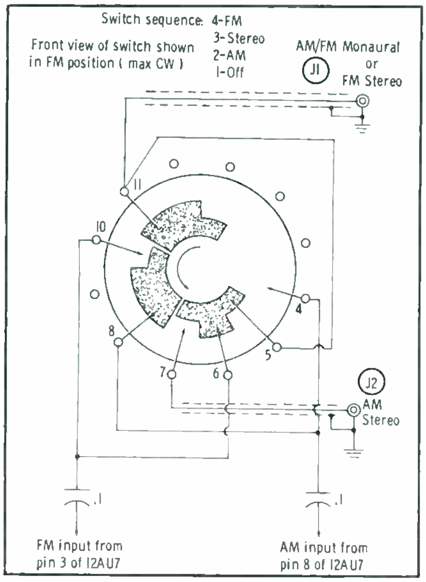


Fig. 3. Twin cathode followers are connected to output jacks through a switch.

audio amplifiers contain switching circuitry that prevents this signal from reaching the right-hand audio channel whenever the function switch is placed in *monaural* position. If the amplifier does not have this feature, the right-channel audio amplifier should be switched off during AM reception.

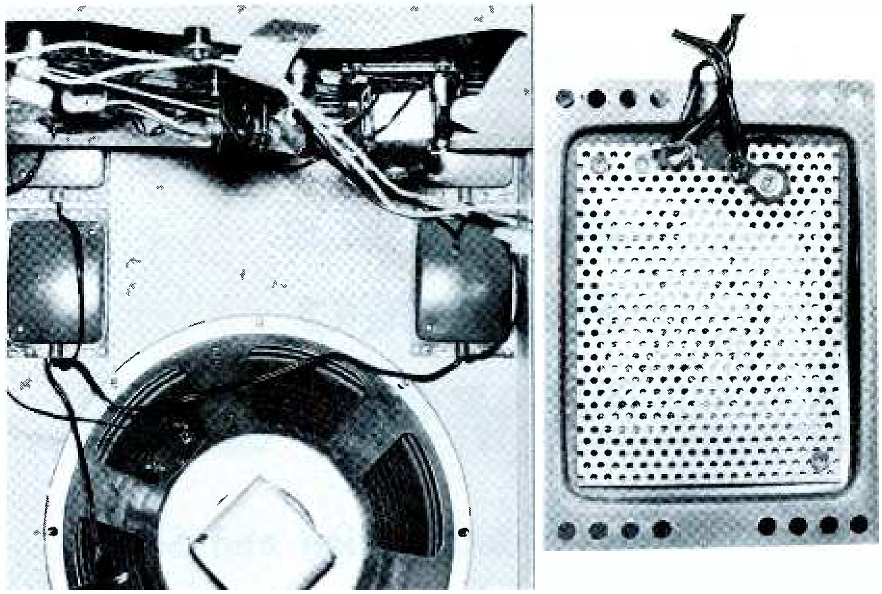
Besides the regular stereo jacks, the Series 330 tuner is equipped with a *multiplex* jack for use when a single FM station is transmitting both channels of a stereo program by the multiplex-subcarrier method (see "The FM Signal" in the July, 1958 issue). Available at this jack is an incompletely filtered output signal from the ratio detector, which contains not only the audio obtained from the main carrier, but also a supersonic signal obtained by demodulation of the multiplex subcarrier. This latter information can be fed to an external adapter unit (soon available) that will further demodulate the subcarrier signal to obtain the second channel of the stereo program.

Multiple TV Speakers

Thanks to the growing interest in good audio reproduction, TV manufacturers have been paying increased attention to sound quality in their new models. Multiple speaker systems are frequently seen in consoles as a result of this development.

Several of the new Silvertone receivers, for example, contain four electrostatic tweeters in addition to the usual large permanent-magnet speaker. Some models may have these smaller units stapled to the cabinet as illustrated in Fig. 4A. The connecting leads must be unplugged from the chassis before it is removed from the cabinet; however, the stapled speakers do not have to be taken out because they are not essential for operating the set on the bench.

Details of an electrostatic speaker are visible in Fig. 4B. One element is a perforated metal plate which is connected to the low side of the external circuit, and the other element is a flexible plastic sheet having a metallized coating which is connected to the high side of the circuit. A DC potential is applied across the speaker terminals to produce an electrostatic charge between elements. In order to vary the strength of this force, and thus cause the plastic sheet to vibrate, an audio signal is applied.



(A) Units stapled to cabinet. (B) Details of speaker construction.

Fig. 4. Some Silvertone TV consoles are equipped with electrostatic speakers.

The speaker circuit of Chassis 528.51400 is presented in Fig. 5. (Other Silvertone chassis have a somewhat different hookup.) Note that all four tweeters are connected in parallel. The required DC voltage is obtained from B+ through isolating resistor R1. The combination of C2 and R2 isolates the speakers from the hot chassis, yet serves as a ground return for the signal. The incoming audio signal is coupled to the electrostatic speakers through C1, which has a relatively small value of .047 mfd in order to keep very low frequencies out of the tweeter circuit.

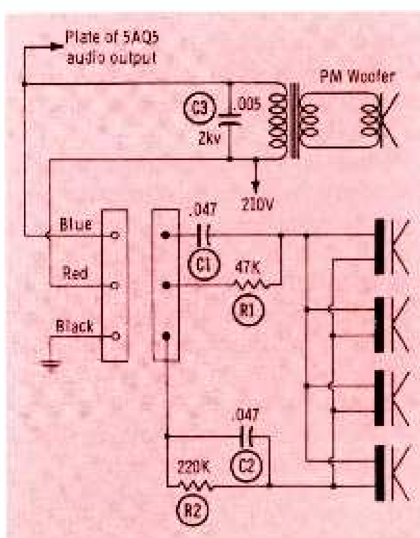


Fig. 5. Electrostatic tweeters require a DC voltage as well as a signal input.

On the other hand, higher audio frequencies are shunted across the primary of the woofer transformer by C3. This capacitor has a very high voltage rating of 2 kv, enabling it to withstand transient voltage peaks that occur when current through the transformer primary suddenly starts or stops.

The new Admiral Chassis 20B6C drives either three or four permanent-magnet speakers. One or two woofers (8" in regular consoles and 6" X 9" in lowboys) are teamed with a pair of 5" midrange units (see Fig. 6). The high-side voice-coil terminal of each speaker is identified by a red dot on the speaker frame. Failure to observe these

• *Please turn to page 73*

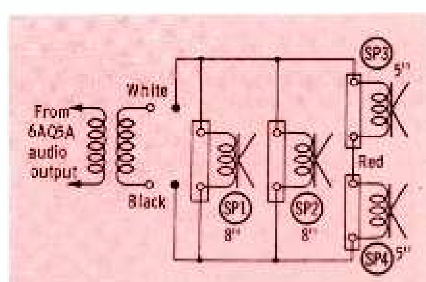


Fig. 6. Admiral sets using the Chassis 20B6C feature as many as 4 speakers.

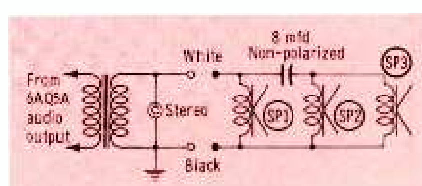


Fig. 7. External amplifier feeds output to stereo jack on RCA Chassis KCS121.

by Leo G. Sands

PORTABLE SOUND SYSTEM

Pointers on Installation and Service

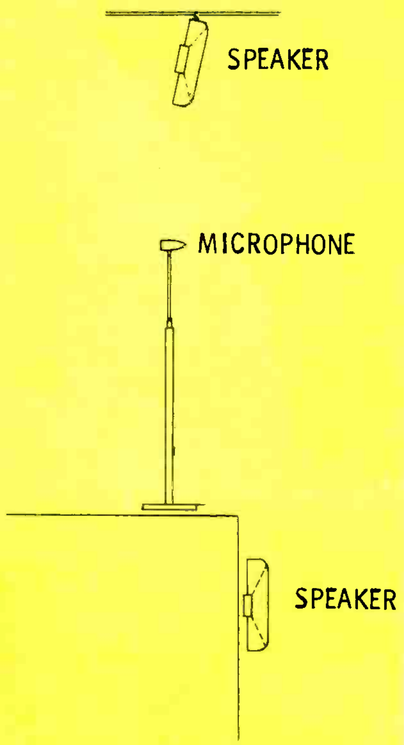


Fig. 1. Single speaker should be placed either directly above or below "mike."

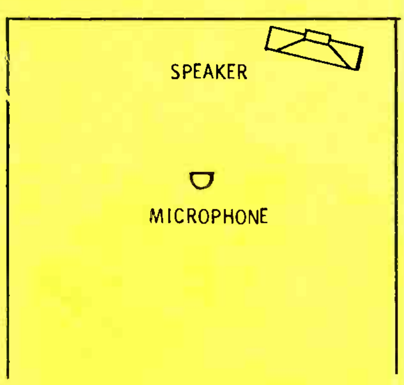


Fig. 2. Placing the speaker away from the "mike" destroys the desired effect.

Speaker Placement

One of the most frequent errors made in the installation of portable systems for sound reinforcement is improper placement of the loudspeaker in relation to the microphone. Another is improper setting of gain; incorrect microphone techniques also lead to poor results.

To obtain the illusion that the sound emanates from the speaker's lips, the loudspeaker (or loudspeakers) must be correctly oriented. Loudspeakers are often installed in a manner so as to permit operation of the system at a higher gain and still not result in acoustic feedback. While this will provide more sound, it may not come from the right directions.

When a single loudspeaker is used, it should be installed above or below the microphone as illustrated in Fig. 1. If the loudspeaker is placed in a corner as shown in Fig. 2, the sound will come from the wrong direction, destroying the desired illusion.

When two loudspeakers are used, they may be installed either in corners or overhead as illustrated in Fig. 3, which shows the right and wrong installation techniques. When correctly oriented, two loudspeakers deliver sound in such a manner as to create the illusion that the sound emanates from some point between the two speakers, depending upon the location of the listener.

EDITOR'S NOTE: The material in this article is based on a chapter from the book *Industrial Sound Systems* by Leo G. Sands, a new publication of Howard W. Sams & Co., Inc.

While greater volume can be obtained without acoustic feedback by placing the loudspeakers farther away from the microphone, the correct illusion is lost and so is the basic intent of a voice reinforcement system. Feedback can be minimized by orienting loudspeakers axially and by selecting the right type of microphone. Cut-and-try methods are often necessary because of varying acoustical conditions encountered in different buildings.

Use of the "Mike"

Most people think that they are using a sound system correctly when they can hear their own voice booming at them through the loudspeakers. This is not true except in very large rooms or out-of-doors where a very large area must be covered. Ted Lewis, the noted entertainer, employs a technique which makes him sound like the personality his audiences have learned to expect after years of listening to his recordings. When he hears his own voice coming

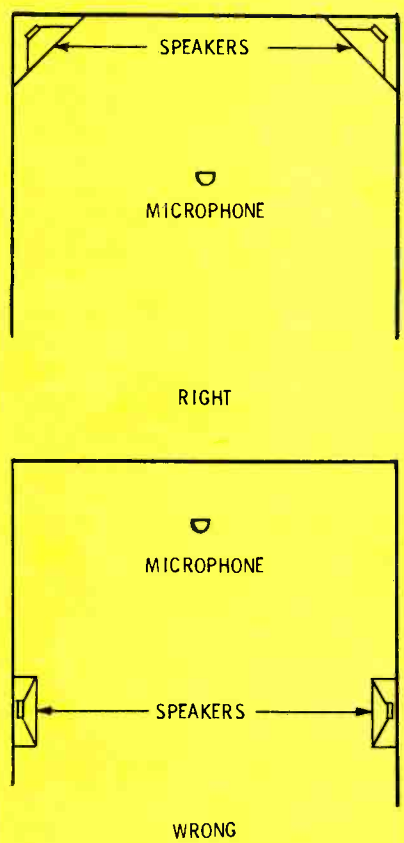


Fig. 3. Right and wrong ways of positioning units in a dual loudspeaker setup.

back at him over the loudspeakers, he quickly flags the sound man to cut the gain. Some people believe they must almost touch the microphone with their lips, while others stand back so far as to make the sound system ineffective. Best results will be obtained if, after installation of the system, you advise the speakers where to stand in relation to the microphone.

More natural sound reinforcement can be obtained by employing two separate sound systems. Two microphones are used, each feeding its own sound system. If the loudspeakers are correctly placed and oriented, stereophonic sound is the result. Correct loudspeaker placement and orientation will vary, depending upon microphone location, acoustics and room size. However, the amplifiers should be identical, and tone and volume control settings should be uniform.

Eliminating Shock Hazards

To avoid shock to persons who might brush against the microphone or its stand, even portable sound systems should be grounded. The ground lead should be attached at one end with a sturdy clamp to a water pipe or other suitable ground. The other end is connected to the amplifier chassis, which also results in grounding of the microphone case through the shield of the microphone cable as illustrated in Fig. 4.

Shock is a possible hazard if the speaker stands on a damp or metallic floor. The microphone case and the amplifier chassis may be "hot" with respect to ground if the amplifier contains a capacitive line filter, or if the insulation in the power transformer or AC-input wiring has any appreciable leakage. Fig. 5 shows how capacitors are often used in the power input circuit of amplifiers. Capacitors C1 and C2 are in series across the AC line, their junction being grounded to the amplifier chassis. One side of the power line is usually at ground potential, the other side is "hot" by the amount of the line voltage (105-125 volts) above ground. If the capacitors are of like value, the chassis, if not connected to an external and effective ground, will have a potential of about 60 volts (rms) above ground. If one of the capacitors is leaky, the voltage can be still higher.

Grounding of the chassis, however, will not cause a short circuit unless one of the capacitors is defective. Usually, .01-mfd capacitors are used, and this value will have a reactance of 270,000 ohms at 60 cycles. The reactance of a .1-mfd capacitor at 60 cycles is 27,000 ohms. In Fig. 6 it can be seen that (for purposes of explanation), if the capacitors are replaced by 27,000-ohm resistors, the potential between point Z (chassis ground) and Y (the grounded side of the line) will be 57.5 volts. Grounding point Z will put R1 across the line and R2 will be shorted out. If the line plug is reversed so that X is grounded, R2 will be across the line.

Since the microphone case is often connected electrically by the shielded microphone cord to the amplifier chassis, the microphone case can be "hot" by approximately 60 volts above ground. An unpleasant "bite" can be the result of a moist hand or lip touching the microphone case or stand; hence, the amplifier chassis should be grounded. However, the microphone case should not be grounded independently, as serious hum may result because of the possible inducement of a voltage, "E" as shown in Fig. 7, which is a common occurrence when two separate grounds are used.

A more satisfactory grounding technique is to use three-wire power cords as commonly used on power tools. The third wire connects to the amplifier chassis. Two-wire cords on amplifiers can be readily replaced with the three-wire type and terminated with three-pronged plugs in which the third prong is the ground connection. While these plugs will not fit directly into conventional two-slot electric outlets, adaptors can be used. These adaptors plug into a standard two-slot outlet. A pigtail lead is connected to the screw which secures the outlet face plate or to an external ground. As a safety measure, the effectiveness of the ground should be checked as suggested in Fig. 8.

Power Considerations

The electric power source at various temporary locations may be in-

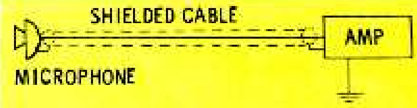


Fig. 4. Shielded cable serves to ground the "mike" if amplifier is grounded.

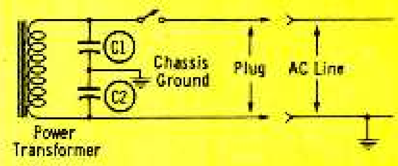


Fig. 5. How capacitors are used in the power input circuit of an amplifier.

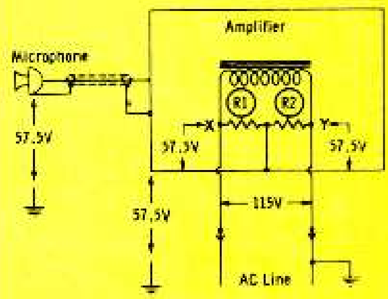


Fig. 6. Analysis of voltages and impedances in the amplifier AC-input circuit.

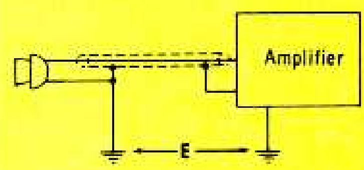


Fig. 7. Grounding both the "mike" and amplifier may cause hum because of "E."

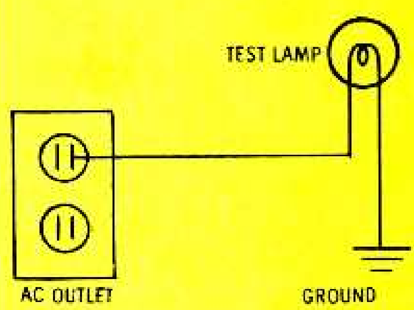


Fig. 8. Effectiveness of the ground may be checked with the use of a neon lamp.

adequate, or electric outlets may not be available at locations where the amplifier is to be installed; thus long extension cords may be required. When frequent connecting and disconnecting is required, sturdy, industrial-type cords and plugs should be used. The wire gauge should be heavy enough to prevent excessive power loss in the cord. Loose, ill-fitting power plugs cause erratic operation and annoying intermittent contacts.

Record players may run at uneven speed when the voltage or frequency (or both) of the electric power source varies excessively. If the frequency remains constant, excessive voltage variations can often be ironed out by employment of a voltage-regulating transformer between the sound system and the power source. Where line voltage is fairly constant but is either too high or too low, a variable transformer may be used to lower or boost the voltage to the desired value.

DC is still the normal power source in sections of some cities, as well as in hospitals and hotels which generate their own power. When an AC-operated sound system is to be used where only DC is available, a power converter is required. There are several types on the market, some employing vibrators and others which are essentially motor-generator sets. Still others, quite new in power applications, employs transistor circuitry.

