OCTOBER, 1960 35 CENTS

PF REPORTER

PHOTOFACT

including Electronic Servicing

Causes and Cures for Negative Pictures

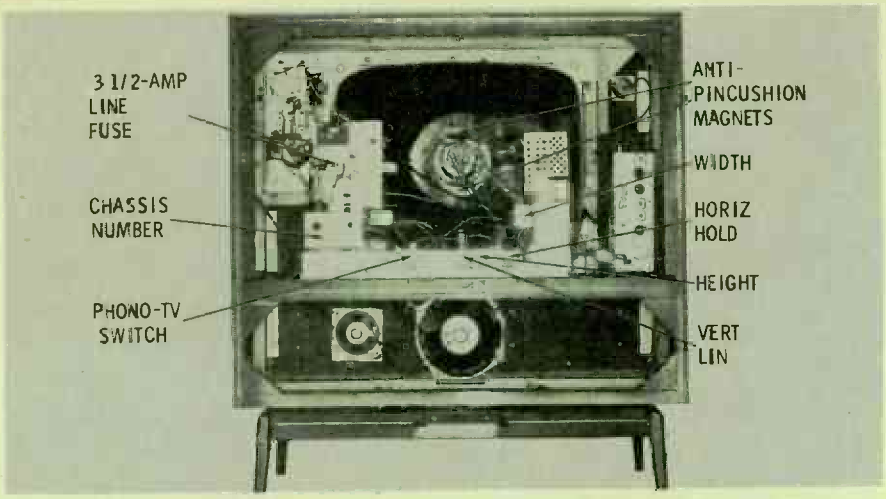
Before You Touch That Chassis - - - THINK

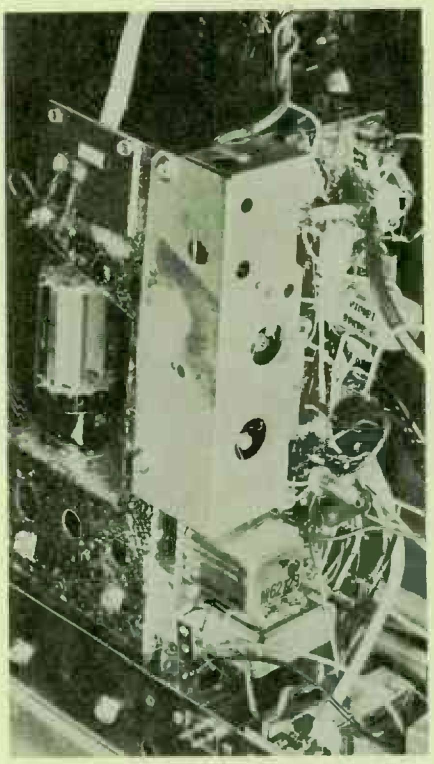
Hints on Making Control Replacements

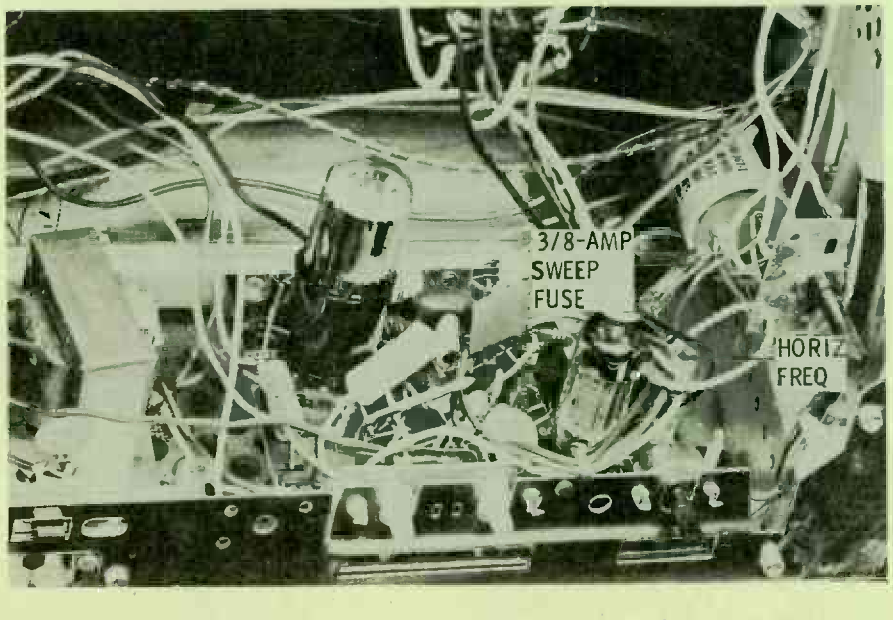
Facts About Tube Substitution

PREVIEWS of new sets

General Electric







General Electric Model R740VWD Chassis M6

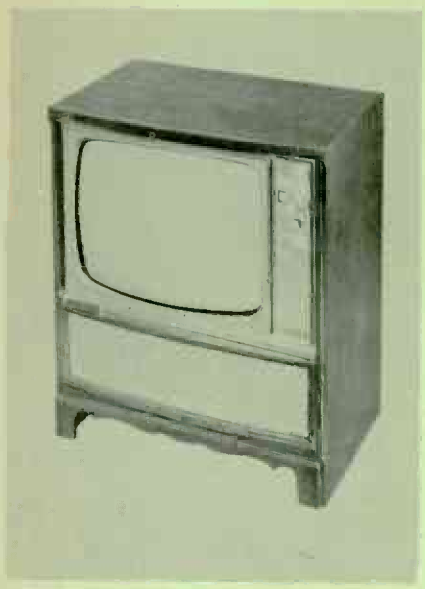
All of GE's 1961 television sets use one of two chassis. This model uses the smaller of the two — the M6. The new line includes 61 different models with 17", 21", and 23" picture tube sizes. All are 110° tubes without the bonded safety shield. To clean the tube and safety glass, the mask retainer can be removed by taking four bolts out of its lower edge.

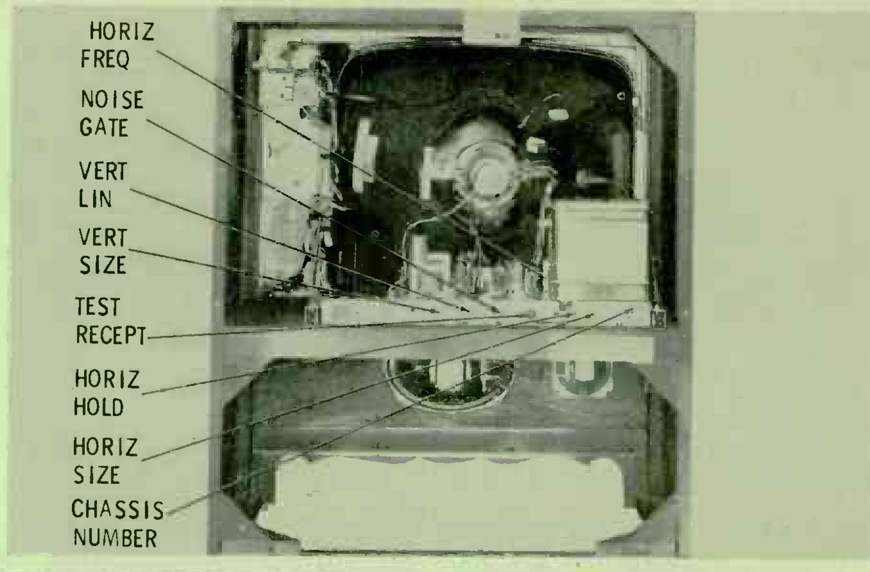
Adhering to the layout of previous versions, the "U"-shaped chassis is designed with serviceability in mind. A new innovation in anti-pincushion magnets is used; the magnets (top and bottom) are encased in a rectangular plastic holder that snaps into either the front or back of the yoke flange. (They may be omitted from some models if not needed.)

The left "chimney" of the chassis, which mounts on a bracket over the power transformer, contains the power supply and main printed board. The rather rare 6CX8 video output-sync separator, 6FM8 ratio detector-audio amplifier, and 6DN7 vertical multivibrator-vertical output (on the base part of the chassis) are carry-overs from last year's line. In addition, a 6EV5 serves as the RF amplifier in all of the tuners used with this chassis.

The remote control receiver used with this chassis incorporates three 6GH8 tubes and its own power supply with a germanium rectifier. A sensitivity control is connected in the bias network, and should be adjusted to provide the proper operation of each function at the normal installation cite. This compensates for any change in "normal" noise levels. To adjust the control, connect a VTVM to the grid of either relay-control tube and set the voltage at —6.5 to —8 volts. Both unidirectional channel selection and four-step volume control (including a mute position) are controlled by a remote transmitter using two transistors to produce supersonic signals.

Following last year's style, wiring paths and other pertinent information are marked on the printed boards. A notable improvement is that the markings are larger and brighter, making them easier to follow. The 3/8-amp pigtail fuse used for sweep protection is mounted at the right side of the board, as is the horizontal ringing coil, which requires a hex-head alignment tool for adjustment.





Motorola Model 23K30M Chassis TS-568

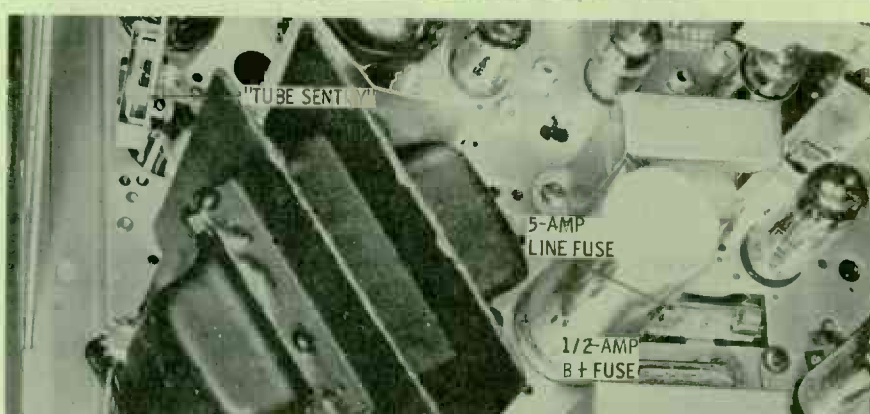
Next to the largest chassis in the 1961 Motorola line is used in this 90°, 23" model — one of 54 in the "Deluxe 23" Series. Four different chassis variations are available, providing manual, remote control, VHF, or UHF-VHF operation. All models use a 23TP4 picture tube with bonded safety shield.

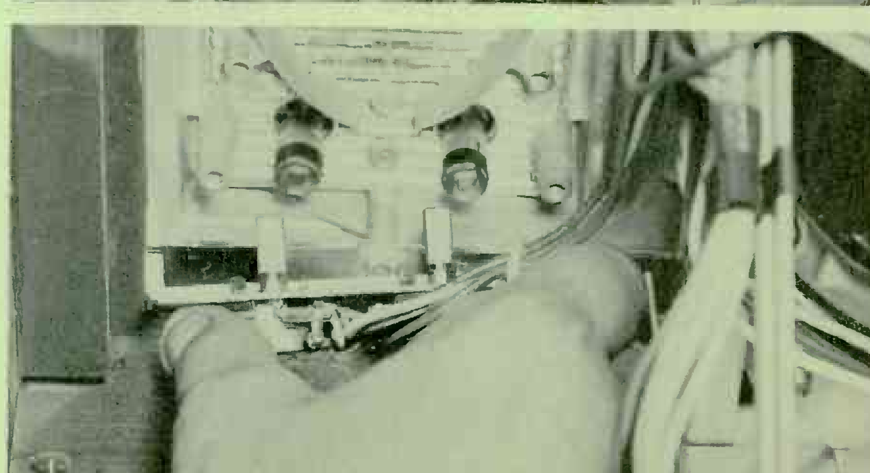
Chassis layout is typically Motorola, with all of the setup controls and a service test receptacle on the rear apron of the 16-tube receiver. The conventionally-wired chassis uses modules in the horizontal and vertical deflection circuits, as did its 1960 predecessor. Also, two sets of tubes (the 1st and 2nd video IF's, and the AGC-sync separator and sound IF) have their filaments wired in series. A *noise gate* control has been added to regulate the bias on the No. 1 control grid of the 3BU8 AGC keyer-noise limiter-sync separator.

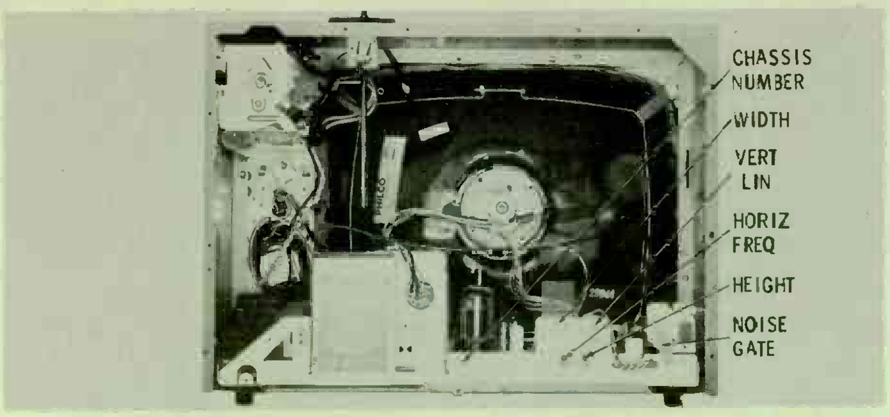
The transformer-powered chassis employs the full range of protective devices. These include the *Tube Sentry* thermal switch to prevent the application of B+ before tube filaments have heated, a 1½" length of #26 copper wire for filament protection, a 5-amp line fuse, and a ½-amp type-N fuse for the sweep circuits.

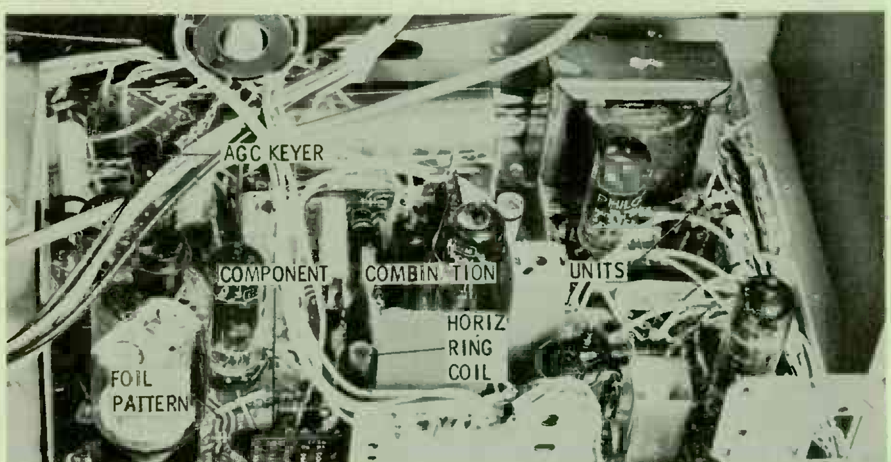
A brand new video output tube makes its debut in these chassis — a 6GK6 high-gain pentode with a gain of about 40 for normal operation. Just in front of the 6GK6 is the video-IF output transformer with its "gold hat" removed to expose the snap-in video detector diode. At the rear of the chassis (next to the horizontal AFC diode) there are three terminal connections provided to obtain focusing potentials of ground, 255 volts, and B+ boost.

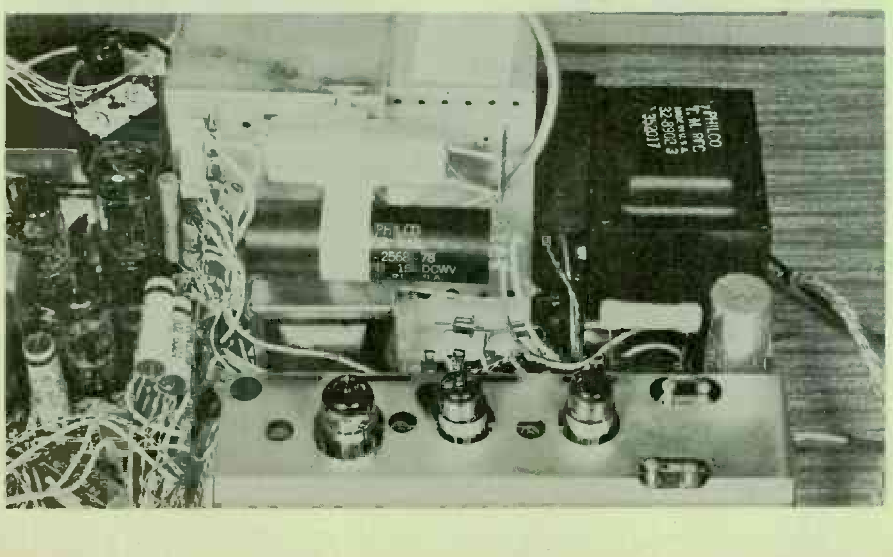
Although the brightness and vertical hold knobs are captive, removing two screws from the control panel in the TS series permits the controls to slip out of the knobs easily. The control panel for the RTS chassis can be removed by rotating the assembly 90° counterclockwise. All chassis provide a slotted bracket on the left side of the chassis frame for mounting the tuner and control assemblies if it's necessary to transport the chassis without the cabinet.











Philco Model J-3702L Chassis 11N51

This 19", 110° model is one of 12 using the same basic chassis. While it looks like the picture tube has a bonded safety shield, it's really a tinted plastic shield covering a conventional CRT faceplate. In order to clean the CRT, the chassis and tube must be removed from the cabinet. Caution! The manufacturer advises use of only mild soap and water — no detergent or abrasive cleaner.)

Nearly all of the 16-tube chassis is contained on 2 printed boards; high- and low-voltage power supplies are the only exceptions. Philco introduces a 6HJ8 high-gain, pentode-diode tube in the 3rd video IF and detector circuits of this chassis. Setup controls are conveniently grouped on the rear apron. The *noise gate* is used to vary the cathode bias of a noise-inverter stage in the sync circuits.

Back to the picture tube for a moment, this new 19ABP4 has a filament rating of 2.68 volts at 450 ma, so watch it when you're testing tubes. Notice the horizontal linearity magnet carried over from previous Philco models. Although it isn't evident from the photo, the connecting wires for the picture tube socket are of solid wire — not the normal stranded type. A little thought when removing the picture tube socket will prevent undue strain on these wires where they enter the socket.

A new-type component combination is used in this chassis, consisting of a phenolic board to which a number of components are clip-mounted. The values are stamped on the reverse side of the board. In the event one of the components fail, the faulty part can be removed and a conventional replacement installed in its place. The foil pattern of the printed board is shown in the same manner as for earlier versions. One of the notable differences in this chassis, compared to former versions, is the adoption of a 6BY8 pentode AGC keyer and clamper.

The front view of the chassis shows the parts hidden by the cage. The chassis is transformer-powered, using a pair of silicon rectifiers connected in a full-wave, voltage-doubler configuration. A 5.6-ohm, plug-in fusible resistor safeguards the rectifiers, and tube filaments other than for the CRT are protected by a length of #26 fuse wire.

RCA Victor Model 171-AR-067 Chassis KCS130M

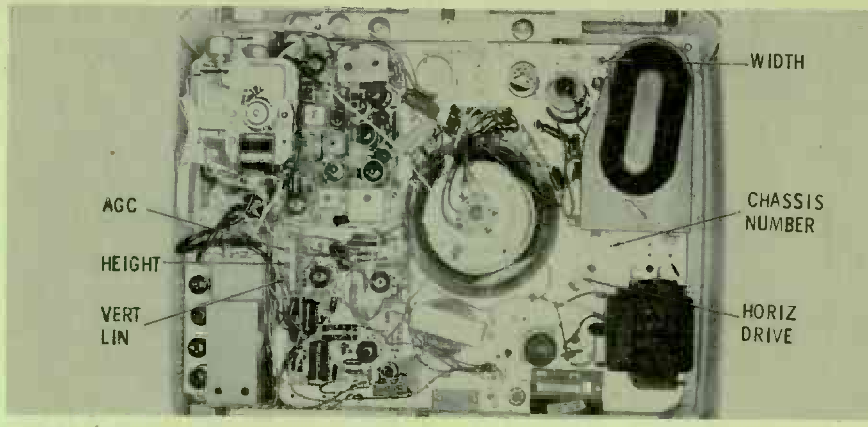
This 17", remotely-controlled portable in RCA's 1961 line can make a fool of you if you don't know how to turn it on. It's quite simple *if* you know that you need only to depress the channel selector bar. Only three of the 19" portable models are equipped with the remote feature, so your first encounter will probably be with one having a conventional off-on switch attached to the volume control.

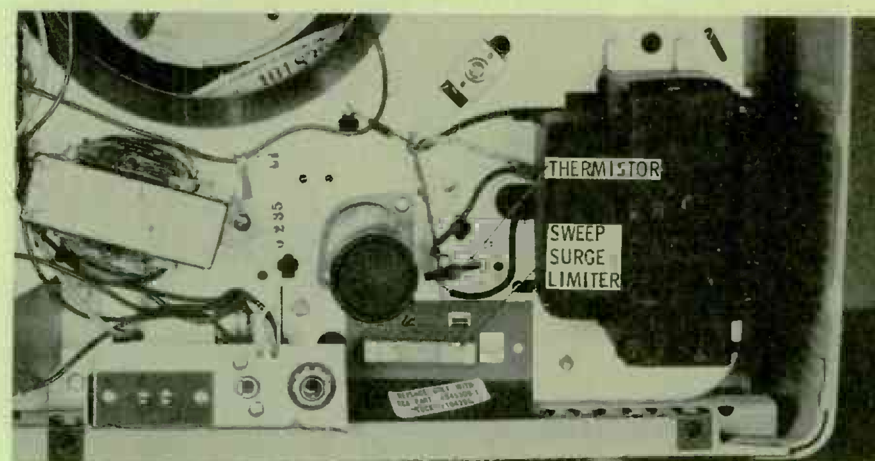
Newest of the 16 tubes used in this 110° chassis is the 6GM6 second video IF; one tuner uses a 6FH5 RF amplifier, and the versions with single function remote control have a 6EV7 in the remote receiver. All TV circuits, except those for horizontal deflection and the power supply, are contained on two printed boards forming the left side of the chassis.

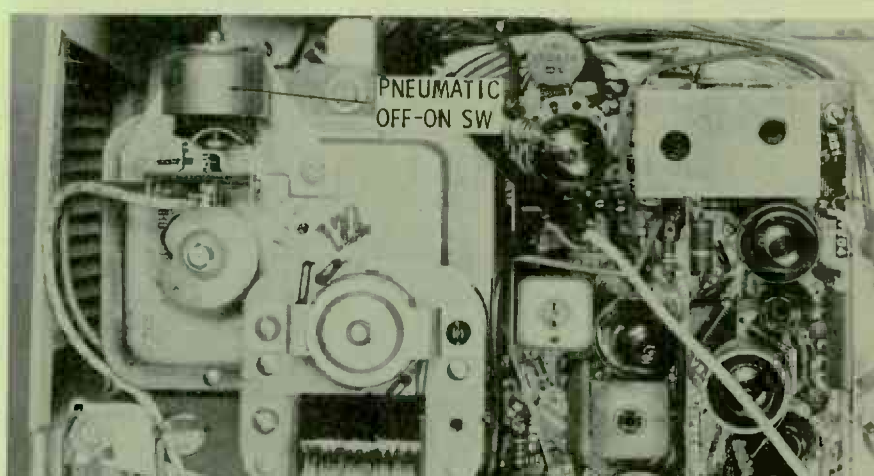
The transformer-powered chassis has a pair of silicon rectifiers mounted on the wiring side in a full-wave, voltage-doubler configuration. A surge-limiting resistor protects the sweep circuits, two lengths of #28 fusible wire protect the tube filaments, and a thermistor (rated at 120 ohms cold) controls tube warmup.

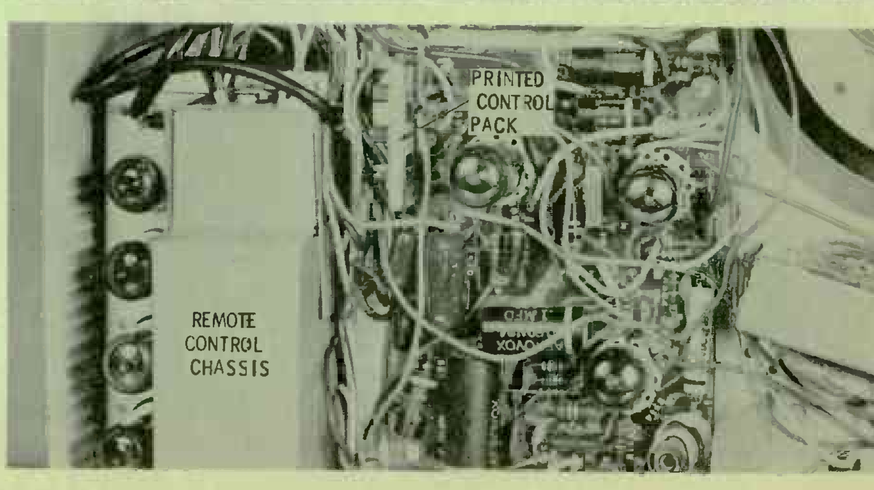
A 14-position tuner and pneumatic switch are used in the peculiar off-on circuit. If the tuner is allowed to stay in the 14th position for over 5 seconds, the internal bellows of the pneumatic switch actuates the power switch and turns off the receiver. Programming adjustments can be made from the front after removing the fine tuning knob and top escutcheon. Turning a cam to its maximum clockwise position stops the tuner, turning it counterclockwise causes the channel to be skipped, and setting the slot to point toward the shaft puts the unit on standby (that is, on channel but with video and sound muted).

As in RCA's '60 line, the AGC, height, and linearity controls are a part of a single control pack which includes some of the circuit's resistors. Also, the same dot pattern is used on the top side of the board to show the printed conductor connections. Chassis with remote control use either a three- or four-tube remote receiver for the off-on operation described above, and unidirectional channel selection. The larger receiver also incorporates a step volume control.









See PHOTOFACT Set 480, Folder 1

See PHOTOFACT Set 480, Folder 1

Mfr: Admiral **Chassis No. 20S6**

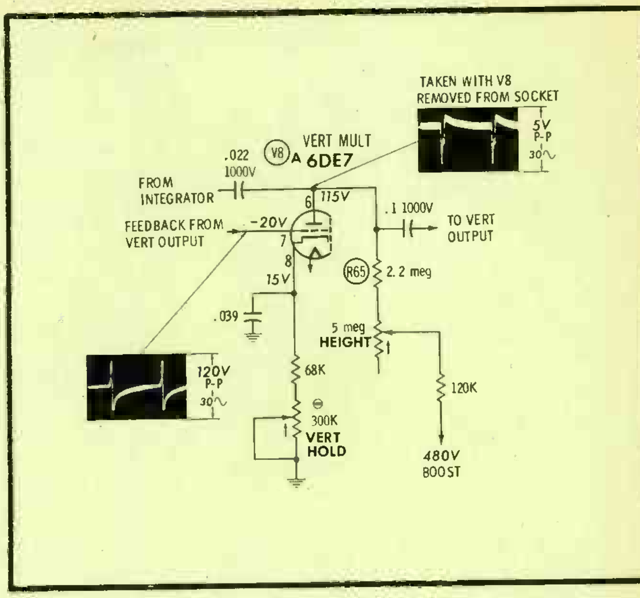
Card No: AD 20S6-1

Section Affected: Raster.

Symptoms: Insufficient vertical sweep after set has played for about half an hour.

Cause: Plate load resistor of vertical multivibrator changes in value.

What To Do: Replace R65 (2.2 meg).



Mfr: Admiral **Chassis No. 20S6**

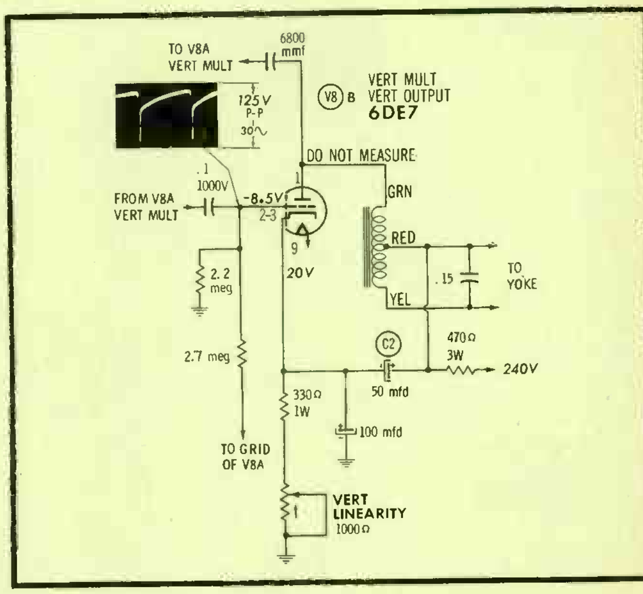
Card No: AD 20S6-2

Section Affected: Raster.

Symptoms: CRT screen dark except for bright horizontal line (no vertical sweep).

Cause: Shorted capacitor in cathode circuit of vertical output stage.

What To Do: Replace C2 (50 mfd—350V).



Mfr: Admiral **Chassis No. 20S6**

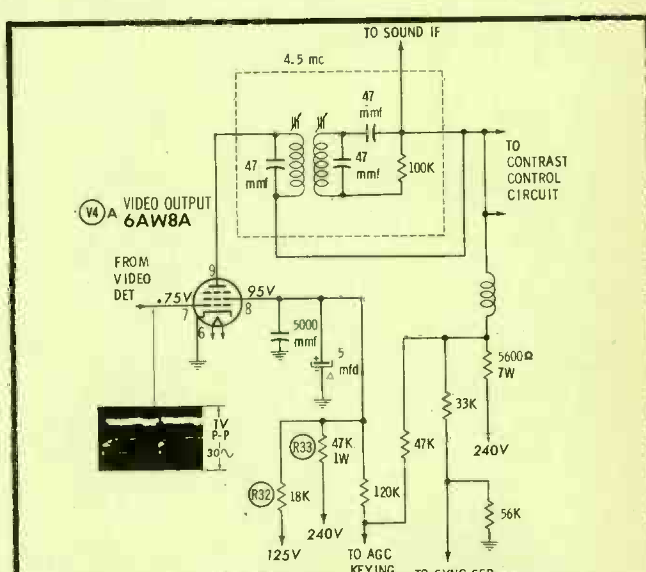
Card No: AD 20S6-3

Section Affected: Pix.

Symptoms: Contrast level fluctuates.

Cause: Video-output screen resistors are overheating and changing value.

What To Do: Replace R32 (18K) and R33 (47K—1W).



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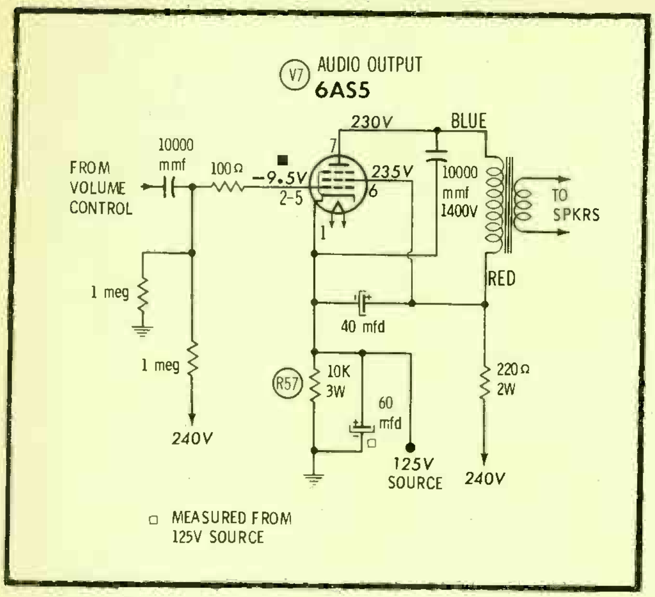
Admiral VIDEO SPEED SERVICING

See PHOTOFACT Set 480, Folder 1



See PHOTOFACT Set 480, Folder 1

Mfr: Admiral **Chassis No. 20S6**

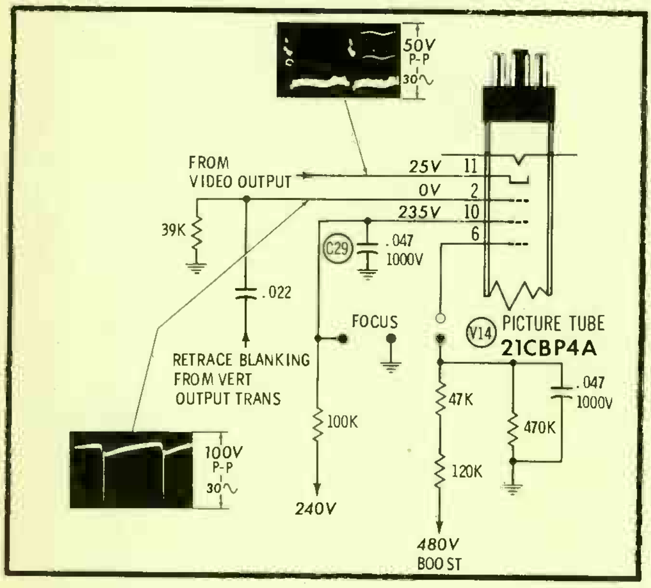
Card No: AD 20S6-4

Section Affected: Sound.