When power converters are used, record players and tape reproducers may operate unsatisfactorily if the output frequency and voltage do not remain fairly constant. If the converter is not defective but is of inadequate rating or design for the particular applications, a converter of appropriate type should be substituted.

Stray Pickup

Hum and radio-frequency pickup, when encountered, may be extremely difficult to eliminate. Hum is quite frequently caused by poor contact at microphone cable connectors. Be sure to check the solder joints between cable plugs and their associated conductors and outer shields, as well as the physical security of plug and socket connections.

Hum may often be reduced or eliminated entirely by grounding the amplifier chassis as suggested earlier. Hum has been known to be induced into sound systems from external causes where the cure was applied at a considerable distance from any portion of the sound equipment. A case in point is where two pipes, one a steam heating pipe and the other a water pipe, crossed and maintained erratic electrical contact with each other. Sliding a piece of cardboard between them isolated the pipes electrically and stopped the hum. A more permanent cure was effected by bonding the two pipes together electrically.

Pickup of radio programs by a sound system may occur due to improper shielding of the amplifier or microphone cables, or in the presence of very strong radio signals, by detector action taking place in one of the amplifier stages. Sometimes, the cure can be effected by grounding the amplifier chassis, repairing microphone or other input cables, or installing an external line filter between the amplifier and the power line.

Again the trouble can be caused by two pipes touching but not making perfect contact, or by improper bonding of sheet metal plates under the tar and gravel on a roof. In one case, the cause was found half a block away; rectification of strong radio signals was caused by high resistance contact between an electric switch box and the conduit attached to the box.

When unwanted radio reception in sound systems cannot be eliminated externally, it may be necessary to modify the amplifier. For example, the bias on an input stage might have to be changed so that the tube will work on some other portion of its operating curve, thus avoiding its acting as a detector in the presence of a strong, unwanted signal. Sometimes, a filter consisting of a 50- to 100-mmf capacitor across the amplifier input will do the trick.

Unwanted radio reception in sound systems is not to be expected normally, and in permanent installations it can be eliminated if it occurs at the time of installation. However, it is more apt to be encountered when installing portable sound systems in various locations and under a variety of environmental and operating conditions. ▲

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PROBING for TROUBLE

How to get the most out of capacitive probes

by Robert G. Middleton

Low-capacitance and capacitive divider probes are essential accessories for modern TV servicing. When used with service oscilloscopes, they provide a wider range test than can be obtained with a direct cable.

These probes are adjustable and require occasional attention in order to maintain their expected performance. If incorrectly adjusted, measurements of peak-to-peak voltages will be inaccurate. Moreover, in the case of low-capacitance probes, incorrect adjustment also causes waveform distortion.

Sometimes, when we overload a low-capacitance probe by accidentally touching it to a high-voltage point, the probe components become damaged and must be replaced. In such cases, adjustment is essential after the new parts have been installed. In other instances, we may want to use a probe with more than one type of scope. Adjustment is required each time the probe is attached to a different instrument in order to obtain proper response.

Low-Capacitance Probes

The simplest form of low-capacitance probe is depicted in Fig. 1. Its purpose is to step up the scope's input impedance and thus avoid loading of high-impedance circuits under test. This type of probe contains a fixed resistor and a trimmer capacitor, although some types contain an adjustable resistance as well as adjustable capacitance and can be used with any type of scope.

Why are adjustable elements provided in low-capacitance probes? It is because the time constant of the probe must be made equal to the time constant of the scope input circuit; otherwise, frequency distortion will result.

What is the time constant of the scope input circuit? Basically, it is the product of the input resistance and input capacitance values. Input resistance is determined by the values of attenuator resistors. Input capacitance is equal to the shunt capacitance of the scope plus the capacitance of the shielded input cable. This brings us to an important consideration: a low-capacitance probe can be adjusted for use with a given input cable, but will require readjustment if we use it with another input cable.

In general, we need not concern ourselves with the exact value of the scope's input impedance or the input capacitance of the cable. We merely make suitable test adjustments to obtain correct probe operation based on waveform appearance. When we set out to adjust a low-capacitance probe, we must keep some basic points in mind. For example, we cannot obtain increased input impedance from the probe without giving up something else. What we exchange in this case is gain, or sensitivity. In other words, if we are using a probe which steps up the input impedance ten times, we attenuate the input signal to one-tenth its initial value.

Adjustments

Referring to Fig. 1, the value of R customarily equals nine times the scope input resistance. This is not essential, but it facilitates measurement of peak-to-peak voltage values. Here's why: if a scope is calibrated for a sensitivity of 1 volt per inch using ordinary test leads, we can plug the probe into the scope without the necessity for recalibration—the scope automatically receives 10% of the input signal, and sensitivity becomes 10 volts per inch. On the other hand, if the probe introduces some odd value of attenuation, the scope will have to be recalibrated when the probe is attached.

Our first procedure covers the case for a probe which has an input resistance nine times the input resistance of the scope. The probe is adjusted as follows:

Connect the output from an audio oscillator directly to the scope's vertical-input terminals. Then, using a 60-cps output from the generator, adjust the output and scope gain for ten squares of vertical deflection.

Next, attach the probe and apply the generator output to the scope through the probe. If resistor R (Fig. 1) has the correct value, scope deflection will drop to one square. If the value is incorrect, you may wish to change it so that you will be working with a standard 10-to-1 arrangement. This can be done by adjusting the variable resistor, if the probe is equipped with one.

We are concerned only with resistance adjustments during the 60-

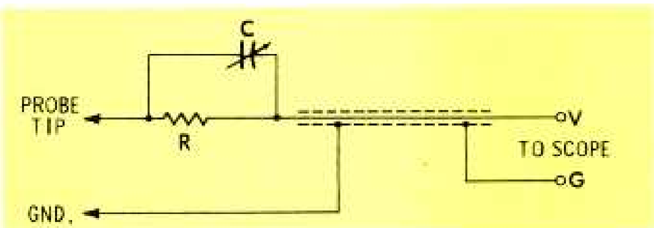

Fig. 1. Simplest form of low-C probe.

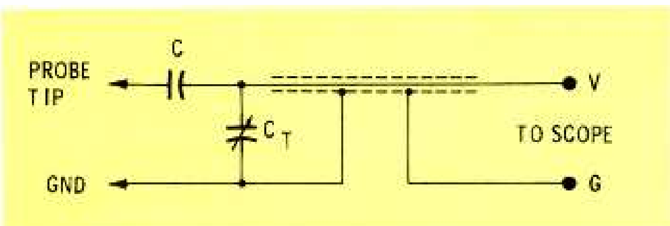

Fig. 2. Basic divider probe to observe HV waveforms.

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Electronic Tube Division · Elmira, New York cps test, because the capacitive reactance in the probe and scope circuits is so high at 60 cps that it can be completely ignored. Capacitive adjustments *are* necessary, however. To begin, disconnect the probe from the scope and increase the output frequency of the audio oscillator to about 100 kc. Apply this signal to the vertical-input terminals of the scope. Adjust generator output (or scope gain) for 10 squares of vertical deflection.

Next, insert the low-capacitance probe in the signal path. You should now observe one square of vertical deflection. If not, adjust the trimmer capacitor in the probe as necessary. The probe adjustment will then be complete.

We are concerned only with capacitive adjustment in this 100-kc test, since the capacitive reactance of the probe and scope circuits becomes much lower in ohmic value than the resistive elements. For practical purposes, therefore, we can completely disregard the resistance during the capacitive check.

Other Considerations

Note carefully that a low-capacitance probe can be satisfactorily used only with a scope having constant input resistance and capacitance. This means the probe will not work properly with old-style, narrow-band scopes having a simple potentiometer for a vertical gain control. All modern, wide-band scopes, on the other hand, have step attenuators in their vertical-input circuits and will operate correctly with low-C probes.

If you try to use a low-C probe with a scope which doesn't have constant input resistance and capacitance, you will find that the probe adjustment requires changing with each setting of the vertical-gain control. This, of course, is impractical.

At this point, let's consider the adjustment of a low-C probe which provides an attenuation factor other than 10-to-1. This situation often results when the probe does not have an adjustable resistance and is used with a scope other than for which it was originally intended.

As a typical example, if you plug a low-C probe into a scope and observe an attenuation of 7-to-1 during the 60-cps test, this ratio be-

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Such an attenuation factor is quite satisfactory for practical work. It gives an impedance step-up of 7 times, which is very useful when testing high-impedance receiver circuits. However, we must be careful in making peak-to-peak voltage measurements with a calibrated scope. With a 7-to-1 probe, we can no longer find out the actual value of the voltage by merely shifting the decimal point in the indicated value; instead, we must now multiply p-p readings by 7. For example, if the scope has been calibrated for a sensitivity of 1 volt per inch using direct test leads, this sensitivity becomes 7 volts per inch when we plug in the low-C probe.

Capacitive-Divider Probes

Capacitive-divider probes are used to check waveforms and measure peak-to-peak voltages which exceed the normal input limitations of the scope. Service-type probes can be used at input potentials up to 10,000 volts p-p.

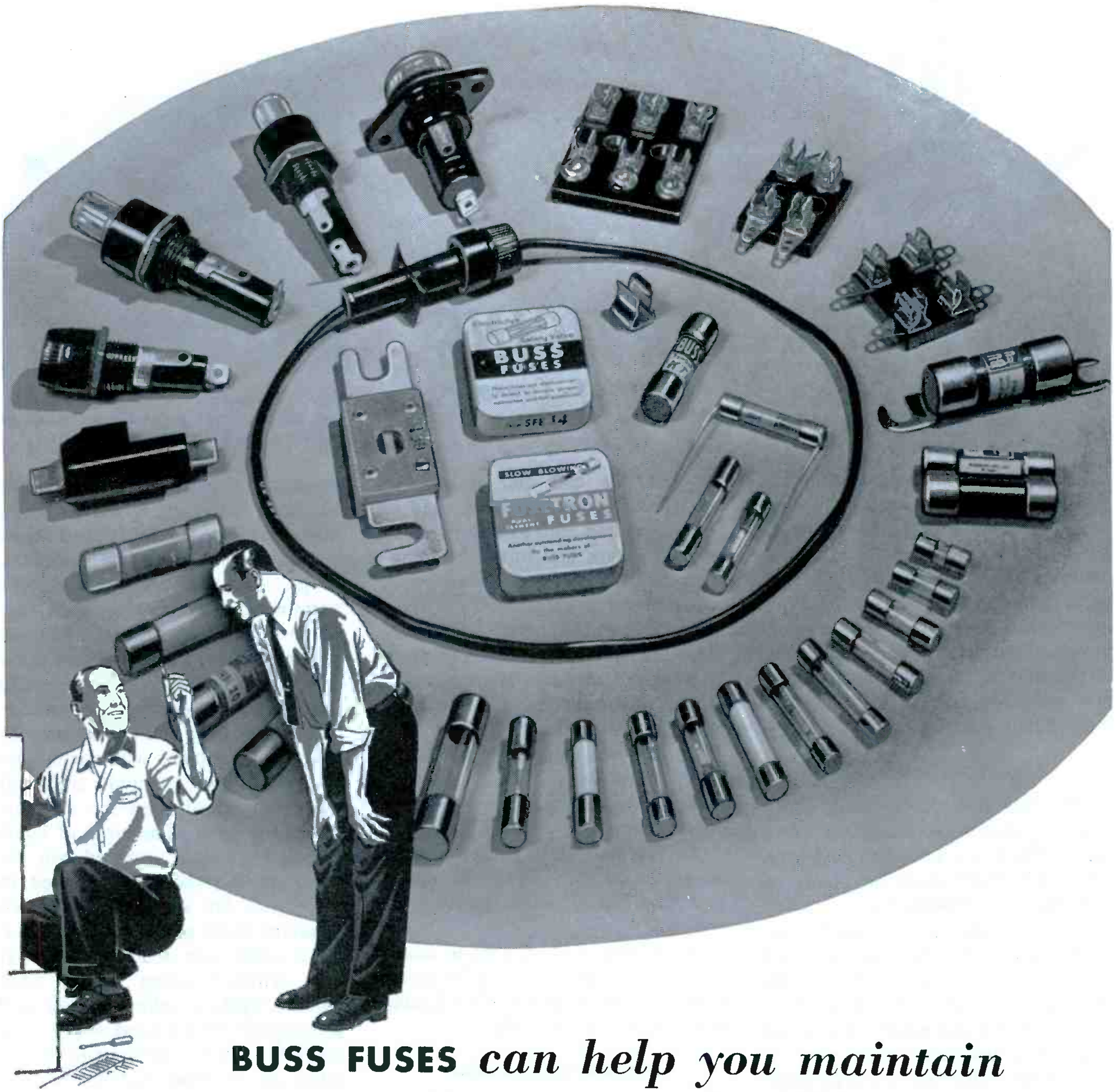
The basic arrangement of a high-voltage capacitive-divider probe is seen in Fig. 2. Capacitor C has a relatively small value (such as 5 mmf) and a voltage rating of at least 10,000 volts. Probe response is adjusted with the use of trimmer CT.

Adjustment

CT is adjusted with the aid of an audio oscillator operating at about 50 to 100 kc. With the scope's step attenuator set at X100, the test voltage is applied directly to the scope and the amount of vertical deflection noted. If you do not get satisfactory deflection—say 10 squares—use a 15,750-cycle waveform from the sweep circuit of a TV receiver, instead of the audio oscillator. Next, connect the divider probe into the signal path and turn the step attenuator to the X1 position, thereby increasing scope gain 100 times. If the probe is in correct adjustment, you will obtain the same deflection as before, or 10 squares. If the deflection is more or less than 10 squares, adjust CT as necessary.

A word of caution is in order concerning the 100-to-1 probe. You will observe from Fig. 2 that there is no resistive element in the probe; consequently, it does not work at low frequencies. The probe operates as intended on higher frequencies, which include those found in TV horizontal-sweep circuits. On the other hand, if you attempt to use such a probe in a vertical circuit (operating at 60 cps), you will get severe waveform distortion and an incorrect attenuation factor. The fact that a 100-to-1 probe cannot be used at low frequencies is not disadvantageous—the probe is not needed in low-frequency TV test work. A 10-to-1 probe will handle these low-frequency voltages adequately, and should always be used in such tests.

Although details of probe construction vary, the basic principles and adjustment procedures described apply to all low-C and capacitive-divider probes. Now that you have these facts at your disposal, they'll help you eliminate a lot of the guesswork that takes so much of your time. ▲



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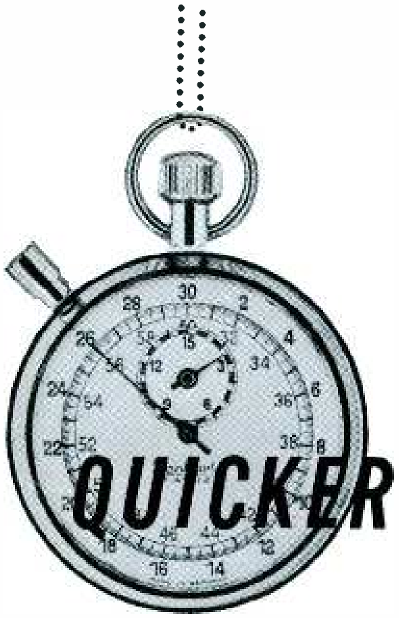

QUICKER SERVICING

By Calvin C. Young, Jr.

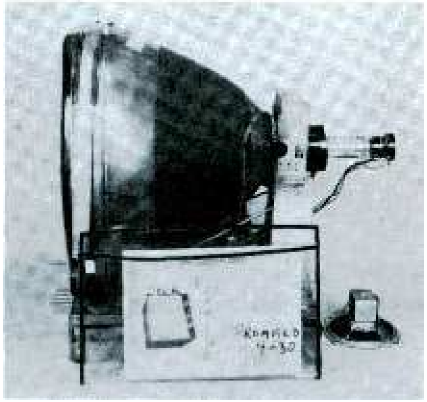

Fig. 2. Heavy plastic envelope containing all pertinent service data and set history should accompany chassis.

The most valuable commodity possessed by a service organization is *time*. How well each minute is employed in productive work can determine the success or failure of your business. Here are a number of ideas to help you reduce nonproductive time; some, as well, will take much of the hard work out of TV servicing and eliminate "dogs" before they develop.

Start the Job Right

All TVs and radios brought into the shop should be placed, complete with service tag, in a specified area (Fig. 1). From there on, here are the operation procedures:

1. Clean the chassis and picture tube thoroughly. Use compressed air or a brush to clean the chassis and either *Windex* or a mixture of water, vinegar and ammonia to clean the screen and safety glass.

2. Check all tubes in a high-quality tester and code those found to be bad or weak. Fast-drying model paint is perfect for this (you might use red for bad and yellow for weak). Consider all shorts, gas or leakage as bad, and low emission as weak. Replace bad tubes, but leave them with the set for the bench technician's information.

3. Obtain all pertinent service literature and set history, and place it with the chassis. Heavy plastic jackets like that shown in Fig. 2 are ideal for this purpose.

4. The service manager should read the service card and order all parts the outside technician has listed as defective.

5. The service manager should assign the set to the bench technician best qualified to make the required repairs.

These five steps, if used to maximum advantage, can save 10 to 15 minutes of the bench man's valuable time on each service job.

Save Bench Service

A considerable amount of bench time can be lost in obtaining equipment, tubes and parts. Each bench position should be completely equipped with small parts, tubes, miscellaneous hardware and basic test equipment, including a VTVM, scope, isolation transformer with variable output, test speaker, antenna outlet, and assorted interconnecting cables, plus two heavy duty-filter chokes and a universal audio output transformer for the speaker. The transformer and chokes may be mounted on a panel with a combination of switches, terminals and leads to permit substitution for speakers left in the home. The types of interconnecting cables required will depend on the receivers serviced in your area, but should include such standard items as high-voltage lead, CRT cable, and octal extension. It goes without saying that a good trouble light, a soldering gun and a complete set of hand tools are a must for every bench position. To eliminate the time lost looking for hand tools, allocate a special place at each bench position for these items.

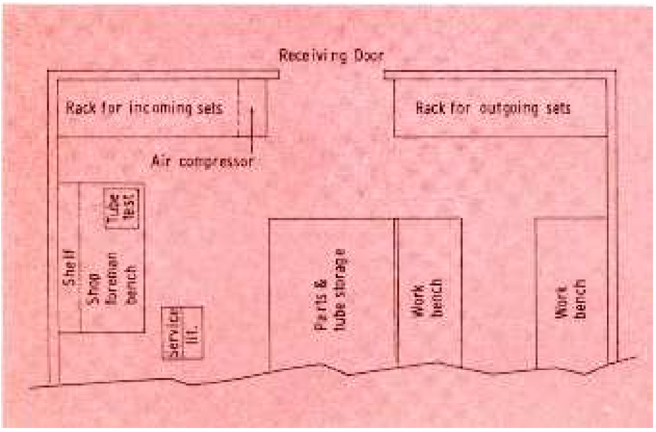

Fig. 1. Layout of shop with rear areas arranged to permit efficient test and troubleshooting procedures.

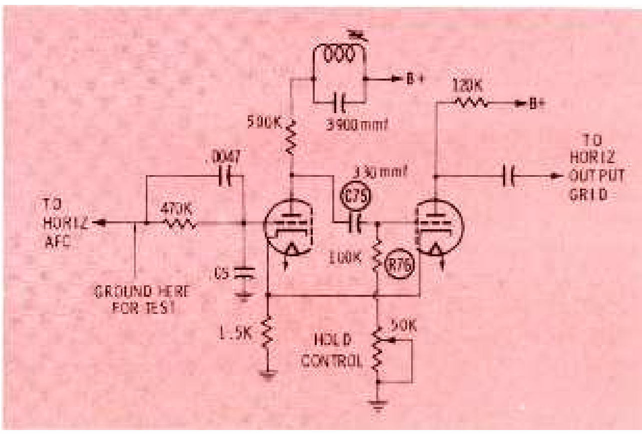

Fig. 3. Where to ground horizontal AFC voltage in order to isolate sync. troubles.

The basic tube assortment for each bench should include those most often encountered in TV receivers. Pre-testing and replacement of bad tubes before the set is given to the bench man reduces the number of tubes needed in each position. One more thing — be sure the bench tubes as well as the newly-installed ones are pre-tested. This will help eliminate time lost in circuit-tracing caused by defective tubes.

The small parts stock will necessarily include a complete assortment of resistors, capacitors, metallic rectifiers, fuses and popular detector crystals. Miscellaneous hardware would consist of assorted self-tapping screws, and bolts and nuts of the most common sizes.

Since it is not possible to have a warehouse at each bench position, "hunting time" can't be eliminated entirely; however, judicious use of the above suggestions can drastically reduce it.

Save Time Troubleshooting

The use of vertical chassis and printed wiring boards isn't always disadvantageous to the technician; in fact, I know of numerous instances when shop repairs have been completed with the chassis in the cabinet.

Some parts that can be so replaced are resistors and capacitors on printed boards, selenium rectifiers, some electrolytics, and some high-voltage "doorknob" capacitors. In addition, controls in a large number of the newer receivers are mounted on subassemblies, and can be replaced without removing the chassis. Further, many alignment procedures can be carried out with the chassis still in the cabinet because of the accessibility of both slugs in the tuned coils from one side. A hex-shaped hole through each of the cores makes this possible. In any case, check the receiver thoroughly before disassembly—you may avoid a great deal of unnecessary labor.

If the chassis must be removed to complete a repair, an empty coffee can is ideal for holding knobs, screws and other miscellaneous items. This will eliminate time lost hunting for small parts that become easily mislaid. Then, too, the coffee can is excellent for retaining defective parts removed from the set.

Isolating Horizontal Sync and AGC Troubles

Horizontal frequency and AGC troubles are among the most bothersome encountered by the service technician. If they are causing you to become prematurely bald, learn to use specific isolation procedures. For instance, frequency troubles in multivibrator-type horizontal circuits can be isolated to the oscillator or AFC circuit by the simple step of grounding the AFC voltage input to the oscillator (Fig. 3) and adjusting the horizontal hold control. This control should vary the oscillator above and below sync frequency. If it does, then the trouble is in the AFC circuit. Naturally, if the control doesn't cover the correct frequency range, the trouble is in the oscillator stage.

In some sets, no hold control is employed; instead, the horizontal ringing coil is used for frequency adjustment. The same isolating procedure can be employed on these

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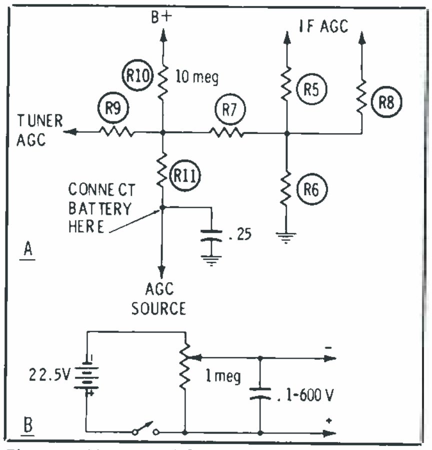

Fig. 4. Circuit of bias pack and connection points for AGC trouble isolation.

receivers by using the coil slug to vary the horizontal frequency with the AFC voltage shorted out. Some of the newer sets require AFC voltage to sync the oscillator, even with no trouble in the circuit. Should you encounter this condition, juggle the value of the coupling capacitor or grid load resistor (C75 and R76 in Fig. 3) until the coil has the proper frequency range. Use a silvered-mica capacitor as a replacement.

AGC troubles can be difficult, especially if a keyed system is employed. To help isolate the fault, clamp the AGC source point (Fig. 4A) with a variable negative voltage. A bias pack comprised of a 22.5-volt battery and 1-meg control with switch (Fig. 4B) is excellent for this purpose. The .1-mfd, 600-volt capacitor is included to prevent horizontal pulse energy from being connected across the control and battery.

To use this bias pack, connect as shown in Fig. 4 and vary the control slowly through its range. If a normal picture is obtained at some setting of the control, the trouble is in the AGC-keyer circuit itself. If a normal picture can't be obtained, the trouble is in the signal circuit. This includes the tuner, video IF, video detector, all stages between the detector and the AGC keyer tube, and the AGC distribution and filtering network. To check this latter circuit, leave the bias pack connected and adjust the control for maximum voltage; then measure the voltage drop across all resistors in the network. Referring again to Fig. 4A, there should be a voltage drop across R11, R7 and R6, but none across R5, R8 or R9. It is also

Fig. 5. *Switchmatic* wall receptacle and antenna plug with strain relief loop.

a good idea to disconnect the delay resistor R10 from B+ to see if too much delay is being introduced. Any voltage drop across R5, R8, or R9 would be an indication of grid current or a leaky coupling capacitor in the IF circuit.

To further isolate the trouble, leave the bias pack hooked up as before, connect the scope across the video detector load, and vary the 1-meg control to change the AGC clamping voltage. The scope should be set for high gain on this test. If a signal appears on the scope, adjust the AGC voltage to produce the most nearly normal signal. (Reduce scope gain if necessary to keep the signal on the scope face.) Check the signals at grids and plates of all tubes between the video detector and picture tube, and at the grid of the AGC keyer. Should a distorted signal be located, use voltage and resistance checks to pin-point the trouble.

If no signal or a badly distorted signal is obtained at the video detector load at all settings of the 1-meg bias control, the trouble is in the IF or tuner circuits. Voltage and resistance checks in these circuits should help you discover the cause.

Multiple Outlets for a Single Set

If you have customers in a suburban or semi-fringe area, you probably have had requests to move the antenna outlet from one place to another, only to receive opposite instructions a few months later. Usually, this means low-profit work for you, and inconvenience for your customer. Because you know that a multi-set coupler introduces losses, you may have hesitated to sell a splitter system.

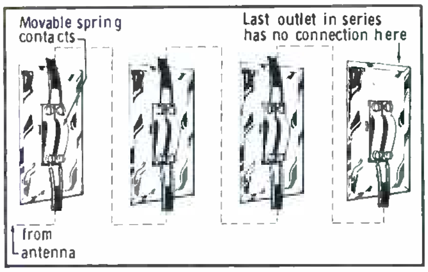

Fig. 6. Wiring diagram of a *Switchmatic* system with 4 outlet positions.

The *Switchmatic* TV receptacle manufactured by R-Columbia Products Co., Inc. (Fig. 5) permits a system to be installed with any number of outlets for a single TV receiver. In the diagram for such a system (Fig. 6), notice that the movable spring contacts in each case are nearest the antenna lead-in. Inserting the antenna plug into a receptacle causes the spring contacts to break connection with the other side, thus isolating all following outlets from the circuit. This means that only one TV receiver can be used on a branch, but it also means that there will be no losses due to stub effects.

The antenna plug supplied with the unit has three pins, and is designed so that a strain-relief loop can easily be included on the lead-in. Three pins are used to prevent the antenna lead from being accidentally plugged into an AC outlet.

The *Switchmatic* is also useful in strong signal areas where several outlets on each branch of a multiple-outlet system are desirable. The *Humi-Kup* two-set coupler, another product of R-Columbia, is a hermetically-sealed unit designed for either internal or external mounting. (The best position is as near to the antenna as possible.) The *Humi-Kup* may be used with *Switchmatic* receptacles to make a two-branch system having any number of outlets on each branch. If more than two branches are desired, a coupler having the required number of outlets can be employed. ▲

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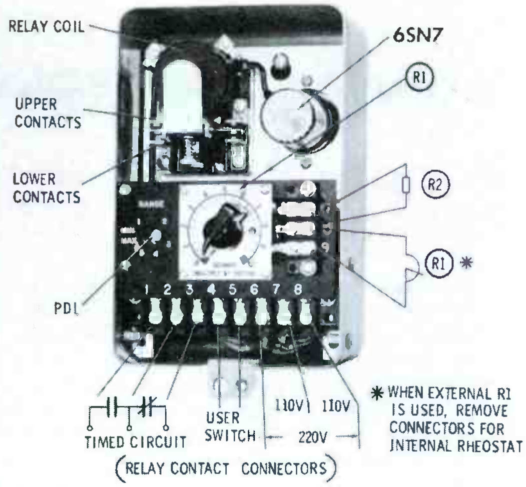

Fig. 2. Internal points in timer circuit connect to an external terminal board.

Time is so vital to man that a variety of devices are used to make the best use of this commodity. While some events are uncontrollable, man does determine how much time shall be allotted to many processes. Industrial time control, in which split-second accuracy is important, uses the science of electronics to cut costs and, at the same time, achieve consistent high quality.

The heart of an electronic timer is a tube with a relay in its plate load circuit. Operation depends on two fundamental principles. One is that a specific grid voltage applied to the tube will result in a predictable plate current, and the other is that a certain minimum current must be fed to the relay winding before it will produce a magnetic field strong enough to pull the armature down and close the contacts. The exactness of timing will depend on the exactness with which tube current is controlled. One desirable trait of grid-voltage control is that through its use, tube current can be changed rapidly in the region near cutoff. A suitable voltage may be obtained from the simple arrangement shown in Fig. 1.

The grid voltage of V1 (Fig. 1A) is controlled by the charge on C1. S1 is closed before the timing period starts, and C1 is allowed to charge to 20 volts. The timed period starts when S1 is opened, permitting C1 to discharge through the combined resistance of R1 and P1. Since the cutoff voltage of V1 is 10 volts, the tube will conduct as soon as the voltage across C1 has decreased to this value. Fig. 1B shows the discharge curve of the capacitor and the timing relationships. As shown, the voltage across C1 is changing rapidly while passing through the tube's cutoff region (T1); thus, tube current becomes heavy enough to operate the relay very soon after the tube comes out of cutoff. In practice, the time of passing through cutoff and the termination of the timed period are considered to be simultaneous. When energized, the contact relay opens the normally-closed contacts and interrupts the circuit being timed.

The actual time between T zero and T1 (the timed period) in Fig. 1B is determined mainly by the product of the capacitance and resistance in the discharge path, and to a lesser extent by the capacitor charging voltage and the applied plate voltage of the tube. If the capacitance is 1 mfd and the resistance is 1 megohm, the product of R and C (one RC time) will be one second—meaning that the capacitor will lose 63% of its charge during this interval. In other words, the voltage remaining across the capacitor one second after T zero will be 7.4 volts if the charging voltage was 20 volts. Since 7.4 volts is above the cutoff level for the tube, it can be seen that T1 will occur before one RC time has been completed. This condition is desirable because the discharge curve is steepest between T zero and one RC, as shown in Fig. 1B.

In actual practice, T1 may occur either before or after one RC time. In the example just given, increasing the charging voltage to 40 volts would permit C1 to retain a charge of 14.8 volts at the end of one RC time, and the tube would remain in cutoff. Thus, T1 would be shifted to a point just beyond one RC. Another controlling factor is the applied plate voltage. If it is changed, the cutoff point will shift. For instance, the cutoff bias for a 6SN7 is 10 volts when plate voltage is 200 volts. Reducing this voltage to 100 volts moves the bias level down to 5 volts.

Commercial Timer

The unit in Fig. 2 is a typical control timer using a 6SN7. Half the tube supplies the charge voltage by rectification, while the other half actuates the relay. The terminal strips across the bottom and along the right side provide access to several points in the circuit. This arrangement allows flexibility in applica-

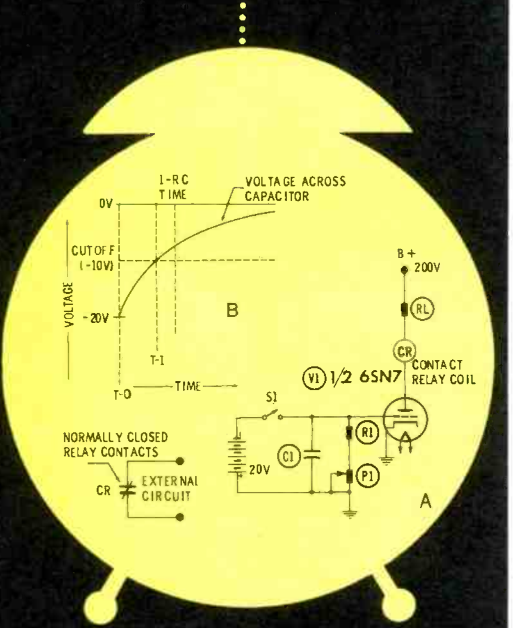

Fig. 1. All electronic timers use the charge or discharge of a capacitor as the timing control.

tions. The range adjustment controls the charge voltage, while the center dial controls the discharge resistance. This unit is directly calibrated in seconds.

Notice that the relay has both upper and lower sets of fixed contacts. The armature always closes one set while leaving the other set open. Since the top and bottom contacts on the left side are connected together, the relay functions as a single-pole, double-throw switch.

The circuit for the unit shown in Fig. 2 is schematically illustrated in Fig. 3. Power transformer PT has a tapped primary with connections brought out to terminals 6, 7, and 8 on the instrument's front panel. For 110-volt operation, either 6 and 7, or 7 and 8, are connected to the line. For 220-volt operation, the power line is connected across 6 and 8 with the neutral conductor to 7. The transformer secondary has three intermediate taps. (Points on the secondary marked X1, X2, X3, X4 and X5 in Fig. 3 are connector terminals on the transformer and are not on the front panel.) The complete secondary between X1 and X5 provides AC power for tube section A and the relay coil; thus, A can only conduct on the half-cycle when X1 is positive.

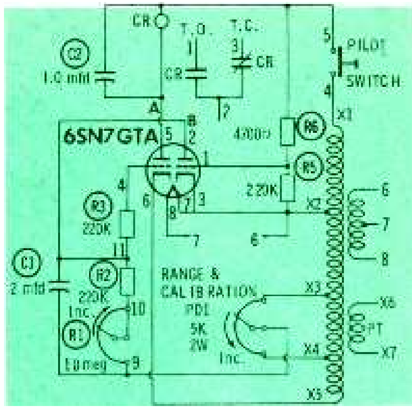

Fig. 3. Schematic of electronic timer that can be used for general purposes.

The charge circuit for C1 obtains power between X2 and the slider arm of PD1. Starting at X2, follow the lead to the cathode of tube section B; then trace from the plate of B to the left side of C1 and R2. Also note that the right side of C1 connects to the slider arm on PD1. Tube section B can conduct only when X2 is negative with respect to X3.

Terminal X1 is more negative than X2 (the cathode of B) at this time. If the pilot switch is closed, sufficient negative voltage will be applied to the grid of B to keep this section from conducting and recharging C1. Capacitor C1 will then discharge through the resistance of R2 and R1, and the voltage applied to the grid of tube section A through R3 will become less negative.

The circuit between X5 and the slider of PD1 places an AC voltage in phase with the plate voltage on the grid of tube section A. This arrangement is similar in purpose to the ringing-coil circuit in the horizontal oscillator of a TV set in that it causes the grid voltage to rise more steeply as the tube comes out of cutoff. Thus, it provides more accurate control of the point at which conduction begins in tube section A.

Capacitor C2 filters the pulsating DC plate voltage produced by conduction of A. If this filtering were not provided, the current through relay CR would vary according to the pulses of plate voltage. The result would be an alternate opening and closing of the contacts—or "relay chatter."

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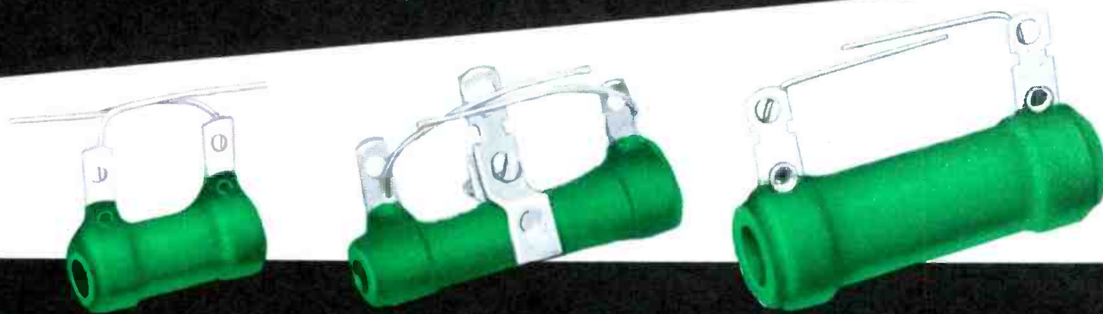

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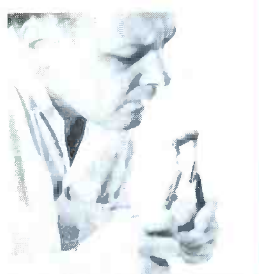

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The entire sequence of control action is: C1 charges before the timed interval begins, and the voltage on C1 holds tube A in cutoff. The timed interval begins at the moment the pilot switch closes. Tube B is held in cutoff by the voltage from X1 through the pilot switch, and this allows C1 to discharge through the resistance of R2 and R1. As the voltage across C1 approaches the cutoff point of tube A, the AC voltage obtained across point X5 and the slider of PD1 (right side of C1) makes the grid voltage level rise out of cutoff at a steep angle. Tube A then conducts and energizes relay CR. Two separate external circuits can be time-controlled in the same operation—one by breaking the upper contacts on the relay—and the other by making the lower contacts.