Symptoms: Distorted sound.

Cause: Resistor in cathode circuit of audio output stage has decreased in value.

What To Do: Replace R57 (10K—3W).



Mfr: Admiral **Chassis No. 20S6**

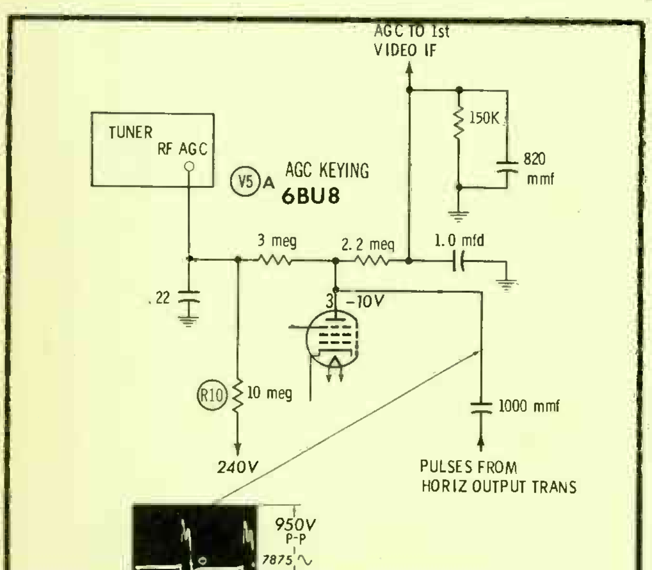
Card No: AD 20S6-5

Section Affected: Raster.

Symptoms: No light on screen, regardless of brightness-control setting.

Cause: Shorted bypass capacitor at accelerating anode of picture tube.

What To Do: Replace C29 (.047 mfd—1000V).



Mfr: Admiral **Chassis No. 20S6**

Card No: AD 20S6-6

Section Affected: Pix.

Symptoms: Snowy picture.

Cause: Open resistor in RF-AGC delay network.

What To Do: Replace R10 (10 meg).

See PHOTOFACT Set 478, Folder 2

Mfr: Hoffman **Chassis No. 426**

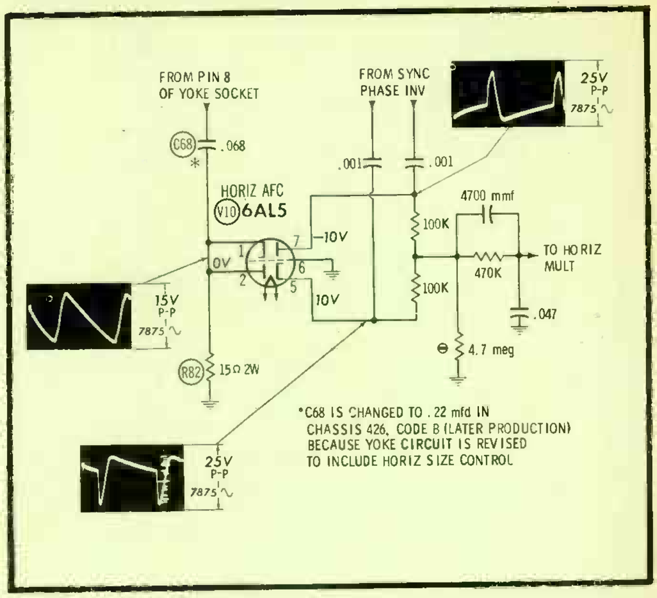
Card No: HO 426-1

Section Affected: Sync.

Symptoms: Poor horizontal hold.

Cause: Resistor in horizontal AFC stage burned and reduced in value.

What To Do: Replace R82 (15 ohms—2W) and check C68 (.068 mfd).



Mfr: Hoffman **Chassis No. 426**

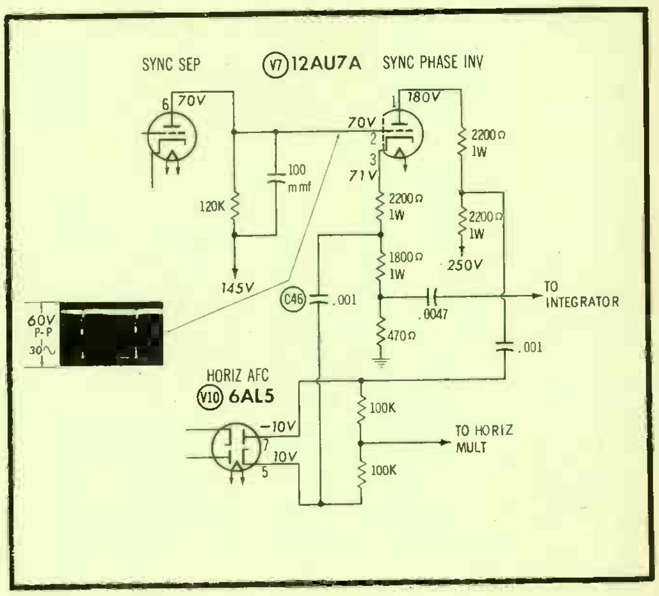
Card No: HO 426-2

Section Affected: Sync.

Symptoms: Complete loss of horizontal sync.

Cause: Leaky coupling capacitor between sync phase inverter and horizontal AFC.

What To Do: Replace C46 (.001 mfd).



Mfr: Hoffman **Chassis No. 426**

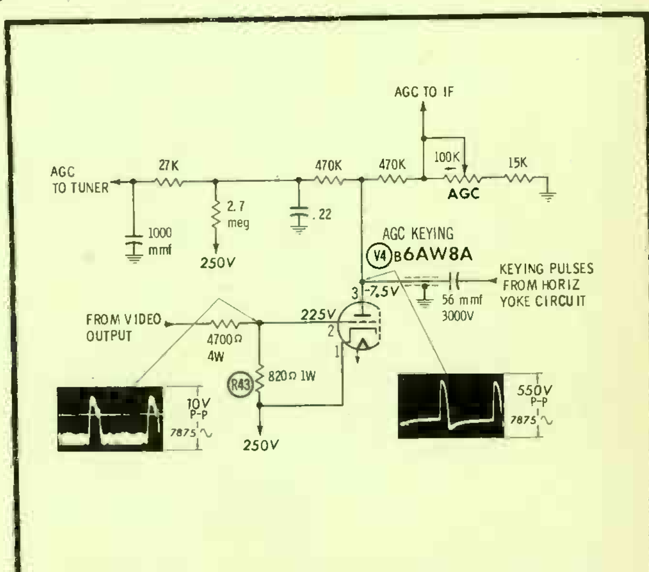
Card No: HO 426-3

Section Affected: Pix.

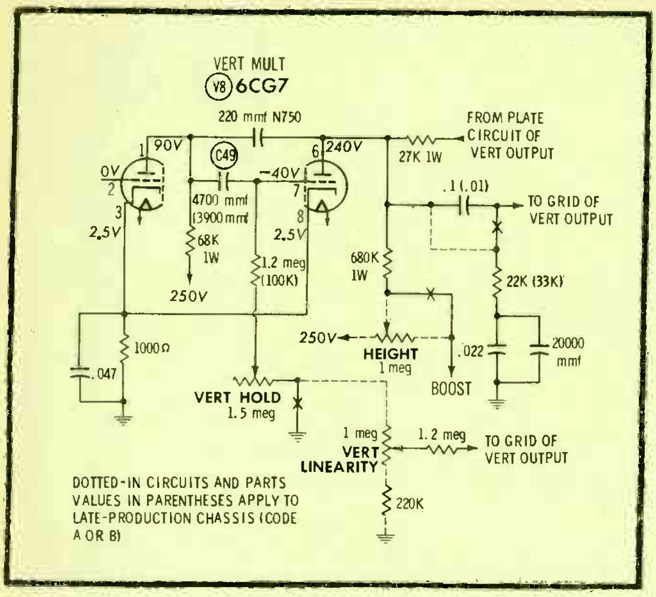
Symptoms: Video overloading.

Cause: Grid-to-cathode resistor in keyed AGC stage burned and reduced in value.

What To Do: Check V4 (6AW8A) and replace R43 (820 ohms).



See PHOTOFACT Set 478, Folder 2



See PHOTOFACT Set 478, Folder 2

Mfr: Hoffman **Chassis No. 426**

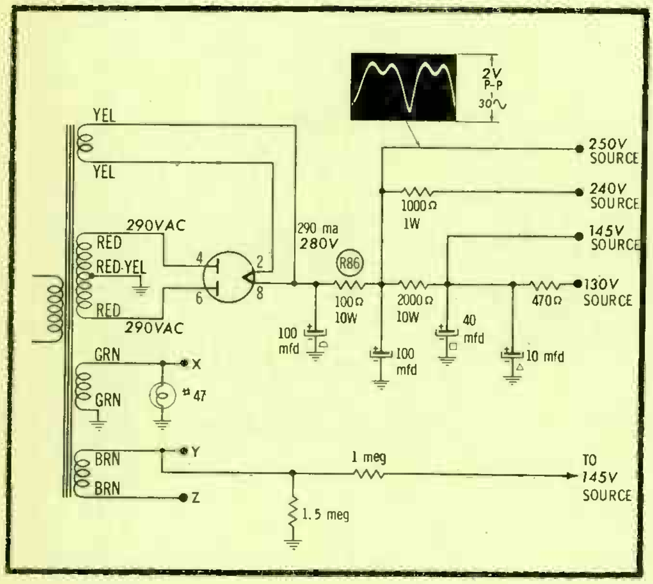
Card No: HO 426-4

Section Affected: Sync.

Symptoms: Vertical oscillator frequency drifts out of "hold-in" range.

Cause: Leaky coupling capacitor in vertical multivibrator.

What To Do: Replace C49 (.0047 mfd). On schematic, note alternate value (.0039 mfd) used with modified circuit in later production.



Mfr: Hoffman **Chassis No. 426**

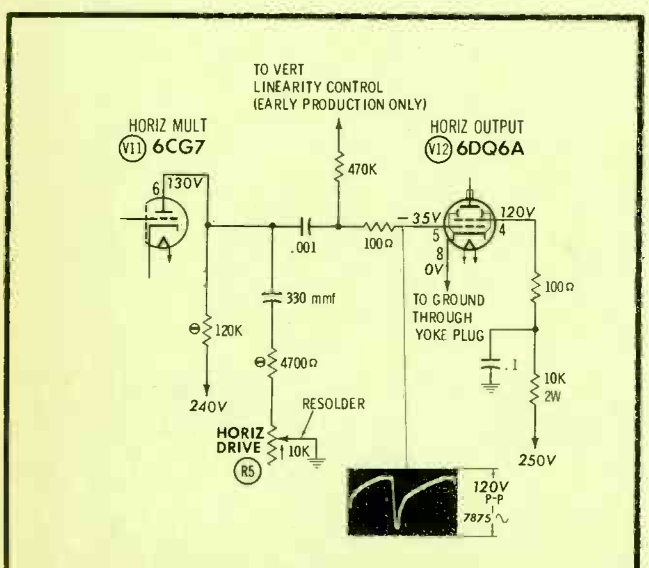
Card No: HO 426-5

Section Affected: Raster and sound.

Symptoms: Intermittent failure of sound; also, no raster when receiver is first turned on.

Cause: Intermittently open filter resistor in low-voltage rectifier circuit.

What To Do: Replace R86 (100 ohms—10W, wire-wound).



Mfr: Hoffman **Chassis No. 426**

Card No: HO 426-6

Section Affected: Raster.

Symptoms: Intermittent loss of raster.

Cause: Bad ground connection to horizontal drive control.

What To Do: Resolder ground connection of R5.

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PF REPORTER

including Electronic Servicing

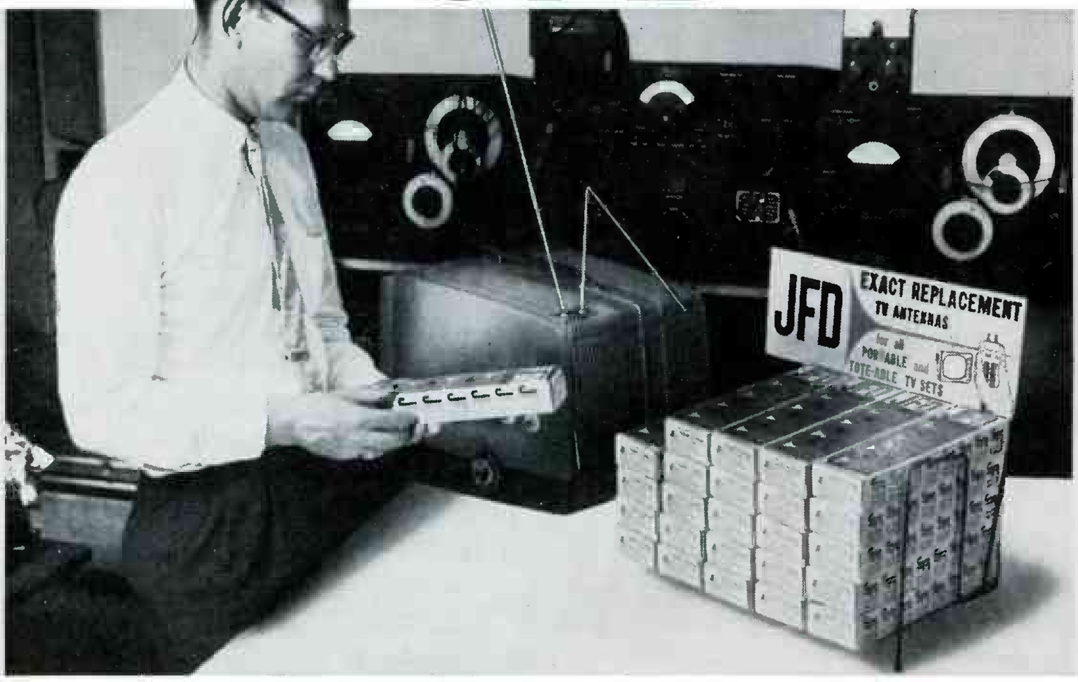
VOLUME 10, No. 10 *OCTOBER, 1960*

CONTENTS

ABOUT THE COVER

Confusing, isn't it? But that's what happens when you become involved with negative pictures. Sometimes they look negative when they really aren't; other times they are negative but don't look it. Anyway, we thought you'd get a kick out of seeing a negative picture of a technician servicing a set with a negative picture of a technician servicing a set with a negative picture. See the feature article on page 30.

Why are more Service-Dealers Switching to JFD EXACT REPLACEMENT TV ANTENNAS?



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50 per cent of all TV sets made in the last 4 years are portables—sending *more* antenna replacement business to service-dealers every day.

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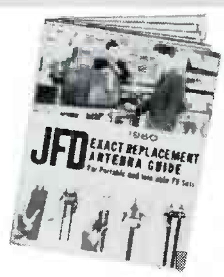

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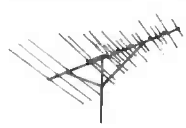
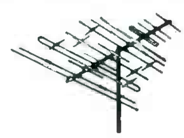


HI-FI FIREBALL
Silver or Gold Anodized



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Letters to the EDITOR

Dear Editor:

The industrial article describing the "little black box" in the May issue is very well done, but he did not go far enough. After repairs are made on the Brown amplifier and associated parts, adjustments must be made, just as on any TV set. Examples are the gain control, clamp adjust, span adjust, bridge adjust, dead-load adjust, and balance adjust. There's also the problem of testing for a "ground loop" caused by defective shielding in some remote location; this can cause hum because of line-frequency currents out of phase with another source.

A VOM with 5000-ohm AC impedance and an output-voltage jack is fine for in-circuit testing. Also, a megohmmeter for checking high-resistance leaks of shielding, and a high-sensitivity scope for checking spurious signals mixed in with AC input signals, are "life-savers" at times.

FRED PARKER

Milwaukee, Wis.

Dear Editor:

After reading the article about the *ElectroniK* continuous-control system in the May issue, I have a few comments and additions as follows:

In working on the input circuit, remember that the red wire in the thermocouple lead is negative and the other color (which varies according to type of unit) is positive.

The thermocouple output is rated in millivolts, not microvolts.

The balancing motor, according to Honeywell, is a two-phase motor.

Fig. 5 of the article shows a 1.5-volt standard cell. Actually, this is a regular No. 6 dry cell. The instrument does use a standard cell, but the voltage is 1.08 volts.

In an emergency, the unit will operate on one 12AU7 with less sensitivity.

The unit has a cold junction in the cabinet, which is shown in Fig. 2 but does not appear on your print. Also omitted was the standardization circuit (which is very important).

We have about 70 or 75 of these units in our plant, some controlling gas furnaces and others controlling electric furnaces.

G. E. TAYLOR

Sheffield, Ala.

Thank you both for the additional details. From your comments, we assume our TV expert did a pretty fair job on his first industrial electronics unit—Ed.

Dear Editor:

I have a suggestion for John R. Zanath of Aliquippa, Pa., regarding his recent technical question ("Skinny Admiral" on page 87 of the May issue). He doesn't need a width control. If he will change the 82K resistor going to pin 6 of the horizontal multivibrator tube to a 68K, he will have what he needs.

This circuit is also found in the 16CU1 chassis.

EARL A. HAMILTON

Oklahoma City, Okla.

We're sure John has his "tough dog" licked by this time, Earl, but there must be others who will benefit from your experience. Thanks.—Ed.

Dear Editor:

I have two Citizens band transceivers similar to those described in the article "Inside CB Radios" in your May issue. Some of the circuits have improvements I would like to include in my models. Are complete schematics available for the models described in the May article?

LEWIS HAWKINS

Hawkins Radio & TV
Dallas, Texas

Circuits shown in the article were composites of typical transceivers, and were not intended to describe any specific brand. You'll be happy to learn, however, that complete PHOTOFACT *Folders are now being produced for Citizens band units.*

Incidentally, don't forget that you must hold at least a second-class radio telephone license to perform any service that would affect the transmitting frequencies of such equipment.—Ed.

Dear Editor:

You must have wanted some mail when you published the striking August cover.

I've had many customers nearly as attractive as your model, and I give them all the same shuffle — into the back seat, or "It's much cooler in the shop — would you call me if the phone rings?"

At first look, I saw "Setting Up for Auto Radio Service," but the thought came out, "Setting Up for a Bruised Noggin." Of course, the dog won't tell her husband or your wife, but there's no insurance against passersby.

L. E. TRUAX

Lawton, Okla.

At risk of a stampede on Indianapolis, we'll let you in on a little secret: Our August cover girl is single, and works in our circulation department (get in line for your subscription, fellows), so there's no husband trouble this time. As for wife trouble, you know your wife better than we do!—Ed.

Dear Editor:

On page 37 of your August issue is an item about servicemen marking unknown TV sets. I've been doing that for two years, relying on my knowledge of TV sets and the pictures in PHOTOFACTS as guides.

RICHARD W. RUBIN

The Fixit Shop
Chicago, Ill.

We always knew our readers were intelligent and progressive. Dick, but you're the first to indicate capabilities as a telepathist!—Ed.

• *Please turn to page 20*

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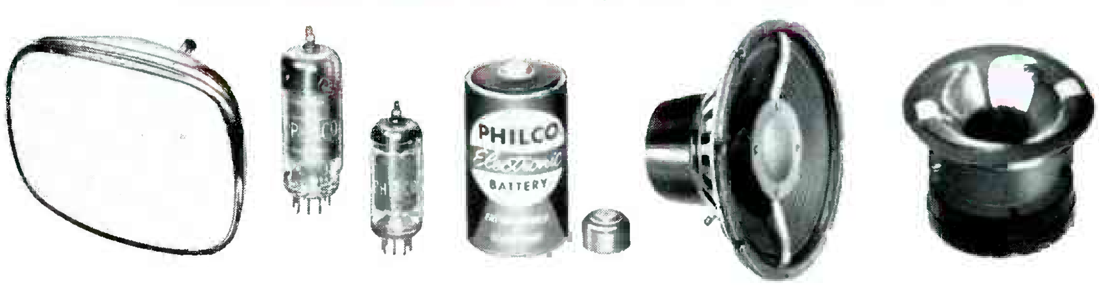

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Letters

(Continued from page 14)

Dear Editor:

Glancing through the August issue, I stopped to read the item, "Nerves of Steel," in the *Dollar and Sense Servicing* column. I must say I read this with some slight amazement, if not downright amusement. No offense meant, but apparently Mr. Groves hasn't been around much, especially out in the small towns. Just ask any of the thousands of servicemen who run one-man shops in the small towns scattered over the nation, and they'll tell you what I mean.

I have been in this game for about 35 years, and have serviced radios and TV's in cities like Chicago and all the way on down to small country villages. I have yet to find any place where a service bench can be put so that some "helpful" customer won't get to it while you are working on his set. This is especially true in small towns where everybody knows everybody else.

I have tried signs, gates, counters, brick walls, barbed-wire barricades, etc., all to no avail. Sometimes they come through torn and bleeding, but come through they will! Yesterday, while checking the tubes in a man's set as he stood between the set and the tube checker, I deliberately stepped on his feet eight different times. Did he move? He did not. He didn't even pull his feet back.

Of course, the old trick of a charged filter left "accidentally" lying on the corner of the bench sometimes deters them for a few minutes, but not for long. They crawl off into a corner somewhere and lick their wounds like an injured pup, and then they come right back for more —never even realizing what hit them in the first place.

We love it, though, and after the first hundred years you get used to it. Also, I have found that the ones who are allowed to hang their chins over your shoulder while you work on their sets never complain about the bill.

M. D. Cummins
Cummins Radio & TV Service
Neosho, Mo.

Here's Joe's answer: "I practiced what I preached — and quite successfully — in a small town for a number of years. My only barricade was a four-foot opening with a hunk of chain from which was hung a "Danger — High Voltage" sign. My bench ran at 90° from the counter and practically touched it. Don't know if it was the layout, the ease with which customers could observe me working without standing over my shoulder, or what — but we made it."—Ed.

Dear Editor:

Like most TV technicians, I'm usually "too busy eating the soup to praise the cook." But keep up the good work!

I'd like to comment about Joe A. Groves' article on *Voltage Analysis* of *Transistor Circuits* in the August issue. I get the feeling that Mr. Groves is among the authors who believe television technicians are having tremendous difficulties with the understanding of transistors! Personally, I find them fascinating and easy to understand (as compared with some vacuum-tube circuits!), and feel that inferences should lean toward their simplicity rather than suggesting that they are confoundingly complex.

Second, it *seems* as though Mr. Groves is suggesting to ignore all other test equipment in transistor troubleshooting. A scope may not have beat him to the ultimate solution, but a dead oscillator or an improper bias causing distortion would be spotted with a scope very easily. I am a scope advocate, as is obvious, but I never fail to call on my VTVM, sig-gen, or screwdriver when the situation warrants. So, while all points are well taken concerning VTVM use, I do feel that other test equipment should not be ignored — either on the bench or in instructive articles.

Nevertheless it was an excellent article, and I'm sure many of your readers will be helped by it.

James W. Burlingame
Pawn Television
Tacoma, Wash.

Surprisingly, there are still many servicemen who need to be coaxed to "get their feet wet" in transistor work. We're delighted to hear from a deep-water swimmer!—Ed.

Dear Editor:

Ordinarily I am just an easy-going serviceman, trying to do a good job and get along with everybody. But Robert W. McAloan's letter in the April *Letters to the Editor* column got me a little bit worked up. When he described how he fixed a TV set that none of the full-time fellows could fix, he gave a prime example of the type of service rendered by some part-time "experts."

He mentioned that he found the fine-tuning belt of the set lying on the bottom of the cabinet, and went on to say that it was fixed simply with rubber cement and shoemaker's thread. I nearly laughed myself sick at this. It reminded me of the old farmer who kept his Model T running by tying it together with baling wire and pasting it with spit. I would call this the shoddiest kind of workmanship, and if I couldn't go to the simple expedient of getting a new belt for the customer, I would get out of the service business!

R. W. Osterland
Service Manager
A and H Radio-TV-Electronics
"Ask Your Neighbor, We Repaired His"
Aurora, Ill.

You have a good point, Ronnie, but it still doesn't explain why the previous servicemen didn't find the trouble! Furthermore, Mr. McAloan assures us his customer is well satisfied with the results —and, after all, isn't that the important thing?—Ed.

Dear Editor:

I enjoy PF Reporter very much, and would like to see an article explaining all about delay lines and their uses in industrial electronics.

Anthony Ruoppolo
New Haven, Conn.

Anyone second the motion?—Ed.

NEW

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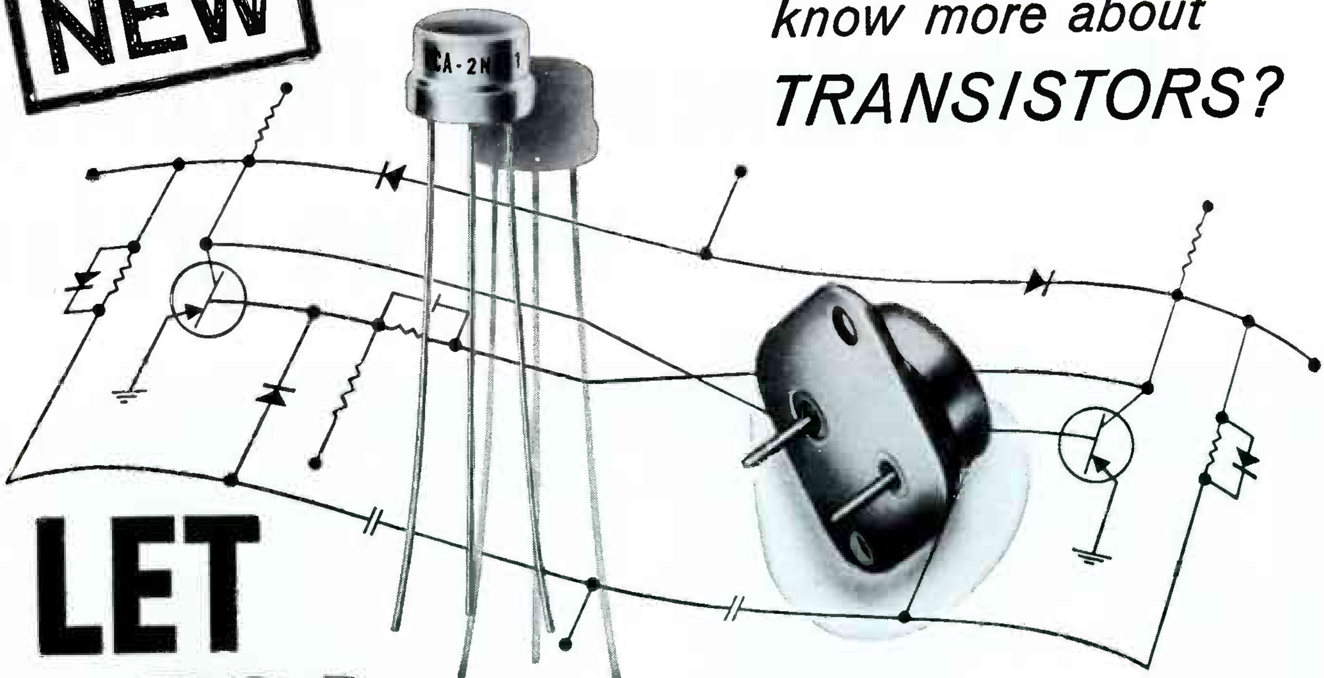

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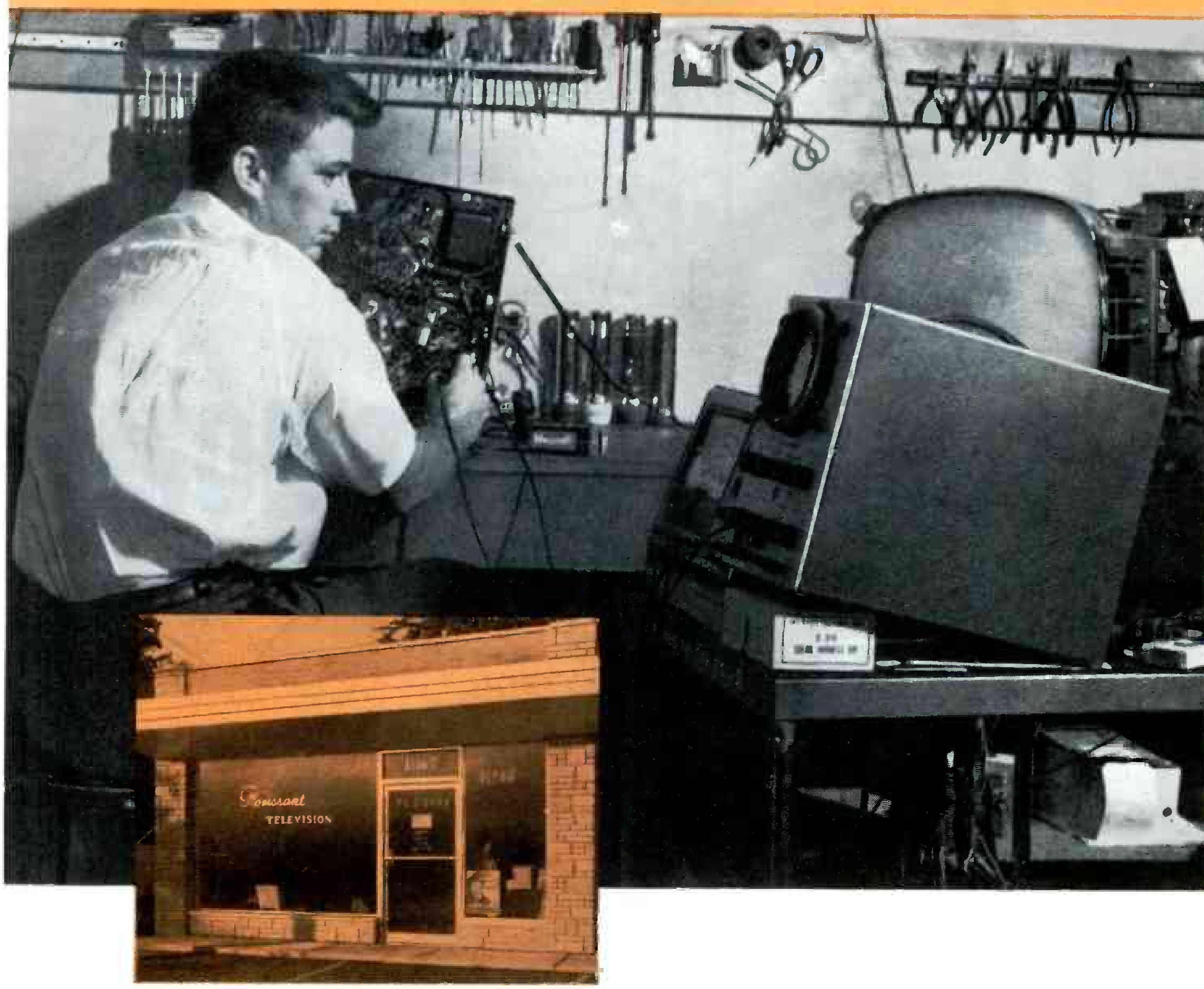

Al Gogel is a co-owner of Ferguson Television Sales and Service Company, Ferguson, Missouri, and Florissant Television, Florissant, Missouri, suburbs of St. Louis. After training at the American Television School, he started his own service shop.

Nine years ago, Al teamed up with Tom Walsh and opened the store in Ferguson. They recently expanded into a new store in adjoining Florissant, and now employ one bench technician and three servicemen, with three trucks making 25 to 30 calls a day. They handle the warranty work on auto radios for the area's four major new car dealers, plus repair work for other dealers and used car lots.