Timer Applications

The timer shown in Fig. 2 is used in control circuits which require a time delay before an action occurs. Such an application is the anti-jam control on a conveyor carrying boxed products. When one box is stopped on the conveyor, causing others to pile up behind it, the timer is tripped and turns the conveyor motor off. The drawing in Fig. 4 shows the boxes moving over a pilot switch on the conveyor. If a box is stopped over the pilot switch too long as a result of a jam-up on the belt beyond, C1 (Fig. 3) will then have sufficient time to discharge. Tube section A will then energize relay CR, thus breaking the circuit for the conveyor motor. (Power for the motor passes through the contacts of CR which are normally closed.)

Thyratron Timer

A thyratron (gas-filled triode or tetrode) has a very sharp cutoff point; as soon as grid voltage rises to the proper level, the tube will suddenly conduct heavily. Thyratron current does not depend on grid voltage but rather upon the supply voltage and the load or limit resistance. The grid can regain control of plate current only if the plate-to-cathode circuit is interrupted. One common method of maintaining grid control is to use an AC supply voltage. In this manner, the grid can regain control at least 60 times in one second, and this provides sufficient accuracy for many timing applications.

The thyratron timer circuit shown in Fig. 5 uses only one tube for charging the timing capacitor and for energizing the relay. The charge path for C1, starting at the slider of P1, goes down to point B, through the transformer, up to point A and through R4 to the thyratron cathode. The voltage divider consisting of R1 and P1 drives the grid of the tube positive with respect to its cathode. Whenever point B is positive with respect to A, electrons are emitted by the cathode and move toward the grid. (Note: At this time, they do not attain sufficient momentum to cause the gas in the tube to ionize; therefore, the tube does not "fire.") The charge voltage is controlled by the setting of P1. To set the minimum useful charge voltage, R1 should have slightly more resistance than P1 (up to 20%). The discharge time is fixed by the value of C1 and R2. On many of the commercial models using this circuit, R2 is made variable and placed on the front panel as a range control.

Closing the user switch (held closed throughout the timing sequence) applies power through the normally-closed contacts of 1TD to energize the contact relay 10CR. One set of contacts on this relay then completes the cathode circuit to point B, and another set of contacts starts current flowing in the timed circuit. Since the cathode of V1 is now connected to point B, it will be positive with respect to the grid whenever point B goes positive in reference to point A. In addition, when point B goes negative, the charge on C1 will become greater than the AC voltage present between the bottom and the slider of P1, because the value of R1 is larger than P1. Therefore, the tube cannot conduct and C1 cannot recharge. After a time the voltage across C1 will decrease; the AC voltage reaching the grid will rise above cutoff, and the tube will fire.

Thyratron conduction energizes 1TD, which controls two sets of contacts. One set is in the cathode circuit of the thyratron, and the other set (shown normally closed) is in series with the contact relay 10CR. The latter is de-energized when the

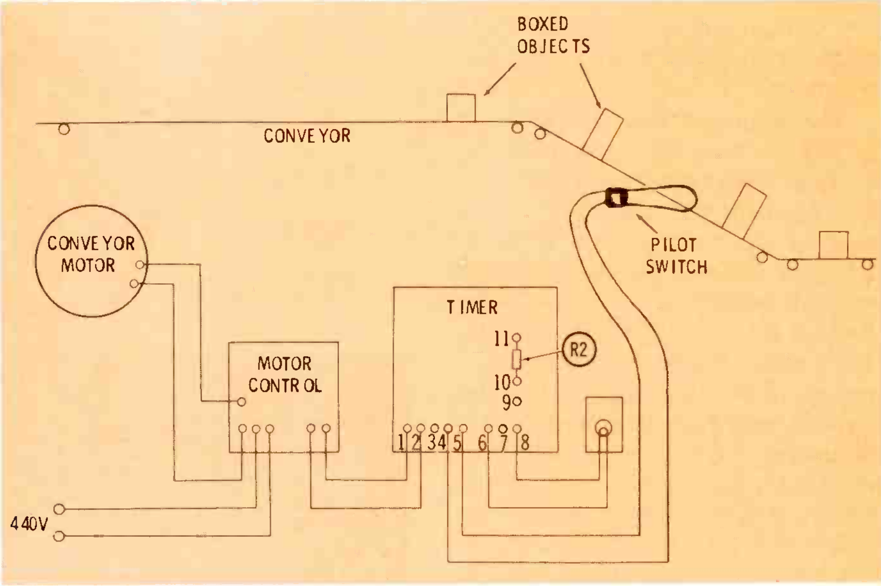

Fig. 4. A timer prevents product damage by stopping a conveyor belt when boxes jam up and hold pilot switch closed.

1TD contacts open; as a result, the thyratron cathode circuit and the timed circuit are also opened. With 10CR de-energized, the thyratron could stop conducting; however, one set of 1TD contacts parallel the 10CR contacts, and thus the tube will conduct as long as the user switch remains closed.

Thyratron Timer Applications

The timer in Fig. 5 can start and stop any function where the required "on" time is from 1/20 to 3 seconds. For example, one production line makes military parts which require a final spray of protective plastic. Since the plastic is expensive, permitting the sprayer to run continuously would increase the manufacturer's cost considerably. To control the sprayer, therefore, a timer and a sensing switch were added. Now, as parts move down the conveyor to the spray, each part trips a switch that starts the sprayer. The timer turns the sprayer off after the part passes; it will not start again until another part comes along and actuates the sensing switch.

Another practical example of thyratron-timer application is where television cabinets are formed from plastic by a large press. In this process, several plastic blocks must be heated evenly before they are placed in the press. The blocks are run through an RF heater (to be described in subsequent articles) which sends high-frequency energy through the material. Timing this heating process is critical, since insufficient heat will result in poor bonding between blocks—too much will make them so soft that they will not hold their shape when removed from the press. A timer of the type shown in Fig. 5 is therefore used to control the heater "on" time.

Timers are also essential to industry in many other ways. One example is spot-welding control where a series of timers are required to control the complete weld cycle. This application will be described in the next article. ▲

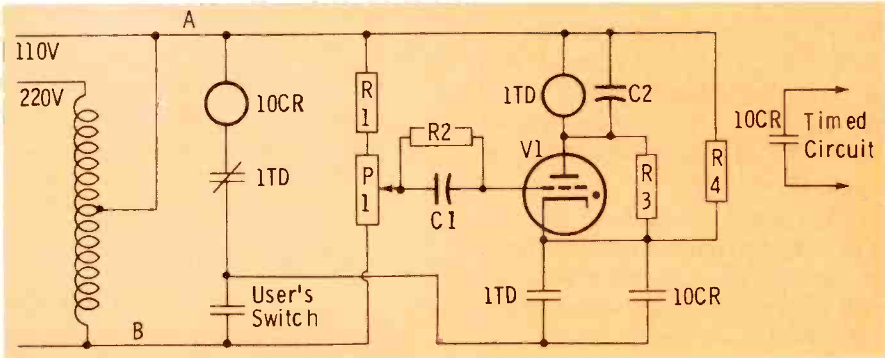

Fig. 5. This timed circuit is controlled by 10CR, which is energized with the user switch and de-energized by relay 1TD.

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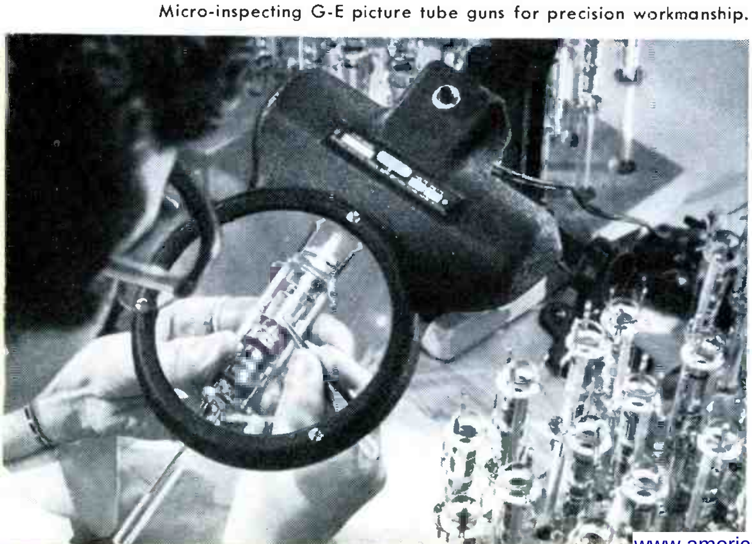

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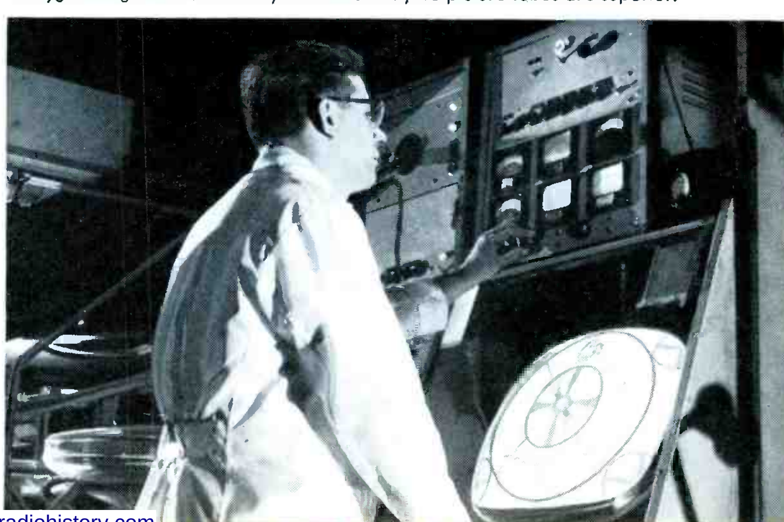

NOTES on test equipment

informative reports from the lab

by Les Deane

Scope Sees Double

The piece of equipment shown connected to an oscilloscope in Fig. 1 is a new product of B & M Electronic Mfg. Co., Fort Wayne, Ind. Referred to as the Model ES-40 Electronic Switch, the instrument permits the simultaneous display of different signal waveforms on the screen of any conventional scope. With two patterns visible, one above the other, the service technician is able to compare signal frequencies, phases, amplitudes, and shapes.

Specifications and features are:

1. Power Requirements—105/125 volts, 60 cps; power consumption 35 watts; power *on* indicator on front panel.
2. Signal Input—frequency response 20 cps to 100 kc ±2 db; channel-1 gain 30 db, channel-2 gain 10 db, both variable; input selector switch provided for each channel; 600-volt maximum input.
3. Switching System—multivibrator with operating rates of 400, 4,000, and 20,000 cps; rate selector provided on front panel.
4. Amplitude Calibration—fixed 18-volt p-p output signal at 60 cps available for either channel.
5. Signal Output—low-impedance cathode follower stage eliminates need for scope matching; positioner control on front panel varies waveform separation.
6. Accessory—Model HO-40, 15,750-cps oscillator, plugs into instrument and operates on either input channel; 15,750-cps output jack also provided on front panel.

Many servicemen may not have had the opportunity to employ an electronic switch, and I have therefore concentrated on the construction and basic operation of the ES-40 in the following discussion.

After analyzing the instrument's schematic, I made up the functional stage diagram shown in Fig. 2. Note that the unit is divided into two signal-amplifying sections, each provided with a 3-position input switch. Each switch selects either an external signal, a built-in calibration voltage, or a 15,750-cps pulse from an optional plug-in adapter.

Signals applied to the channel-1 input terminals pass through two stages of amplification, which provide a gain up to 30 db. On the other hand, signals applied to channel 2 undergo only one stage of amplification and thus can be stepped up a maximum of 10 db. The switching multivibrator automatically triggers the operation of the channel amplifiers, and their two signals are applied alternately to the cathode-follower output stage. Thus, in one instant, the scope traces the waveform represented by the channel-1 signal, and in the next instant, the signal from channel 2. The predetermined switching rate of the multivibrator is controlled by a 3-position switch located on the front panel.

Two separate patterns can be made to appear on the scope screen by adjusting the instrument's positioner control. This is electrically located in the cathode circuit of the channel-2 amplifier; its rotation varies cathode bias and causes a difference in tube conduction between the two channels. Without any external input signal, the signal from the switching multivibrator will appear as a square-wave pattern on the scope. The horizontal trace portion at the top and bottom of this waveform represents the two signal base lines.

Checking out the servicing applications of the Model ES-40 as outlined by the manufacturer, I compared input and output signals of several audio amplifiers, TV sync circuits, video output stages, and horizontal phase detectors. I was also able to test the operation of a vertical blocking oscillator stage by comparing its signal with sync pulses from the vertical integrator network.

The patterns pictured in Fig. 3 are actual photographs of scope

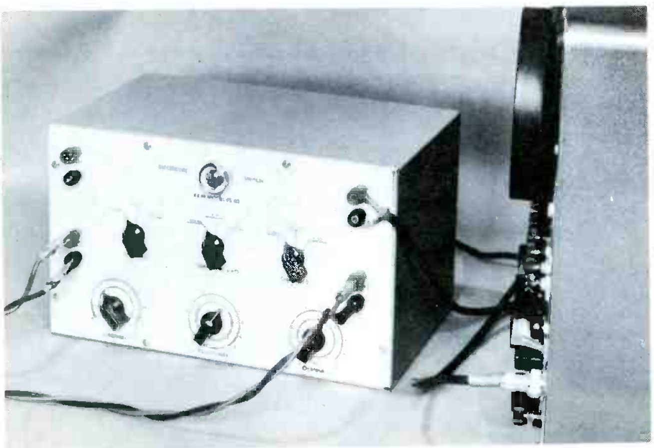

Fig. 1. Using B & M Electronic Switch in conjunction with a scope, two signals can be viewed simultaneously.

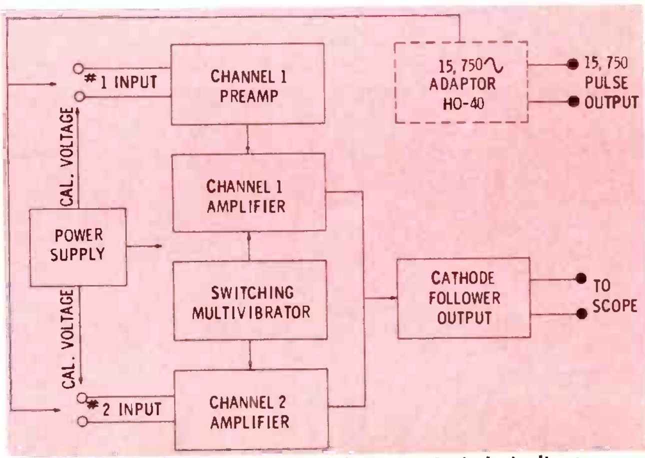

Fig. 2. Block diagram of Model ES-40 Switch indicates use of a multivibrator to rapidly alternate the output signal.

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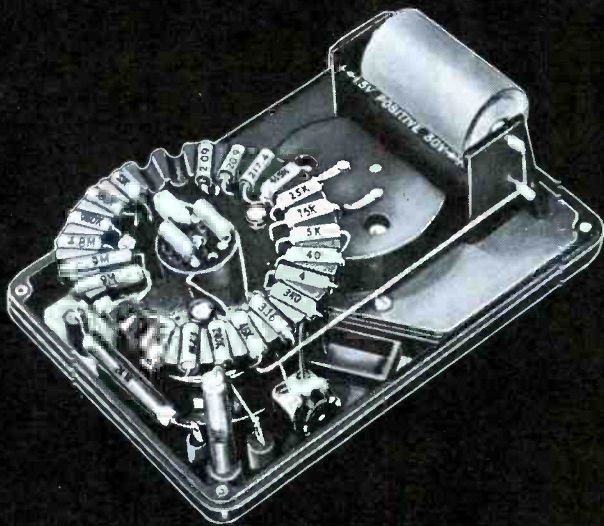

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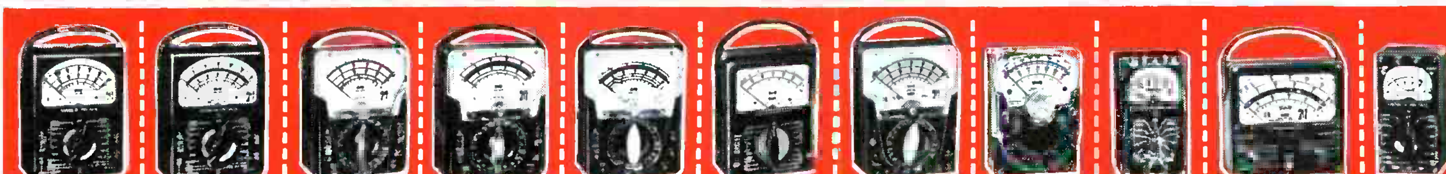

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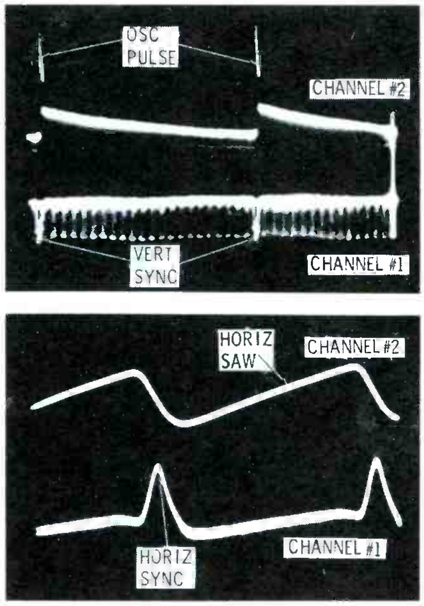

Fig. 3. Signal waveforms seen on scope screen when using the B & M Switch.

waveforms obtained in our lab. Fig. 3A shows a comparison between the output from a sync amplifier and the vertical signal present on the grid of the blocking oscillator. If desired, both waveforms can be superimposed by changing the setting of the positioner control.

The patterns in Fig. 3B represent two signals normally found in a typical horizontal phase-detector stage, the sawtooth signal being the feedback from the output or flyback circuit and the other representing incoming horizontal sync. Incidentally, when working with the horizontal frequency, I noticed that it was expedient to synchronize scope sweep with an external signal. This I accomplished by clipping the sync input lead to the body of a capacitor in the horizontal oscillator section.

Since one input voltage may be greater than the other, I found it more desirable in each case to apply the weakest signal to channel 1 because it offers the most amplification. Signals from this channel are fed to the scope in their original phase; however, those passing through only one stage of amplification in channel 2 will be inverted 180°.

In my examination of the B & M Switch, I also found that when the unit is used with its HO-40 adapter, any signal applied to one channel can be compared with a 15,750-cps internal signal on the other channel. The *15,750 out* terminals on the Model ES-40 furnish a 15,750-cps pulse of approximately 56 volts peak-to-peak. This generated signal may be fed to the sync input stage of a TV receiver and used to check sync circuit operation as well as vertical and horizontal locking.

Due to the high impedance characteristic of its input, and the fact that one channel offers considerable gain, I discovered that I could also employ the Switch as a scope preamp. This application is limited only by the frequency response of the instrument's amplifiers.

Show Your Colors

Complete color TV servicing requires a good-quality color-bar/dot generator. Such an instrument is necessary for convergence adjustments, chrominance-channel alignment, and general troubleshooting.

Hycon Electronics, Inc. of Pasadena, California has recently developed a complete, self-contained unit for use in home or shop. Pictured in Fig. 4, this portable instrument is identified as the Model 616 Color Bar/Dot Generator. It will furnish precise test signals for both color and monochrome TV receiving or transmitting equipment.

Specifications and features are:

1. Power Requirements—115 volts, 60 cps; power consumption 195 watts; line fuse provided.
2. RF Output—crystal-controlled with modulated carrier for channel 3 or 4 (optional); 10,000 microvolts fixed, with or without sound carrier; special 300-ohm cable provided.
3. Modulation or Video Output—composite signal of either phase, variable from 0 to 3 volts p-p across 75 ohms; 3 color bands providing NTSC signals for Y, G-Y ∠90°, R-Y, B-Y, I, and Q patterns; phase accuracy ±5°, luminance and chrominance amplitude ±10%, quadrature accuracy ±1°.
4. Signal Input—separate jack provided

Fig. 4. Hycon Model 616 generator is portable and offers 7 test signals.

Fig. 5. Front panel of the Hycon unit features ABC chart in bright colors.

on front panel for external sync, sync separation automatic.

5. White or Black Output — vertical and/or horizontal bars, both variable in number; dot pattern, variable in number of vertical and horizontal rows.
6. Size and Weight—8½" X 11" X 14¾", 27 lbs. approx.

In my lab examination of the Model 616, I found that it generates a complete selection of color signals in addition to patterns for checking linearity and convergence, quadrature signals for color balancing tests, and a composite video signal.

A close-up of the instrument's front panel is presented in Fig. 5. The first thing that caught my eye was the large ABC chart in full color near the top of the panel. The ABC designation corresponds to positions marked on the output selector switch located in the center of the panel directly below the chart.

In switch position A, the NTSC-type color bar signal is available at the RF or video output terminals. Bar sequence is (row A in the chart) white, yellow, cyan, green, magenta, red, blue, and black.

Checking out the instrument on the other color signals, I found that the three color-difference bars plus

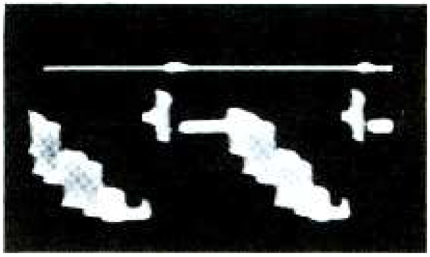

Fig. 6. Composite video signal generated by Model 616 as seen on scope.

a black bar are produced on position B. This pattern should match row B in the chart—provided, of course, the set is in good working order. In switch position C, I obtained two black bars and both I and Q signals (phase angles of 57° and 147°, respectively). The vivid colors shown on the panel chart are clearly defined and are large enough for making direct comparisons with patterns displayed by the set, convenient when checking saturation and hue.

Most of the adjustments and terminals on the front panel are self-explanatory. The *V-BAR* control, positioned just above the power-sync switch, varies the number of vertical bars (15 to 20) or the number of dots in a horizontal row. The *H-BAR* control changes the number of horizontal bars, or dots in a vertical row, from 10 to 15. The only other operator's adjustment (not shown in Fig. 5) is the subcarrier on-off switch located on the rear. This switch permits color modulation to be removed from the video and RF output signals, thus changing them from composite color to composite monochrome.

A waveform photo of the composite color signal generated by this Hycon instrument is shown in Fig. 6. Using a fairly wide-band scope, I fed the video signal directly to the vertical input terminals and adjusted the scope sweep frequency to 7,875 cps. Internal scope synchronization and a video input signal of negative polarity were used.

I noticed that the Model 616 employs elaborate circuitry with a complement of 31 tubes; however, its compact design makes it practical for home service calls. Printed wiring is featured in its chassis construction, and a built-in cooling fan maintains operating temperature at a desirable level.

Metering Without Loading

Extremely high input impedance is the predominant feature of the Model 311 Vacuum-Tube Volt-Ohmmeter pictured in Fig. 7. Developed by Simpson Electric Co. of Chicago, the instrument also offers a selection of voltage and resistance scales well suited to the needs of the serviceman. The meter comes complete with AC - DC - ohms probe, ground lead, and operator's manual.

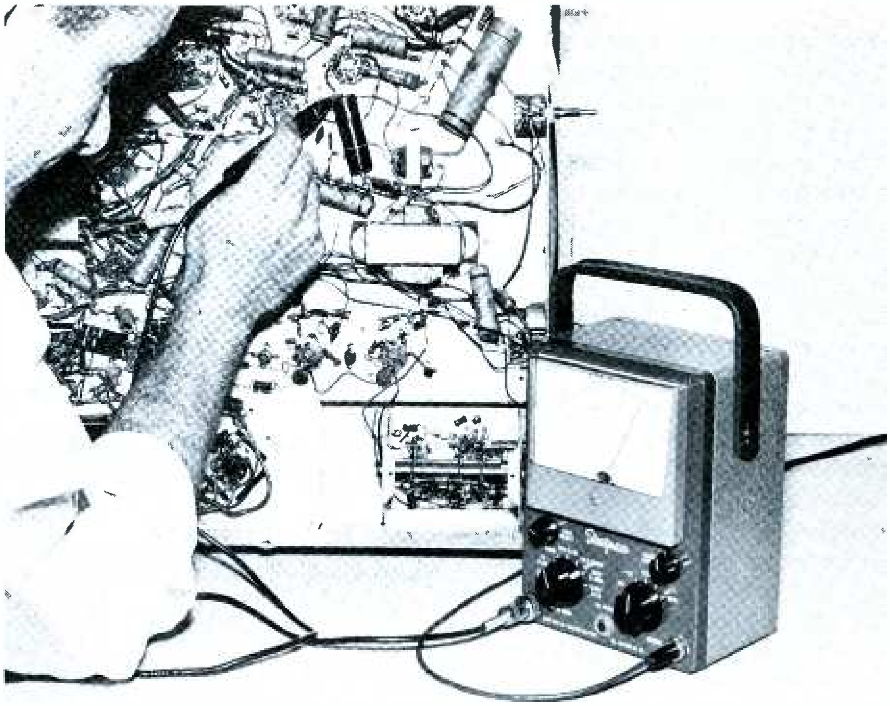

Fig. 7. Simpson's new VTVM has an easy-to-read scale and high input resistance.

Specifications and features are:

1. Power Requirements—105/125 volts AC, 50/60 cps; power consumption 5 watts; one 1.5-volt battery supplied for resistance measurements.
2. DC Voltmeter—ranges 0 to 1.5, 5, 15, 50, 150, 500, and 1,500 volts; input resistance 22 megohms; accuracy ±3% of full-scale deflection when powered by 117.5 volts, 60-cps.
3. AC Voltmeter—RMS ranges 0 to 1.5, 5, 15, 50, 150, 500, and 1,500 volts; peak-to-peak ranges 0 to 4, 14, 40, 140, 400, 1400, and 4,000 volts; input impedance 2.2 megohms at 60 cps; accuracy ±5% of full-scale deflection when operated at 117.5 volts, 60 cps; frequency response 30 cps to 100 kc within 5%.
4. Ohmmeter—ranges R X1, 10, 100, 1K, 10K, 100K, and 1 meg; center-scale value 10; zero and ohms-adjust controls provided on front panel; accuracy ±3° of scale arc.
5. Meter Accessories — high-frequency probe extends response to 100 mc flat within 5%, input capacity 10 mmf, RMS range 0 to 150 volts for sine waves, peak-to-peak range 0 to 400 volts for all inputs; high-voltage probe extends DC ranges to 100 times switch markings, increases input resistance to 2,200 megohms, maximum safe measurement 30,000 volts.

When examining various pieces of equipment in our lab, I'm always curious to see what they look like inside. In the case of the Model 311, I slipped out two Phillips-head screws from the back of its case and lifted out the entire chassis, including meter panel (see Fig. 8). Note the modern printed-board construction and the orderly placement of components.

The 200-microamp meter movement is attached to the front wiring deck. Two tube sockets are also mounted on this board; the tops of the associated tubes extend through cutouts in the rear deck. Meter adjustments for which a detailed calibration procedure is outlined in the manual are pointed out in Fig. 8.

In addition to the voltage and re-

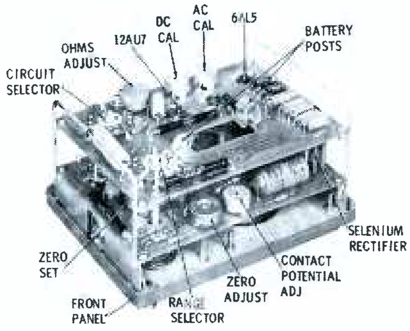

Fig. 8. Model 311 removed from its case reveals double-decked printed boards.

Fig. 9. Simpson's latest VTVM features new type probe with "timesaver tip."

sistance scales mentioned in the specifications, the meter face is also marked for zero-center indication. This feature comes in handy when metering bias-voltages or performing FM and TV sound alignments. A special jack labeled *RF PROBE,* located at the bottom center of the front panel, accommodates the phone-plug end of the accessory high-frequency probe.

Putting the instrument to a practical test, I measured several known AC voltages to check meter accuracy. Using a sine wave voltage, I found that both peak-to-peak and RMS readings were right on the button. I also found that peak-to-peak voltages having irregular, complex shapes could be measured on a direct-reading scale. The RMS indication for signals of this type is, of course, only relative.

Knowing the importance of high input impedance in a test instrument, I took several voltage measurements in video IF and horizontal oscillator grid circuits. In several instances, accuracy was somewhat better than that obtained with meters offering lower impedances. Resistance measurements I made, which included some low-ohms readings in transistor circuits, substantiated the accuracy figures stated in the manufacturer's specifications.

Supplied with the Model 311 is a special probe which permits changing the meter input to either DC or AC-ohms with a simple push-pull action. Pictured in Fig. 9, the probe features an S-curved tip that can be either pressed against a contact or hung from a terminal or wire. The latter makes it unnecessary to hold the probe while taking readings. ▲

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Trends. All the talk you may hear about brisk sales of transistor radios and expensive hi-fi sets is not just ballyhoo! These up-to-date units are beginning to crowd some other types of equipment out of the picture.

For example, at the end of last year, it was estimated that no less than 49% of all new portable radios being produced were transistorized models. "Cordless" table radios using transistors had also appeared on the scene.

And, thanks to the hi-fi boom, sales of all kinds of phonograph equipment during 1957 were up 19% over 1956. This figure is not too impressive in itself, but a further study of the statistics reveals the striking fact that inexpensive table-model phonographs actually dropped off in sales while big consoles went far up in popularity. For example, look at the figures for hi-fi phonographs selling at a list price of over $300. Only 51,000 were sold in 1956, but the figure for 1957 was 405,000.

These statistics should serve as a warning not to get caught untrained when someone offers you a chance to service one of these modern radios or phonographs.

$ & ¢

End of a Phase. Obsolescence is catching up with the pint-sized portable TV sets that were making such big news only a couple of years ago. Since the 110° picture tube opened the way to more compact large-screen portable sets, no more of the units with screen diagonals under 14" have been introduced. What's more, about ten 17" sets are currently being produced for each 14" receiver that leaves the factory.

The trend to bigger screens is a good deal for everybody. The viewer has a picture that is easier on the eyes, and the seller has a chance of making a reasonable profit on the higher-priced large-screen receivers. Luckiest of all is the serviceman who will be having fewer worries about hard-to-work-on "miniature" TV's, and the accompanying high labor charges which seem so far out of proportion to the low original cost of the set.

$ & ¢

Getting the Message. Does a secretary (or other non-technical employee) receive service requests over the phone in your shop? If so, be sure that she has mastered the technique of obtaining all the information you need for proper handling of the service call. If the customer is merely allowed to volunteer information, he is likely to omit some important points and you will have to disturb him with a return call.

Specific questions should be used in a logical sequence to find out the nature of the trouble. "Do you have a picture?" is a good starting point. If the answer is no, the order taker should then ask if any light at all appears on the screen. In cases where some sort of presentation is visible, she should encourage the customer to describe it. Give her a "short course" in recognition of common trouble symptoms and their names (snow, pulling, etc.) so that she can give the shop force some sort of preliminary diagnosis and also advise the customer on "what to do until the technician comes."

Other miscellaneous information should be picked up at opportune times during the conversation. The order taker should attempt to find out if the call is to be made as part of a service contract or warranty agreement; approximately how old the receiver is; whether the trouble is continuous or intermittent; and any other facts that the technician should know before starting out on the house call.

Scheduling the call will be less of a problem if your "girl Friday" has an up-to-date copy of the truck-routing schedule within easy reach.

After a quick glance at this sheet, she can suggest, "Our man will be in your neighborhood about — o'clock; will you be home then?" If the response is negative, or if the customer is in too much of a rush to be satisfied with the regular schedule, he should then be invited to suggest a more suitable time.

$ & ¢

Test Your Tact—VII. How do you go about presenting your bill to the customer after a shop job? This chore doesn't call for any particular standardized technique, but anything you say should contribute to the customer's impression that you have earned your fee.

At least, you should be on guard against putting your foot in your mouth, as did one serviceman who was called by some out-of-town friends of ours. On returning their set from the shop, he didn't say much about what work he had done; but he cheerfully rambled on to tell them that business was fine and that he was building a new shop. Then he handed over a bill for about $30!

"Aha," thought our friends, "we see where he's getting the capital to put up a fancy new building." When we paid them a visit several days later, we had quite a time reassuring them that his charges were fair. Finally, we examined his bill and explained each item. It turned out that the set had not been worked on for about a year, and his replacement of a half dozen tubes and several other parts seemed to be well within reason.

The picture on the set was noticeably clearer than the last time we had seen it. When the technician returned the TV, he could profitably have pointed out that he had been able to make picture improvements beyond simply restoring the set to working order. In this way, he could have done a better job of justifying a bill that might easily strike the set owner as being exorbitant.

$ & ¢

We Give Stamps. Valas TV, Denver, used a popular brand of trading stamps as a powerful lever to pry some slow-moving used TV sets out of their resting place on the sales floor. A bonus of 5,000 stamps was offered with each console sold at prices ranging from about $60 to $100.

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Vertical Foldover

An Emerson Chassis 120133B has vertical foldover at the bottom of the raster, together with extreme nonlinearity and increased height. There is also some loss in brightness. I have replaced the linearity control, the output transformer, and a number of capacitors in the vertical section. All voltages seem to be within tolerance.

R. W. Gregware

Troy, N. Y.

Did you try replacing the output tube? How about C2B? In case it opens, R82 will be added to the plate load circuit of the vertical output tube. Its presence will tend to distort the waveform applied to the yoke, and nonlinearity in the raster is one possible result.

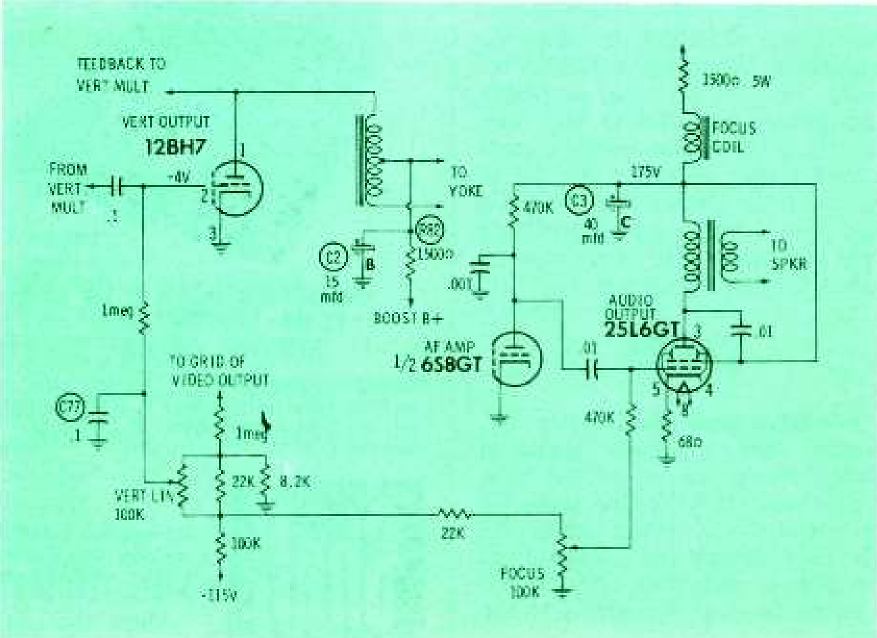
Since you say the brightness is not up to par, the boost voltage might be too low. This would mean insufficient plate voltage for the vertical output tube, which could account for the distortion.