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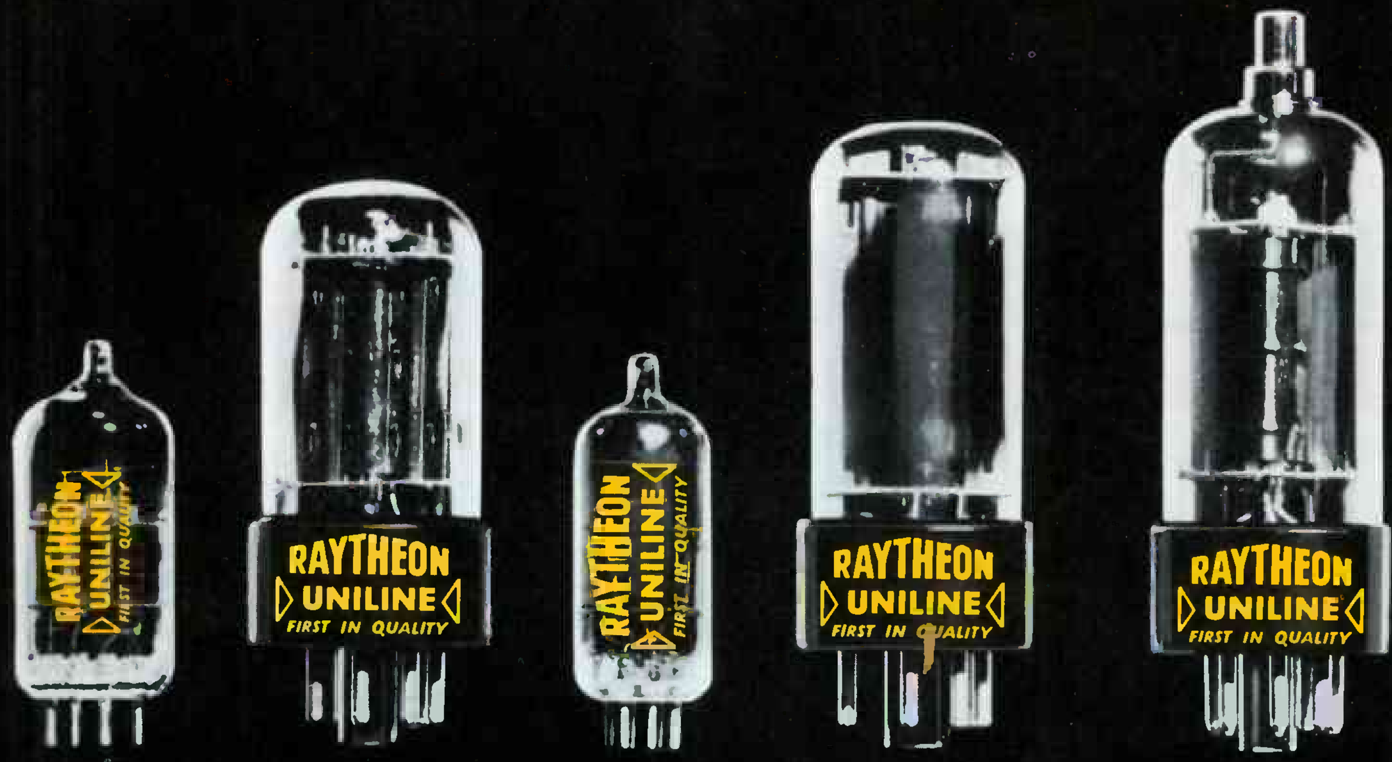

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THINK

DON'T THINK—

WORK

LET THE BOSS

DO THE THINKING

Here's a sign that should *never* hang in a TV service shop. It naturally doesn't make sense in a one-man shop where the serviceman is his own boss, and it doesn't apply any better to technicians employed by a larger shop. The boss isn't interested in doing the thinking for his men; when it comes to troubleshooting TV sets, a serviceman earns his pay mostly by being able to reason out problems for himself.

Yet, many inexperienced servicemen are so anxious to begin working on a set that they leap to conclusions about where the source of the trouble might be. Once this snap judgment is made, they stick doggedly to it, working on the suspected circuit until they become discouraged. Men with more experience have generally learned to sit back and size up the situation more carefully before taking action. This involves many steps —critically looking at the picture, carefully adjusting various controls, studying the schematic, recalling similar past experiences, and perhaps turning to reference books if needed to "get the wheels turning." This approach seems complicated, but it takes only a short while and enables you to begin working much closer to the seat of the trouble than you might believe possible.

I can recall many instances where I was able to save time by mulling over the problem before plunging into activity. For example, we once had a split-chassis Philco set in the shop for repairs to the horizontal circuit. While "cooking" the receiver

• *Please turn to page 86*

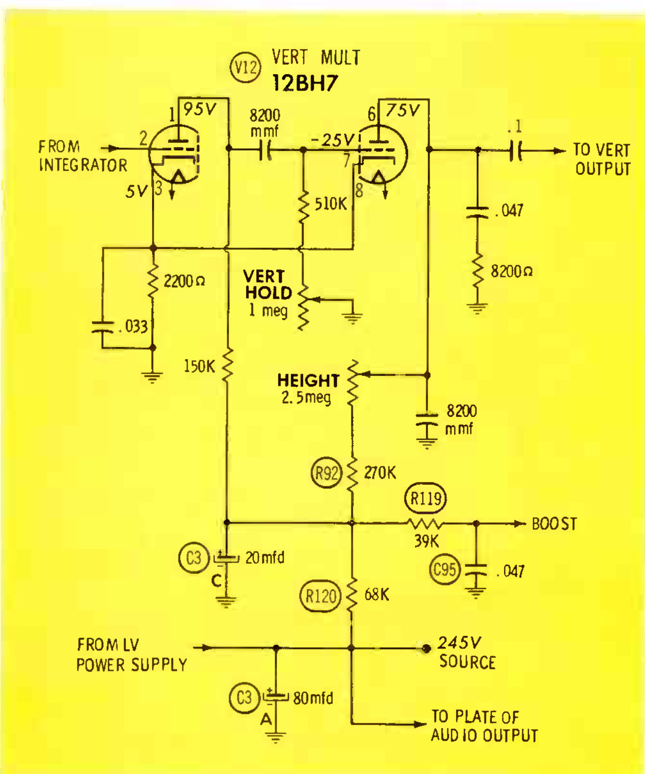

Fig. 1. Poor filtering of B+ supply to vertical multivibrator caused tunable hum to appear in audio output.

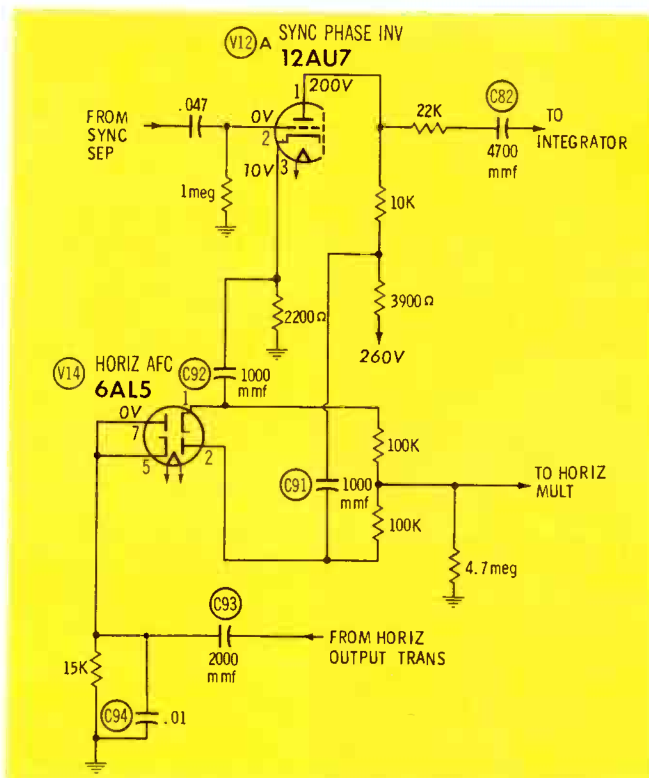

Fig. 2. Which component would be most likely to cause vertical roll, followed by severe unbalancing of AFC?

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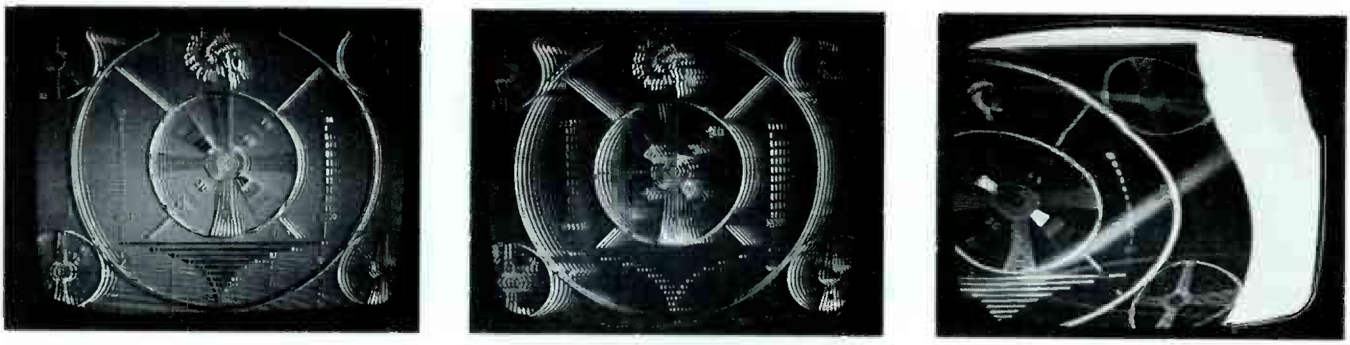
How to pinpoint defects that produce this



(A) Mild "gray-out" is false negative. (B) Stronger "gray-out" shows ringing. (C) True negative picture is reversed.

Fig. 1. Three picture symptoms commonly described as being negative.

Negative pictures have long plagued novice technicians and "old pros" alike. When a set comes into the shop with this trouble, some consider it a "dog" from the start. This attitude stems from a lack of understanding of the fundamental principles involved, as well as from a misinterpretation of the visual symptom.

Quite often the trouble symptom shown in parts A and B of Fig. 1 is misnamed a "negative picture," although it is definitely not the same as a true negative image. Notice that the original black tones are still present, but the whites have turned to gray, and ringing within the circuit has produced "trailing whites" that give the picture a negative appearance. On the other hand, a true negative picture (Fig. 1C) is formed by a simple reversal of dark and light tones, with ringing usually slight or absent. True and false negative pictures may stem from somewhat related causes, but the two symptoms are different enough that the distinction between them is important in troubleshooting.

Understanding Symptoms

Close scrutiny of the image on the picture tube will reveal clues to the nature of the fault producing the negative picture. While this won't necessarily pin down the trouble to a specific component or stage, it will tell you what to look for in tracing the trouble to its source.

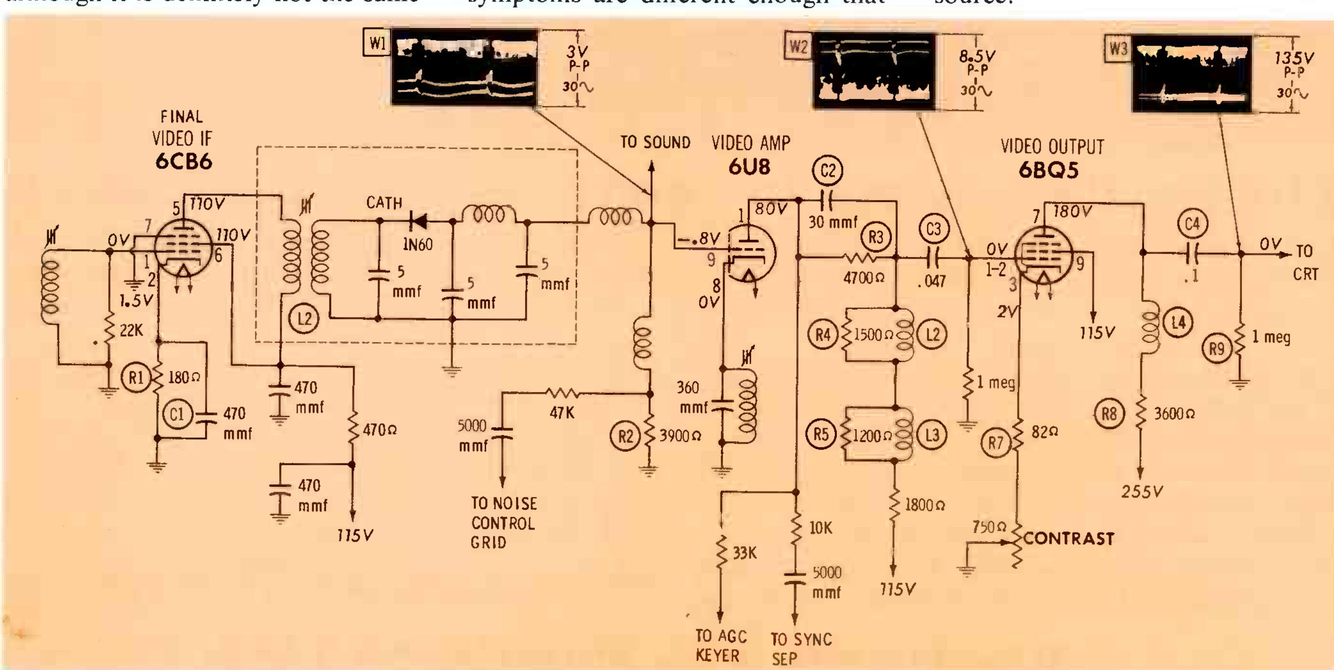


Fig. 2. Stages usually involved in tracing negative pictures to their source.

NEGATIVE pictures

misleading symptom . . . . by Joe A. Groves

The "gray-out" symptoms in Figs. 1A and 1B invariably point to a condition of tube saturation or excessive drive. Reducing input signal strength, adjusting the AGC control, or clamping the AGC line helps to isolate the affected stage. If any of these tests alter or remove the negative-picture symptom, the trouble is usually in the RF, IF, or AGC section. However, it is also possible for the fault to lie in a video amplifier stage.

A true negative picture (Fig. 1C) may result from signal rectification in the last IF stage, or may possibly be due to the addition or subtraction of a stage of video amplification. You may wonder how an additional stage can be created. For now, let's just say a video stage may become a *negative* amplifier. (We'll soon explain how this happens.) As for subtraction of a stage, the signal will occasionally be coupled through a dead video amplifier by means of stray capacitance; since it is not inverted in this process, a negative picture will result.

If the black and white tones in the negative picture are rich and clear, as shown in Fig. 1C, this generally points to rectification in the last IF. A very faint image — what you might call white and whiter-than-white — means the loss of a stage or a negative-amplification effect. We'd show you a picture of this last symptom, but the amount

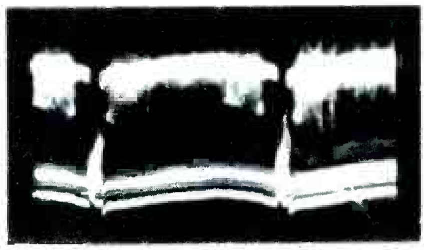


Fig. 3. Nearness of video to blanking level in W3 indicates trouble.

of contrast in the image is so slight as to render it practically invisible.

Troubleshooting the Circuits

Up to this point we have considered only the general nature of the troubles which can produce certain symptoms. Before going further, let's take a brief look at the circuitry involved in tracing a negative-picture problem to its source.

The circuits chosen for this analysis are shown in Fig. 2. The two-stage video amplifier is a little unusual these days, but it presents no special troubleshooting problems; the extra stage just provides one more place for trouble to develop. (You'd follow the same general servicing procedure if the chassis had only one video amplifier and a cathode-driven picture tube.) Notice that the final video IF stage has been included in the schematic, since it plays a major role in many negative-picture troubles.

Take a critical look at waveforms W1, W2, and W3. These are your main guideposts in analyzing negative-picture troubles. Of course, you should be quite familiar with normal composite video signals; but study them anyway. (For you fellows who haven't got around to using your scopes yet — dust 'em off and get with it! When you're tracing these troubles, voltage readings don't often mean what you might expect them to.)

See how the "blacker-than-black" sync-pulse region in W1 and W2 occupies roughly 25% of the total signal amplitude. On the other hand, W3 is an unconventional waveform with compressed sync pulses, indicating that the 6BQ5 video output tube is deliberately being driven into saturation by the sync portion of W2. This mode of operation increases the available video drive to the CRT, and yet it does not interfere with synchronization because the sync take-off point is on the input side of the 6BQ5.

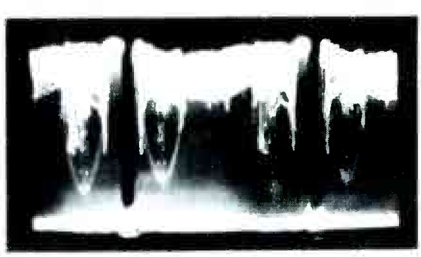
Note that the black level (traced by the bases of the sync pulses) is well separated from even the "blackest" peaks of the video information. Malfunctions which produce negative pictures alter this relationship — sometimes quite drastically.

"Gray-out"

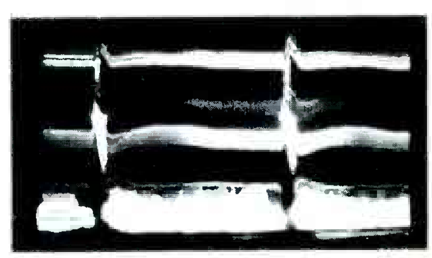
Probably the most common symptom to be interpreted as a negative picture is the "gray-out" effect shown in Figs. 1A and 1B. This

• *Please turn to page 82*

(A) Scrambled video results when R8 is 56 ohms. Visual symptom is like Fig. 1B.



(B) When R8 is 10K, setting contrast at minimum produces this waveform.



(C) The plate signal becomes inverted when the contrast control is advanced.

Fig. 4. Waveforms produced by use of various plate-resistor values in the output stage.

Across the Bench

HIGH WIDE &

by Stan Prentiss

Wider, taller, and originally even more expensive than many of today's color receivers, the 1950-model DuMont RA-109 series gave the buyer a lot of TV set for his money. The big, L-shaped horizontal chassis has 35 tubes (including CRT, but not counting four receiving tubes in the radio tuner) — at least a dozen more than the average of its contemporaries. Dual dampers, two high- and two low-voltage rectifiers, and a pair of horizontal output tubes partially account for the "extras," but this doesn't tell the full story. These receivers also have such forgotten luxuries as four video IF's, three sound IF's, two audio amplifiers *besides* the output stage, a separate AGC detector, and a DC restorer. The three-tube "front end" is an efficient *Inputuner* that continuously tunes all VHF TV channels and the FM radio band. A final touch of splendor is a massive power transformer with a built-in voltage-regulating feature.

Notwithstanding the great advances made in TV receiver design since 1950, this group of old DuMonts can be put back in such excellent shape that you wouldn't realize their age. True, these receivers have their weaknesses, and perhaps their problems are more numerous than those which modern sets will have 10 years from now. However, if you replace weak tubes, leaky and shorted paper tubular capacitors, off-value resistors, etc., many an old RA-109 will continue to render highly useful service. Of those under my wing, I have yet to see the first one sold, traded, or discarded. The same goes for the companion RA-112 and RA-113 series which were made the same year, but have "only" 26 tubes. With a little care, you can do well by these receivers, and make a solid buck in the process.

A Typical Shop Job

I hadn't seen this particular RA-109 in almost two years. The last time, it had been in for repairs to the sound section. After I replaced several leaky bypass and coupling capacitors and one electrolytic, a good crystal-accurate IF and discriminator alignment turned the trick. Audio was pure, and the magic-eye tuning indicator on the output side of the discriminator

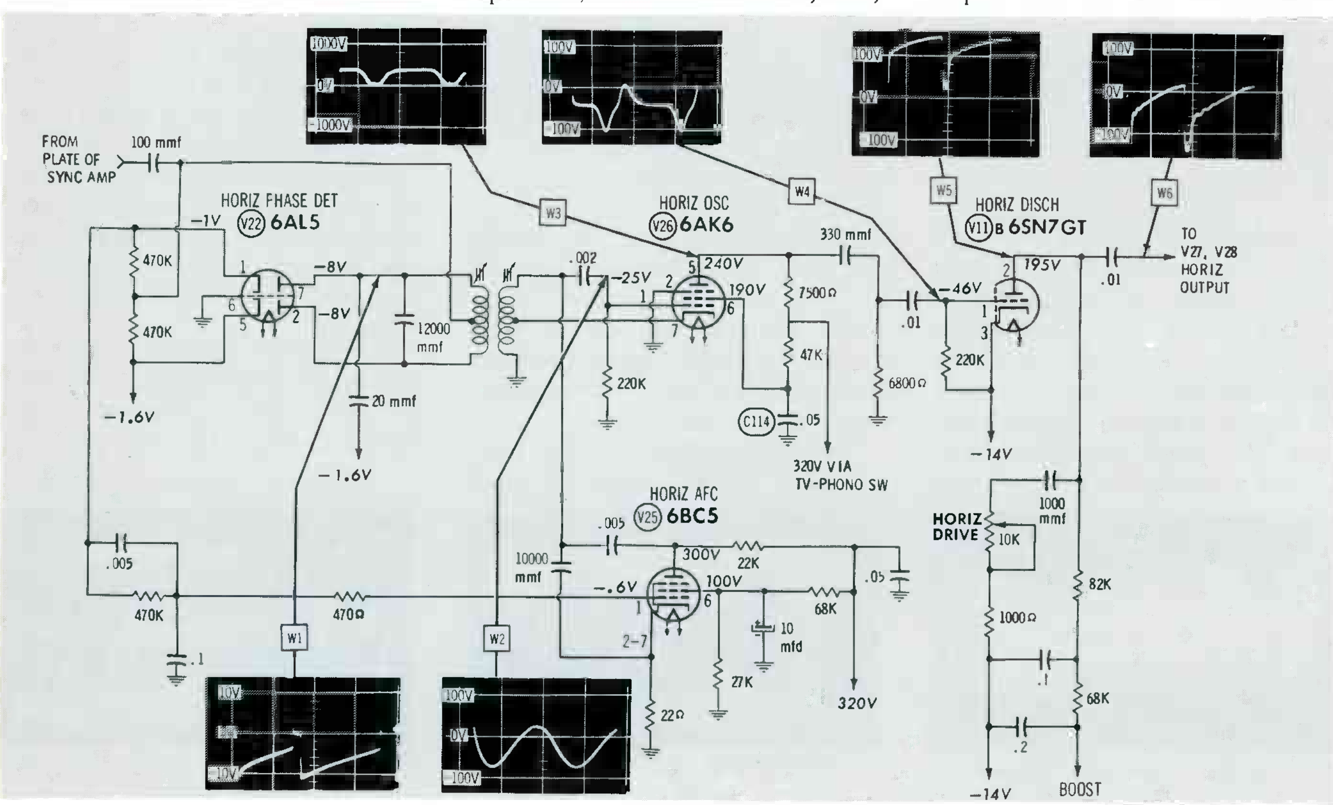
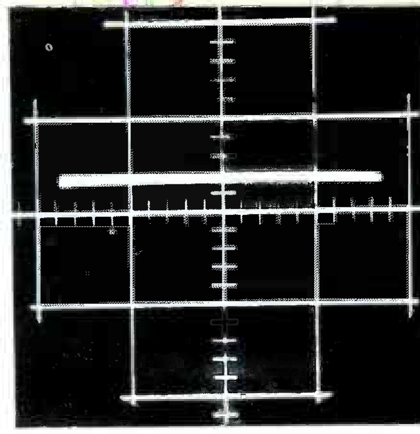


Fig. 1. Horizontal AFC and oscillator section of RA-109 Chassis, showing normal voltages and waveforms.

HANDSOME



(A) DC only on oscillator plate.

revealed excellent tracking of sound and picture — no mean accomplishment in an elderly split-sound receiver! This surely wouldn't have happened if I had tried aligning the sound IF stages by ear.

This time, the customer's complaint was "no picture," but she added that reception had been generally bad before the picture went out completely. I recalled that she had moved to a new house last year, and emphatically did not want to adorn her brand-new chimney with an "ugly outside antenna." Could I do something? "I'll be right over," I told her.

At the scene, I found worse trouble than I had bargained for; there was no raster at all. A quick check of the horizontal oscillator, output, damper, and high-voltage tubes showed them to be weak, but none were in such poor condition as to cause complete loss of high voltage. Since I suspected that any failure other than tubes would be a whopper after so long a time without service, I asked permission to take the set out and give it a thorough overhaul.

"If the picture tube is all right," she responded, "go ahead." My tester showed that it was, so I hauled the old-timer back to the shop.

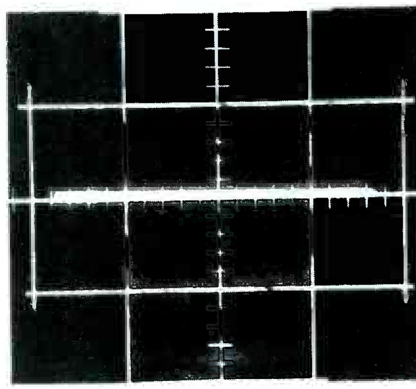
On the Bench

First, I tested the remaining tubes in the receiver by substitution and found six more that could stand replacing. Then I fired up my oscilloscope. While waiting for it to warm up, I checked the seven DC outputs of the low-voltage power supply (four positive and three negative). All were well within tolerance, according to PHOTOFACT Folder 110-7. At the end of 15 minutes, I figured that the DC amplifiers of the scope had warmed up enough to become stabilized, and checked to make sure there was no up-and-down motion of the horizontal sweep line across the graticule when I varied the vertical gain. (The input terminals were shorted during this test.)

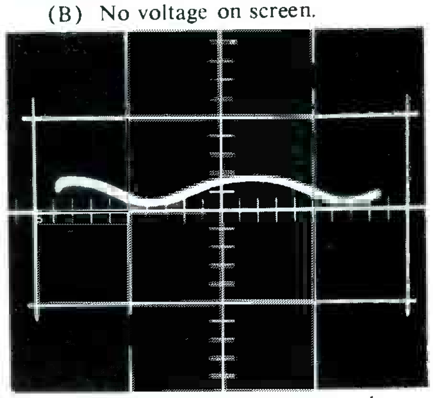
Then, taking scope probe in hand, I searched for the horizontal section (Fig. 1) and soon located the plate of the horizontal oscillator V26. "What have we here?" I mused. As shown in Fig. 2A, the trace line rose to somewhere above the 300-volt level, but there was no sign of an output waveform. Since the plate-supply voltage was obviously more than adequate, I knew immediately that the tube was not conducting.

At the screen grid, where there should have been more than 200 volts DC, I found practically zero (Fig. 2B). Here was the trouble; the screen was shorted to ground. I solved the problem quickly by just clipping the ground lead of C114 with a pair of side cutters. The scope trace bounced up to a

• *Please turn to page 72*



(B) No voltage on screen.



(C) Screen with C114 removed.

Fig. 2. Waveforms with C114 shorted. (Each major division equals 1000V.)

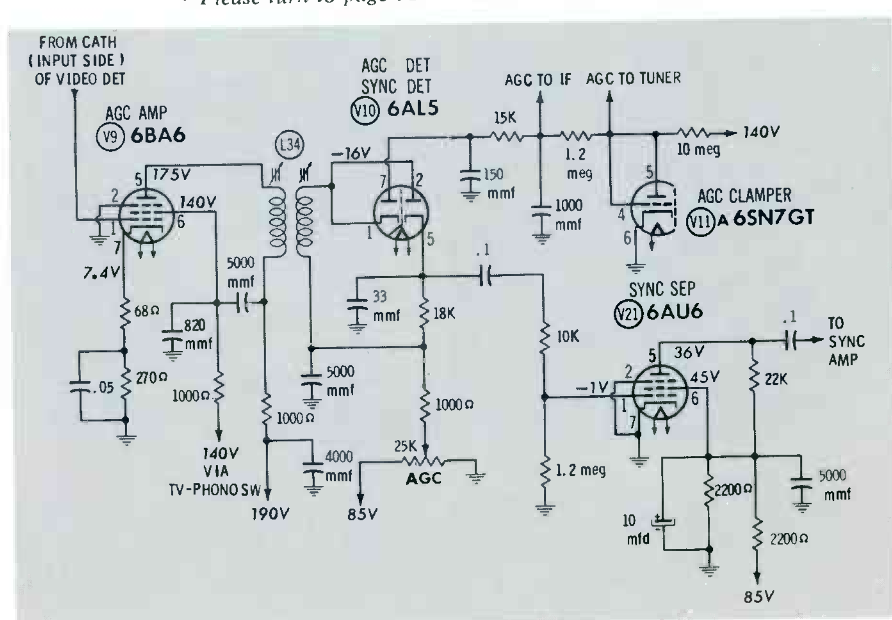
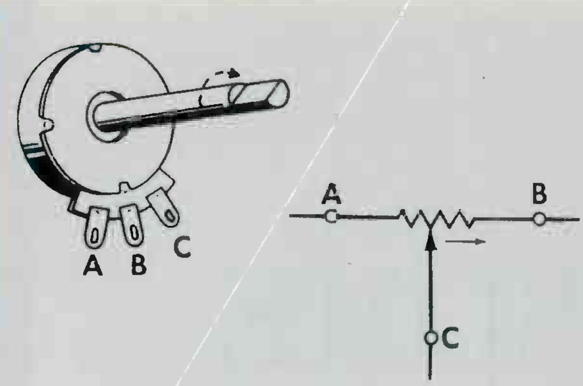


Fig. 3. Unusual circuit for separate detection of AGC and sync inputs.

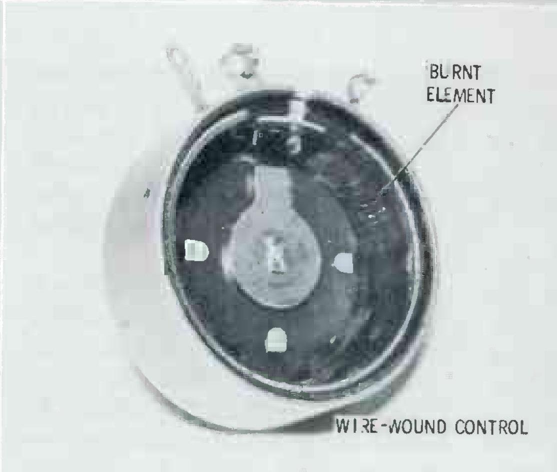
HINTS ON MAKING CONTROL REPLACEMENTS

The word control naturally has a broad meaning, but to most of us who service radio and TV receivers, it takes on a very specific connotation—namely, "potentiometer." If you're having any trouble checking controls for defects, removing them from printed boards, or making them work when using other than an exact replacement or a manufacturer's original, the following tips should help you out. For additional help, refer to Volume 3 of "Replacement Guide for TV and Auto Radio Controls," just published by Howard W. Sams & Co., Inc.

A control's total resistance should be measured across terminals A and C, and its taper or variable action between A and B. These points can be determined from a schematic by referring to the small arrow usually shown next to the resistive symbol. Denoting clockwise rotation, the arrow always points toward terminal C. To insure accurate resistance checks, beware of "sneak" or parallel paths through external circuits. Disconnect leads from all control terminals except one — unless, of course, leads are attached to capacitors or tube elements that provide no path for DC.



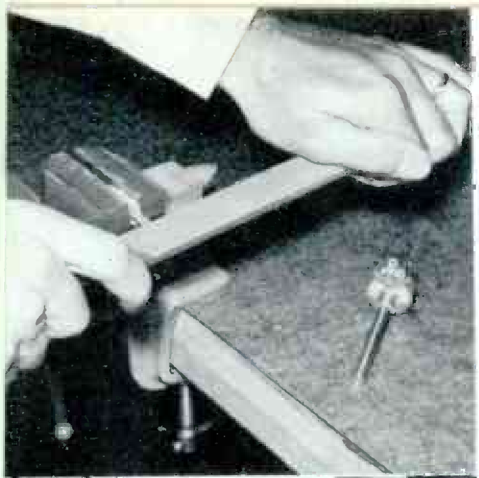
CARBON CONTROL



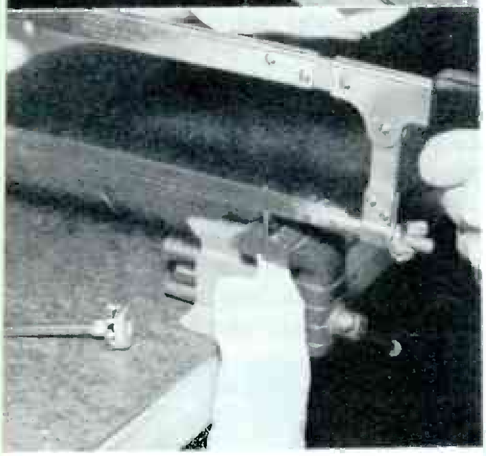
WIRE-WOUND CONTROL

A faulty control can sometimes be detected by simply rotating the shaft and noting whether or not there are any rough spots. You may even be led to the trouble by a "burnt" odor, or perhaps you'll find the shaft frozen — as is sometimes the case with wire-wound units. Occasionally a control will increase in resistance value, but this trouble is less likely to develop than an intermittent or open condition. Intermittent failure is most often caused by a cracked element, a poor internal connection at rivet points, or a dirty or bent wiper arm. When you encounter an open control, always check circuit conditions as you would before replacing a blown fuse or burnt B+ dropping resistor.

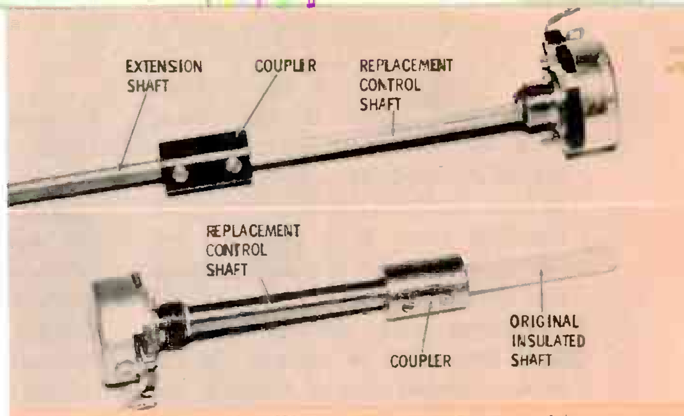
Even when you've obtained an exact replacement for a control mounted on a printed wiring board, removing the old and installing the new can be a problem. Since the controls generally have a number of spear-type lugs, you'll find special soldering tips very helpful. Tips such as the one pictured, or wire loops fashioned to heat all terminals simultaneously, will help do the job in a jiffy. When a control is not entirely dependent upon its electrical connections for physical support, it may be more expedient to clip off the original terminals and solder the replacement to the remaining stubs. In the case of a multiple-control unit, the easiest procedure is to clip the pins as shown and then heat and remove them from the board individually.



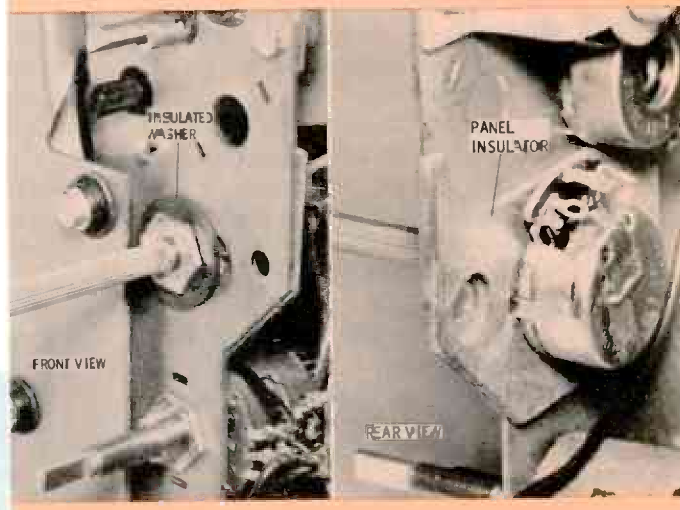
To accommodate a particular type of knob, a replacement shaft may occasionally have to be modified beyond routine alterations (such as cutting to proper length). Sometimes a "flat" must be filed on the end of a shaft or shaft extension like the round 3/16" example shown here. If convenient, position the control upside down in the vise to prevent filings from falling into the control and eventually damaging its elements.



In many dual concentric controls employed in modern TV receivers, the inner shaft has a screwdriver slot accessible through the hollow outer shaft. Cut the inner shaft of the replacement unit shorter than the outer one, and file or cut a slot on the end of the inner shaft before the complete control is assembled. As shown here, a hacksaw may be used to cut the slot, after which burrs may be removed with a fine file. Note that the control element is covered during the cutting operation.

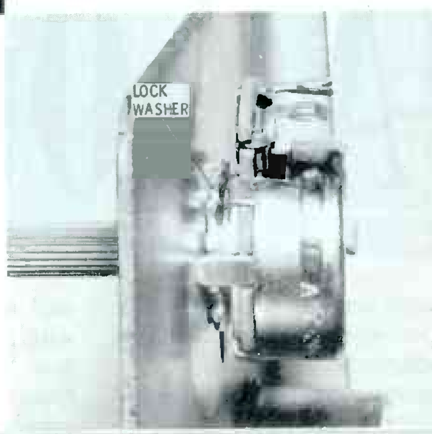


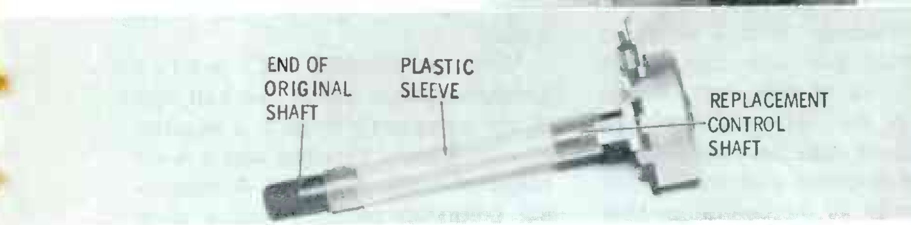
A coupler is useful for replacing a control with an exceptionally long shaft—also when you must duplicate a special insulated shaft or one with an odd diameter. In either case, a portion of the original shaft is spliced to that of the replacement.



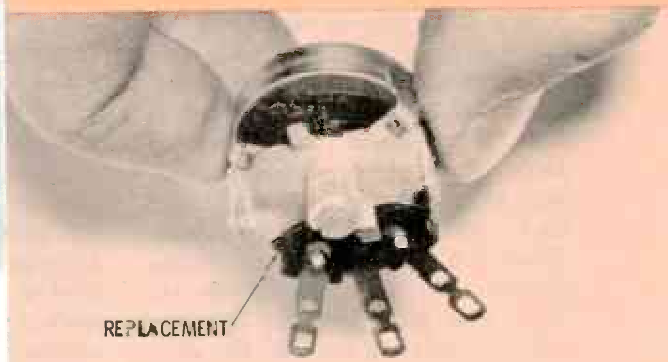
When the control being replaced has its shaft and/or case electrically isolated from chassis, always make sure the replacement is also isolated. Both surfaces of the mounting panel may be insulated as pictured here. If the fiber or other insulating material is damaged or missing, replace it before completing the job. When a metal shaft is involved, this situation becomes extremely important—especially if the receiver chassis is "hot."

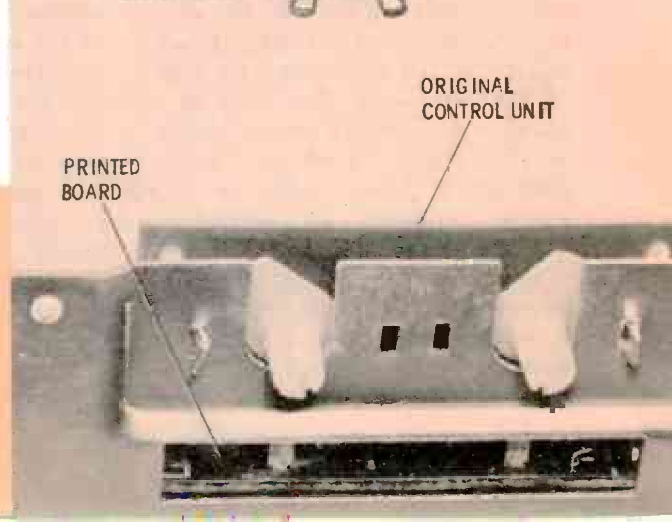
If the shaft of a replacement control is just a trifle too long, or if the bushing of a replacement must be flush with the outer mounting surface, a control can be set back from its mounting plane by using a simple spacer of some sort. Washers or a single bushing nut may be used in this application. To eliminate the possibility of the control working loose and turning, it's a good idea to place a lock washer next to the inner mounting surface as shown.





Replacement controls for TV service adjustments are sometimes designed with short, fixed shafts. When these units are used in place of a control having a longer shaft, an extension sleeve can be employed. The type shown here is a 2" hollow polyethylene tube. If the end of the original shaft has a finger-tip knurl or any other special feature, a portion of the shaft on the original control may be cut and then forced into the open end of the tube. Long pieces of similar plastic tubing are now available; you might carry a few of these in your caddy, since they are handy for the replacement of broken or damaged original plastic extensions often found on TV portables.





In many late-model TV receivers, you'll run across printed-board units which are a combination of two side-by-side controls. Provided the chassis is slotted to accommodate tab-mounted controls, single units may be used as replacements. However, cutting a dual control in two would result in a lack of physical support for the remaining half of the original unit; so both control elements generally must be replaced even if only one is found defective. If the replacements do not have spear-type terminals, lugs on the original unit may be clipped off and the replacement's terminals soldered to the remaining stubs.

AC Outlet

The AC outlet in the home, farm and office is an innocent looking affair, and its appearance has become standardized throughout the last fifty years. It is, however, the final delivery point of power, voltage and current and is the terminal for generating and delivery activity from thousands of sources. In the average circuit that is properly adjusted, designed and loaded, the outlet will normally deliver a 60-cycle alternating current at 117 volts. Note in the above statement that three words — *designed, adjusted* and *loaded* — condition the delivery of the proper voltage and current at the AC outlet.

In the design of voltage and current generating equipment, undersize generators and copper conductors as well as poorly designed line transformers and insulators have a cumulative effect on the delivered voltages.

Adjustments on generating and delivery equipment are made daily in the operation of the electric plant and in the scheduling of switching for peak and off-peak loading. Adjustments of the voltage regulation on the lines and of the taps on line transformers at the delivery points are also required.

Today only a small portion of the house and office load is permanently wired to the fuse panel — the rest might be termed migratory or mobile because it constitutes a load of the *plug-in* variety. In this last category, you will find such load items as: floor and table lamps, radio and television sets, refrigerators, deep-freeze units, electric ranges, fans, air conditioners, heaters, office calculators, small shop tools and electronic equipment. There are a number of other appliances that have the familiar AC cord with plug attached. Anyone who has tried to unravel the various line cords on his shop bench will know and understand the type of load we mean. This leads to a peculiar serviceman's disease known as "linecorditis." (Industrial loads, although a prime factor in line voltage variations, are omitted in this treatise for brevity.)

In addition to being migratory or mobile, the house and office load is a whimsical affair. It will vary with the weather, with the hours of the day, with the days of the week or with the seasons of the year. These variations, if the line voltage regulation is poor, affect the voltages at AC outlets. It is because of this that power generation and distribution is no simple task, and elaborate devices are in use to detect changes in the load and make the necessary adjustments to keep the voltage stabilized.

At the points of delivery where the high voltage is stepped down to user level, we come to the place where the greatest compromises are required and where a great deal of damage can be done. Distribution transformers, varying in size and load capacity, can supply a single home, an office building, an apartment house, a group of homes or whole parts of a town or city. The primaries of these transformers are designed for the various standard high voltages and currents that the distribution engineer selects for best delivery efficiency.

The secondaries of these units are primarily single-phase 220- or 110-volt windings with a common leg grounded and with taps which permit 3- or 4-volt incremental changes in the delivered voltages. Most of these taps are adjusted by the utility lineman and are set for a compromise of the conditions that exist at the time the lineman is at work on the pole. Some companies arbitrarily set these secondary taps at 125 volts. Other companies make a careful load appraisal and set the taps for what they feel will be best for average load conditions. Some taps are set and left undisturbed for long periods, while others may be changed frequently as load variables dictate.

At best, the selection of the tap to use on the secondary of the distribution transformer is a compromise, and the variable and mobile load previously described can alter the delivered voltages to the outlets. Voltage regulators on the high voltage side are of some help, and properly designed distribution transformers can also minimize this variable. The big problem exists in the tap selection and the load conditions at the time of that selection. The secondary is generally set on the high side of 117 volts. This makes more power available at the consumer outlet and is satisfactory only if normal outlet voltages are not exceeded.

In a recent comparison of AC line voltage readings, a certain technician was amazed when his local power representative could not make a voltage check at a standard AC outlet. The power man's meter (a good one, by the way) had only alligator clips for attachment. The technician was curious about this and asked if they had any meters with a standard AC plug. The reply was, "We set all distributed voltages from the transformer pole and need only alligator clips on our meter leads."

With a standard AC meter (which checked within one-half volt of the company's meter), a number of outlets were checked and a wide range of readings noted. A recording voltmeter plugged into a shop outlet over a long weekend showed wide swings and changes in the delivered voltage.

By this time, you are probably asking yourself what all this has to do with electronic servicing and why worry about it at all? You might even add that it's none of our concern anyway.

But, is it none of our concern?

About a year ago, a customer called at the shop with a 9-month old TV set of a good standard make and proceeded to detail the following complaints about the set's performance.

We were advised that the picture tube was still covered by the manufacturer's warranty. The principal complaint was that the set had been serviced seven times in the nine months of its use and that numerous complaints to the dealer had been of no avail — the breakdowns continued. Further questioning revealed most of the troubles had been due to tube failures for which, on the last five calls, the customer had been billed at standard rates. The customer was mad at the set, the dealer, the manufacturer and the serviceman.

On opening the back of the set, we noted that the set had a distinctive burnt odor. While the customer waited, the picture tube was tested — it proved to be a dud.

The chassis was removed, and an inspection of the cabinet revealed large spots of melted wax. A look at the chassis showed many capacitors with large wax drippings and dry casings, and wax from the horizontal-output transformer had melted in a glob at the bottom of the high voltage cage. The power transformer showed signs of overheating, and a test of the tube complement pointed out that many of the smaller tubes were defective.

Considering the service history on the set, permission was obtained to check the AC outlet voltages at the house. This check disclosed voltages ranging from 138 to 141 volts. Further questioning revealed that electric lamp failure was commonplace and that a high-wattage yard light required replacement every two or three weeks.

Additional probing revealed that with the voltage found at the house outlets, the set had been dissipating 240 watts. With normal voltage, it would have used only 175 watts. In addition, the set was located in a small cove near a gas heater. The added heat and lack of circulation combined with the high line voltage had caused rapid tube failure.

The customer was advised to call the service department at the power company and have them reduce the voltage and to call the shop when this had been done. The call came a couple of days later, and a check by our serviceman revealed that the voltage had been reduced — but only to 128 volts. The customer was advised that this was still too high and that it should be reduced still more. To get the power company to make this second change took a little time and some urging, but they finally adjusted the outlet voltage to 120 volts.

The television set was repaired by replacement of all obviously defective parts, together with the weak tubes and the picture tube.

This experience has led us to adopt a policy of making line voltage and wattage checks whenever tube or component breakdowns occur at short intervals or callbacks for adjustment occur frequently. In some instances the meter is left connected in an outlet, out of the way of children, and mother and dad are asked to read the meter at intervals of one or two hours.

As a result of this procedure, high delivered voltages have been found more often than previously expected. We also found that where a number of houses are tapped to one transformer, the house closest to the transformer receives the highest voltages, the highest surges and the most damage to appliances. In some cases, these conditions can only be corrected with surge regulators and autotransformers for downward voltage adjustments.

The importance of having a constant voltage source of 115 to 120 volts for the operation of a television receiver may be more fully appreciated when the voltages of the components of a television set are considered. For example, the picture tube of a popular make 21" television receiver requires an applied voltage of 18,000 volts at the anode to function at its normal efficiency. This means a voltage boost from the 115 volt source of supply to 18,000 volts at the picture tube anode. Now, if the voltage of the source of supply were to fluctuate widely, with a 10% to 15% drop below the normal 115 volts, then the same ratio of fluctuation will result in the voltage to the picture tube. A 15% drop in line voltage to 99 volts would result in the picture tube receiving only 15,300 volts. This is far below the engineered requirements needed for good video reception.

Over-voltage can also impair the performance and shorten the life of picture tubes. If primary voltage should increase to 130 volts, then automatically the voltage at the picture tube would proportionately increase to 20,200 volts which is more than the maximum tube rating.

All other electronic tubes are similarly affected by under-voltage or over-voltage. Whether it be for series-string circuits or conventional power transformer circuits, the heater current and heater voltage must remain within close limits to avoid tube failure from voltage surges or improper steady state voltage.

The experiences with television sets are the only ones cited here — but with high delivered voltages, other appliances are subjected to high wattage dissipations which can shorten their useful lives. High-wattage use makes for high meter readings and the customer pays in two ways — shorter equipment life and higher electric bills.

Repeated set failures have a way of reverberating against the technician who is called to get the set operating, and very few customers will patronize the same shop for seven repeat calls in nine months, even though a different failure is found each time. In this case, on the second call, the technician should have had doubts about the trouble, and the third tube replacement definitely should have made him look for something out of the ordinary. ▲

SINGLE-SIDEBAND ADAPTERS

by Edward M. Noll

Ways of converting standard communications receivers to take advantage of SSB operations.

Single-sideband transmission is one of the more important signs of progress within the rapidly changing and expanding field of communications. On crowded communications-radio channels, the spectrum-saving feature of SSB transmission has found much favor. The reduction of carrier interference howls and squeals alone is an advantage that must be reckoned with on our nearly-saturated channels.

In short-wave communication, SSB sharply reduces the distortion caused by selective fading (attenuation of some frequencies, but not others, in a transmitted signal). The single-sideband technique also opens the door to useful new types of radio services such as two-channel multiplexing, where the upper and lower sidebands of a single RF carrier contain separate information.

The communications receiver, especially under adverse reception conditions, must offer peak performance if full benefit is to be attained from SSB transmission. Although a standard communications receiver with a stable beat-frequency oscillator can be used to demodulate an SSB signal, some of the good characteristics of the SSB method are compromised. A better plan is to add an SSB adapter to a standard communications receiver.

The adapter obtains its signal from the IF amplifier of the receiver. Often this is accomplished by removing an IF amplifier tube and inserting a plug from the adapter into the vacated socket. The tube is then plugged into the adapter. Hence, the SSB signal is removed from the regular communications receiver at the IF frequency.

As shown in the basic block diagram of an adapter (Fig. 1), the IF signal from the receiver is first applied to a mixer which converts it to a lower frequency range (generally somewhere between 50 and 150 kc). This low-frequency IF system contains a filter that permits the passage of frequencies in one sideband of the input signal but presents maximum attenuation to all other frequencies—particularly those corresponding to the undesired sideband.

This narrow-band selectivity is important in establishing a high signal-to-noise ratio and in rejecting interference that could enter on frequencies adjacent to the desired information. Passbands are usually no more than 3 kc for voice communications. Receiver adapters with bandwidths up to 6 kc are available for systems which must convey music or other wide-range modulation. Some adapters have switching facilities that permit a choice of bandwidth.

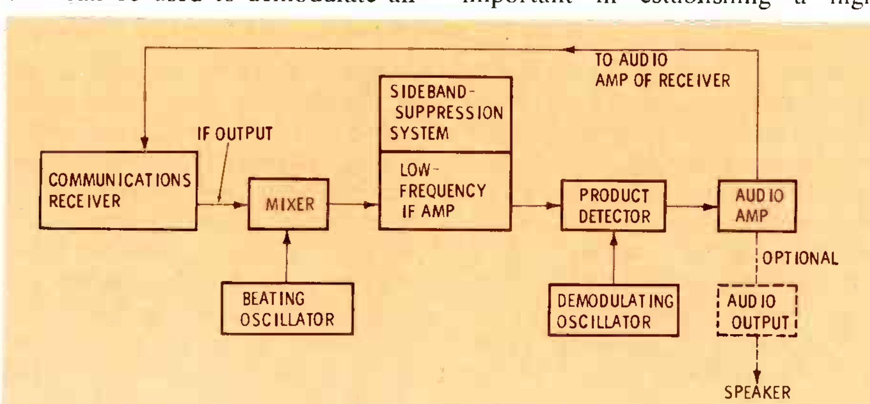
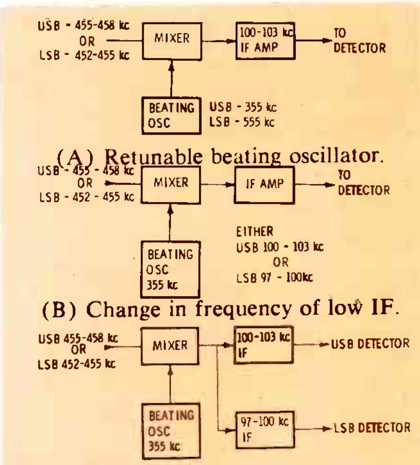


Fig. 1. Basic plan of a typical single-sideband adapter.

Choice of Sidebands

The adapter must be tuned to accept whichever incoming sideband is carrying the information. Three basic methods, as shown in Fig. 2, may be employed to select one sideband or the other. In the first plan (Fig. 2A), the frequency of the beating oscillator in the SSB mixer can be set to either side of the carrier frequency, depending on which sideband is being occupied by the incoming signal. Let us assume a condition in which the upper sideband (455-458 kc) contains all the modulation. Let us also assume that the IF bandpass of the adapter will accept only the frequencies between 100 and 103 kc. With the beating oscillator set to 355 kc, the upper sideband will be converted to the desired 100- to 103-kc range. If the modulation is on the *lower* sideband (452-455 kc), the beating oscillator must be reset to 555 kc in order to convert the input signal from the receiver to the adapter's IF passband.

In a double superheterodyne arrangement, one must keep in mind the frequency relationship between the receiver local oscillator and the incoming RF signal. When the os-



(A) Retunable beating oscillator.

(B) Change in frequency of low IF.

(C) Separate IF for each sideband.

Fig. 2. Methods of sideband selection.

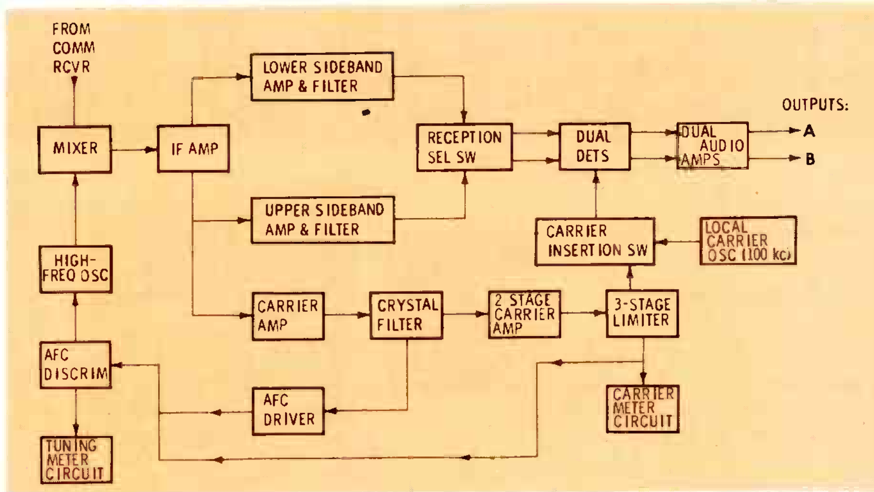


Fig. 5. Simplified block diagram of Crosby Type 51A adapter unit.

cillator is tuned below the frequency of the input signal, the sidebands in the IF output will remain on the "same side" of the carrier as the original RF sidebands. (For example, the upper sideband of both the input and output signals will consist of frequencies higher than that of the carrier.) With the local oscillator changed over to the "high side" of the incoming signal (a common occurrence when a communications receiver is switched from one band to another), the sidebands exchange places when the signal is heterodyned. In other words, the upper sideband of an RF input signal becomes a lower sideband in the receiver IF amplifier. The SSB adapter must then be reset to pass the lower-frequency portion of its input signal, even though the upper sideband of the incoming RF signal is carrying the desired audio.

In the second method of selection (Fig. 2B), the passband of the adapter IF amplifier can be changed from 100-103 to 97-100 kc (or vice versa) by switching. The beating oscillator may then be given a fixed frequency of 355 kc, regardless of which sideband is to be passed. An incoming upper sideband beating against the 355-kc oscillator signal produces a 100- to 103-kc output; to receive the lower sideband, the IF acceptance range is set to 97-100 kc.

In the third method (Fig. 2C), two separate IF systems are incorporated in the adapter. One passes the upper sideband range; the other, the lower sideband spectrum. The desired sideband is chosen by selecting the output of the proper IF channel. This type of adapter is suited to multiplex reception. Both sidebands of an incoming signal could be carrying two different "streams" of information; in such instances, two separate and unrelated audio signals could be made available simultaneously at the output of the adapter.

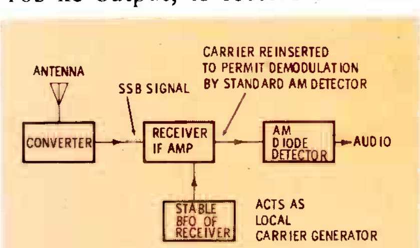


Fig. 3. How a standard communications receiver can demodulate SSB signals.

SSB Demodulators

The amplified SSB signal is next applied to the demodulator. In pure single-sideband systems (suppressed-carrier operation), the carrier frequency has been filtered out at the transmitter. If a substitute carrier is reinserted at the receiver, the SSB signal can be demodulated by a conventional AM detector. When a standard communications receiver is used for SSB reception, it is the BFO that reinserts the carrier. The signal can then be applied to the demodulator as shown in Fig. 3.

A standard AM detector is not the preferred circuit for SSB demodulation, because it is lacking in fidelity and noise rejection as compared to the special SSB demodulator circuit known as a synchronous detector. In this type of demodulator, a "beating" process is used to recover the original modulation. A CW oscillator reintroduces a carrier into the SSB signal at the demodulator. The output circuit is tuned to the difference frequency between the carrier oscillator and the incoming IF signal—in other words, to the frequency range of the original audio modulation. For example, by introducing a 100-kc carrier, the detector reduces a 100- to 103-kc single-sideband signal to 0-3 kc.

Three typical demodulators are shown in Fig. 4. The one in part A of the illustration uses a multi-grid tube. The single-sideband IF signal is applied to the control grid, while carrier injection is made via the No. 3 grid. In addition to certain performance advantages, this type of demodulator requires only a very

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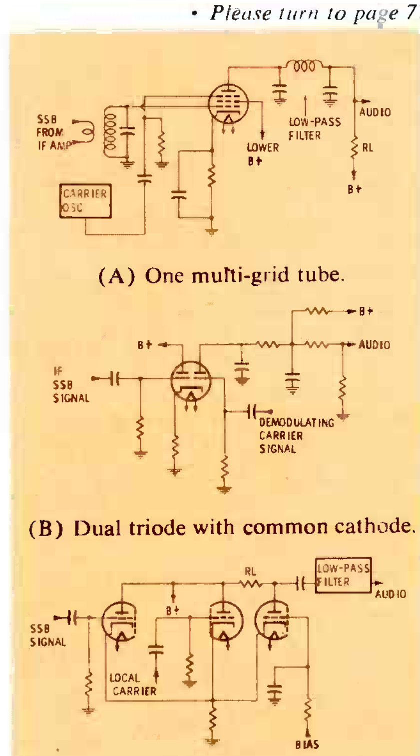

(A) One multi-grid tube.

(B) Dual triode with common cathode.

(C) Crosby triple-triode system.

Fig. 4. Typical SSB demodulators.

STOCK GUIDE
for tv tubes

The tube types listed on this page should account for well over 90% of your tube stock requirements. To keep the chart down to a manageable size, about 100 of the rarest type numbers have been omitted; however, we will keep you informed on these rare types and where they are found. Look for this information in *Previews of New Sets,* and also in special coverages like the article "The 1960 Crop of TV Tubes" in the March, 1960 issue.

Two columns of figures are listed along with the type numbers in the chart. The first column is purely a matter of statistics. Here's the meaning of the figures: If you took a cross-section sampling of 1,000 tubes from all TV sets now in service, you could expect to find the stated number of tubes of each type in this sample. (To avoid omitting many types which are only moderately popular, we have listed a figure "1" for each type with a usage frequency of at least once per 2,000 sockets.)

This column of figures, as it stands, is naturally not a suggestion to stock the exact number of tubes listed. The statistics should be combined with your own experience to produce information tailor-made to your own needs. Here are three factors to be considered:

1. Relatively high failure rate of certain types such as cascode RF amplifiers and power output tubes.

2. Specialization in certain makes of sets, such as regional brands. (As a national publication, PF REPORTER necessarily gives nationwide averages based on all brands of receivers.)

3. Average age of those sets which contain a particular tube type.

The second column of figures marked "Caddy Stock" is a suggested stock of 350 tubes to be carried on home calls—either in two medium-size caddies or one "king-size" caddy. This list attempts to strike a balance between having enough different types and having a sufficient stock of widely-used types to meet most contingencies.

Keep yourself informed of trends toward increased or decreased use of various tube types. This is easy to do by comparing the current *Stock Guide* with previous editions, which appear in the April and October issues.

*Note: *indicates a 450-ma series-string tube.*

PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE	PER 1000	CADDY STOCK	TUBE TYPE
33	5	1B3GT	1	1	5EA8	1	1	6BK5	1	1	6DB5	1	1	*8CG7
7	2	1G3GT	1	1	5EU8	6	2	6BK7A/-B*	2	2	6DE4	1	1	8CX8
4	1	1J3	1	1	5J6	4	2	6BL7GT	5	2	6DE6	1	1	8GN8/8EB8
1	1	1K3	2	1	5T8	2	2	6BN4	1	1	6DE7	1	1	*9AU7
1	1	1S2A/DY87	37	6	5U4GB	7	2	6BN6	1	1	6DG6GT	2	1	10DE7
8	3	1X2B	6	3	5U8	2	1	6BN8	2	1	6DK6	1	1	12AF3
2	1	2BN4	2	1	5V3	3	2	6BQ5	2	1	6DN7	6	3	12AT7
3	2	2CY5	1	1	5X8	12	3	6BQ6GTB	13	4	6DQ6B	21	6	12AU7/-A
2	1	3A3	2	1	5Y3GT	12	4	6BQ7A	1	1	6DR7	1	1	12AV5GA
2	1	3AL5	1	1	6AB4	1	1	6BR8A	1	1	6DS5	1	1	12AV7
4	2	3AU6	2	1	6AC7	1	1	6BS8	1	1	6DT5	8	3	12AX4GTB
1	1	3BC5	1	1	6AF3	4	2	6BU8	6	2	6DT6	4	3	12AX7
3	2	3BN6	3	2	6AG5	1	1	6BW8	1	1	6EA7	1	1	12AZ7A
3	2	3BU8	1	1	6AG7	1	1	6BX7GT	5	2	6EA8	1	1	12B4A
16	4	3BZ6	2	1	6AH4GT	3	2	6BY6	1	1	6EM5	8	3	12BH7A
10	3	3CB6	4	2	6AH6	1	1	6BY8	2	1	6ER5	1	1	12BQ6GTB
2	1	3CS6	1	1	6AK5	21	6	6BZ6	1	1	6ES8	1	1	12BV7
1	1	*3CY5	39	4	6AL5	2	1	6BZ7	1	1	6EU8	11	4	12BY7A
2	1	3DK6	5	2	6AM8/-A*	4	2	6C4	2	1	6EW6	3	2	12C5/-CU5
6	2	3DT6	4	2	6AN8/-A*	82	8	6CB6	1	1	6FH5	1	1	12CA5
2	2	4BC8	18	4	6AQ5/-A*	2	2	6CD6GA	1	1	6FV6	1	1	12CU6
2	1	4BQ7A	3	1	6AS5	2	1	6CF6	1	1	*6FV8	2	1	12D4
1	1	*4BU8	1	1	6AS8	30	7	6CG7	1	1	6GH8	1	1	12DB5
2	1	*4BZ6	2	1	6AT6	5	2	6CG8/-A*	3	2	6GN8/6EB8	7	3	12DQ6B
1	1	*4CB6	2	2	6AT8/-A*	2	1	6CL6	2	1	6J5	1	1	12DT5
1	1	*4CS6	5	2	6AU4GTA	1	1	6CL8/-A*	13	4	6J6	1	1	12ED5
1	1	*4DE6	67	6	6AU6	1	1	6CM6	4	2	6K6GT	3	2	12L6GT
1	1	*4DT6	3	2	6AU8A	5	2	6CM7	1	1	6S4A	2	2	12SN7GTA
2	1	5AM8	2	2	6AV5GA	2	1	6CN7	1	1	6SL7GT	1	1	12W6GT
1	1	5AN8	10	3	6AV6	2	1	*6CQ8	41	8	6SN7GTB	1	1	*13DE7
6	2	5AQ5	14	4	6AW8A	3	2	6CS6	2	1	6SQ7	1	1	*13DR7
1	1	5AS4	27	6	6AX4GTB	1	1	6CS7	10	3	6T8	1	1	*17D4A
2	1	5AT8	4	2	6BA6	1	1	6CU5	15	5	6U8/-A*	2	1	*17DQ6B
1	1	5B8	2	1	6BA8A	2	2	6CU6	1	1	6V3A	3	2	19AU4GTA
1	1	5BK7A	3	2	6BC5	1	1	*6CU8	10	3	6V6GT/-A*	1	1	25AX4GT
1	1	5BR8	3	2	6BC8	1	1	6CX8	7	3	6W6GT	1	1	25BK5
1	1	5BW8	4	2	6BE6	2	2	6CY5	6	2	6X8	1	1	25BQ6GTB
3	2	5CG8	2	2	6BG6GA	1	1	6CY7	3	1	7AU7	1	1	25CD6GB
2	1	5CL8A	2	1	6BH8	1	1	6CZ5	1	1	*8AW8A	1	1	25DN6
1	1	5CZ5	1	1	6BJ8	1	1	6DA4	1	1	8BQ5	2	1	25L6GT

New this issue: To make this chart easier to use, all figures are shown to LEFT of tube types.