Recheck the output-tube grid voltage to be sure that it is close to normal. A shift in grid bias would cause the tube to operate on a nonlinear portion of its characteristic curve, with resulting severe distortion of the drive waveform.

If it is, and you have not already replaced C76, then do so. Even a slight leakage through this capacitor would provide a DC path to B+ (through the vertical multivibrator plate circuit) and tend to bleed off some of the bias voltage on the output tube. Also check for defects in the network that supplies this bias voltage.

You're in for a few surprises when you trace out the bias circuit. Basically, the portion included in the vertical circuit is merely a voltage divider (with an adjustable tap) across the minus 115-volt branch of the power supply. The same network also supplies fixed bias to the grid of the video output tube, and there is a third connection that includes a focus potentiometer.

Although I doubt that this focus circuit has much to do with your trouble, it is a very interesting setup and is worth a little study. The arm of the focus control goes to the grid of the audio output tube! Before you decide that this is a typograph-



ical error, take a good look at the audio section. You soon discover that the audio amplifier and output tubes derive their plate voltage from a 175-volt source, and that the only return path from this point to the B+ supply is through the focus coil. Here is an interesting variation of the familiar scheme in which the audio output tube serves as a dropping resistor between the high and low B+ lines. As for the effect of the focus control, it varies the bias on the audio output tube and thus regulates the DC current through the focus coil. Any resulting change in volume can be corrected by resetting the volume control. Clever, yes?

Line-To-Antenna Short

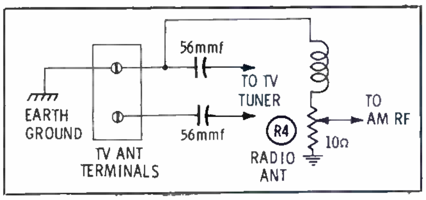
What causes the radio antenna control on a Setchell-Carlson Model 71 TV-radio combination to burn out? Both the control and a series choke are burned, and the chassis is "hot" with AC.

O. Gremsgard

Northwood, N. Dak.

I would size up your situation in this manner:

An outside antenna which features an earth ground is employed, and some component breakdown in the receiver has created a short between one side of the AC power line and chassis. If the line plug is inserted so that the receiver's shorted side is connected to the "hot" side of the incoming line, the low-resistance radio antenna circuit is then connected directly across the power line. No wonder the control burns out!



The trouble is probably a short or leakage in a filter capacitor connected from one side of the line to chassis in the primary circuit of the power transformer. Another possibility is insulation breakdown in the power-supply circuit; this could easily have happened if the antenna was ever subjected to a "near miss" by lightning or the transformer overheated.

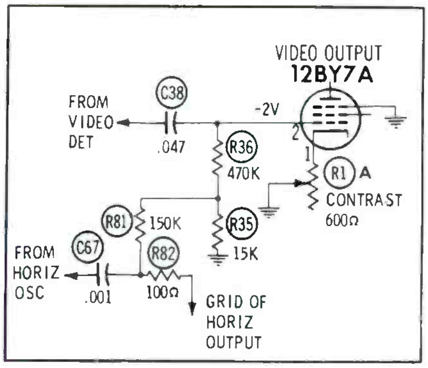
Negative Picture

When the contrast control of an Emerson Model 1114J is advanced about ¾ of the way, the picture turns negative or silver. Below this setting, it is normal. All necessary voltage and scope measurements were taken in the RF, IF, AGC and video sections, but nothing abnormal was located. New tubes (including two different picture tubes) have been tried, and capacitors and resistors check OK.

Michael Nahorniak

Fairport Harbor, Ohio

This symptom is almost always caused by overloading of a stage, and the video



output stage is most likely to be at fault. The best procedure is to check voltages and waveforms in the circuits you mentioned when the picture looks normal, and then go back and make the same checks again when the negative-picture symptom is present. You should see some definite changes that should help you localize the defect.

The waveform at the cathode of the picture tube MUST be abnormal if the picture looks negative. If you find that the video-output grid waveform is also incorrect (inverted 180°), then you should go back to the video detector or an earlier stage to find your trouble. Otherwise, you can assume that the defect is in the video output stage.

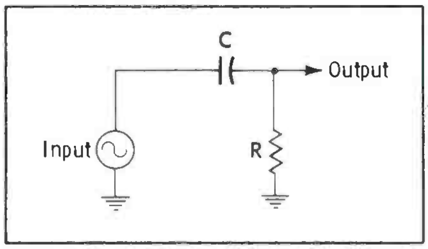
Notice that the video output grid receives a small fixed bias voltage from the horizontal output grid circuit. Insufficient horizontal drive or trouble in the connecting circuit would mean lower-than-normal bias on the video output tube, and this could account for your overloading. Although the grid voltage might have seemed to be within tolerance when you checked it, it could be too low for the conditions under which the set is operating. Low plate and screen voltages would also tend to cause overloading.

RC Coupling

During a discussion on power-supply filtering, I contended that a capacitor will not filter or couple any signal frequency at which it is able to charge and discharge. However, others argue that the capacitor must charge and discharge at a given frequency in order to couple a signal of that frequency. Can you settle this difference of opinion?

DELTON AGERTON
Ariton, Ala.

You win! In order to couple a signal, a capacitor has to "pass" all frequencies contained therein; in other words, it should offer little or no impedance to any or these frequencies. When the capacitor has no impedance to a signal, it will not become charged by it and no



voltage drop will appear across it.

Referring to the sketch of a simple coupling circuit, suppose that the time constant of the RC combination is very long in comparison with one cycle of the input signal. The capacitor will then be charged only slightly by each cycle, and practically all the signal voltage will appear across R. Almost 100% of this signal has been coupled through C.

Let's take another case in which the RC time constant is much shorter — so short, in fact, that C receives a considerable charge during each cycle of the signal. The input signal voltage becomes divided across C and R in series, and only a fraction of it is available across R as an output. Thus, the second RC circuit has done a poorer job of coupling the signal than the first circuit.

Replacement Tuner Hookup

Can you tell me what the terminal connections and voltages are for a Standard Coil TC-009 tuner? The tubes are a 6BQ7A RF amplifier and a 6J6 oscillator-mixer.

WILLIS H. SOILEAU

Will's TV-Radio Service
Ville Platte, La.

The plate of the second section of the cascode RF amplifier is returned to the high B+ source in the receiver—usually 225 to 265 volts. Plate voltage for the oscillator-mixer may also be obtained from this point through a dropping resistor, but you may find a separate connection from the plates of the 6J6 to the low B+ source (125 to 150 volts) in the receiver. Heater voltage in this case is naturally 6.3 volts, and the AGC voltage will depend on the type of AGC circuit used in the receiver as well as on the strength of the incoming signal.

If pins 6 and 3 of the 6BQ7A are tied together through a coil, this indicates that pin 1 is the plate connection of the second RF stage. Trace from this pin to one of the external terminals (using an ohmmeter to check continuity through the tuning coils) and connect high B+ to that terminal. If pins 1 and 8 are tied together through a coil, the high B+ should go to pin 6.

Follow the connection from pin 1 of the 6J6 to the terminal board. If it does not go to the high B+ line, but comes out at a different terminal on the board, connect this latter terminal to low B+.

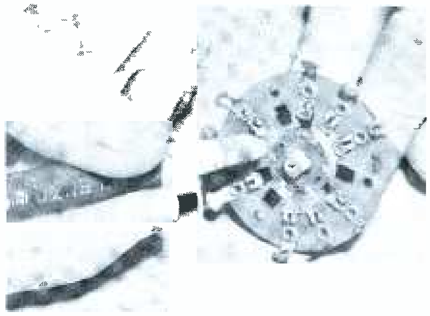
One of the grids of the 6BQ7A (pin 2 or 7) will be connected to the junction of two high-value resistors—over 100K ohms apiece—and the other grid will be connected through a much lower value of resistance to the external terminal where the AGC voltage is fed into the tuner. Find the heater connection by locating the terminal tied to pin 3 or 4 of the 6J6 and pin 4 or 5 of the 6BQ7A.

The 21-mc signal output lead is brought out to the top of the tuner from the plate circuit of the mixer. Connect the output terminal to the IF input point on the receiver, and also ground the tuner to the main chassis. Keep both leads as short as possible and dressed away from each other.

TIPS for TECHS

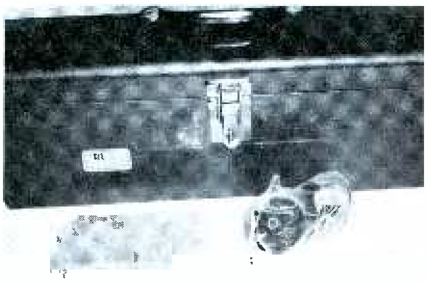
Holder for Fragile Parts

Paper-fiber egg cartons make handy containers for odd bits of hardware removed from a set, and they're also ideal for holding miscellaneous breakable parts. When a customer brings in some tubes to be checked, for example, tested tubes can be kept separate from the others by placing them in the individual compartments. After all the tubes have been tested, it's a good idea to let the customer carry them home in the carton—there's much less danger of tube breakage, and he will surely appreciate your thoughtfulness.



Eraser is Servicing Tool

An ink-typewriter eraser of the "pencil" type added to your tool kit will provide the solution to several small service problems. In addition to being especially handy as an electrical contact burnisher, it makes a neat probe to use for poking amongst wires and components while making a visual inspection of a defective circuit. When you have to make a solder connection to a corroded terminal lug, use of the eraser to clean the lug assures a low-resistance connection. One of these erasers can be purchased at a five - and - dime store.

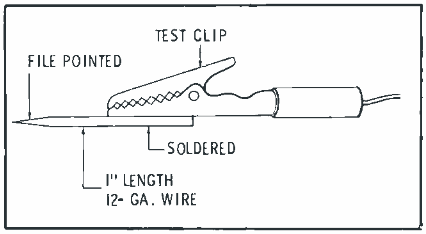


Plastic Bags are Handy

Carry several small plastic bags of various sizes in the home service kit. They are particularly handy for holding hardware removed from a set when the chassis is taken to the shop. One of these bags may also be used as a cone protector for a speaker if it has to be taken to the shop along with the set. Another bag could serve as a protective cover for a rag moistened with furniture polish. Once you start using them, you'll find the bags useful for many other purposes, too.

Your Tools Deserve Care, Too!

To prevent rust and corrosion, tools should be wiped off occasionally with a plastic sponge which has been moistened with machine oil. This is the easy, modern way to keep them in good shape, and it takes only a few minutes of your time. Between oilings, keep the sponge stored in an airtight container to prevent spontaneous combustion and evaporation of the oil. Give your hand tools the care they rightly deserve, and they will last almost forever.



Making Test Clips Semi-Universal

If you have some test leads or jumper cords with alligator clips on the ends, you can increase their usefulness by soldering a 1″ length of 12-gauge solid copper wire to the back of the stationary jaw of each clip and filing the end of the wire into a sharp point as shown. This will enable you to use them as prods or plugs to fit into phone jacks, while still allowing you to make snap-on connections.

Padding Prevents Marred Cabinets

Need some sort of padding to protect the finish on those TVs you transport between home and shop? Sponge-rubber padding (available at many furniture stores and mail-order houses) is ideal for this purpose. It's much better than an old blanket, quilt, or other cover because of its resiliency. The cost of a large sheet of this material is nominal when compared to the loss of a customer.

Binoculars Extend Serviceman's Vision

Looking up from the base of a tall TV tower makes you wish for some easier way to tell if the trouble really *is* up there. A good pair of binoculars can give you a "bird's-eye view" of the antenna and lead-in without the necessity for climbing the tower. And even if you do spot trouble, it's always a big help to know just exactly where or what the trouble is before you get up there. Just don't let your extended vision and mind stray to other tall feminine subjects in the neighborhood—especially from the top of the tower!

Hint for Tinning Your Iron

Does the tip of your soldering iron over-heat and scale up badly when standing idle on the bench? You can minimize this condition if you use a coarse-cut file to clean the tip. The roughened surface readily accepts solder, permitting it to penetrate deeply into the surface. The deep-solder penetration gives a tinning that will stand up to high temperatures and long use.

Shop Talk

(Continued from page 18)

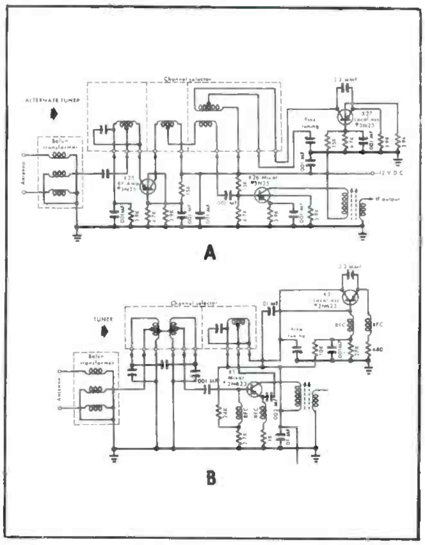


Fig. 3. Two different tuners were developed for transistorized set.

tetrode transistor is its higher cost, an important consideration in commercial receivers.

The other tuner (Fig. 3B) has two 2N623 diffused-base triode transistors, one serving as mixer and the other as local oscillator. No RF amplifier stage is employed because available triode transistors provide little or no gain on channels 12 and 13. Without the RF amplifier, this second tuner provides only half the gain of the other; however, low-noise performance is more important than gain at this point in the system.

Video IF Section

The video IF system consists of five grounded-base amplifiers. All of the tuned circuits, with the exception of the one between the third and fourth stages, are peaked at 44.5 mc. The remaining circuit is double-tuned and overcoupled to provide a flat top for the response curve. This arrangement not only provides considerable gain (between 70 and 75 db), but also is extremely simple to align and has an adequate bandpass characteristic. Adding the IF and tuner gain figures, we find that 100 microvolts at the 300-ohm antenna input will result in approximately 1 volt peak-to-peak at the second detector.

AGC is provided by diode M4 and DC amplifier X10 (see Fig. 4). The diode conducts on the sync-pulse tips, developing a voltage proportional to the level of these tips across the 20-mfd capacitor. This voltage, properly filtered, is amplified by X10 and supplied to the base of the first and second IF stages. Two other diodes are included in the input circuits of the controlled IF stages, but these do not enter into AGC action. Their purpose is to keep the input impedance of these stages constant as AGC voltage varies. As the transistors approach cut-off under strong-signal conditions, their input impedance tends to rise, a condition which would narrow the IF bandpass. Before this can happen, however, D1 and D2 begin to conduct, and the rise in input impedance is prevented.

Of further interest in this section is the fact that each video IF stage is neutralized. Triode transistors, in common with triode tubes, are susceptible to internal feedback at high frequencies, so a counterbalancing external feedback arrangement must be utilized to prevent the circuit from oscillating.

Video Amplifiers

Beyond the IF system, there is a video detector diode followed by two 2N623 video amplifiers. The first video stage is an emitter follower, while the second uses a conventional grounded-emitter circuit. Sufficient gain is provided to drive the output stage to its full swing of 40 volts when the video-detector signal has an amplitude of one volt. The over-all video bandwidth, 2.7 mc, is sufficient for the 9" screen. A larger tube could be used, but among other things, it would require more driving voltage than the 2N623 could provide.

DC coupling is employed between the video detector and second video

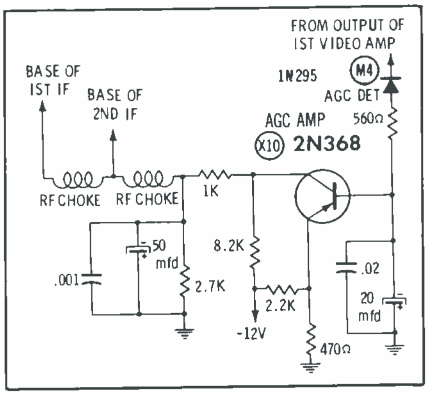


Fig. 4. AGC circuit of transistorized TV set includes diode and DC amplifier.

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(Signed) MAL PARKS, Jr., Bus. Mgr.
Sworn to and subscribed before me
this 25th day of September, 1958
(Seal) Mary Helen Whipp, Notary Public

TUBE TYPE	MODEL 648 CIRCUIT FIL.	D.	E.	PLATE TEST	MODEL 1157/715/561 FIL.	X.	PLATE	YZ
1G3	1.4	12	9	35XZ	1.4	2457	44	8Q
1K3	1.4	12	9	65XY	1.4	-	50	8Q
					This type OK if reads above 45			
5BW8	5.0	A129	678	50V	5.0	-	38	7JOR
		125	3	60X			30	2Q
			4	60X			30	9Q
6DN7	6.3	234	A17	20WZ	6.3F	-	11	1NS
		238	AC56	42V			18	4LS

TUBE TYPE	SEC	MODEL 49 A	B	C	D	CATH. SHORTS	E
1G3	D	1.4	2X	1358	0	-	30
1K3	D	1.4	2X	-	0	-	100
5BW8	P	5.0	4	X	689	4	30
	D	5.0	4	-	1X.	2	62
	D	5.0	4	-	3X.	2	62
6DN7	T	6.3	7	-	12	3	5
	T	6.3	7	-	45	6	9

Latest Chart Form 648-20, 1157/715/561-10, 49-4

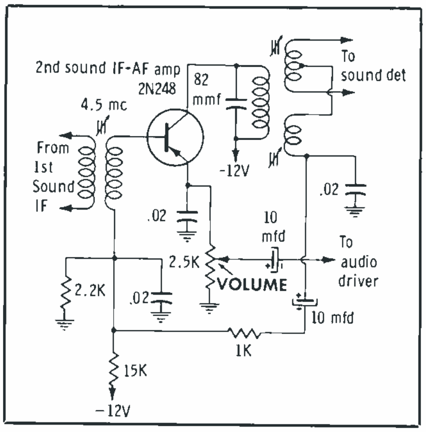


Fig. 5. Second sound IF and first audio stages are combined in reflex circuit.

amplifier. This has several advantages, the principal one being low transistor dissipation under no-signal conditions. Using fixed bias, transistor dissipation would be much greater—signal or no signal. It is possible to operate a transistor with little or no bias (i.e., near cutoff) and still maintain a low level of distortion because transistor characteristic curves are linear at points close to cutoff. In a comparable vacuum-tube circuit, the distortion developed would be too high for practical usage.

AC coupling is employed between the final video amplifier and the picture tube. It was found that, if DC coupling were used, the black level of the signal would not stay constant with varying signal levels, and the resulting change in picture brightness would be annoying under certain conditions.

Sound IF System

The first video amplifier drives the AGC system, sound IF amplifier, and sync separators. As pointed out earlier, the sound system is fairly straightforward, although it does employ a reflex circuit. The ratio-detector output is fed back to the second sound IF stage (Fig. 5), which is operated as a reflex amplifier and therefore presents a higher input impedance to the audio signal than a conventional common-emitter arrangement. Neither signal in the reflex stage interferes with the other because of the wide difference in their frequencies.

For limiting, a diode connected between the base and collector circuits of the first sound IF clips the negative half of the wave on strong signals. The action of the resonant circuit that follows the diode imposes the same limits on positive half cycles.

Sync Separator Section

Three stages are employed in the sync system. The first uses a self-biased *n-p-n* transistor. The video signal arriving at the base has positive-going sync pulses. After the first few pulses, enough voltage is developed by the 10-mfd input coupling capacitor and its associated 100K-ohm resistor to bias the transistor to cutoff. Conduction then occurs only on sync-pulse tips. A video signal of about .75-volt p-p will drive this stage from cutoff to saturation. Since this small a signal is less than the usable minimum, good clipping action can be expected for all normal conditions.

The second sync stage amplifies the sync pulses and then transfers the horizontal pulses via the emitter resistor to the AFC stage through a .02-mfd capacitor. The signal at the collector is coupled through an integrating network consisting of a 1,000-ohm resistor and a .1-mfd capacitor to the stage labeled "Vert. Sync Amp." in Fig. 2. The major portion of the vertical-pulse shaping occurs in the integrator, although some additional integration is provided by a 2,700-ohm resistor and a .1-mfd capacitor in the emitter circuit of the vertical sync amplifier.

This stage amplifies only the vertical sync pulses before applying them to the vertical blocking oscilla-

All right then . . . don't pay the bill!

tor. This is done not so much for the additional amplification as it is for the isolation which it provides between the vertical oscillator and the horizontal sync system. Any appreciable coupling between them would degrade picture interlace and produce a hook at the top of the picture.

Vertical Deflection System

The vertical deflection system is a two-stage affair utilizing a blocking oscillator and a common-emitter output amplifier. (An extended discussion of this system was described in the Nov., 1957 PF REPORTER.) The usual vertical hold, linearity and size controls are present; in addition, a control provides for adjustment of the bias applied to the vertical output transistor in case it should have to be replaced. This is required because current amplification (β) among power transistors of the same type may vary over a considerable range. It will be found that all of the vertical controls are interdependent to some extent and that adjustment of one will usually require some touching up of all others.

One interesting feature of this circuit is the shunting inductor connected to the collector of the output transistor. This has an inductance of 470 millihenries and a DC resistance of only slightly more than 7 ohms. In the circuit discussed previously, transistor DC current, passing through the vertical deflection yoke windings, shifted the position of the image vertically and necessitated a special centering arrangement. In the present circuit, much of this difficulty is avoided by the shunting inductor. Since its DC resistance is extremely low, most of

Open up! Open up!

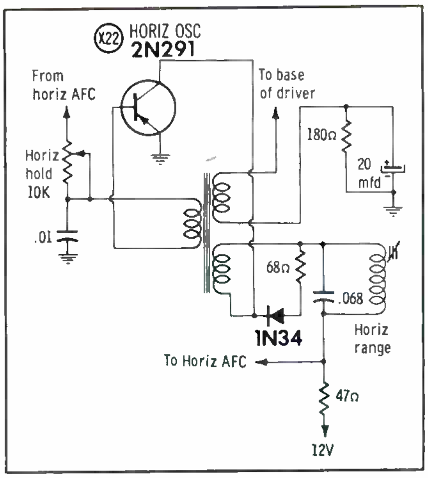


Fig. 6. Horizontal oscillator is of blocking type and includes ringing coil.

the DC current passes through it, leaving very little for the vertical deflection windings. Because the AC impedance of the choke is high, however, the yoke receives its normal deflection-signal current.

Horizontal Deflection System

In keeping with current vacuum-tube practice, the horizontal deflection system is considerably more extensive than the vertical system. The AFC circuit is quite common, and therefore a detailed description of its operation is not required. A control voltage, developed by two 1N34 diodes with a common cathode connection, is applied to a 2N366 DC amplifier in order to obtain the desired range of oscillator frequency control. The output of this amplifier goes to the base of the 2N291 horizontal oscillator (Fig. 6) through the horizontal hold control. This oscillator is of the blocking type and is designed so that the transistor is saturated during retrace and cut off during scan. Such action produces an output pulse which is essentially rectangular in form. The collector winding of the blocking transformer is shunted with a diode in series with a 68-ohm resistor to prevent too high an inductive kick from developing when the transistor is dropped sharply into cutoff. Failure to take this precaution would soon destroy the transistor. The same winding also has connected to it a resonant circuit for frequency stabilization. This is in line with current practice for vacuum-tube TV circuits.

A driver stage follows the horizontal oscillator which, in the ab-

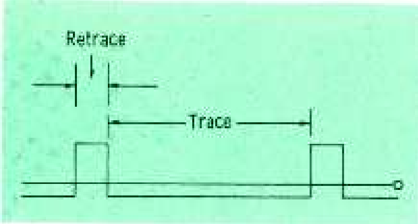


Fig. 7. Voltage waveform applied to base of horizontal driver transistor.

sence of any drive from the oscillator, is cut off. However, when the driving pulse arrives, the 2N291 driver transistor changes quickly from cutoff to saturation. At the end of the pulse, the transistor is brought back to cutoff, although not quite as sharply as conduction began. This slight lag is due to the fact that carriers accumulate in the base region when a transistor becomes saturated, and a short period is needed to clear this region after the forward bias has been removed.

To better understand what happens in the driver stage and in the output amplifier that follows it, let's look at the pulse which the driver receives. Due to the AC coupling between windings of the blocking transformer, the waveform shown in Fig. 7 is applied to the base of the driver. Note that the wave distributes itself about a zero axis so that there is just as much area above as below. Because the driver is a *p-n-p* transistor, conduction occurs when the base is driven negative with respect to the emitter. The waveform in Fig. 7 shows that the negative voltage applied to the driver is quite small during the relatively long scan period. In spite of this, however, the transistor is driven into saturation.

When the positive pulse arrives, it drives the transistor into cutoff. This is the flyback or retrace interval, lasting for about 10 microseconds, after which the forward bias is reapplied for the next line scan. If the oscillator should cease to function for any reason, the forward bias on the driver is removed and the transistor will cut off. Thus, this arrangement possesses a built-in safety feature.

The output stage, in its basic form, appears as shown in Fig. 8. Its main parts are the output transistor X24, the horizontal deflection yoke, a damper diode, an output transformer for high voltage, and a 1V2 vacuum-tube rectifier. The same type of square wave that was

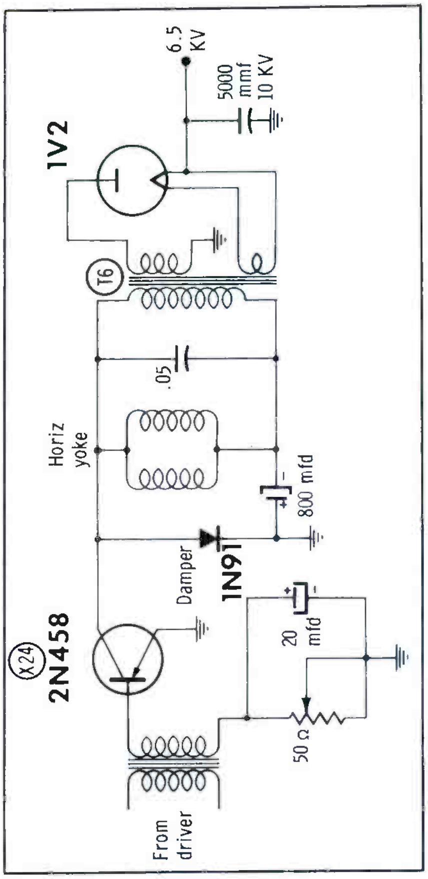


Fig. 8. Horizontal output and high-voltage circuit includes 1V2 rectifier tube.

applied to the driver tube is also fed to X24. This is permissible here because, when the transistor is conducting heavily, its internal resistance is less than 1 ohm. This leaves only the inductance of the horizontal deflection winding predominant in the circuit — and a square wave of voltage, applied to a pure inductance, will produce sawtooth current.

During the forward trace of the scanning beam, X24 is driven into saturation. When the beam reaches the right-hand side of the screen, the incoming pulse goes sharply positive. Since X24 is a *p-n-p* transistor, this reverse-biases the base-emitter circuit and drives the transistor into cutoff. Cutoff does not occur as sharply as the pulse change —again, because of the accumulation of carriers in the base region.

With the transistor cut off, the yoke and any capacitance across it are shock-excited into oscillation. For one-half cycle, the circuit oscillates and returns the electron scanning beam to the left-hand side of the screen. Then the damper diode conducts, and the current decay brings the scanning beam from the left-hand side of the screen to the center.

At this point we have an interesting departure from vacuum-tube practice. Since a transistor can conduct in the reverse direction (from collector to emitter), some of the decay current passes from collector to emitter of X24. This is possible because the transistor is forward-biased while the damper is conducting. When the decay current reaches zero, the beam is in the center of the screen. Then the transistor starts conducting in the forward direction (i.e., emitter to collector) and the beam is gradually brought to the right-hand side of the screen to complete the scan cycle.

During beam retrace, a pulse voltage develops across the primary winding of T6. This is stepped up by the secondary winding, rectified by the 1V2, and applied to the second anode of the picture tube.

In the actual horizontal output circuit, there are three low-voltage semiconductor diodes attached to T6 at several points. These serve to develop various DC voltages for the video amplifier, and brightness and focus controls. The voltage requirements for these circuits are greatly in excess of the battery voltage, and this is an easy method of procuring them.

The entire receiver with its cabinet is 8″ high, 9½″ wide and 14″ long. Weight, including the battery, is 19 pounds. Servicing suggestions will be presented in the next installment. ▲

I own 50 motels with TV in every unit—and they all need service.

New Designs

(Continued from page 23)

dots when reconnecting speakers will result in improper phasing and thus degraded sound. A similar red-dot code is employed on the three- and four-speaker systems used with Hoffman Chassis 424.

RCA Chassis KCS121 is equipped with a *stereo* jack that allows the user to apply the output of an external audio amplifier to the TV speaker system (refer to Fig. 7). The television set should be turned off when the speakers are being used in this manner.

Multi-speaker systems in RCA receivers include a variety of speaker sizes: 3½", 4" X 6", 5", 6" X 9", and 8". The secondary leads of the output transformer are returned to the audio printed wiring board, where attachments for the speaker leads are provided.

Plain Talk on Transistor Interchangeability

The transistorized portable TV set developed by Texas Instruments, Inc., (see "Shop Talk," this issue) is evidence that such receivers have moved another step closer to mass production. Considering this in addition to the success of transistor radios, the time is fast approaching when servicemen can ill afford the luxury of ignoring the problems associated with serving transistorized equipment.

Preparing for transistor work involves more than just studying circuit theory. It is also important to re-examine some tried-and-true troubleshooting techniques to see if they are adequate when applied to transistor circuits. As a case in point, one of the most deeply ingrained habits of many good technicians is to check the tube in a circuit (preferably by substitution) as soon as a trouble has been isolated to that circuit. Since the tube is often at fault, this procedure has been highly effective. Many servicemen attempt to carry this substitution technique into the transistor field — even though transistors are earning the reputation of being much less likely to fail than tubes.

There is actually nothing wrong with this approach to transistor servicing; after all, it is reassuring to find out that the transistor is OK before tearing into the rest of the circuit. However, a special problem exists because of the numerous transistor types in use. At least for the present, it seems hopelessly impractical for the average service shop to stock them all. In order to ease this situation, servicemen are constantly asking for interchangeability guides, or at least a list of minimum stock requirements.

The simple truth is that different transistor types are not identical, and good results from interchanging cannot be guaranteed. Nevertheless, it has been found that the various types of transistors used for a given purpose might be interchangeable to a limited extent because of a basic similarity between them.

One of our readers reports that he has made some tests, and has come up with the following "minimum stock" of transistors. He states that the types on this list have worked satisfactorily (in the stages indicated) in most transistor radios repaired in his shop.

P-N-P	
Converter	2N136
Oscillator	2N135
RF-IF	2N136
Audio (Lo-Pwr)	2N192
Audio (Hi-Pwr)	2N188A
N-P-N	
Converter	2N168A
RF-IF	2N169A
Audio (Lo-Pwr)	2N169A
Audio (Med-Pwr)	2N214

Of course, his chart is based on types available from a particular supplier. Different transistor lines include other widely-used types that might be suggested as possibilities for "universal" or "minimum-stock" use. Here are a few of these alternate types:

P-N-P	
Converter	2N252, 2N411
IF	2N112, 2N410
Audio (Med-Pwr)	2N109, 2N138, 2N185
N-P-N	
Converter	2N172
IF	2N253

Such a basic group of transistors is of definite value for bench use, if you can correctly interpret the results obtained when using them for substitution tests. If you stop and consider the anticipated results, you will find that they fall into one of the following categories:

1. Equipment will resume normal operation, indicating that the original transistor is bad.

2. Symptom will be unaffected by substitution, indicating either that the original transistor was not causing the trouble in the first place, or else that the substitute works no better than the original.
3. The original trouble will disappear, but a different type of abnormal operation will develop, indicating that the replacement transistor is not suitable for use in the circuit being checked.

It's natural to wonder why you can't expect more sure-fire results than this. The best available answers are furnished by the engineering staffs of transistor manufacturers, who are closer to the problem than anyone else. They state that audio-frequency types can be interchanged to a great extent as long as maximum rating limits are observed, but that problems begin to mount when you start dealing with RF-IF and converter applications. Because of differences in power gain and interelement capacity, the interchanging of transistor types can cause regeneration (if the substitute unit is too "hot") or loss of sensitivity (if it is not "hot" enough). Neutralizing networks are included in IF circuits to minimize such problems, but neutralization is usually fixed and provides only enough leeway to take care of variations between different transistors having the same type number. In order to work well, a substitute unit therefore must closely match the original. You are sometimes lucky enough to find one that does; on the other hand, you can occasionally run into trouble even when trying to use an exact replacement.

In summary, the best words of advice concerning repairs to transistorized equipment are "Don't be half-safe." Exact replacements, if available, will eliminate most of the risk that a substitute transistor might not work, or that a customer will bring back a radio saying, "It doesn't play as well as it used to." However, if you're faced with the choice of finding a substitute type, or losing a service job, you would be justified in making a cautious substitution. In such instances, an extremely thorough "air check" of the equipment after completion of the repair is your best insurance against callbacks. ▲

PRODUCT report

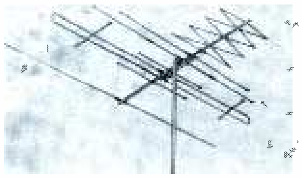
Absorption Analyzer

The Kingston Model PO-1 Absorption Analyzer permits oscilloscope users to view RF signals without making a direct connection to the circuit being tested. Signals picked up by an electrostatic probe are fed through an RF amplifier (modified turret tuner) and a detector before reaching the scope input. There is a built-in speaker for audio signal tracing. Price is $197.50.

For further information, check 41X on Literature Card.

Balanced Sleeve Dipoles

All models of JFD Helix *Colortennas* (Power-Helix, Star-Helix, Super-Helix and Junior-Helix) now employ balanced sleeve dipole construction — a feature formerly used only in the Satellite-Helix model. All types are available in either regular or gold-anodized finish.



For further information, check 42X on Literature Card.

Flybacks For CBS Sets

Three new Rogers flyback transformers are exact replacements for original parts in CBS-Columbia TV sets. Type EFR 200 replaces Part Nos. PC10147 and PC10161 in Chassis 1021 and -2, the EFR 202 is a substitute for No. 12001251 in 3001 series chassis, and the EFR 203 replaces No. 12001181 in Chassis 1621.

For further information, check 43X on Literature Card.

Handle For Spray Can

Nothing can spray a spray from a spray can the way a spray can handle can!

A pistol-grip handle made by Walsco fits over the nozzle of an aerosol spray can, thus allowing it to be used in the same manner as a spray gun. Operation of the nozzle is controlled by a trigger. Dealer net price of the handle is 89c.

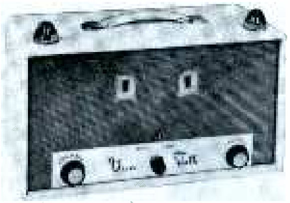
For further information, check 44X on Literature Card.

Miniature Microphone

Only 1 5/32" in diameter and 63/64" in depth, the American Microphone Model D801 dynamic microphone can easily be concealed or flush-mounted in speakers' stands or other locations. This high-output, low-impedance unit has a frequency response of 250 to 6,000 cps.

For further information, check 45X on Literature Card.

Intercom With Visual Signals



An incoming call to the master station of the Masco *View Talk* intercom causes a light to flash — red if the call is from one remote unit and green if from the other. A lamp or appliance, when plugged into an AC socket on the master, also announces arrival of a message by operating intermittently.

For further information, check 46X on Literature Card.