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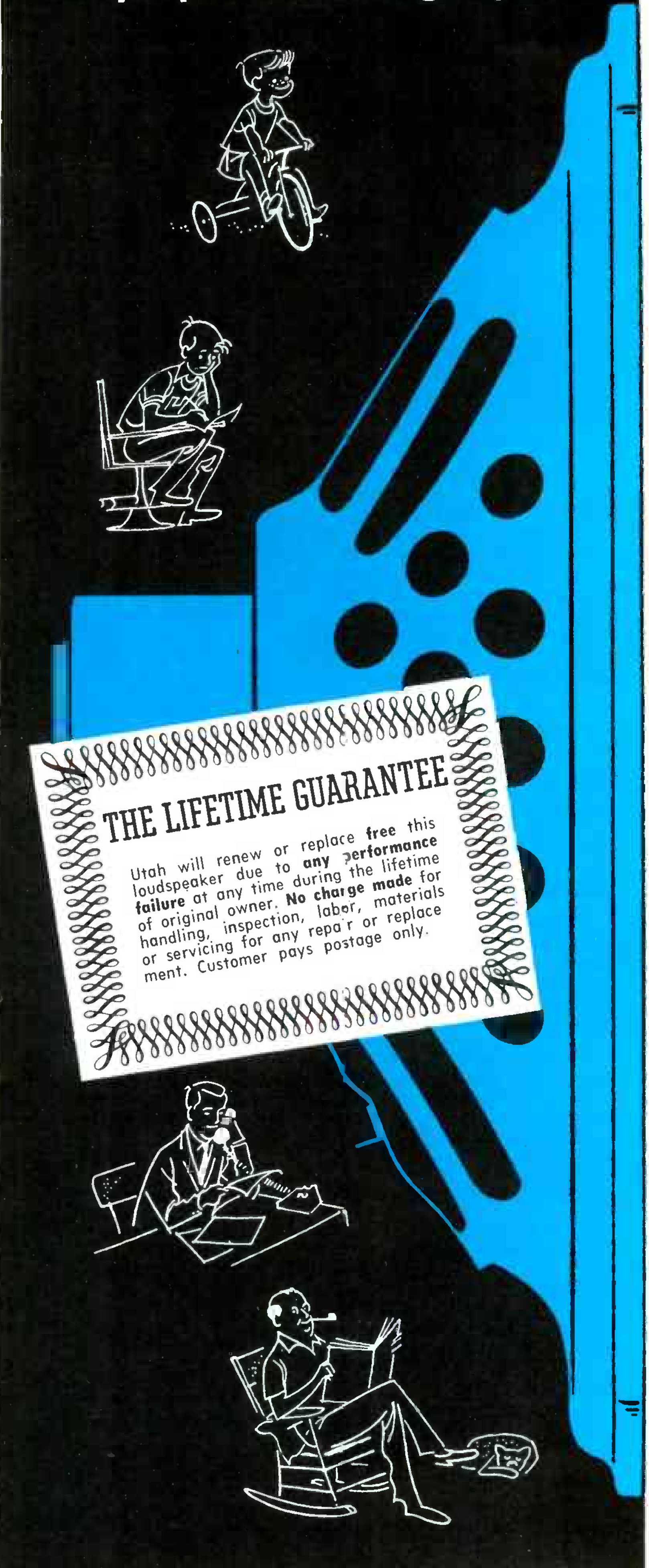

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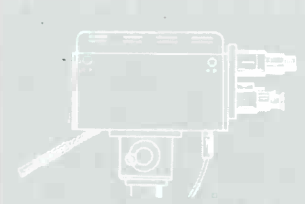

The Electronic Scanner

New Film for Service Clinics

The third in a series of slide films has just been released by **Sencore** for use in their "Time-Saving Service Clinics." The new film, "Old Tubes Seldom Die . . . They Just Fade Away," features the new **Mighty Mite** tube checker. Arrangements for its showing can be made through **Sencore** distributors or with the company. Incidentally, construction of a new addition to the **Sencore** plant, now under way, will nearly double its capacity — apparent proof that their instruments have been widely accepted by the service fraternity.

Lion of Allentown is "Lamm"

Winner in a "My Favorite Dealer" contest sponsored by **Winegard** distributor Art Peters of Allentown, Pa., was **Carl Lamm.** Details of the contest were aired over a local radio station, encouraging listeners to make a nominating statement about their favorite TV dealer. Best entries each week won a **Winegard Color 'Ceptor** antenna installation. Mr. Lamm's prize was a trip for him and his family to the Winegard plant in Burlington, Iowa.

Learn by Doing Transistor Course

A low-cost transistor home-study course which makes use of practical experiments is now available from **CBS Electronics.** Details on the cost and availability of the course can be obtained from CBS distributors.

Help for Hi-Fi Dealers

Hi-fi service dealers needing suggestions on what small-ticket items to carry, how to display them in building store traffic, and making the most effective use of floor and counter space will be interested in **Robins Industries'** "dealer display workshop" program. Details may be obtained through their distributors.

Noisiest Spot in Town

How far will a manufacturer go to improve product performance? **Shure Bros.** has recently installed a special sound room to aid in the development of microphones for use in noisy environments. In the presence of noise intensities so great a person literally cannot hear his own voice, clear and audible speech transmissions are conveyed from special microphones within the room to an outside loudspeaker.

Expands Capacitor Line

The latest step in **Arco Electronics'** plans for becoming a full-line capacitor supplier is the opening of an electrolytic plant in Terryville, Conn. The new "Arcolytic" line includes single and multiple section aluminum units in metal-can tubular, wax-filled tubular, and twist-prong styles.

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FACTS ABOUT TUBE SUBSTITUTION

. . . with a chart showing which types can be replaced by others.

Why are tube-type substitutions even considered? Probably the first reason that pops into your mind is, "Because I don't have the one I need." Secondly, you may be thinking, "I sometimes use an improved version of a tube to obtain better performance." Still another reason may be, "I keep my tube inventory cleaner and smaller by substituting tubes." There may be other considerations, but these are the major ones. Just how valid are these reasons, and how can it be determined when and what to substitute?

The first reason—not having the required tube—is certainly valid enough to justify substitution. In most cases, however, the substitution should be temporary in nature; that is, it should be done only to prove a new tube is required. Of course, if the proper tube can't be obtained for a day or two, the customer should not be forced to go without TV when substituting another tube would allow him to "get by" for the time being. Be sure the customer understands the situation in such cases, and install the proper tube as soon as possible.

It takes careful consideration to determine what constitutes a proper substitution. The first thing to remember is that two given types of tubes aren't necessarily interchangeable just because they have the same base connections and are used in similar applications. Also, alternate versions of a single basic type (such as the 3-, 4-, and 6CB6), with different voltage and current requirements, normally aren't satisfactory as substitutes for each other.

Substituting an improved version or an industrial equivalent of an original radio-TV tube type is generally a good idea. However, *never go in reverse*! To give a classic example, you can use a 6AX4 to replace a 6W4, or a 6SN7GTB to replace a 6SN7GT—but not the other way around. When a "hotter" version of a tube appears on the market (for instance, a 6DQ6A as opposed to a 6BQ6), several factors must be taken into account before employing it as a substitute for an older type. Interelectrode capacitance, cathode-bias requirements, and detuning of circuits all have a bearing on RF-IF applications; and, as for power amplifiers such as the horizontal output types just cited, there is some question as to whether or not a circuit defect is being covered up by using a "hotter" tube.

Tube substitution as a means of inventory control is a sound business practice, and — if used with discrimination — a sound technical policy. Stocking 5AR4's to replace 5V4's, and letting 6AV4's double as 6W4 replacements, are two typical examples. Extreme caution must be used, however, in determining what to stock.

The following substitution guide covering some of the more common tube types is an excerpt from the *Tube Substitution Handbook* recently published by Howard W. Sams & Co., Inc. Only tubes having similar or improved characteristics are listed as replacements for the tubes shown at the left of each column. Each tube is listed in only one filament-voltage rating, but corresponding substitutes may also be available for versions having other filament voltages. No consideration has been given to physical space limitations. This chart *does not* constitute a recommendation of such substitution by either Howard W. Sams & Co., Inc., or PF REPORTER.

Type	Replace with
1B3GT	1G3GT, 1J3, 1K3, 1N2
1X2	1X2A,-B
2AF4	2AF4A,-B
5AW4	5AS4,-A, 5AU4, 5DB4, 5U4GA,-GB, 5V3
5BK7A	4BC8, 4BQ7A, 4BS8, 4BX8, 4BZ7, 4BZ8, 4CX7
5U4	5AR4, 5AS4,-A, 5DB4, 5T4, 5931‡
5V4G	5V4GA, 5AR4
5Y3	5AR4, 5AX4GT, 5AZ4, 5CG4, 5R4, 5T4, 5V4, 5Z4, 6087‡, 6106‡
6AG5†	6AK5*, 6BC5, 6CE5, 5654‡, 6096‡
6AK8†	6T8, 6T8A*
6AL5	5726‡, 6058‡, 6097‡, 6663‡
6AQ6†	6AT6*, 6AV6*, 6BK6*, 6BT6*
6AQ8†	6DT8*
6AT8†*	6AT8A, 6CG8,-A
6AU4GT	6AU4GTA, 6CQ4, 6DA4A, 6DE4
6AU5GT	6AV5GA,-GT
6AU6	6AU6A, 6BA6, 6136‡, 7543
6AU7†	7AU7
6AU8	6AU8A, 6AW8,-A
6AV4*†	6BX4*
6AV5GA	6AV5GT, 6AU5GT
6AV6	6AT6, 6BK6, 6BT6, 6AQ6*
6AW8	6AW8A, 6AU8,-A, 6EB8*
6AX4GT, A	6CQ4*, 6DA4,-A, 6DE4*
6AX8†	6U8A*, 6GH8, 6EA8, 6GJ8*
6BA6	6AU6,-A, 5749‡, 6660‡
6BA8	6BA8A, 6BH8
6BC8†	6BK7*,-A*,-B*, 6BQ7,-A, 6BS8, 6BX8, 6BZ7, 6BZ8, 6CH7, 6CX7, X155

Type	Replace with
6BD5GT	6AV5GT,-GA, 6AU5GT
6BE6	6CS6, 5750‡
6BF6†	6BU6
6BF7†	6BF7A, 6BG7
6BH8	6BA8,-A
6BL4	6AU4GT,-GTA
6BL7GT	6BL7GTA, 6DN7, 6BX7GT
6BQ5	7189,-A, 7320‡
6BQ6	6CU6, 6DQ6,-A,-B, 6FH6
6BU8†	6GS8
6BX6*†	6BY7*, 6EC7*
6BX7GT	6BL7GT,-GTA
6BZ6†	6CB6,-A*, 6CF6, 6DE6, 6DK6
6C4	6100‡, 6135‡
6CB5, A	6CL5
6CD6G	6CD6GA, 6DN6, 6EX6
6CJ6†	6DR6
6CM6	6CZ5
6CS6	6BE6
6CU6	6BQ6GTB, 6DQ6,-A,-B, 6FH6
6CX8	6AU8*,-A*, 6AW8*,-A*
6CY5†	6EA5, 6EV5
6DA4, A	6CQ4, 6DE4
6DA6*†	6DG7*
6DC6	6BZ6, 6CB6,-A, 6CF6, 6DE6, 6DK6
6DE4	6AU4GT,-GTA, 6CQ4, 6DA4A
6DG6GT	6W6GT, 6EF6, 6EY6, 6EZ5
6DJ8*†	6ES8, 6FW8*
6DN6	6EX6, 6CD6G,-GA
6DQ6	6DQ6A,-B, 6FH6
6EA7†	6EM7

Type	Replace with
6EB8	6GN8, 6AU8*,-A*
6EF6	6DG6GT, 6EY6, 6EZ5, 6W6GT
6ER5†	6ES5*, 6FH5*
6ES6†	6ET6
6EW6†	6GM6
6EY6†	6EF6, 6EZ5
6FH6	6DQ6B
6GN8	6EB8, 6AU8*,-A*, 6AW8*,-A*
6SN7GTB	6SN7GTA*, 5692‡
6U4GT	6AX4GT,-GTA,-GTB, 6CQ4, 6DA4,-A, 6W4GT
6V4	6CA4
6V6GTA†	6V6*,-GT*, 7408*
6W4GT	6AX4GT,-GTA,-GTB, 6CQ4, 6DA4,-A, 6U4GT
6W6GT	6DG6GT, 6EF6, 6EY6, 6EZ5
6X4	6BX4, 6AV4*
12AD7†	12AX7*,-A*, 12DF7*, 12DM7*, 12DT7*, 7025*,-A*
12AE6†	12AE6A, 12FT6
12AF6	12BL6
12AT7†	12AZ7*†,-A*†, 6060‡, 6021‡, 6679‡, 7728‡
12AU7, A	6067‡, 6189‡, 6680‡, 7730‡
12BV7†	12BY7,-A, 12DQ7
12C5/12CU5	12C5, 12CU5, 12R5
12DW7	7247
12DZ6†	12EA6
12EN6†	12L6GT, 12W6GT
19T8	19C8
7543	6AU6,-A

* Parallel-filament circuits only. † Substitutes for each other. (Excludes industrial) ‡ Industrial type.

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- 4 A47-500K-Z
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C*
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- 2 C47S-500K-S
- 2 C47S-1 Meg-Z

SWITCHES
- 6 SWE-12
- 2 SWE-20
- 2 SWE-21

SHAFTS
- 4 FKS-¼
- 4 FKS-½
- 4 KFS-3
- 4 RS-2
- 4 FS-3
- 4 KSS-3

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DOES HIGH FIDELITY DEMAND HIGH POWER???

AUDIO FACTS

by Thomas A. Lesh

A recent comment by a serviceman called attention to a problem faced by technicians as well as laymen. Here's what he had to say:

"It seems to me that the facts about good high fidelity from an amplifier are becoming more confusing, what with the increasing output rating of amplifiers as of late. I would like to know what the power output of a good amplifier would have to be in order to enjoy full, undistorted high-fidelity reproduction in the average living room. I have read many articles which contradict each other on this point."

There is a great deal of room for contradiction in attempting to settle the hi-fi power question. The "right answer" depends on what you are trying to accomplish with an amplifier, and whom you are trying to please with its performance. As if this didn't create enough problems, three different power-rating standards are currently in use, so it's no wonder that this subject breeds confusion! Nevertheless, the problem of amplifier power is well worth your careful consideration, because the output wattage of an amplifier definitely affects its ability to provide faithful reproduction of music.

This fact, obvious though it may seem, is not given its full share of attention, because most people without specialized training tend to exaggerate the importance of "flat frequency response from 20 to 20,000 cps" when trying to define high fidelity. This oversimplification of the facts is just as misleading as trying to define an economical car as "one which gives good gasoline mileage." True, a wide frequency range is the most obvious feature of hi-fi equipment, but "20-20,000 cps" doesn't tell the whole story. A number of other factors are also involved in high-fidelity reproduction.

All right, then, just what *is* high fidelity? Let's get down to fundamentals. It's important to bear in mind that "hi-fi" is a relative matter, not an absolute state of perfection. If an audio amplifying system were perfect, it would reproduce sounds exactly as they would be heard during a live performance. This goal is never reached, but best practical results come close enough to perfection to be highly satisfactory, and somewhat *less* than the best results are good enough to please millions of listeners. Audio components and systems are available to suit every taste. Since some of them introduce more "flavoring" into the sound than others, some sort of arbitrary minimum standards must be set in order to define what is "high fidelity" and what is not. In effect, this is the gist of the comment at the beginning of this article.

But the man who raised the question cannot arrive at a valid answer without taking inventory of his listening habits and standards of judgment. If he's like most of us, his tolerance of imperfections is inversely proportional to his budget! Luckily for those of us with limited means, the human imagination does very well at filling in deficiencies in the music we hear. This last statement is not intended as an excuse for maintaining low standards of music reproduction, since the listener's unconscious effort to overlook poor sound quality is known to be tiring. However, the ear's distortion tolerance helps to explain why a great deal of mediocre equipment has found acceptance as "hi-fi" simply because it is vastly better than anything previously available in a similar price class. In other words, equipment having limited capabilities is adequate for use where the demands placed on it are also limited.

Power vs. Loudness

The most easily-made compromise with "true high fidelity" is in the realm of output power. Did you ever stop to think that a hi-fi set cannot reproduce music with *complete* realism unless the volume level is the same as for the live rendition? In case you haven't heard a live orchestra, at close range recently, you may have forgotten how loud it is — unnaturally loud for an average-sized living room. Even if you can take this much volume without flinching, your family and neighbors are likely to lay down the law and insist on moderation. Fortunately, music can still sound quite natural at less than room-shaking volume, especially when a loudness control is available to compensate for changes in the ear's frequency response at different sound intensities. (See the December, 1959 *Audio Facts.*) At a comfortable listening level, you may unconsciously adjust the loudness and tone controls so that the music seems to come from

some distance away — thus "taking a back seat in the concert hall."

Now, at last, we have reached the heart of the problem! Assuming some moderation in volume (and a normal-sized listening room), even someone with more than a passing interest in hi-fi will more than likely be satisfied with a well-designed amplifier having an output power of about 15 watts. But wait! This power figure represents a *continuous* rating, the most conservative way of expressing amplifier power. Measured with a steady sine-wave signal applied to the input, the rated wattage indicates the maximum audio power obtainable without going above a specified percentage of distortion in the output.

Certain hi-fi owners prefer larger amplifiers. For some, the reason may be a desire for higher volume or larger area coverage; for others, the main consideration may be an extra reserve of power to guard against distortion; and, to be frank, there are also some who are guided by the "horsepower race" instinct.

As the output rating is decreased below the 15-watt level, the maximum usable volume (without introducing distortion) becomes progressively lower — although it's still far from being a whisper! Borderline distortion isn't too easily recognized, since it occurs almost entirely on signal peaks. Most of the program material in a high-fidelity recording can be cleanly reproduced with a power of only a few watts; only an occasional sharp burst of sound would require a great deal of power. (Examples are a drum beat, a crash of cymbals, or an entire symphony orchestra rising to a crescendo.) An "almost good enough" amplifier will be overdriven on these sound peaks, but not on the rest of the signal: thus, the only complaint may be a "fuzziness" of the sound which may seem worse on some recordings than on others.

Most of the strongest peaks in a typical audio signal have a very short duration, and this fact is an important key to understanding the significance of various power ratings. An amplifier can deliver considerably more than its rated rms power for brief intervals. Accordingly, a number of audio-equipment manufacturers have rated their amplifiers according to *peak* power output, which figures out mathematically to twice the rms power. This is said to furnish a much closer index of the unit's true power capability, and it has the undeniable advantage of sounding more impressive. Output figures grow to sensational proportions when a stereo amplifier is rated according to the sum of the peak power outputs of both channels — which has been a fairly common practice in some branches of the audio field.

Just because an amplifier remains below a certain distortion level at a specified rms power rating doesn't automatically mean that the unit will be equally distortion-free during momentary signal peaks drawing twice as much power. With this limitation in mind, and hoping for an eventual end to the confusion caused by different power-rating standards, two associations of manufacturers have recently adopted and publicized a new compromise standard known as *music power output*. This specification is intended to serve as a key to the maximum *undistorted* power available on peaks of a typical audio signal.

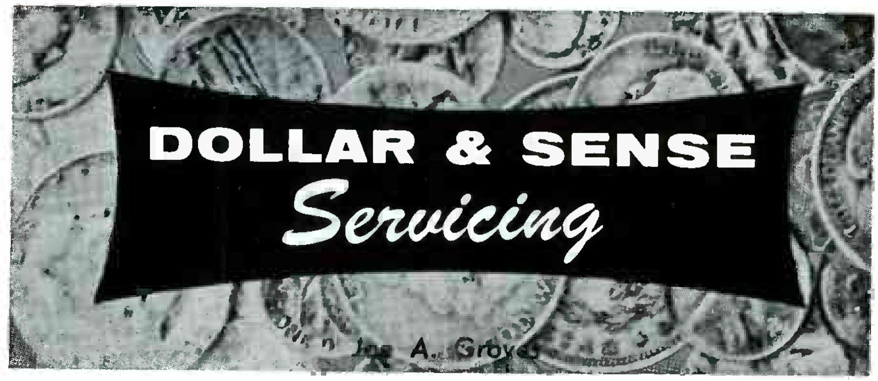
The Institute of High Fidelity Manufacturers defines music power as follows for component-type equipment: ". . . the greatest single-frequency power obtainable without exceeding the rated total harmonic distortion *(claimed for the unit in question—Ed.)* when the amplifier is operated under standard test conditions, *except* that music power is measured immediately after the sudden application of a signal and during a time interval so short that supply voltages within the amplifier have not changed from their no-signal value."

In other words, an effort is made to measure the operating conditions within the audio output stage when a sharp signal peak is applied. If the duration of the peak is quite short, the drain on the power supply is almost negligible, and the B+ voltage to the audio output stage remains practically constant. However, a broader signal peak (such as that of an audio-frequency sine wave) could cause enough of a change in current drain to make a noticeable change in power-supply voltage. (Any fluctuations in B+ act to reduce the maximum undistorted power output.)

Literally interpreting the above instructions for measuring music power is impractical, of course, but it *is* possible to simulate the effect of a short-duration signal with good results. The amplifier's output stage is disconnected from the regular power supply and hooked up to an external supply having excellent voltage regulation. In this way, the supply voltages are maintained at the no-signal values regardless of how long the test signal is applied. The resultant reading of maximum undistorted output power in a typical amplifier will be about halfway between the continuous rms and peak power readings. Thus, our "average" 15-watt amplifier would probably have a music-power rating of over 20 watts. In amplifiers equipped with exceptionally well-regulated power supplies, there would be an unusually small difference between the continuous and music power ratings.

The Electronic Industries Association has adopted a very similar standard for measuring music power in "packaged" hi-fi sets, except that a maximum harmonic distortion of 5% is specified under the stated test conditions. This distortion figure is notably higher than those allowed under the stiffer IHFM standards, in line with the generally less strict interpretation of "hi-fi" from the mass-market standpoint.

If you scan the specification sheets for a number of recent-model amplifiers of many popular brands, you will notice that the music-power standard is being widely adopted. When determining whether or not a specific amplifier can handle a certain job, be sure to check and see whether music power or one of the older standards is being specified. Also be on the lookout for other significant figures which can help you answer questions such as "Is the frequency response and distortion level the same at high power as when the power output is only moderate?" Finally, make sure the speaker system is capable of handling the full output of the amplifier without being overdriven. Used intelligently, amplifier power ratings can be a valuable tool in helping you to decide how close a given amplifier comes to "concert-hall realism." ▲



Hard-core soft sell. Sales are the lifeblood of business; every commercial endeavor is faced with selling some service or product. Just how masterfully a firm accomplishes its sales objectives is reflected by the success of the business. Sales techniques vary between two extremes — often referred to as *hard sell* and *soft sell*. The most vivid example of hard sell is the technique used by salesmen who won't take NO for an answer. From all indications, Americans are fed up with these tactics. You may have noticed that many manufacturers are giving up hard-sell TV commercials (such as endless, loud-voiced repetition of slogans) and are turning more toward informal presentations and cartoons. However, they are retaining a hard core to their soft-sell technique.

A complete departure from the high-pressure sales approach is the soft-sell technique of a TV serviceman who, upon restoring a TV set to operation, *offers* to check all tubes in the set *if* the customer would like him to. Here the customer is offered an additional service, with no admonition of the consequences which might result if he said, "No, thanks" to the offer. Compare this with hard-sell methods, where the customer is persuasively directed into an action, and you will see the marked contrast between the two sales techniques.

Many shop owners have found it profitable to *sell* preventive maintenance as part of the repair routine. Others have gained business by simply *asking* if any other radio, phonograph, or antenna installation services are required by the customer. Some even carry phonograph needles, FM or portable radios, etc., into the home when making a TV call, to let customers know they have the item *just in case* they are interested.

It all boils down to the fact that you must sell to stay in business. In selling you must be aggressive—but not too much; make your customers want what you have—but make them think it's their idea; offer them what their station in life permits—but in such a way that they won't be offended if it's beyond the *immediate* reach of their budget. This is applying the hard core to soft sell.

$ & ¢

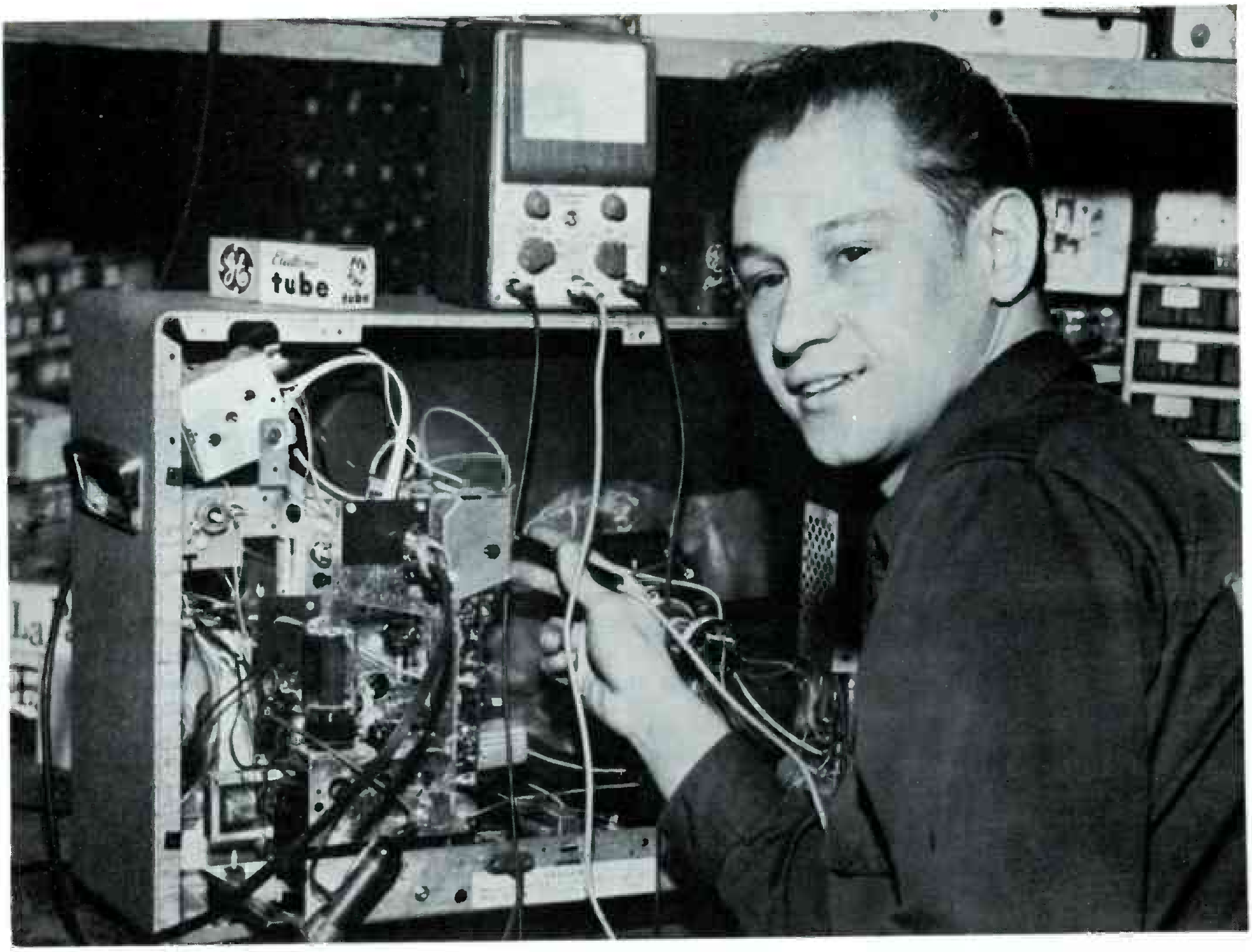
Snowed under? Has that wonderful snowfall of TV receivers needing service blanketed your shop yet? To say the very least, we'll bet your business has picked up since the beginning of the fall season.

This condition brings up many problems for set owners and technicians alike. You know John Q. Public — his set is the only one in town that needs service, and he wants it yesterday. As for yourself, you have umpteen John Q's breathing down your neck, and a time-consuming "dog" on the bench. It's a time of tried patience, mental stress, ulcer development; time to apply a little "oil" to your business operation (in the form of brain work) and get it running like a finely-tuned machine. Here are a couple of areas where you may be able to take some strain out of the rush period:

Many technicians have found it helpful to place a time limitation on each set they service — setting a "dog" aside to complete a couple of normal jobs. If you follow this approach, bear in mind that you *must* return to the "dog" in a reasonable time, and you should start on it as if it were appearing on the bench for the first time. The greatest deterrent to "whipping a dog" is going back to where you left off. You'll find it much easier to make a fresh start!

$ & ¢

Profit Builder. Training sessions after hours and during slack periods increase efficiency and improve the profit picture.



"The 'Designer' is the

LEAST TROUBLESOME SET

we have ever serviced,"

says Bob Wauganman of Bob's Television, 9518 Madison Street, Cleveland, Ohio.

"Speaking of the General Electric 'Designer'," says Bob Wauganman of Bob's Television in Cleveland, Ohio, "there probably isn't an easier set on the market today to service.

"We can do 90% of shop work without removing the set from the cabinet, and we find that, because General Electric licked the heat dissipation problem, 'Designers' last longer and suffer less breakdown.

"We have very few service calls on 'Designers'. Those that we do have are easily corrected. This gives us lots of time to get in more calls per day and, of course, it helps us to make more money, too."

"Designer" Tubes are directly replaceable, fuses accessible, and you easily get at the key check points. Another thing: the painted schematic on the boards helps you find your way around quickly. Again, more calls per day—and more money.

Precision Etched Circuitry is used in all "Designer" sets and is reliable and uniform so that when you have serviced one you will never have to puzzle over the next one.

"Designer" TV—called the easiest-to-service set in television! General Electric Company, Television Receiver Department, Syracuse 8, New York.

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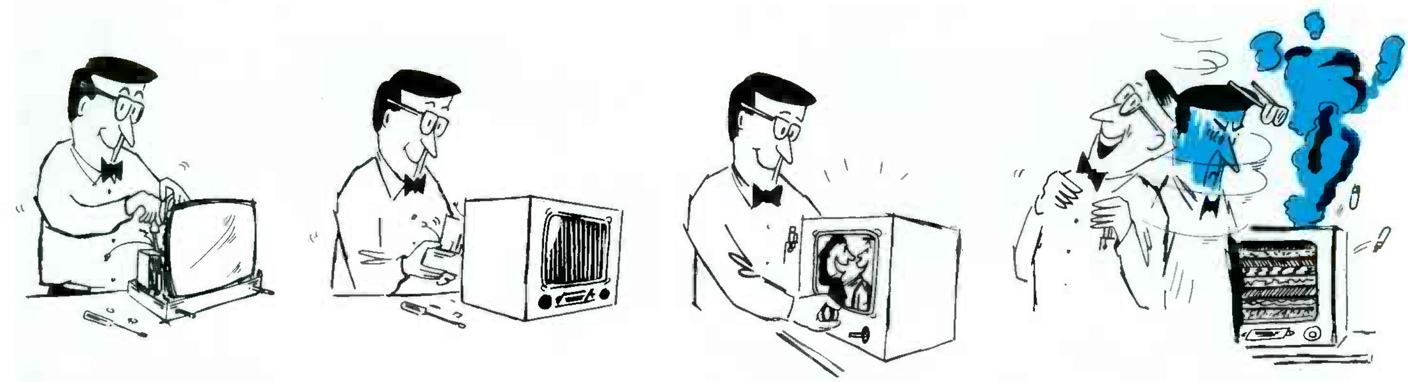


fixed at last . . . OOPS!

Recently, I went through an exasperating troubleshooting bout with a Zenith Model H2438R TV receiver. Several aspects of the case were enough out of the ordinary to be worthy of interest. When first brought in, the set had only about 2" of vertical sweep. This problem wasn't difficult in itself; however, before the set could be returned to its owner, the tuner required service for a burned resistor, an arcing flyback demanded attention, the AGC circuit needed repairing, and the sound section was realigned. In order to save time on this service job, it was also necessary to figure out a way of checking the vertical yoke circuit without observing the raster.

Tackling the Problem

When the set was placed on the bench and power was first applied, two major symptoms were noted:

1. The raster was normal in width but extremely low in height, with compression at the bottom.
2. The flyback transformer coil was arcing to its core.

The greatly reduced and distorted appearance of the raster (unaffected by tube substitution) made me suspect that either the vertical output transformer or the deflection yoke was defective. However, since the flyback was arcing, I didn't dare operate the set long enough to permit normal troubleshooting procedures. I was anxious to save the flyback, because the customer wouldn't stand for replacement of both the yoke and the flyback on such an old set, and also because I felt that a little corona dope and beeswax would cure the arcing condition. Red corona dope was liberally applied to the surface of the flyback coil and core. Since several minutes' time is required for the coat of corona dope to dry, and several coats were deemed necessary, I decided to proceed with troubleshooting the vertical sweep problem. The ¼-amp fuse was removed from the horizontal output stage to disable the horizontal sweep system and thus permit the corona dope to harden. Since this killed boost B+, and the vertical output stage operated from boost, a temporary connection (Fig. 1) had to be made between the vertical output stage and the regular B+ source. The voltage thus obtained was not too far below the value normally supplied from boost through the 1800-ohm dropping resistor; so, with near-normal voltage fed to the output stage, adequate troubleshooting techniques could be employed.

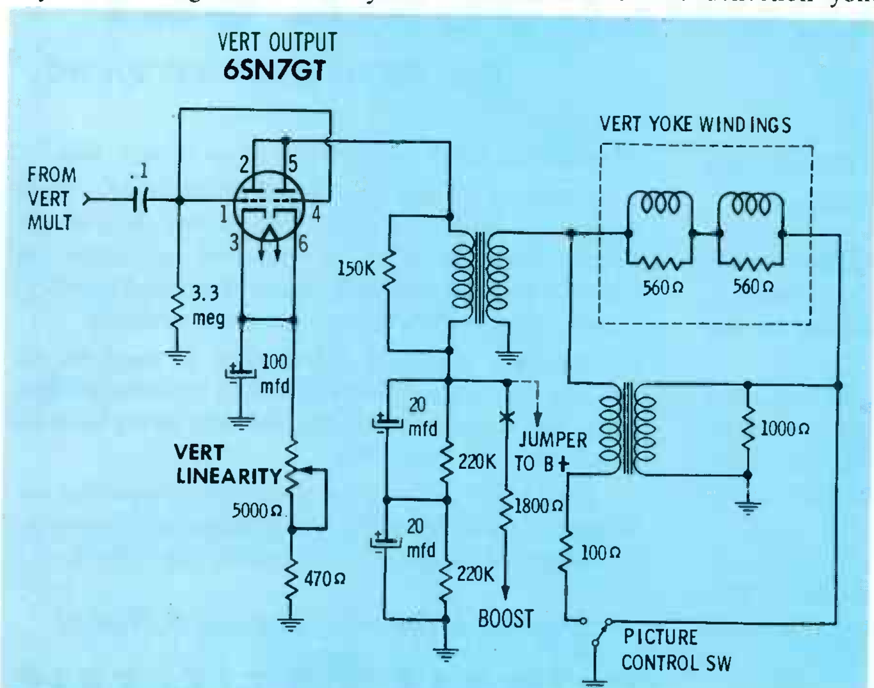
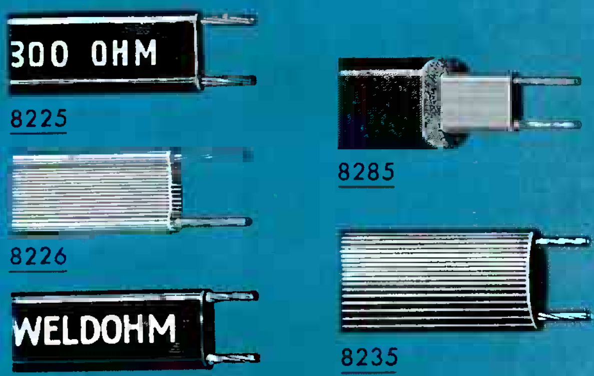


Fig. 1. Vertical sweep was powered by B+ while boost circuit was disabled.

Operating the PICTURE CONTROL switch had failed to produce a noticeable effect on the picture, so I knew this network wasn't causing trouble. Voltage and oscilloscope checks around the vertical output

Transmission Line Cables



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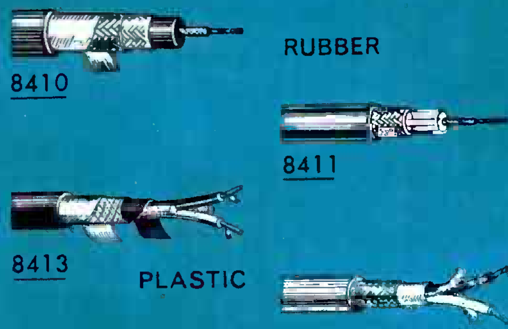

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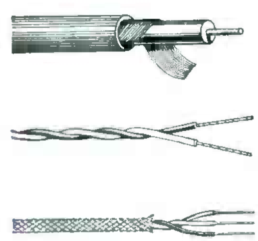

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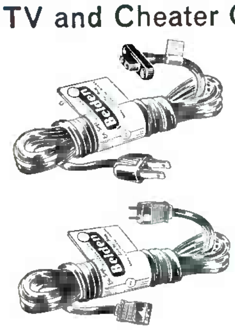

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stage revealed normal signals and voltages at the output tube, but little or no sweep-signal energy across the yoke.

Yoke Substitution

A check of the service literature revealed that the vertical windings of the yoke should be 13 mh. An old yoke with an open horizontal coil, but with the correct vertical winding inductance, happened to be on hand. The leads of the yoke in the set were simply unsoldered and the other unit's leads soldered in place. No attempt was made to install the test yoke on the picture tube, since the picture couldn't be viewed anyway. A scope check of the yoke signal revealed the expected sawtooth waveform, proving that the old yoke was defective. Resistance checks of the old yoke's vertical winding revealed a minor reduction in resistance, and it was assumed that a few turns had shorted.

When the correct replacement yoke had been obtained from the local parts house and installed, the yoke waveform was again checked.

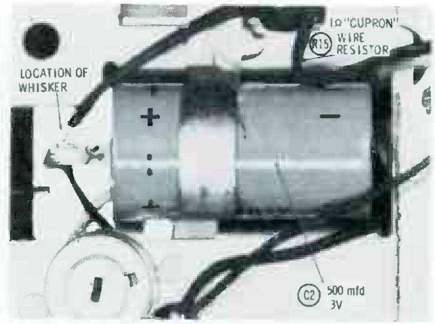


Fig. 2. Wire stub shorting to chassis caused intermittent volume changes.

No signal at all was found! Rapid voltage measurements soon revealed an open cathode resistor (Fig. 1), which had finally given up the ghost at this crucial moment. On close inspection, it turned out to be a 10-watt wire-wound unit of the wrong value. Replacing it with a 470-ohm, 1-watt composition resistor restored the yoke signal.

Arcing Cured

During the initial troubleshooting procedure, the first application of corona dope had dried, and a second coat had been put on. Now that both coatings had set, the beeswax could be applied. It was warmed up until it reached a thick, putty-like consistency, and a layer of the warm wax was then applied over the coil surface. In about 20 minutes, when the wax had hardened, the fuse was installed and power was applied. The results obtained were rather a disappointment. The picture was upside down, the sound was full of buzz, and the sync was jittery.

Gilding the Lily

First of all, the yoke leads were reversed to right the picture. Next, the AGC amplifier was checked and

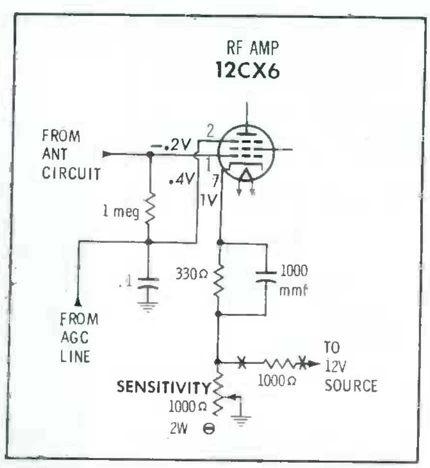
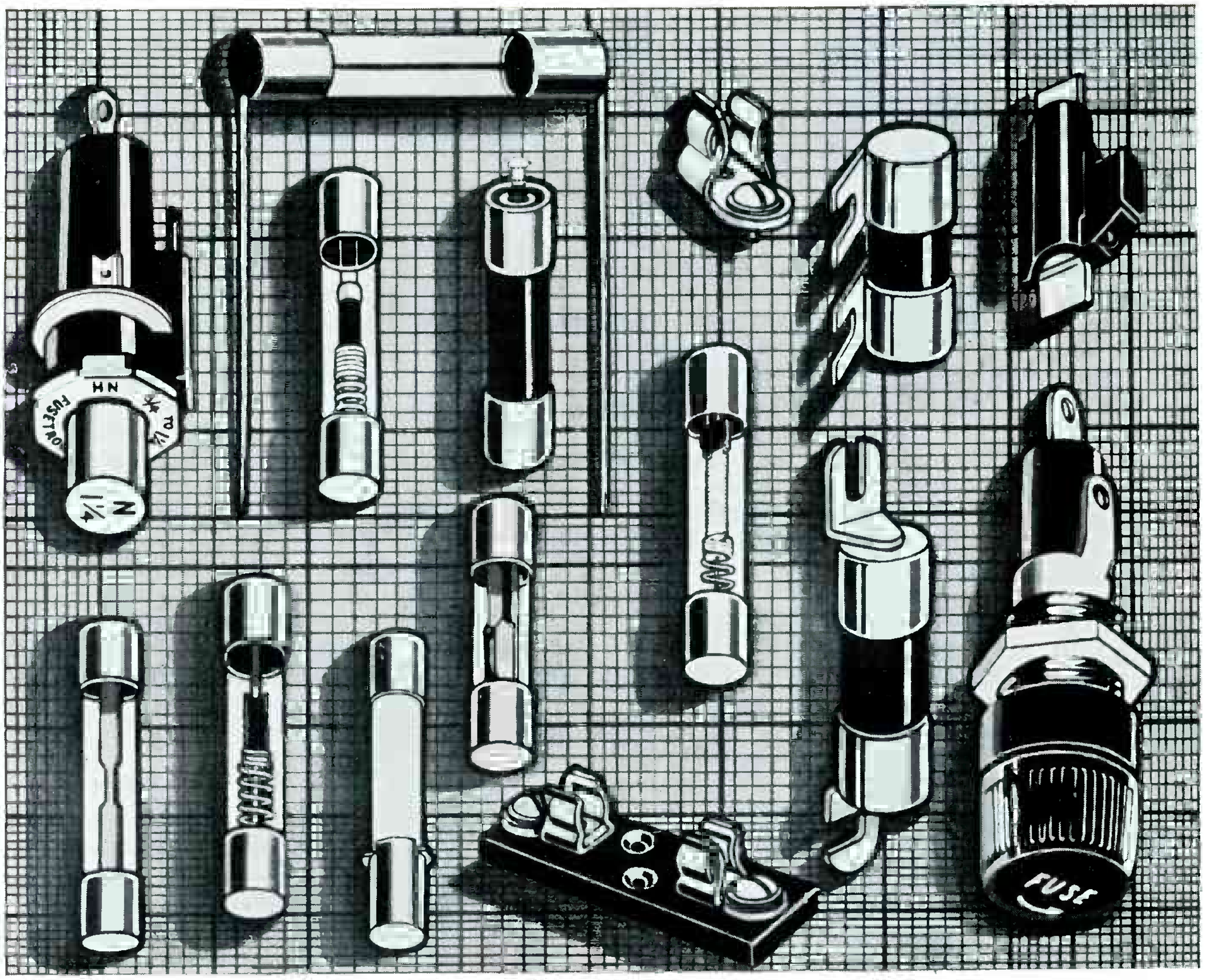


Fig. 3. Sensitivity control adjusts the cathode bias of the RF amplifier stage.



found to be defective. Replacement of this dual triode cured the picture jitters, but the sound was still full of buzz. Touch-up adjustments of the quadrature coil and the buzz control remedied this situation. Just when everything seemed to be going fine, the picture went out and the tuner started to smoke. A check of the tuner tubes failed to locate any shorted or gassy tubes, so the cover was removed from the tuner chassis. Investigation here revealed a scorched 1000-ohm resistor between B+ and the mixer stage. A new resistor was installed, power was applied, and in only a second or two the new unit began to boil. Substituting a new mixer tube failed to produce a cure. A check was made for shorted bypass capacitors, but none were found.

A thorough check of the tuner failed to produce a reason for the burning resistor. Analyzing the schematic, I found that AGC voltage was applied to the mixer in this set; so I decided to check the video IF strip on the off-chance that a positive voltage was getting onto the AGC line. At the second IF stage the trouble was located; a coated resistor in the B+ circuit was leaning against a terminal lug in the AGC network. The coating had finally broken down, and the resultant plus voltage on the mixer grid caused the smoke. Dressing this part away from the lug removed this puzzling condition, and a few hours of "cooking" the receiver proved that this job was completed — at last.

Quick Current Checks

An often-neglected task in servicing horizontal output stages is the measurement of cathode and screen currents. These tests can frequently turn up important clues to the cause of repeated tube failure, flyback failure, and width problems, but they raise a point of irritation when it comes to the unsoldering and soldering required. Often the irritation is strong enough so that the job is put off until too late.

Here's an easy way out, in the form of a simple adapter you can assemble "out of the junk box" in just a few minutes. All it takes is an octal socket and the base from any discarded octal tube. Wire all of the pins "straight through" except 3, 4, and 8. Drill 3 pairs of holes in the base, and bring out extension leads from both socket and base for each of these pins. (Photo in Fig. 4 shows only pins 3 and 8 wired.) All horizontal output tubes use either pin 3 or pin 8 for the cathode connection, and pin 4 or pin 8 for the screen grid.

Fig. 4. Octal base adapter wired to permit in-circuit cathode-current checks.

Simply plugging the tube into the adapter, connecting the milliammeter to the appropriate pair of leads, and using clips to "jumper" the other leads allows you to make both cathode and screen current measurements without ever unsoldering a wire.

CRT Test Adapter

No doubt you've realized that three different basing arrangements are being used in 110° picture tubes now on the market. This, of course, complicates testing as well as troubleshooting. However, the Anchor *Test Adapt* Model UT450 pictured in Fig. 5, manufactured by Antronic Corporation of Chicago, offers a solution to this testing problem. Equipped with sockets for both rigid-pin and wire-pin base styles used in 110° tubes, the *Test Adapt* automatically switches to the correct basing connections when you select the appropriate filament voltage (2.35, 2.68, 6.3, or 8.4 volts).

Designed to plug into any picture-tube tester, the device also has a color-CRT socket. Grid switching is provided to permit all three guns to be separately tested. ▲

Fig. 5. Antronic Model UT450.

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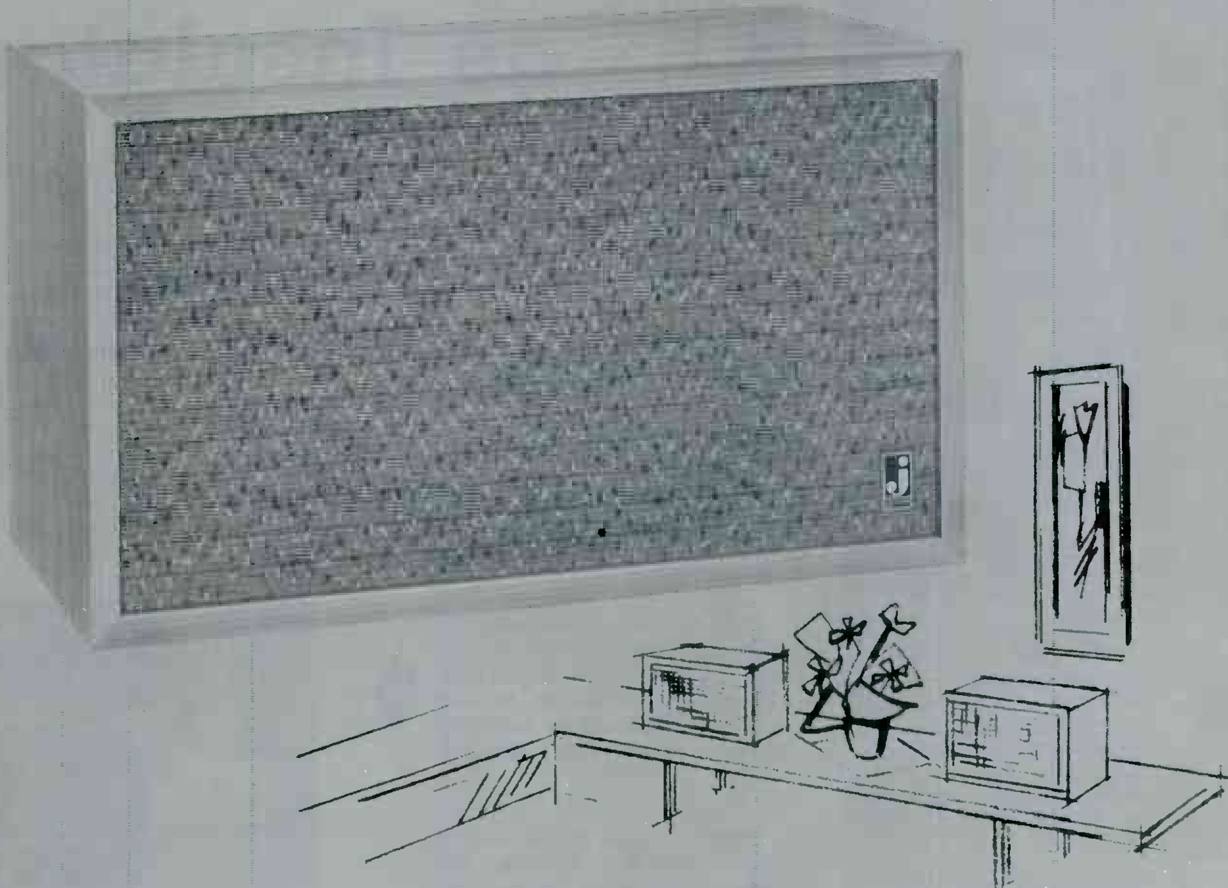

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Jensen LOUDSPEAKERS

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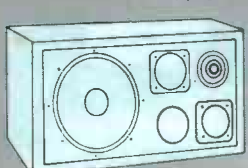

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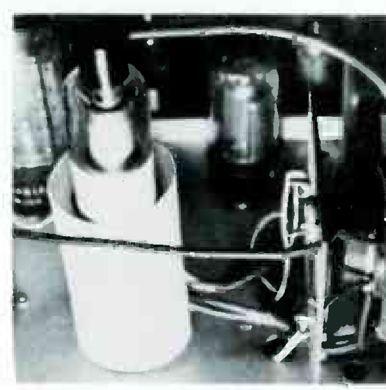
"SQUEEZE BOTTLES" as Insulators

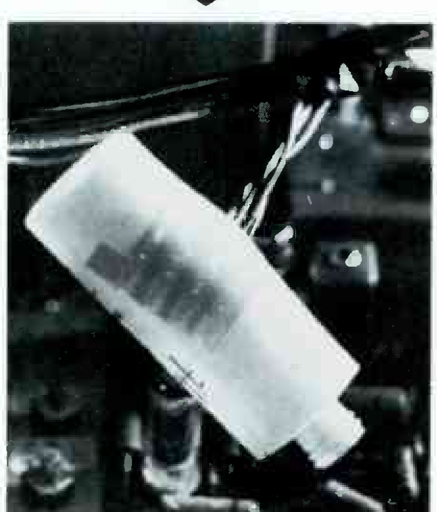
When a polyethylene "squeeze bottle" has been emptied of its original contents (shampoo, sun-tan lotion, etc.), it has many uses around the TV service bench. The sizes holding from 3 to 7 fluid ounces are particularly useful. Refillable types, left intact, make handy containers for carrying glass cleaner or chemicals in the tube caddy. (A medium-sized bottle slips neatly into the space left by removing one 5U4GB.) Bottles can also be cut up in various ways and utilized as shown below.

With a small hole pierced in the bottom, a bottle insulates the temporary connection between a high-voltage anode lead and an extension wire used in a bench setup. The dual insulation—large air gap and plastic sheath—gives excellent protection against HV arcing.

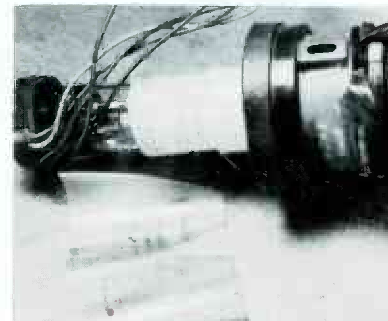
With both ends completely cut off, the remaining polyethylene tube can be slid down over a high-voltage rectifier socket to stop corona or safeguard the technician during bench-servicing operations.

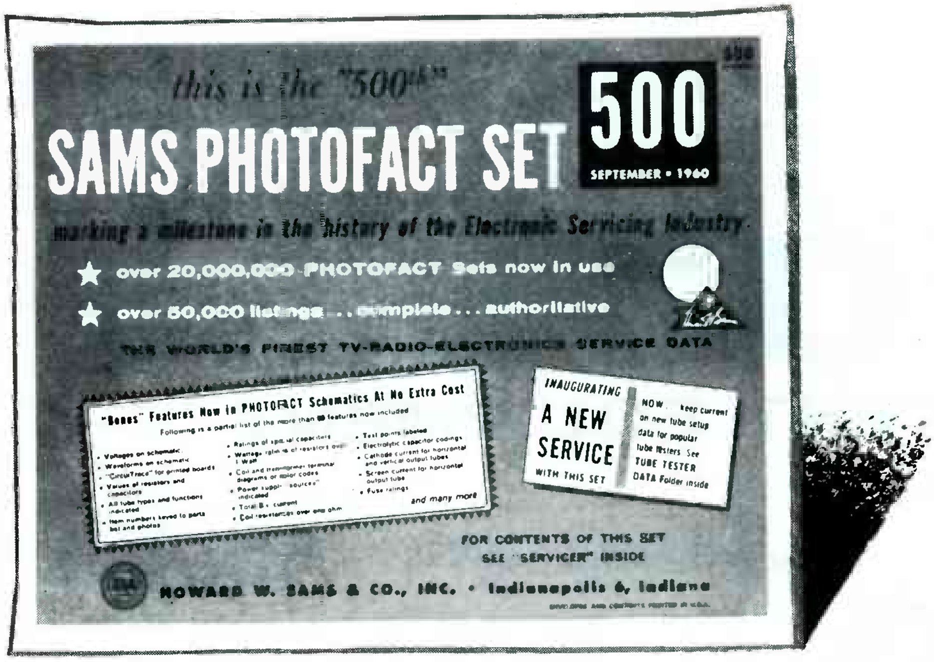


With a slit cut in the side, a bottle encloses a dangling "live wire" (such as the RCA tuner-power connector shown in the photo) and prevents accidental grounding or body contact.



When bottles are too worn for further use as insulators, they can be cut into strips and used as wedges to hold yokes in place on the neck of an 8" check tube.





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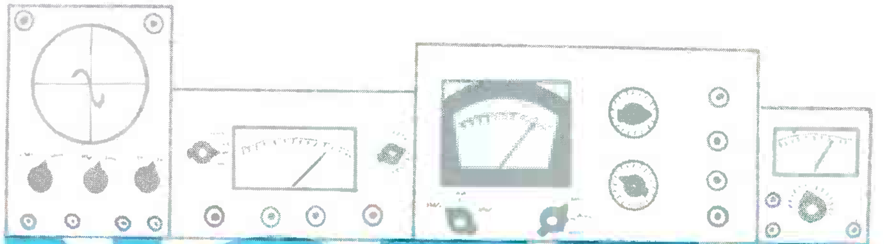


NOTES ON TEST EQUIPMENT

by Les Deane

Need a Crystal Ball?

Fig. 1. Seco's new portable unit for checking Citizens band transceivers.

Most of us at one time or another have probably wished we had one, especially when troubleshooting an unfamiliar piece of equipment; but, to be honest with ourselves, we know we can't depend on "hocus-pocus" to provide the answers. Since many of you are now, or soon will be, servicing Citizens band transceivers, you should have far greater need for a crystal checker than a crystal ball.

Seco Electronics, Inc. of Minneapolis has recently developed a combination crystal checker and multiple test instrument for servicing virtually all crystal-controlled two-way radio equipment, including Citizens band gear. The Model 500 *CrystalignMeter* (Fig. 1) is transistorized and completely self-powered.

Fig. 2. The 500's extension cable is helpful while making field tests.

Specifications are:

1. *Power Requirements — two self-contained 1.5-volt "C" batteries; power-off position provided on selector switch.*
2. *Crystal Checker — determines activity of both fundamental and overtone types; test load based on good crystal having an impedance of 30 ohms; test circuit for CB types designed for 26- to 28-mc range; useful frequency range of untuned circuit from approximately 1 mc to over 20 mc; test sockets provided on panel.*
3. *Field Strength Meter — untuned meter detector circuit measures relative power output; built-in pick-up loop and remote cable supplied.*
4. *Modulation Monitor — picks up and reproduces transmitted modulation by use of auxiliary headphones or audio amplifier; meter also indicates modulation peaks.*
5. *Signal Generator — supplies low-level crystal-controlled RF output, either unmodulated or modulated by internal or external source.*
6. *DC Voltmeter — with test leads connected to proper jacks, meter movement becomes zero- to 5-volt indicator; smallest scale division .25 volts.*
7. *DC Milliammeter — during voltmeter operation, with test prods placed across 100-ohm current-sampling resistor, meter movement becomes zero- to 50-ma indicator.*
8. *Frequency Comparer — built-in germanium diode serves as beat-frequency detector; output monitored by auxiliary headphones or audio amplifier.*
9. *Size and Weight — plastic case 2" x 3 3/4" x 6 1/4", 1 1/4 lbs.*

Because this instrument has so many applications, it has been identified as a *two-way radio test set* rather than merely a crystal checker or field-strength meter. Since the Model 500 is designed for troubleshooting equipment not altogether familiar to many of you, perhaps a full understanding of its operation will be easier to grasp if I outline how I used the instrument in some practical applications.

Crystal testing with the unit is simple and straightforward; you first determine the type of crystal, set the slide-type selector switch to its recommended position, and plug the crystal into the test jacks provided on the panel. The meter automatically indicates the activity of the crystal on a scale which tells you whether the output is good, questionable, or poor. This output indication is based on the Q of the crystal. I found that the average good crystal will give a reading of about one-half scale, a very active one near full scale, and a weak or marginal one near the question-mark area.

For those of you not fully familiar with crystal types, it might be well to explain the meaning of the term *overtone crystal*. It is difficult to produce a crystal having a very high fundamental frequency, but the effective output frequency can be increased by forming the crystal in such a way that it vibrates in sections rather than as a single unit. To visualize this action, you might compare it to the "vibrations" set up by two people whipping a rope between them. Depending on how they maneuver the rope, they can cause a simple up-and-down motion (corresponding to a fundamental frequency), or a series of smaller motions (corresponding to a multiple or overtone frequency). As an example, a third-overtone crystal with a fundamental of 9 mc. will have an effective output of three times this fundamental, or 27 mc.

Employing the unit as a field-strength meter, I found that I could evaluate the relative power output of a transmitter by placing the back of the Model 500 at the base of the antenna. For this operation, the selector switch is placed in the OFF position and the RF signal is picked up by a loop of wire contained within the instrument. The strength of the radiated RF signal may then be noted on the meter.

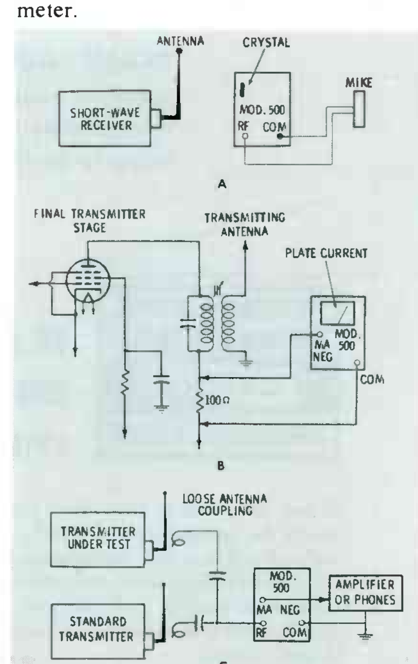


Fig. 3. Basic setups for checking CB units with the *CrystalignMeter*.

The instrument is also supplied with a 15′ shielded cable which permits the operator to take RF measurements from a remote location. Experimenting with this procedure, I attached one end of the cable to the base of a mobile antenna and the other to the Model 500—which I observed while sitting in the vehicle. This convenient arrangement is shown in Fig. 2. Voice modulation of the transmitted signal can also be monitored by attaching a set of phones, or an audio amplifier and speaker, to the proper output jacks of the instrument.

To use the *CrystalignMeter* as an RF signal source, a crystal for the proper frequency is plugged into the appropriate panel socket and the selector switch moved to its required position. For an internally-modulated signal, the switch is placed in position A or C, depending upon the type of crystal employed. If an unmodulated signal is desired, or you wish to use external modulation, the switch is placed in position D. To pick up this generated signal with the receiver of a two-way system, the Model 500 need only be placed within a few feet of the receiver's antenna. This application is illustrated in Fig. 3A. Although a precise frequency cannot always be assured, the test signal is satisfactory for checking squelch circuits or peaking RF and antenna coupling stages. For an accurate frequency output, special crystals can be obtained from the manufacturer.

Another handy function of the Model 500 is its use in measuring plate current of a transmitter's final amplifier stage. Two test leads are attached to the jacks marked MA NEG and COM. These leads are then placed across the current-sampling resistor usually located in the plate supply circuit of the final transmitter stage. This resistor must have a value of 100 ohms, since the milliammeter function of the instrument is calibrated for this value. Plate current is monitored on the zero-to-50 scale of the meter. (See Fig. 3B.)

As I have shown in Fig. 3C, the *CrystalignMeter* may also be employed as a beat-frequency demodulator. Here, one transmitter of known correct frequency is being used to track or calibrate the output frequency of another. The procedure calls for coupling the "on-frequency" transmitter to the RF jack on the Model 500. The coupling should be such that only one-tenth of full-scale deflection is obtained. The output of the other transmitter is likewise coupled to the instrument and a similar reading obtained. Headphones or an audio amplifier and speaker are connected to the proper output jacks of the instrument as an audible indicator. By listening for a beat-note indication, the transmitter being tested can then be adjusted to the precise frequency of the other transmitter. In the lab, I also found an accurate signal generator useful in this tracking procedure.

Aside from its applications on Citizens band transceivers, aircraft and marine gear, and police or fleet radio equipment, the *CrystalignMeter* is also handy for troubleshooting remote-control devices such as automatic garage-door openers and industrial control apparatus. The instruction manual for the instrument incorporates several charts for Citizens band Class D transmitting and receiving crystals. Each chart lists channel number, operating frequency, and number by which the crystal is properly identified.

Transistor Tranquilizer

The piece of equipment shown in Fig. 4 may help to relieve your anxiety about accurately checking the performance of temperamental transistors. This *Dynamic Beta Transistor Tester* was recently developed by Hickok Electrical Instrument Co. of Cleveland.

Designated as the Model 870, the unit is designed to test small-signal, medium-signal, and power-type transistors under typical operating conditions.

Specifications are:

1. *Power Requirements — 105/125 volts, 50/70 cps, power consumption 35 watts at 115 VAC; regulated B+ supply; line fuse,* ON *indicator, and isolation transformer provided; two internal 6-volt nickel-cadmium batteries (with recharging circuit) employed for transistor biasing.*
2. *Leakage Tests — measures* NPN *and* PNP *transistors of either small-signal or power types for collector leakage currents* ICBO, ICEO, ICES, *and* ICER; *shorted transistors also*

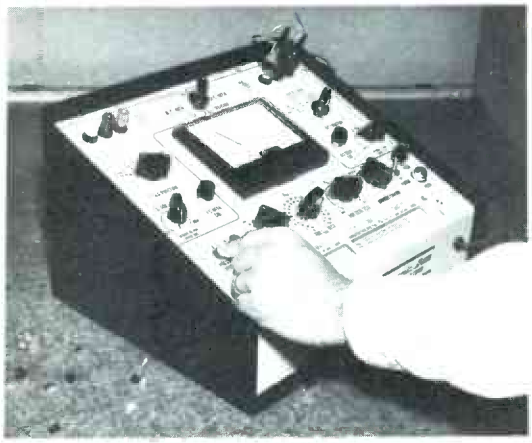


Fig. 4. Hickok's 870 offers an accurate way to check all transistor types.

detected by test results.