Dual Preamplifier

The two audio channels in the Grommes *Premiere* Model 209 stereo preamp have ganged loudness, bass, treble, loudness contour, turnover, and roll-off controls. Each side has 6 input circuits, controlled by push buttons that permit mixing of two or more input signals. Heaters are DC-powered. Net price is $159.50.

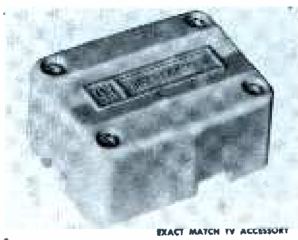
For further information, Check 47X on Literature Card.

8" Speaker

A specially processed cone with an unusual flared shape enables the 8" Sonotone WR-8 speaker to cover a frequency range from 55 to 15,000 cps. The voice coil has an impedance of 8 ohms and is rated at 8 watts. List price is $12.00 — slightly higher in the West.

For further information, check 48X on Literature Card.

Antenna Couplers



Two separate 300-ohm low- and high-band VHF antennas can be connected to a single transmission line with the Blonder-Tongue Model A-105 *Hi-Lo* VHF coupler. Isolation exceeds 21 db, and forward loss is 1 db. Another coupler, Model A-107, couples VHF and UHF antenna circuits. Units have a list price of $3.50 each.

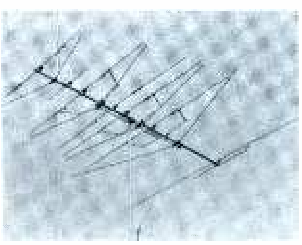
For further information, check 49X on Literature Card.

Capacitor Kit

Small-sized *Tobemite* molded plastic tubular capacitors are supplied by Tobe Deutschmann in a kit of 76 units. Nine different values are included: .001, .002, .003, .005, .0068, .01, .02, .03, .047, .05, and 0.1 mfd. There are at least five capacitors of each value, and extra quantities of the most popular ones (such as .01 and 0.1 mfd) are furnished.

For further information, check 50X on Literature Card.

All-Channel Antennas



All 1959-model Trio *Zephyr* family and *Color* series antennas have wing-shaped driven dipoles and front directors. A new "No-Strip" lead-in connector has teeth that penetrate the insulation to contact the wires. The wing-type elements are attached to the boom with *Quik-Lok* clamps instead of nuts and bolts.

For further information, check 51X on Literature Card.

Wide-Band Scope Kit

Flat frequency response within 3db from 1 cps to 4.5 mc is provided by the vertical amplifier of the PACO Model S-55 wide-band 5" oscilloscope kit. Other features include vertical sensitivity of 25 mv/in RMS, choice of direct or capacitive input coupling, "V" and "H" positions on horizontal sweep range switch for TV waveform analysis, and a 200-mv, 60-cps internal calibrating signal. The unit costs $87.50 in kit form, and is also available fully wired. Model AS-1 Accessory Probe Set is available at $14.95 extra.

For further information, check 52X on Literature Card.

Printed Circuit 'Lytics

Three series of Cornell-Dubilier electrolytic capacitors are printed boards. An indexing lug designed for mounting on is located off-center to prevent incorrect insertion. Types UPL and UPC have straight-pin connections — long and short ones, respectively. Type UPSC snaps into the mounting holes on the board to insure a firm mechanical connection.

For further information, check 53X on Literature Card.

Stereo Record Changers

A new line of Collaro four-speed record changers has been designed especially for playing stereo recordings. The "Conquest" Model TSC-640 (shown) is priced at $38.50. Also available are the "Coronation" Model TSC-740 ($42.50) and the "Continental" Model TSC-840 ($49.50). Wow and flutter are held to 0.25% RMS in all models.

For further information, check 54X on Literature Card.

VOM-Ammeter Set

The Triplett Model 100 VOM and Clamp-On Ammeter Set includes a compact Model 310 volt - ohm - milliammeter, a Model 10 clamp-on adapter for measuring AC line current (in amperes) by inductive pickup, a Model 101 Line Separator that can be series-connected in the AC line to provide a test point for the Model 10, and a leather case to hold the meter and accessories.

For further information, check 55X on Literature Card.

Replacement Flybacks

Flyback transformers used in Westinghouse or Airline TV sets and bearing any of the part numbers 493V004M02, -04, -05, -06 or 493V004H02, -04, -05, -06 can be replaced with Ram Model X163. Transformers 493V004M01, -03 and 493-V004H01, -03 are all replaceable with Ram Model X164.

For further information, check 56X on Literature Card.

Self-Service Tube Tester

The "Atlas" self-service tube tester manufactured by Affiliated Television Labs. is equipped with a "memory bank" (a system of plug-in connectors) which allows the owner to modify the tester as necessary to prepare it for checking new tube types. Directions for changes are periodically issued by the manufacturer. Other features of the tester include 40 beryllium copper sockets and a 4½" meter with "Good-Bad" scale. List price is $129.95.

For further information, check 57X on Literature Card.

Home Antenna System

TV and FM signals from one antenna can be delivered to every room in a home with a Jerrold "Master TV-FM Home System" kit, which comprises a broad-band VHF amplifier, a group of wall outlets and plugs, and enough lead-in wire to complete an average installation. Plugs have a third prong to prevent accidental insertion into an AC outlet. List price of the kit is $67.75.

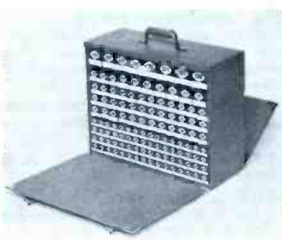
For further information, check 58X on Literature Card.

Dual Preamp Kit

Dual preamplifier and control circuits for a stereo sound system are contained in EICO Model HF 85. Level, bass and treble controls for the two channels have a clutch arrangement that permits either separate or ganged operation. Price, including cover, is $39.95 in kit form or $64.95 wired.

For further information, check 59X on Literature Card.

Tube Caddy



An assortment of 64 miniature tubes, 38 GT's, 16 large-bulb types, and various tools and parts can be loaded into the CBS-Hytron "Junior Tube-and-Tool Caddy," Model SH-38, which measures 7¼" x 14¼" x 17½". Pin straighteners for both 7- and 9-pin miniature tubes are molded into the plastic handle.

For further information, check 60X on Literature Card.

Antenna Packaging

Clear Beam FM radio antennas are being packaged in display cartons designed to catch the audiophile's eye. Types of antennas available are an omnidirectional dipole, a folded dipole with reflector, and 5- and 8-element yagis.

For further information, check 61X on Literature Card.

Tube Tester Chart

Owners of Seco Model 107 tube testers can bring their tube charts up to date with a new "Flip Chart Kit," Part No. FC-2-958. A complete set of cards and a new index panel give data on all tubes including newly-introduced types. Dealer net price is $2.00.

For further information, check 62X on Literature Card.

INDEX TO ADVERTISERS

November, 1958

CATALOG AND LITERATURE SERVICE

ACCESSORIES

1X. *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 70.*

ANTENNA SYSTEMS

2X. *BLONDER-TONGUE* — Catalog sheet on 2-set, 4-set, UHF-VHF, Hi-Lo antenna couplers (Form No. EM-100). *See ad page 59.*

3X. *CLEAR BEAM* — Literature on do-it-yourself antenna kits sold by servicemen. *See ad page 55.*

4X. *JERROLD* — New 16-page booklet tells how to obtain optimum TV and FM reception in every room, and gives complete details on new "Amplified Plug-In TV-FM Home System." *See ad page 52.*

5X. *MARJO* — "Channel King" Indoor Antenna Bulletin No. 25 describing new models and model revisions. *See ad page 74.*

6X. *TACO* — New literature describing the TACO "Comparator", and outlining free antenna-sales material available to the installer.

AUDIO & HI-FI

7X. *ELECTRO-VOICE*—Catalog No. 126 on public-address and general-purpose microphones. *See ad page 13.*

8X. *FANON*—4-page catalog describing complete line of low-cost high-fidelity speaker-amplifier cartridge kits to convert phonos for stereo. Catalog also lists portable and console stereo units.

9X. *GELOSO* — 8-page brochure describing "StenOtape" recorder and transcriber; 4-page brochure on "Ham" gear, and 2-page catalog sheet on "Four-Bander" FM-AM short wave receiver and FM tuner.

CAPACITORS

10X. *CORNELL DUBILIER*—Literature on the "Treasure Chest Twins," service bench capacitor chests.

11X. *SPRAGUE*—"ABC's of Ceramic Capacitors," a comprehensive brochure on theory and applications. *See ad page 10.*

12X. *TOBE DEUTSCHMANN*—Cross-Reference Chart for Twist-Prong Capacitors, a 24-page booklet providing over 3,525 listings of "preferred" Tobe twist-prong and tubular electrolytics to replace 5 other major-brand types. *See ad page 67.*

COMPONENTS—MISCELLANEOUS

13X. *CENTRALAB* — New 16-page "P.E.C. Guide" contains a new "How to Select, Test, and Replace" section. Also complete information on 8 new circuits. *See ad page 51.*

14X. *ELECTRONIC UTILITIES* — New 6-page catalog gives helpful information on imported electronic components for original equipment and replacement use. Includes data on Hitachi receiving tubes, capacitors, resistors, miniature components for transistor radios, tone-arm and crystal-pickup assemblies and cartridges, and transistor radio earphones. *See ad page 61.*

CONTROLS

15X. *CLAROSTAT*—Data on complete line of sound system controls, pads and attenuators (form No. 751773). *See ad page 43.*

16X. *IRC* — Form S-054-No. 22 lists entire stock of replacement controls. *See ad 2nd cover.*

FUSES

17X. *BUSSMANN* — Quick reference catalog to all types of fuses used in the electronic industry (Bulletin SFUS). *See ad page 33.*

18X. *LITTELFUSE* — Illustrated price sheet on fuses, fuse-holders, etc. *See ad 4th cover.*

PICTURE TUBES

19X. *SYLVANIA*—"There's a Big Difference in Television Picture Tubes," a 16-page illustrated brochure describing precision manufacturing material and techniques that contribute to the life and performance of quality picture tubes. *See ad page 19.*

POWER SUPPLIES

20X. *ACME* — Variable Voltage Adjustor Catalog VA-312. *See ad page 66.*

SERVICE AIDS

21X. *ROGERS* — Literature on the "Tel-A-Turn," new TV chassis rack designed to decrease repair time, eliminate struggling with heavy, hard-to-handle chassis, and permit full rotation and locking in any position.

TECHNICAL PUBLICATIONS

22X. *HOWARD W. SAMS* — Descriptive literature on new book, "Servicing Transistor Radios," plus new 1958 Book List including latest technical publications on servicing TV, radio, audio, hi-fi, etc. *See ads pages 27 and 70.*

TEST EQUIPMENT

23X. *AFFILIATED TV* — Catalog sheets, literature and sales plans for servicemen on complete line of self-service tube testers. *See ad page 66.*

24X. *B&K* — Bulletin AP12-R gives helpful information on new point-to-point signal-injection techniques with Model 1075 TV "Analyst"; other bulletins describe "Dyna-Quik" Models 500B, 650, and automatic 675 portable dynamic mutual conductance tube and transistor testers plus Model 400 CRT cathode rejuvenator tester. *See ads pages 9, 32.*

25X. *B&M* — 4-page folder describes inductive-winding tester and electronic switch. *See ad page 75.*

26X. *EICO* — New 20-page catalog shows you how to save 50% on professional test instruments, hi-fi, and "ham" equipment in both kit and factory-wired form. *See ad page 46.*

27X. *HICKOK* — Complete information on new, low-cost dynamic mutual conductance tube tester. *See ad page 58.*

28X. *HYCON* — 8-color data sheet on Model 645R rack-mounted digital volt-ohmmeter contains complete specifications and describes operating principles. *See ad page 73.*

29X. *JACKSON* — Folder covering entire line of "Service Engineered" test equipment. *See ad page 65.*

30X. *RCA* — Form 3F764 on currently-available instruments. *See ad 3rd cover.*

31X. *SECO* — Descriptive literature on test equipment and servicing aids. *See ad page 68.*

32X. *SERVICE INSTRUMENTS* — New multicolored catalog includes photographs of each Sencore product in use, contains complete information and schematics. *See ads pages 54, 66, 73, 74, 78.*

33X. *SIMPSON* — Brochure No. 2060 includes descriptions of latest additions to company's line. *See ad page 63.*

34X. *TRIPLETT* — Special bulletin on new Tube Tester Model 3414. *See ad page 49.*

35X. *VIS-U-ALL* — Descriptive literature on Model V200 Picture Tube Tester-Reactivator. *See ads pages 54, 70.*

TOOLS

36X. *WELLER* — 2-color flyer illustrating features of new soldering irons with built-in "Magnastat" temperature control. *See ad page 45.*

37X. *XCELITE* — Catalog of hand tools for electronic servicemen. *See ad page 64.*

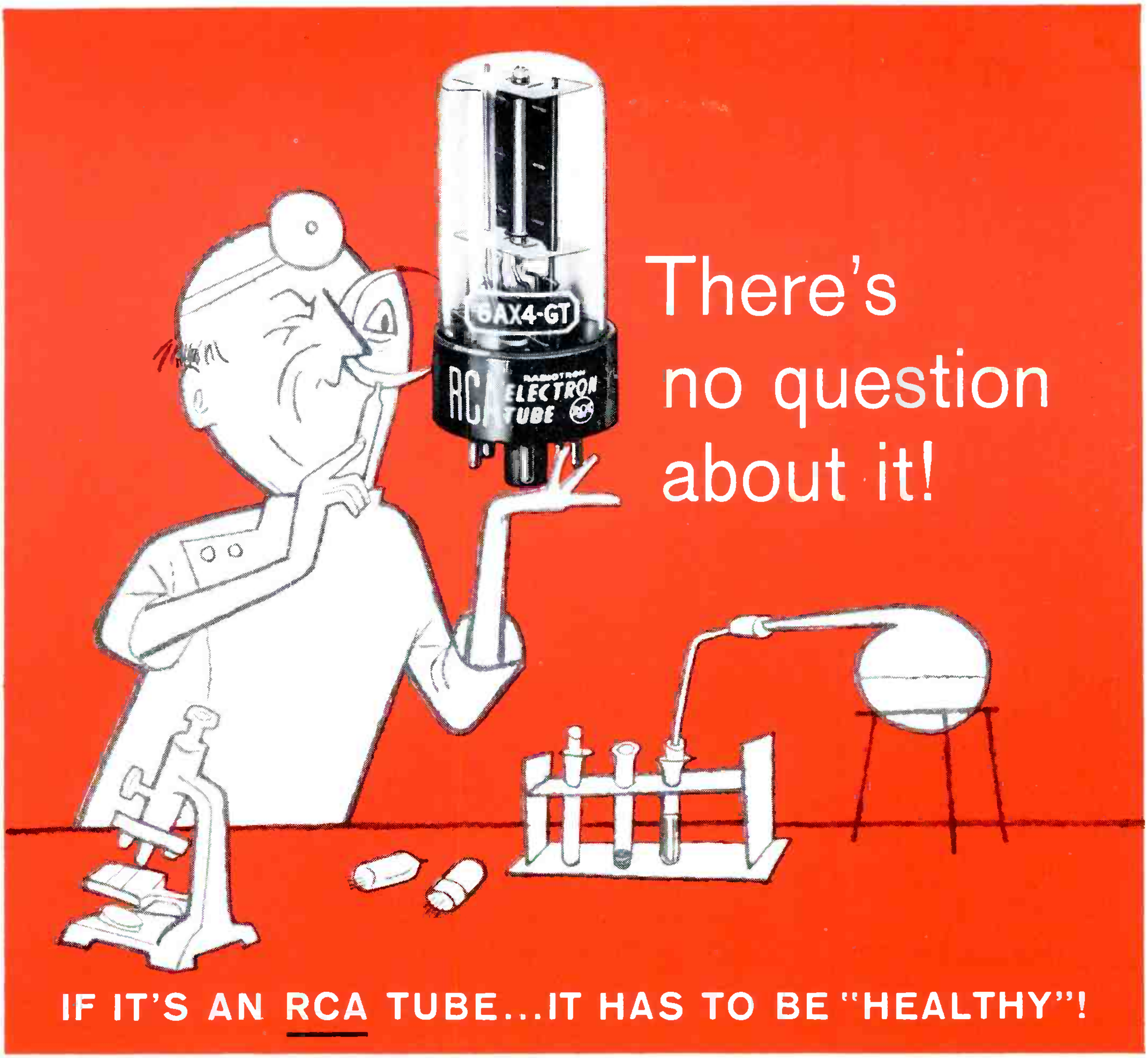
TRANSFORMERS

38X. *CHICAGO STANDARD* — 100-page TV Transformer Replacement Guide, cross-referenced for over 7,000 chassis of 98 manufacturers. *See ad page 36.*

TUBES

39X. *GENERAL ELECTRIC* — New brochures on G.E. tubes — "Here's Why General Electric Receiving Tubes are Better," and "Receiving Tube Interchangeability." *See ads pages 14-15, 47.*

40X. *RAYTHEON* — Revised 14-page Television Picture Tube Characteristics booklet includes data on aluminized black-and-white and color tubes, faceplate deflection angle, bulb dimension, ion-trap requirements, and basing diagram. *See ad page 38.*



RCA *specializes* in the production of *"healthy"* tubes. Take the RCA-6AX4-GT, for example. It features important built-in safety factors that minimize internal breakdowns and "arc-over", reducing early-hour failures—while providing reliable performance in TV damper circuits. Here are some of the ways RCA builds this "good health" into the 6AX4-GT:

Heater wire has been specially developed to improve welds, thereby reducing early-hour failures due to an open circuit at the weld point. Heater-spacer assemblies are pre-fired to eliminate leakage-producing contamination during tube production. And micas are specially sprayed to control plate-to-cathode leakage.

These are some of the reasons why many designers and manufacturers of TV sets specify RCA's 6AX4-GT—the very same reasons why you should always ask your RCA Tube Distributor to *"Ship RCA Only"*!

RCA Technical Booklet Available

RCA Receiving Tubes and Picture Tubes for AM, FM, and Television Broadcast (1275-H) . . . includes socket information and useful data for more than 700 tube types. Ask your RCA Tube Distributor for your copy today!

RADIO CORPORATION OF AMERICA

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