3. *Gain Tests — dynamic current-transfer ratio for small-signal transistors measured at 1000 cps (AC beta); DC current-transfer ratio also measured for power types (DC beta); reference values given in roll chart for transistors listed.*
4. *Other Tests — AC input impedance of transistor; collector saturation voltage* VCE *(sat) at a given base current.*
5. *Panel Features — 5", 100-ua meter with four individual scales providing all current, beta, and voltage readings plus a battery test indication; two sets of test receptacles, each with standard transistor socket plus individual element terminals and test leads; dual-window roll chart listing transistor test information.*
6. *Size and Weight — 14½" x 12" x 8", 15½ lbs.*

The Hickok 870 comes equipped with a roll chart, selector switches, and test buttons much the same as you would find on an elaborate dynamic tube checker. You might consider the unit as two separate testers in one, since its panel is divided into two parts — one for testing small-signal transistors and the other for power types. Basically, the sections have identical adjustments and test connections; however, the panel meter and switches located directly above the roll chart are common to both.

The housing for the instrument is designed so that the test panel slants toward the operator at an angle of about 20°, making it easy to view the roll chart, meter, and switch markings. As pictured in Fig. 5, the detachable lid has this same angled contour, and features an elastic band which secures the instrument's instruction manual and test leads. After removing the hand-wired chassis from its case, I could plainly see that this was no simple "go—no go" transistor checker, but a complex precision instrument designed to meet high laboratory standards.

Fig. 5. The tester's detachable lid is used to store manual and test leads.

The two principal tests given a transistor are leakage current (I_{CBO}) and beta gain (either AC or DC depending on the type under test). I have shown closeup photos of the 870's panel and roll chart in Fig. 6. If you refer to these illustrations as I explain a typical operating procedure, I'm sure you'll have a better understanding of what the instrument will do and how to operate it.

When testing a 2N35, for example, I first located this number on the roll chart. Naturally, it's impossible for the chart to include all types; therefore, manuals or manufacturers' specification sheets listing characteristics may be used equally well to determine test settings and results. Since the roll chart did list the 2N35 (Fig. 6B), I followed instructions as I would on a tube tester and placed the TYPE switch in its NPN position and the TEST SELECTOR (top center Fig. 6A) in position #1. With the selector in this first position, the left side of the panel is supposed to be used — so I connected the transistor to the test socket on this side.

To measure I_{CBO}, which is collector current with a given reverse bias and an open emitter connection, I set the

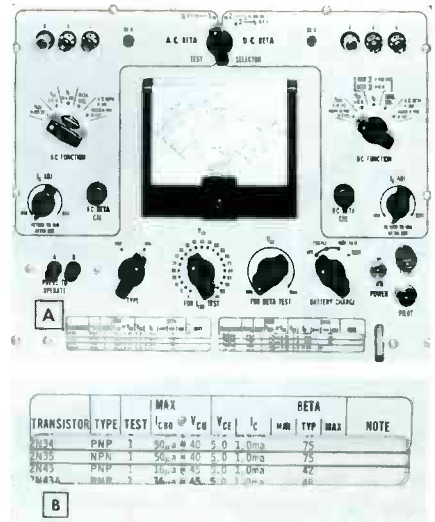


Fig. 6. Controls and roll chart of the 870. Note the two panel divisions.

FUNCTION switch on the left side of the panel to its first position labeled I_{CBO}. As recommended on the chart, I then placed the V_{CB} switch on 40, pressed the red test button A, and read leakage current on the 100-ua scale of the panel meter. This particular transistor produced an indication of 20 ua. Comparing this to the maximum (50 ua) listing on the roll chart, I knew that the transistor's base-to-collector leakage was within satisfactory limits. The preceding test might be considered similar to a preliminary shorts-leakage test for vacuum tubes; so I continued with a beta test, which can be compared to a mutual conductance measurement.

Referring again to the left side of the panel, I set the function switch to its next position (V_{CE}). Holding test button A down, I then adjusted the V_{CE} control so that the meter needle came to rest at the specified value listed on the roll chart — or full deflection on the 5-volt scale. Leaving this control set, I next advanced the FUNCTION switch to its I_C position and, depressing the A button, rotated the I_C ADJ knob until I obtained a reading of precisely 1 ma on the 5-ma scale of the meter. Note that this 1-ma value is listed under the I_C column of the roll chart's beta section (Fig. 6B). Moving the FUNCTION switch one more step to the BETA CAL position and depressing button A, I proceeded by adjusting the AC BETA CAL knob until the meter needle rested directly over the CAL SET mark on the top meter scale.

With the Model 870 now set up and calibrated for a direct beta measurement, I placed the FUNCTION switch in its last position (AC BETA). After pressing the A test button, I observed a reading of slightly less than 50 on the 0-300 scale. Since this value was less than 100, I also depressed the B test button, which automatically produced a more accurate reading on the 0-100 scale. The typical value of beta listed on the roll chart is 75, but for the transistor tested I noted a reading of only 42. When a minimum acceptable figure is not given, you can usually assume it to be about 50% of the typical value. Therefore, the transistor I tested should have adequate gain for most applications.

The test procedure actually requires only a fraction of the time it takes to tell about it; the steps are simpler than those necessary for many tube testers, once you get the hang of them. The instrument's manual also explains the other tests listed in the specifications. One interesting feature that I have failed to mention thus far is the unique recharging arrangement for the instrument's batteries. Located near the power switch on the front panel, you'll find a BATTERY CHARGE selector with four positions — OFF, TRICKLE, HIGH RATE, and TEST. With this selector in the trickle position, the internal batteries are recharged at a relatively slow rate. In the high rate position, as the name implies, the batteries are recharged more rapidly. As long as power is applied to the instrument, these charging circuits are operative regardless of the position of the power switch. To test the condition of the batteries, the operator need only place this selector in its test position and note the meter indication on a special battery scale.

Tubes, Tools, and Tester

The combination serviceman's case and tube tester pictured in Fig. 7 is a recent addition to the line of test equipment marketed by Shell Electronic Mfg. Corp., Westbury, New York. Identified as the *Tube Cadi-Tester*, the Model TC-18 features a *Test-O-Matic* chassis conveniently housed in one of the foldout compartments of a vinyl-covered tube and tool caddy.

Specifications are:

1. *Power Requirements — 110/120 volts, 60 cps; power consumption in standby less than 5 watts;* ON *indicator provided in meter housing.*
2. *Tube Tests — checks more than 800 tube types; automatically indicates shorts, leakage, and gas on two panel lamps; tube emission registered on panel meter; multi-purpose tube sections tested separately; set-up data supplied.*
3. *Vibrator Test—output condition of 6- or 12-volt units indicated on matched pair of panel lamps.*
4. *Other Features — 18 individual tube-test and 3 vibrator-test sockets provided on panel; pin straighteners for both 7- and 9-pin miniature tubes; 4½" panel meter with* BAD-?-GOOD *scale plus linear 0-100 scale for relative indications; operating instructions printed on panel with set-up data for over 300 popular tube types furnished inside lid; case includes 19¾" x 7½" x 6¾" storage compartment in base plus fold-out section 19¾" x 6" x 4" with dividers and separate lid.*
5. *Size and Weight — portable case 20⅜" x 14" x 8", 14½ lbs. complete.*

If you're in need of a compact tube

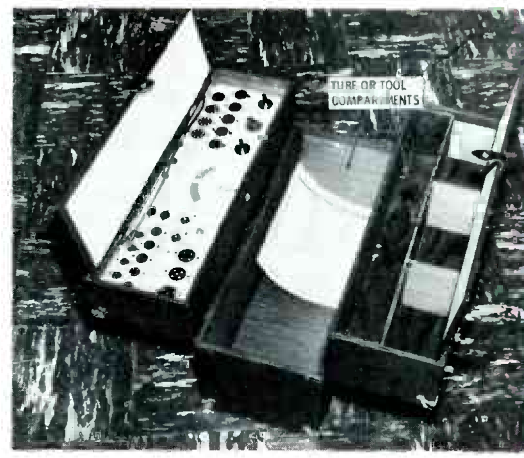


Fig. 7. Shell's Tube Cadi-Tester has storage space for tubes and tools.

tester to carry on service calls, this unit should fill the bill. The checker occupies only one tray of the caddy, and the entire tray can be lifted out easily for use at the repair bench or on a sales counter. (See Fig. 8.) Unsnapping and lifting the lid of the tray, you'll find a bright yellow panel and tube chart trimmed in red and black. The *Test-O-Matic* meter is situated in the center of the panel with two rows of tube test sockets on each side near the top. There are only three set-up adjustments, and these are in a line to the lower right of the meter. The lower left portion of the panel incorporates a tube-test button, two short indicators, and a vibrator-test section.

Making use of the Model TC-18 by testing a number of known good and bad tubes, as well as vibrators, I found its operation very simple and certainly very expedient. For an emission checker of this type, I also noted that it had reasonably good accuracy. To test a tube in the instrument, you first locate the tube type on either the chart inside the lid or a supplementary chart also furnished with the unit. The test data is contained within four individual columns — one for each knob adjustment, and the other identifying the correct test socket to be employed.

After setting up adjustments (a matter of two to four seconds) and inserting the tube into the proper socket, leakage, shorts, and gas are automatically in-

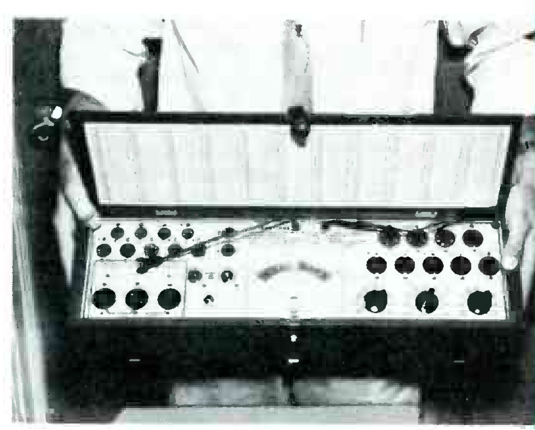


Fig. 8. The tester itself can be detached from caddy and operated anywhere.

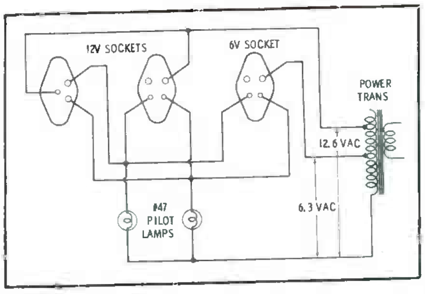


Fig. 9. The vibrator test circuit incorporated in the TC-18 *Cadi-Tester*.

dicated by a glow of either or both of the neon bulbs directly to the left of the meter. When I checked several known gassy tubes, I noted that these bulbs would start to flicker as soon as the tubes heated up. Those with sufficient gas to cause trouble will generally be detected in this test. Here's something you might keep in mind, however, when testing tubes in *any* checker: If you suspect certain tubes of being gassy, always give them adequate warm-up time or else preheat each one before placing it in the test socket.

To check sensitivity of the short-indicator circuit, I set up the instrument to test a number of tube types; instead of placing the tubes in the test socket, I used a resistance decade to introduce a controlled amount of leakage between certain socket connections. Varying this simulated leakage, I found the maximum resistance which would still produce a detectable glow in the neon bulbs. Overall results indicated that the sensitivity for heater-to-cathode leakage was about 500K ohms, and for grid-to-cathode leakage 1.5 megohms.

If a tube passes the initial shorts test, its emission is checked by pressing a small red button located directly below the two short lamps. The condition of the tube is then revealed on the BAD-?-GOOD scale of the panel meter. Individual sections of multipurpose tubes are checked by resetting only one of the panel knobs for each section tested. Switch z is merely positioned to the alphabetical letters designated in column z of the tube chart.

I removed the *Test-O-Matic* chassis from its caddy tray to see exactly how vibrators are tested in the instrument, and drew a schematic (Fig. 9) to help explain this relatively simple arrangement. Three panel test sockets are involved — two for 12-volt vibrators and one for 6-volt types. The input test voltage is supplied from a couple of taps on the unit's power transformer, while two #47 pilot lamps are series-connected in each branch of the vibrator's output circuit.

When the vibrator's reed makes contact with each pin, the lamp in that branch will glow or flicker at the frequency rate of vibration. If the unit under test is okay, both lamps will glow with equal brilliance; however, if a loss is present across one of the contacts, the lamp in that branch will appear dimmer. Naturally, if the vibrator is completely defective, neither lamp will light. ▲

THE TROUBLESHOOTER

answers your service problems

Fusible Burnout

In the March *Troubleshooter* column, you advised Mr. R. E. Rumpf to change the 5-ohm fusible resistor in a Motorola set to 7.5 ohms when changing over from selenium to silicon rectifiers. Wouldn't the 7.5-ohm unit tend to burn out more readily than a 5-ohm one?

In past conversions, I've found that silicon rectifiers increase the B+ voltage to a considerable extent, sometimes causing flyback and associated failures. I always take care of this problem by adding a 7.5-ohm, *10-watt* series resistor between the AC line and the rectifiers to reduce the DC output to the specified value.

CHARLES F. ANDREWS

Rochester, N. Y.

The suggested 7.5-ohm fusible resistor fulfills the same electrical purpose as the 7.5-ohm, 10-watt unit you have been employing in your conversions; in addition, it provides fuse protection. It's true that an excessive failure rate has been known to result from replacing a fusible resistor with a higher-value unit, but this is likely to occur only when the rest of the rectifier circuit remains unchanged. Substituting silicon for selenium rectifiers is another story; don't forget that the currents and resistances in the circuit are significantly altered by the change in rectifier type.

Production Changes

Were there any production changes or vertical circuit revisions in a Philco Model 22C4113, Chassis TV-301? I have a vertical roll problem and have tried everything except juggling component values.

BEN JOSEPH

Midland, Pa.

This chassis is covered in PHOTOFACT Folder 276-7 and does have information available in Production Change Bulletin Folders 299-1 and 305-1. In addition, the main schematic shows a "note" symbol for the 680K resistor in series with the vertical hold control—a modification from the 470K value to provide better hold.

If adjustment of the vertical hold control will stop the rolling, it is safe to presume the oscillator is functioning properly and the trouble lies in the sync circuits. A critical evaluation of both shape and amplitude of the waveform at the oscillator grid (with the oscillator stage disabled) will confirm any suspicions you might have in regard to the vertical sync signal at this point.

A Bend With Pull

Several Silvertone Model 9154 and 9156 TV sets have a common complaint: The picture pulls toward the left side of the screen. This normally happens during commercials and programs with a large amount of black information in the scene. The pulling can be reduced by backing off on the contrast and AGC controls, but we're in an area where these controls are operated at maximum settings.

I've checked the video detector, output, sync, AGC, and horizontal sections without results. The only clue I've found is "fuzz" in the separated horizontal sync pulse, evidently consisting of video information. Any help you can give will be appreciated.

EDWARD C. COOPER

Albany, Ore.

The symptom you describe can be caused by many things. It usually results from the horizontal oscillator being on the verge of losing synchronization. From all indications, this is caused in your particular case by stray video information in the waveform presented to the horizontal AFC circuit.

The fact that the pulling seems more severe during commercials, and in other scenes containing a large amount of black information, again points to improper sync separation. Perhaps a review of the "Tough-Dog Sync Troubles" series appearing in our February through April issues will be of help in tracing the trouble to its source.

Since the trouble seems to be affected by the various settings of the contrast and AGC controls, it seems the fault may be in the RF or IF stages. Make a critical check of the waveform at the grid of the sync separator, paying particular attention to both the amplitude and shape. With a signal applied, the negative voltage at the grid should equal approximately three-fourths of the peak-to-peak amplitude of the waveform. If it does not, additional checks in the coupling and biasing networks—or in preceding stages—should *lead to the root of the trouble.*

It would be advisable to observe the waveforms at the detector and video output while varying the settings of the contrast and AGC controls. If sync-pulse compression gets worse when these controls are adjusted to provide more gain, you will have isolated the trouble to some point in the RF-IF, video, or AGC circuits, and can concentrate on troubleshooting these stages.

Ion Glow

There's a bright blue glow in the neck of a new CRT I installed in an Emerson Chassis 120351E. It jumps around when you bring your finger near and will leave if either the accelerating or focus anode is disconnected. Of course, I can't do this to cure it. What causes the glow, and how can I stop it?

PAUL REED

Alexandria, La.

The glow is caused by a small quantity of gas within the tube ionizing from ion bombardment. The ion trap "squirts" a stream of ions with sufficient force to do the trick. There's no need to worry about it. The condition may last for the entire life of the tube, but it won't have any harmful effects.

Sneaky Resistance Path

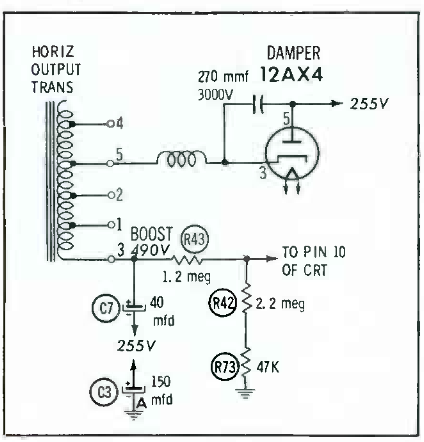
The resistance measurements chart for a GE MM line chassis shows 60K for the reading from pin 3 of the damper to ground. I can't get a reading that comes near this value. Also, for pin 10 of the CRT it shows 750K to pin 3 of the damper, and I get only 300K. Will you please show the correct tracing for this circuit?

J. M. MCDERMOTT

Pittsburgh, Pa.

Redrawing the circuit should help clarify the parallel resistance paths.

The 60K-ohm reading from pin 3 of the 12AX4 to ground depends on the condition of the two electrolytic capacitors C7 and C3A. Any variation in the internal resistance of these components alters the value of the reading considerably. The 300K-ohm reading you obtained from pin 10 of the picture tube to the cathode of the damper seems rather low. The parallel path for this reading would be near the 750K indicated when computing the resistance of R43, C7, and C3A in parallel with R42 and R73 to ground.



High, Wide, and Handsome

(Continued from page 33)

normal DC level, and ripple appeared due to the removal of the filter capacitor (Fig. 2C).

Replacing C114, I watched plate waveform W3 assume its normal clipped-sinusoidal shape and 400-volt peak-to-peak amplitude. W4 at the grid of the horizontal discharge tube V11 was good, too; its amplitude was over 100 volts, and its positive tip reached more than 35 volts above the center "plateau." The DC level of approximately -50 volts also looked about right.

At the plate of the discharge tube there was a 130-volt sawtooth W5 riding somewhere above 100 volts. This DC level was somewhat low according to the tube-pin voltage chart in the service data, but this discrepancy didn't seem to hurt W5's waveshape or amplitude. Grid waveform W6 of the twin 6BG6 output tubes had pretty much the same appearance as W5. The significant thing here was the DC level, which averaged about –40 volts — as it should.

Erasing Retrace Lines

The horizontal circuit was quickly and easily repaired this time, and the picture promptly returned; but it was marred by vertical retrace lines. I remembered that this chassis is not equipped with a retrace-blanking circuit, but depends entirely on the blanking pulses in the video signal entering the CRT grid circuit. This signal is steadied by a DC restorer diode which clamps the blanking pulses at a constant voltage level. Once the receiver is properly adjusted, the pulses will always drive the picture tube grid into cutoff during vertical retrace time—thus preventing the appearance of slanting white lines in the picture. This type of blanking is ineffective at high settings of the brightness control, when the cathode voltage is raised to such a high positive level that the blanking pulses can't achieve cutoff.

Various component failures (including changes in value) within the video output and picture-tube circuits can result in constantly visible retrace lines. In the RA-109 I was working on, I discovered that an electrolytic screen-bypass capacitor in the video output stage had

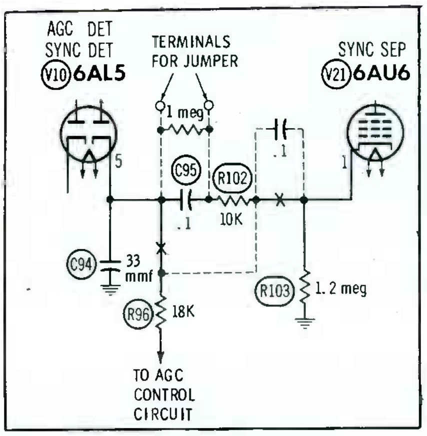


Fig. 4. Modifications to circuit connecting sync detector to separator.

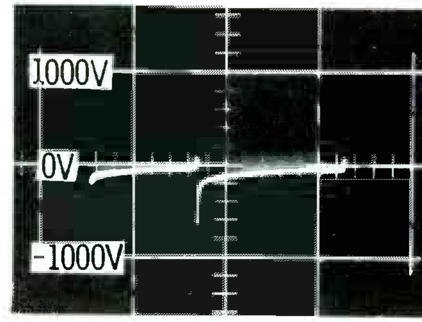
opened. This defect not only lowered the gain of the stage and interfered with DC-restorer operation, but also coupled some video-signal information back into the low-voltage power-supply circuit.

Trouble in the DC restorer can also make it impossible to extinguish the retrace lines. However, the DC-restorer tube is the "other half" of a 6AL5 dual diode which also serves as a video detector; and, since complete failure of the tube is more probable than partial failure, you are more likely to lose the video signal entirely than to experience serious trouble in the DC restorer alone.

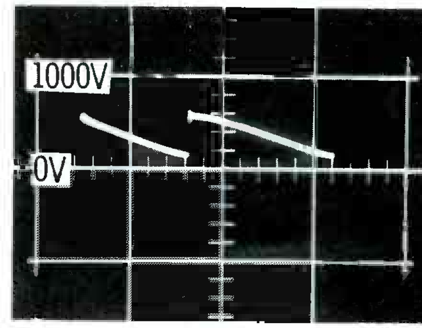
The potential on the accelerating anode (pin 10) of the CRT can be varied with a CRT SENSITIVITY potentiometer to establish the best operating range of the contrast control. This adjustment should be performed while the receiver is being set up in the customer's home.

AGC and Sync

The input signal for the AGC and sync sections of the RA-109 is taken from the video circuits *before* detection — a most unusual arrangement. The output of the video IF strip is fed to the grid of V9, a special narrow-band IF amplifier using a remote-cutoff 6BA6 tube (see Fig. 3). The output transformer of this stage, L34, is tuned fairly sharply to the picture-carrier frequency; therefore, the signal coupled to the AGC and sync detector V10 contains mostly low-frequency video information (including sync pulses), with a minimum of high video frequencies and impulse noise. The left half of this 6AL5 rectifies the IF signal to obtain a negative DC



(A) Grid of blocking oscillator.



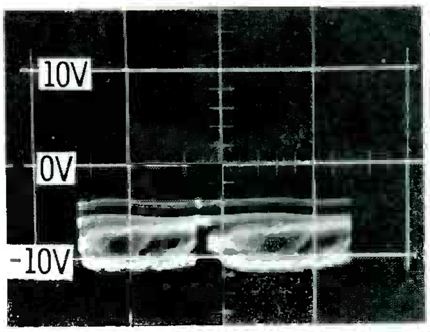
(B) Plate of vertical output.

Fig. 5. Vertical sweep waveforms.

control voltage for the first two video IF stages and the tuner. The input signal is separately detected by the right half of V10, and the output of this side is fed to sync separator V21.

Located in the cathode circuit (pins 1 and 5) of V10 is the AGC control, which permits adjustment of the bias on the AGC detector. This control has no effect on sync-detector conduction because it simultaneously varies both plate and cathode voltages of this section.

A revised version of the coupling circuit between the sync detector and sync separator was introduced some time later; for details, see the dotted-in connections in Fig. 4. Newly-added parts are a 1-megohm resistor shunting C95, an additional .1-mfd capacitor between R102 and the grid of V21, and a pair of terminals to accommodate a jumper wire for shorting out C95 and its shunt resistor. Use of the jumper (3" of #12 wire) tends to improve sync noise immunity and increase the amplitude of the sync waveform. However, horizontal sync stability is sometimes improved by omitting the jumper. If you notice an unusually great amount of horizontal bounce or pulling in one of these sets, simply check this jumper connection and remove the wire if present. Don't try to get around the problem as some shops in high-signal areas have done, by installing a weak tube in



(A) At grid of video output.

(B) At grid of picture tube.

Fig. 6. Normal video signals.

the IF strip to reduce the over-all video gain of the receiver. If removing the jumper doesn't remedy the trouble, be sure to check the various sync-coupling capacitors for value and leakage. Above all, don't try to lower the sync-signal amplitude by detuning L34. You'll merely decrease your AGC voltage, thus possibly overloading the video IF strip and adding more sync troubles to those you already have.

LV Power Supply

As anyone knows who has ever serviced one of these receivers, the power transformer is just about the biggest unit ever to appear in a TV set. The chief reasons for its great size are its generously high step-up voltage (almost 400 volts AC on *each side* of the center-tapped secondary) and the heavy current drain imposed by the many load circuits. In addition to seven DC output voltages ranging from +320 to minus 14 volts, the power supply furnishes filament voltage to all of the many TV and radio tubes except the 6W4GT damper, which is connected to a small separate transformer.

The most noteworthy feature of the RA-109's power transformer, as I mentioned earlier, is that it has automatic voltage regulation. A 2-mfd capacitor across the entire rectifier-plate winding (high-voltage secondary) forms a resonant circuit at 60 cps which produces a high circulating current in the winding.

Part of the transformer core then becomes saturated; as a result, it exerts a voltage-stabilizing effect which prevents the output from fluctuating more than ±2% over a range of primary voltages from 105 to 129 volts. This feature is very advantageous in regions where the power-line voltage is greatly affected by changes in load.

The normal supply voltages and virtual absence of ripple in this particular set were convincing evidence that the entire power supply was in excellent shape, so I made no further effort to test this section of the receiver. However, before returning the set to its owner, I made the usual last-minute check of several other circuits in order to catch any additional troubles which might be lurking under the chassis.

In the vertical section, the grid waveform of the blocking oscillator (Fig. 5A) looked clean. The DC component was also normal, allowing the grid voltage to rise above zero only at the beginning of the retrace period. The plate waveform of the vertical output (Fig. 5B) also looked strong and healthy. Even in this old 70° circuit, the retrace action was accompanied by a sharp voltage spike of well over 1000 volts. (My scope and low-capacitance probe are rated to withstand this much voltage; make sure yours are, too, before trying to view this waveform.)

In the two-stage video amplifier, the grid waveform of the output stage appeared as in Fig. 6A. (Note the positive-going sync pulses.) Since fixed bias is applied to the grid, all parts of the waveform remained well below the zero-volt level. The output of this stage, after being coupled through a capacitor to the grid of the picture tube, appeared as in Fig. 6B. As illustrated here, the blanking pulses were being clamped by the DC restorer at approximately +10 volts. They remained at this level regardless of changes in the picture signal, proving that the DC restorer was functioning properly.

Try as I might, I found very few components anywhere which were in bad enough shape to need replacing. So, I readied the set for delivery, not expecting to see it again for another couple of years or more. ▲

Single-Sideband

(Continued from page 39)

weak carrier injection signal.

Dual-grid excitation means that plate-current variations will occur at carrier, sideband, sum, and difference frequencies. The output circuit is tuned to emphasize the difference components, developing them across the load resistor. The carrier (100 kc), the sidebands (100-103 kc), and sum frequency components (200-203 kc) are removed by the low-pass filter in the output circuit.

The upper limit of this filter is in the 3-kc range, so it acts as an effective shunt to all frequencies above this point. This type of demodulator is often referred to as a product detector because the output is the product of the two input signals, carrier and single-sideband IF.

A second type of product demodulator (Fig. 4B) uses a dual triode. The SSB signal is applied to the first stage, which acts as a cathode follower to apply the signal at low impedance to the cathode of the second section. Carrier injection is made at the grid of the second stage. The difference frequency is accented by low-pass filtering in the plate circuit of the second triode.

Three triodes are employed in the Crosby triple-triode product detector shown in Fig 4C. The two input stages act as cathode followers for the SSB signal and the locally-inserted carrier. They share a common cathode resistor with the output triode, which is a grounded-grid amplifier. In the Crosby arrangement, each section can be biased to provide the most linear operation, as well as maximum rejection of possible interference beats and cross modulation. An audio output is obtained at the plate of the grounded-grid stage.

SSB AVC Circuit

It is possible to use AVC circuits with SSB receivers. The AVC circuit in a conventional AM set rectifies and filters the IF output carrier, thereby developing a DC voltage that is a function of carrier strength. This DC voltage follows any change in IF output amplitude caused by fading, in addition to compensating for signal-level variations among different stations.

In a single-sideband, suppressed-carrier system, no carrier is present; hence, the AVC system must be made to respond to the sideband amplitude. A generally conventional type of AVC circuit can be employed, but the filter has a much longer time constant than in a double-sideband receiver. The sideband amplitudes, of course, vary with the audio information carried. The time constant of the AVC network must, of necessity, be much longer than the periods of these variations. Time constants of ten seconds and upwards are employed so the AVC bias will not change in response to low-frequency modulation of the sidebands.

Some SSB AVC circuits are more complex, using a charging time constant that is substantially faster than the discharging time constant. This feature enables the AVC action to follow rather fast changes in signal level while still filtering out the slowest audio variations.

Commercial SSB Adapter

A simplified block diagram of a commercial adapter (Crosby Type 51A) is shown in Fig. 5. This unit can be attached to any communications receiver having an IF between 440 and 510 kc. Its single-sideband filters have a frequency bandwidth of 250 to 6000 cps, and its dual-channel IF amplifier permits SSB two-channel multiplex as well as standard single-sideband suppressed-carrier reception.

The adapter can also be used to demodulate any standard double-sideband AM signal as well as various special signal types. Single-sideband demodulation is possible with no carrier present (suppressed-carrier operation), or at any carrier level between zero and a full amplitude-modulated carrier.

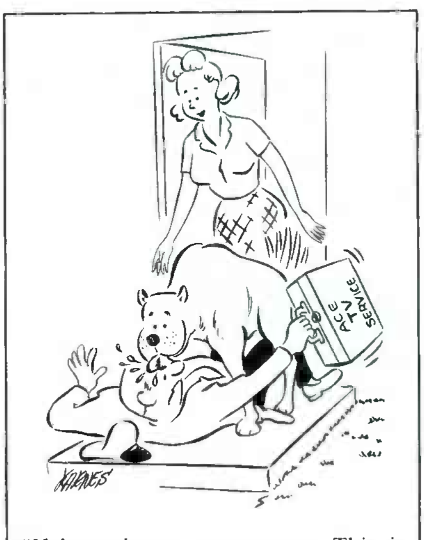
The Type 51A includes AGC and AFC circuits. AGC action (not shown in Fig. 5) can be switched to derive control from the incoming carrier (if present), the upper sideband, the lower sideband, or both sidebands and carrier combined. For operation with no carrier present, the AGC filter is set for a fast-charging and slow-discharging time constant.

An AFC system is operated off the output of a carrier filter that has a bandwidth of only 20 cycles. Hence, a high order of carrier protection from interference and jamming is attained.

In pure SSB reception (carrier completely suppressed), the incoming SSB signal is applied to the grid of the mixer tube, and the high-frequency oscillator is set to crystal control in order to bring the SSB signal exactly down to the 100-kc range.

The reception-selector switch must be set to whatever sideband is to be received (upper or lower—US or LS) in accordance with the audio channel to be used. Circuit A is tuned to the upper sideband; B is set for the lower sideband. With both channels in simultaneous operation, SSB duplex reception is possible.

Inasmuch as no carrier is present, the carrier-insertion switch must be set for local carrier (LC) injection. The 100-kc local-carrier generator is also crystal-controlled. All the various carrier-amplifier and limiter



"He's so happy to see you. This is the night that Lassie is on you know."

stages are inactive when no carrier is present with the incoming signal. AFC cannot be employed under these conditions, but it is not needed because crystal control is being employed for the high-frequency oscillator.

Some single-sideband transmissions include a weak carrier component, meaning that some carrier information will be present at the mixer input. This carrier is not passed by the two single-sideband amplifier channels. However, prior to these stages, the carrier component is removed and applied to the grid of the first carrier amplifier tube. This carrier signal is built up and limited (reconditioned) in succeeding stages and is made available at the output of the first limiter stage for application to the AFC discriminator (near the lower left corner in Fig. 5). Here the signal is compared with the output of the high-frequency oscillator. The latter can then be AFC-controlled, and crystal operation is no longer required. The AFC action corrects for any frequency drift of the signal applied to the adapter.

In adjusting the receiver for reception of an SSB signal with some carrier present, the adapter is first operated with the AFC off. The signal is tuned in by adjusting the communications receiver and the adapter's high-frequency oscillator. Proper tuning is indicated when a reading appears on the carrier meter in the first limiter stage. When the AFC is turned on, the adapter oscillator is held on the correct frequency for best mixing with the incoming signal. The tuning meter indicates any frequency drift.

The reconditioned carrier output of the third limiter stage can be used as a demodulating carrier; therefore, the crystal-controlled local carrier oscillator does not have to be employed when a carrier component is present in the incoming signal. The demodulators receive their 100-kc input through an insertion switch that permits a changeover from local-carrier (LC) to reconditioned-carrier (RC) operation. Various special types of signals, as well as phase modulation and standard AM reception, are suitable for RC demodulation. The three-stage limiter maintains the reconditioned carrier at constant amplitude, thus overcoming the adverse influence of fading, multipath reception, and interference on the incoming signal. The above process may also be called *exalted-carrier* operation, meaning that the receiver builds up the weak incoming carrier into a strong, stable signal to assure linear demodulation and more reliable reception.

The exalted-carrier technique can be used to receive an entire conventional double-sideband AM signal, with both demodulators in operation at once. If considerable interference is present, however, only the "cleaner" of the two sidebands need be demodulated in order to recover the desired audio information. The reception-selector switch is simply set to either the LSB or USB position, whichever results in clearer output. This sideband-selection feature is highly useful in making interference-ridden signals more audible. For example, if interference is present in the upper sideband as a result of transmission on the adjacent higher channel, reception can be greatly improved by changing the selector switch to the LSB position.

This illustration goes to show that an adapter designed for ideal SSB reception can be made to render superior demodulation of other types of transmission as well—if it is equipped with a versatile switching arrangement and a few additional circuits. Single-sideband transmission and related techniques are prime examples of how much has been done in recent years to refine and improve the reliability of communications. ▲

"Look at it this way . . . you saved your pick-up charge."

Negative Picture

(Continued from page 31)

is true for several reasons. For one thing, this type of symptom is often noted early in the development of overdriven IF's as a result of improper AGC action, gassy RF or IF tubes, or some other trouble ahead of the video detector. This is why changing the signal level and clamping the AGC line were suggested earlier as rapid "in-the-home" checks to help pinpoint the trouble. Perhaps we should say that this trouble is often accompained by bends, unstable sync, buzzing, etc.; however, you're probably aware of this fact already.

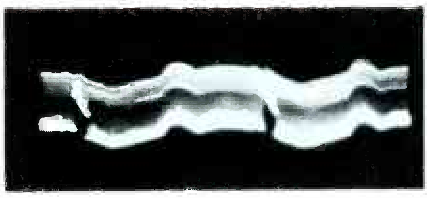
In tracing the trouble shown in Fig. 1A, we found that an unusually high negative clamping voltage improved the picture. However, the AGC bias voltage checked "normal for the area" even without clamping, and the picture had none of the sync instability usually associated with overloaded IF's. So, without spending additional time searching for an AGC defect, we headed our low-capacitance scope probe toward the output side of the video detector. Sure enough, W1 was a picture of health. So was W2, which indicated that the AGC and sync circuits were receiving normal inputs from the plate of the first video amplifier — thus accounting for the normal operation of these circuits.

As Fig. 3 shows, W3 presented a different story. The compression of the sync pulses was no reason for alarm, being normal in this circuit; but the black portions of the video signal were suspiciously close to the base of the vertical sync pulse, and the over-all peak-to-peak amplitude had dropped to only 40 volts. Pay dirt! With a good signal going in, and a distorted signal coming out, the trouble had to be in the output stage. Further tests pinpointed the plate load resistor R8 as the culprit. It had changed from 3600 to only about 500 ohms.

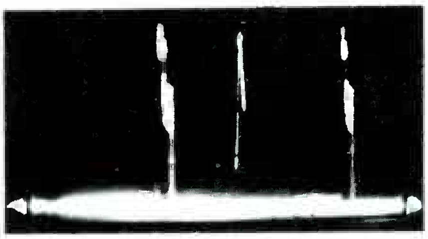
Having solved the problem, we took a few minutes to "jumper in" a resistance decade box and try a few experiments. Lowering the value of R8 to 56 ohms produced a picture like Fig. 1B and the output waveform shown in Fig. 4A. What a mess this waveform is — 45 volts peak to peak, but indicative of complete saturation.

Deciding to go the other way, we switched in a 10K resistor for R8. This was interesting! With the contrast control set at minimum, the output waveform appeared as in Fig. 4B; with maximum contrast, it looked like Fig. 4C. As the control was advanced, the signal (starting with a 75-volt peak-to-peak amplitude at B) shrank, wrapped over, and wound up reversed with only 3.5 volts of amplitude in C. The picture had gone from a blurry positive to a very weak negative.

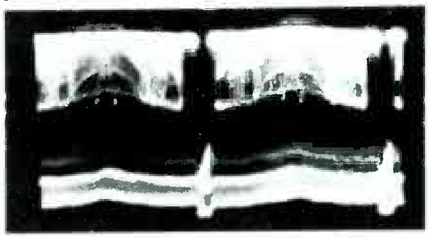
What happened? The answer isn't simple, so hang on — we're off on the darndest excursion into tube theory you've encountered in a long time. To begin with, plate current begins to increase as the contrast control is advanced. Then, since the plate load resistance has been raised, the plate current produces an abnormally high voltage drop across it. This, of course, reduces the plate voltage more than normal. While the plate voltage decreases, the screen voltage remains the same; so the screen is soon drawing as much current as the plate. Continued advancement of the contrast setting reduces the bias



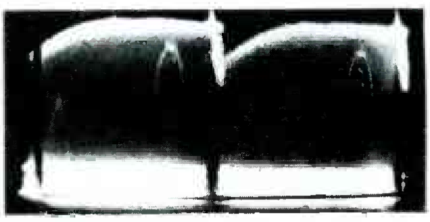
(A) Normal waveform obtained when probe is connected to plate of the final IF.



(B) With the low-capacitance probe at grid of IF, only "spike" sync is seen.



(C) Composite video at plate of final IF shows stage acting as video amplifier.



(D) Overdriven IF produced video detection at grid, as this waveform shows.

Fig. 5. A low-capacitance probe can be used to check the final video IF stage.

on the tube, resulting in still more plate current and still lower plate voltage. At some critical point, the screen voltage takes over control of the tube. The screen attracts more and more electrons, and the current drawn by this element soars to 15 or 20 times its normal level. At the same critical point in the tube's operation, the plate loses control and takes on a negative-resistance characteristic normally found only in tetrodes. Influenced by the flow of electrons from the cathode, the plate itself emits electrons to the screen. Plate current thus starts to flow in the opposite direction through the load circuit, producing an output signal of the same polarity as the grid signal. (Refer once more to Fig. 4C.) This waveform produces a weak negative picture on the CRT.

In reality, the video output tube begins to function as a sort of two-stage amplifier. The first section can be considered to consist of the cathode, control grid, and screen, while the other section is formed by the plate, suppressor grid, and screen. The second stage inverts the signal, as in an ordinary amplifier, but it attenuates the signal instead of amplifying it. Therefore, we can say that a stage of negative amplification has been added, and the requirements for a true negative picture have been met.

Overdriven IF's

As mentioned earlier, excessive conduction in the RF and IF string can produce a condition of "gray-out" by simply supplying a video-detector output signal of such great amplitude that the video amplifiers are driven into saturation. In this discussion, however, we would like to explain a condition of severe overdrive which produces the symptom in Fig. 1C.

The trouble manifests itself in the final video IF stage. This doesn't mean the source of the trouble centers in this stage; more often than not, it doesn't. Improperly operating RF, IF, and AGC circuits have already been cited as the most com-

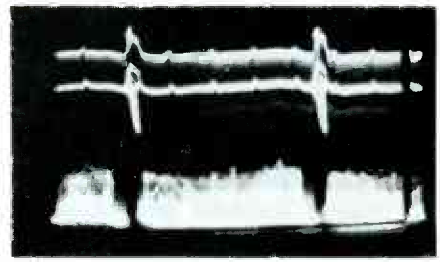


Fig. 6. Detector's output is inverted by the action of the IF stage and diode.

mon causes underlying this trouble. The final IF stage is simply the victim of circumstances, being driven into its action by a strong signal applied to its grid.

Under certain special conditions, the last IF ceases to be a stage of 40- or 20-mc amplification and turns into something more closely allied to a detector. It may surprise you to learn that your old friend, the low-capacitance probe, will permit you to spot this type of operation when it occurs. Figs. 5A and 5B show the respective waveforms of the plate and grid signals in this stage under normal operating conditions. Such tests admittedly detune the stage and kill the picture, but they permit you to find out what's going on in the final IF. To prove the point, compare Figs. 5C and 5D with parts A and B. Here you see the respective plate and grid signals of the last IF stage when driven into the condition associated with Fig. 1C. These waveforms clearly show that a composite video signal has been produced by demodulation of the IF signal.

The plate waveform of the over-driven IF stage includes not only video-frequency information, but also a distorted and rectified 40-mc component. This remnant of the IF signal can't be seen in Fig. 5C, because of the frequency limitations of a scope with a low-capacitance probe. Nevertheless, it's there; the plate circuit of the final IF stage has no filter network to remove it. Since the detector-input transformer is tuned to the 40-mc range, the signal coupled to the detector consists essentially of rectified IF—not pure video, as you might suppose from viewing Fig. 5C. The distortion in the detector-input signal is the basic cause of the negative picture on the CRT.

Checking W1 at the output of the detector, we find the signal already inverted from its normal polarity

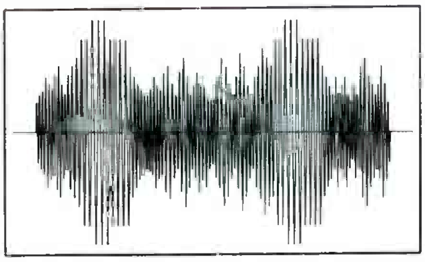


Fig. 7. Theoretical waveshape of modulated IF signal applied to detector.

(see Fig. 6). To understand why this inversion takes place, let's go back to the fact that overloading of the last IF stage has caused at least partial rectification of the detector-input signal.

During normal operation, the modulated IF signal applied to the detector diode is symmetrical—with identical information in the positive and negative halves of the signal envelope (Fig. 7). The strongest peaks always correspond to the sync-pulse tips in the video-signal modulation, regardless of any signal inversion which may take place.

A typical video-detector diode of the type shown in Fig. 2 conducts on the negative swings of the input signal. The output voltage, developed by diode current flowing down through R2, fluctuates around some average negative value at a video-frequency rate. The most negative peaks (sync tips) applied to the cathode cause diode current to reach maximum, thus forming the negative peaks in the output signal W1.

When the final IF is so badly overloaded as to cause rectification of the grid signal, the 40-mc output of this stage no longer has equal positive and negative peaks. In effect, the positive half of the signal envelope is removed. If the signal is inverted in passing through the detector-input transformer, the positive peaks of the signal applied to the detector will then be normal, but the negative peaks will consist of distorted picture information. The sync tips will drive the cathode voltage of the detector in a positive direction, thereby reducing diode conduction. Minimum negative voltage will then be developed across the detector load, and "positive peaks" will appear in the output signal—just the opposite from normal. (These peaks are not positive with respect to ground. Actually, the waveform in Fig. 6 measured 5 volts peak to peak and was riding around an abnormally high negative DC level of –15 volts.) As might be expected, the abnormal operation of the final IF stage causes distortion in the picture-signal portion of the waveform; however, the signal inversion is sufficiently clear-cut to give a true negative-picture effect.

Summary

While we've used only four examples in our discussion of negative pictures, every *type* of problem has been discussed except improper installation of a video detector diode. We presume you understand the simple problem involved when diode polarity is not observed.

Waveforms have been used extensively to show what to look for when "negative picture" is the complaint. Conditions of saturation, inverted signals, overdriven IF's that become video detectors, and even dead video stages have received detailed explanations. While no attempt has been made to pinpoint specific components as frequent causes of negative pictures, we feel that a better understanding of what happens will help you immensely in your future troubleshooting operations. ▲

Think

(Continued from page 26)

after changing the CRT, we noticed a hum in the sound when the volume control was turned down. The customer hadn't complained of this, and had probably never even noticed it. Although not loud, the hum could be plainly heard without putting your ear against the speaker.

We don't take chances on minor deficiencies such as this, because they have a habit of becoming *major* deficiencies soon after the set is delivered. So we listened intently. The noise was neither a sync buzz nor a 60-cycle hum; however, when we turned the vertical hold control, we noticed that the hum varied in tone. The audio circuits were apparently picking up a signal from the vertical circuits.

To find out why, we turned to the schematic diagram (Fig. 1). This set (Model A-T1816) is one of the few split-chassis Philcos equipped with a multivibrator instead of a blocking oscillator in the vertical section. The DC supply voltage for both plates is picked off at the junction of R119 and R120, the midpoint of a voltage divider between the B+ and boost sources. There is a filter capacitor (C3C) at this point in the circuit, physically mounted on the sweep chassis. Bridging this filter killed the hum, which apparently had been reaching the plate of the audio output tube through the B+ wiring. Section A of C3, used to filter the main B+ source voltage, was evidently too deteriorated to do its part in suppressing the hum.

The repair was completed when we replaced the entire multi-section electrolytic can C3. We had saved considerable time because our suspicion of the vertical circuit made us

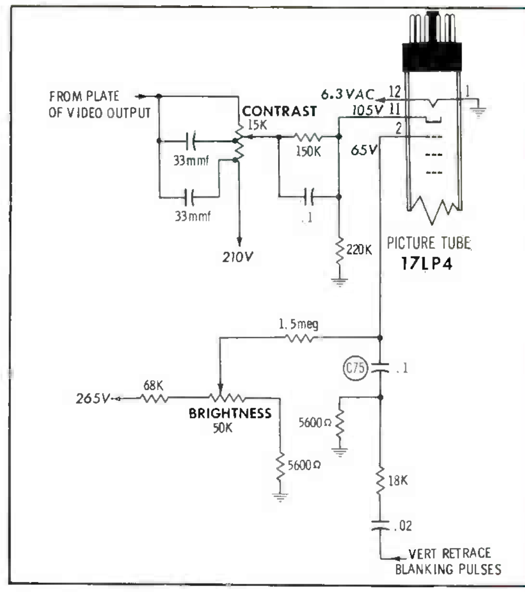


Fig. 3. Brightness control was ineffective as a result of short in C75.

proceed directly to the sweep chassis, where the bad part was mounted. If we had first tried the obvious move of checking the audio output circuit, we would have unnecessarily removed the RF chassis from the cabinet.

More Detective Work

Here's another illustration of finding a defective part through a process of reasoning:

The set worked well for a short while after it was turned on; then the picture would begin to roll intermittently, suggesting a momentary "drop-out" of vertical sync. After just a few minutes of this, the horizontal output transformer gave out a squeal and the brightness went off. I had the impression that the horizontal oscillator was being driven far off frequency.

We pored over the schematic (Fig. 2), trying to figure out which part could possibly cause intermittent vertical trouble and also cause the horizontal oscillator to be detuned badly enough to kill the brightness.

It didn't seem likely that a single bad tube could cause the combination of symptoms we had observed; but on the slight chance that two or more tubes might be defective, we substituted all tubes in the affected circuits. However, this did not cure the malfunction.

If this were really a single trouble, the fault would most logically be at a point common to both vertical and horizontal circuits. Furthermore, it would have to unbalance the horizontal AFC to a great degree, or else create some serious disturbance in the horizontal oscillator circuit, to account for the extreme shift in oscillator frequency. The circuits ahead of the sync phase inverter did not seem at all likely to produce this odd result, since a failure there would be more apt to cause a simple loss of sync. Thus, we began our investigation at the phase inverter circuit.

To reduce the number of components we would actually have to check, we considered each one in turn and tried to estimate whether or not it would be likely to cause the trouble. We rejected C82 because it would probably have a much more definite effect on vertical sync than on the horizontal oscillator. C92 *could* have been at fault, but it was debatable if a fault here could cause the horizontal oscillator to change frequency enough to cut off the brightness. The other AFC-coupling capacitor C91 has quite a bit more voltage impressed across it, and would be expected to have more effect on vertical sync than C92; therefore, C91 seemed to be a more likely prospect. We also considered C93 and C94, but we couldn't see how these capacitors would be able to affect vertical stability.

After carefully considering the possibility of resistor trouble, we sidetracked this notion because we couldn't imagine any one resistor failure causing all the symptoms noted. A defective resistor in the AFC circuit would cause horizontal sync trouble, but not vertical. Any faulty resistor in the sync inverter stage would cause both vertical and horizontal sync trouble—but once again, probably not such a drastic shift in horizontal oscillator frequency.

There was a chance of double trouble or some other odd quirk; however, when first thinking over any service problem, we believe that the best place to look for trouble is in the most obvious parts. If the problem is not thus solved, then more extensive service procedures are called for.

In the present case, C91 was the best prospect for testing. It was changed, and the set was left to run awhile. The trouble didn't reappear, so we evidently had the right part. One end of the old capacitor was hooked to a B+ point, and a voltmeter connected to the opposite end. After a few seconds, the meter needle flicked a few times, then returned to zero for a while, and finally moved over to the 200-volt mark. Our trouble had definitely been eliminated.

This gradual breakdown, starting as an intermittent arc-through, explained the pattern of symptoms which had been observed. The horizontal oscillator had stayed in sync as long as the failure was intermittent; but when a continuous short developed, it totally disabled the oscillator.

Wild Goose Chase

Now that we have seen a couple of examples of how a job can be made easier by thinking in advance, let's consider some instances where a serviceman made trouble for himself by *not* thinking.

One day I was visiting a young friend of mine who had just started in business. His practical experience was almost nil, and his servicing education consisted of a correspondence course. He told me he had a set on the bench with a raster but no picture. Starting with his scope at the input to the picture tube, he had found no signal. When he moved to the plate of the video amplifier, a waveform was barely discernible with the scope gain at maximum.

I looked at this signal and agreed it was very poor. He told me he had measured the screen voltage of the stage and found it higher than the schematic called for. He had also changed the screen resistor and bypass capacitor, and had checked around the video amplifier without any success.

I asked about the grid waveform, and he said that one was present; but when I checked it, it was almost insignificant. Unfortunately, he had "seen something" at the grid and had decided that the video amplifier was not working. Consequently, he had wasted quite a bit of time trying to find something wrong.

I asked if he had checked the AGC voltage, since I knew that many novice servicemen neglect to do this unless they see a definite indication of AGC trouble (such as overloading). He said he had not, and so I asked him to do so. Practically no AGC bias was being developed.

Next, I turned the brightness down and the contrast up, and I adjusted the fine tuning while looking at the CRT screen. A picture could just barely be seen. Since it was faintly snowy, I suspected tuner trouble, and said so.

Then my friend told me he had changed a burned part in the tuner! He showed me the component, which was badly charred but still recognizable as a capacitor. We took the tuner apart again and found a resistor which had also been damaged, even though it did not look burned.

Having removed one bad part, he thought he had "fixed" the tuner trouble. Reasoning should have told him to look more carefully at the tuner when the set didn't come back to normal. Too bad—overlooking this point meant tearing *twice* into the tuner. This is what I call "servicing the hard way."

Is It CRT Trouble?

Jumping to conclusions about the cause of a service problem is especially risky when the picture tube is involved. It's very bad business judgment to get the customer unnecessarily worried about the prospect of a big bill for CRT replacement.

Let me tell you a couple of sad tales about incidents where a serviceman guessed wrong about the condition of a picture tube.

In the first case, I was called to the customer's home and informed that another serviceman had previously been there. The customer quoted the other man as saying the picture tube was bad and had to be changed. He had decided not to have this done without first consulting someone else about it. On operating the controls, I noted that the brightness was fairly low and the brightness control had no effect. This proved to be the cause of the original complaint. The customer said he could see no reason to change the picture tube because a control wouldn't work. I told him that the fault could possibly be in the picture tube, but I couldn't be positive without making a few checks first. No elements of the picture tube checked shorted, but voltage measurements at the tube socket clearly indicated some deficiency in the brightness-control circuit. The customer was satisfied to go ahead and have the set fixed when I reassured him that the cost of the repair would not be half that of a new picture tube.

In the shop, I analyzed the schematic of the CRT grid and cathode circuits (Fig. 3). DC coupling was employed between the video output stage and the picture-tube cathode; and, as usual for sets with this feature, the brightness control was in the CRT control-grid circuit. The grid voltage was thus supposed to change when the control was rotated, but I found that it remained nearly constant at an abnormally low level. This check was made with the *socket not plugged into the picture tube*, so the CRT could not possibly have been causing the trouble.

I reasoned that the brightness control or one of its series resistors might be open, or that the retrace-blanking circuit might be defective. A fast ohmmeter check proved the latter to be correct. C75, the coupling capacitor through which the blanking pulses were fed to the CRT grid, was shorted. This failure provided a low-resistance DC path from the grid to ground, thus lowering the grid voltage and disabling the effect of the brightness control.

The first serviceman had immediately assumed a short existed in the picture tube, and did not bother to check any farther. He could have been right, but the odds were against it. His bad guess cost him a customer.

Almost as bad as immediately condemning the picture tube is the opposite error—giving the customer false hope that the tube is in good condition. My next story illustrates this point.

The customer told the serviceman that the picture was gone. When the set (a Westinghouse Chassis V-2263-11) was turned on, it presented a very clean, bright raster with no trace of a picture. Without trying any of the controls, the serviceman started taking the back off the set. He knew the sound was perfect, and from the tube chart inside the set, he found that only one video amplifier tube is used in this chassis. "How simple this job is going to be," he thought, "just change the video amplifier tube and that will be it." As luck would have it, this *wasn't* it.

He decided to try turning up the contrast control, but this didn't help, either. "Maybe it's the AGC control," he mused—but he hit a dead end here, too.

He then advised the customer that the set would have to be taken to the shop. All customers seem to crave assurance that the picture tube isn't bad, no matter what type of trouble they are experiencing. The set owner in this case was no exception, and he questioned the serviceman along this line.

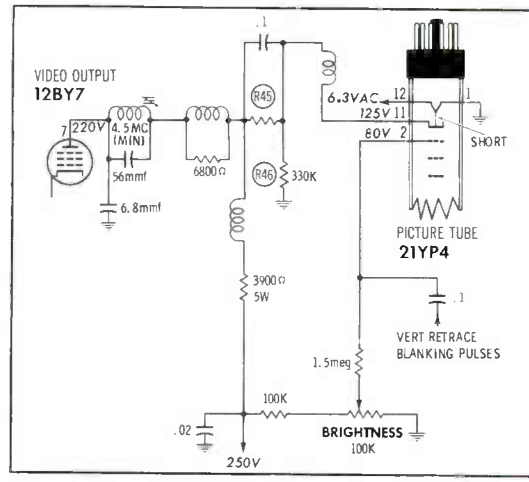


Fig. 4. Short in picture tube caused blank raster of maximum brightness.

The serviceman began to think, "Maybe something's wrong with the video amplifier or AGC circuit; most likely some small part would put it in shape again." So he proceeded to assure the customer that the picture tube was not at fault.

If he had tried out some of the other controls, he would have found a clue which would have prevented him from being so quick to give the picture tube a clean bill of health—as we'll soon see.

At the shop, he checked the AGC voltage and found it normal. The plate voltage of the video output stage was also checked and found to be very close to what it should be (see Fig. 4). For a second, the serviceman was stumped. He turned on his scope and took a long look at the signal going into the video-output grid. To his surprise, it was perfect. Moving the scope probe to the plate, he found no video signal present, but only a humped-up line with a peak on one side. He went back to measuring voltages again, but found nothing wrong. Returning to the scope, he traced from the video-output plate toward the picture-tube input. At the junction of R45 and R46, the humped-up line disappeared. Another VTVM check revealed that there was no voltage present at this point. Neither resistor was open, so he had to conclude that the cathode of the picture tube was shorted to the heater.

If he had tried to operate the brightness control in the customer's home, he would have found that it had no effect. Note that this is another DC-coupled set, with a variable positive voltage on the grid and an even higher positive voltage on the cathode. (A "sitting duck" for a short!) When the short occurred, the video signal was grounded out; in addition, the tube was forced to operate with positive bias. This caused it to remain at maximum brightness, regardless of the setting of the brightness control. A brief check of CRT socket voltages in the home would have revealed this fault, even if the serviceman did not happen to know the exact value of voltage to expect at each element. This statement can be made because virtually *all* picture tubes, regardless of circuitry, carry an appreciable positive DC voltage on the cathode unless a short has occurred in the cathode circuit.

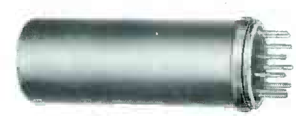
Here we have a serviceman who knows how to use his test equipment and has a fair knowledge of TV circuit operation. However, because he jumped to conclusions without making *all* the necessary checks, he had to make an embarrassing call to explain the picture-tube failure to the customer. A few such experiences are enough to show a serviceman the importance of taking time to THINK. ▲

PRODUCT report

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

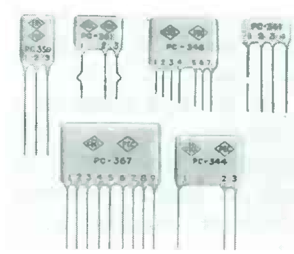
Plug-In Silicon Rectifiers (45U)

The **Sarkes Tarzian** S-5347 silicon rectifier "tube" has a standard 9-pin miniature base and is a direct plug-in replacement for type 12BW4 or 6BW4 vacuum-tube rectifiers employed in Citizens band transceivers. Its peak inverse voltage rating is 1600 volts, and maximum DC output current is 500 ma. User net price is $13.00.



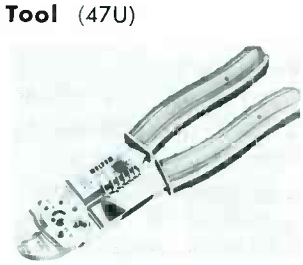
Printed-Circuit Components (46U)

Loudness-contour networks and other high-fidelity audio circuit elements are included among the 27 new types of PEC units (numbered from PC-344 to -370) recently released by **Centralab.** The list also contains a number of component combinations for TV circuits—for example, a phase detector-horizontal oscillator unit.



Wire-Working Tool (47U)

The **Waldom** CT-3050 Universal Crimping Tool is useful for cutting and stripping wire in gauges ranging from #10 to #22, and also for crimping solderless terminals onto wires of these sizes. In addition, it can shear bolts and screws in sizes 4-40, 6-32, 8-32, 10-24, and 10-32. Price is $4.25.



Miniature Silvered Micas (48U)

Arco Electronics has announced the addition of miniaturized silvered mica capacitors, with dipped phenolic casings, to the **Elmenco Dur-Mica** line. The components in this new DM-10 series maintain capacitance tolerances as close as ±½%. Values available range from 1-250 mmf at 500 WVDC, 1-300 mmf at 300 WVDC, and 1-360 mmf at 100 WVDC.

Set Coupler With Amplifier (49U)

Two TV sets and one FM radio can be connected to a single antenna through the **Jerrold** Model HSA-43 Amplified 3-Set Coupler. A one-tube amplifier gives at least 5 db gain from each of two outputs, with unity gain from the third output. Case size of the coupler is 4½" square x 3" high. Both input and output circuits have 300-ohm impedance; terminals have serrated washers which pierce insulation of twin-lead to make connections. Price is $29.95.

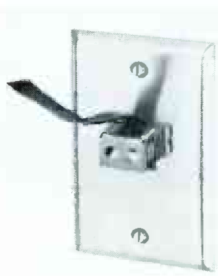
Tubes for Electronic Heaters (50U)

Amperex Types 7806 and 7807 are electrically identical high-vacuum power triodes, designed for use as oscillators at frequencies up to 30 mc in dielectric and induction heating applications. The 7806 (shown) has an integral radiator for forced-air cooling, while the 7807 is supplied with a separate jacket for water cooling. Power output of the tubes is said to remain relatively constant in the presence of impedance variations experienced in industrial electronic heating operations.

Capacitor Kit (51U)

A stock of 15 miniature tubular electrolytic capacitors for servicing transistor radios is packaged in the **Sprague** EK-4 Littl - Lytic Assortment. Designed for extremely low leakage current and long shelf life, the capacitors all have welded, hermetically-sealed metal cases. One unit is provided in each of the 15 most frequently-needed ratings. Dealer net price of the kit is $13.29.

Antenna Outlets (52U)



Wall outlets for plug-in antenna connections are supplied by **Winegard** in two styles, both for use with 300-ohm twin lead. Surface-mount outlets are available with ivory finish at a list price of $3.00, and flush-mount wall plates are offered in brass ($3.50), chrome ($2.30), or ivory ($2.10). Both styles are furnished complete with connector plugs having "no-strip" terminals.

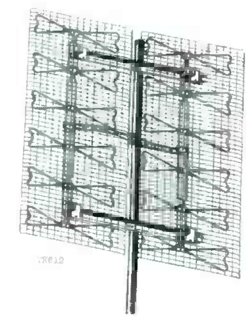
Dynamic Headphones (53U)

The **Telex** Dyna-Twin headset is equally suitable for private listening to high-fidelity music or for communications applications that demand a wide audio-frequency range (30 to 15,000 cps). If two-way communication is desired, headsets can be supplied with any type of integral boom-mounted microphone. The headband is adjustable, and the earphones are padded with air-filled neoprene. Voice-coil impedance is 6 ohms; total weight, including cord, is 9 oz.

Ceramic Cartridge (54U)

Output voltage of the **Sonotone 9T** ceramic cartridge is 0.4V, frequency response is flat within ±1 db from 20-17,000 cps, and compliance is 3.5 x 10^{-6} cm/dyne (permitting tracking pressure as low as 2 gm for tone arms or 3 gm for changers). Types and list prices are: 9T-S (with 0.7- and 3-mil sapphires) or 9T-S77 (with two 0.7-mil sapphires), $16.50; 9T-SD (with 0.7-mil diamond and 3-mil sapphire), $19.50.

UHF Translator Antennas (55U)

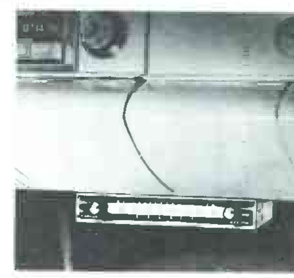


Cardioid-shaped dipoles are used in **JFD's** new series of antennas for TV translator reception, to provide more uniform response over the frequency band covering channels 70-83. The dipoles are made of solid aluminum rod, while the screen is of galvanized, welded heavy-gauge wire. Available models and list prices are as follows: TR604 (4-bay), $8.75; TR606 (6-bay), $10.95; and TR612 (12-bay), $24.95.

Wall Baffles (56U)

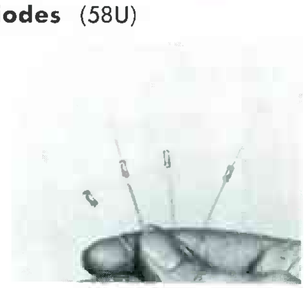
A foam plastic material called Expanded Dylite forms the ⅝"-thick walls of the Watterson Model 888 speaker baffle (made by **J. W. Davis & Co.**). Designed to accommodate an 8" speaker, the enclosure measures 11" wide x 11⅝" tall x 6¾" deep (at top). A choice of blond- or mahogany-colored finish is offered. Necessary hardware for wall mounting is furnished with each unit.

FM Tuner for Autos (57U)



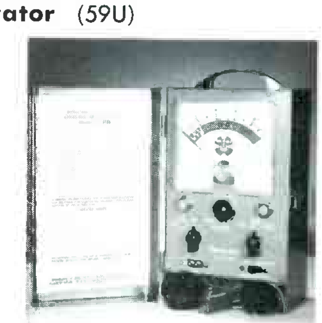
Utilizing the audio circuits and antenna of an existing auto radio, the **Granco** FM Car Converter provides all additional circuits needed for FM radio reception. The coaxial-type RF tuner is equipped with AFC. Operating voltages are taken directly from a 12-volt source. The converter, 1¼" thick, mounts under the dash with two screws. Price is $49.95.

Germanium Diodes (58U)



Semi-Elements, Inc., has in stock 151 different types of 1N-series germanium crystal diodes, including many which find use in radio and TV receivers. For example, all popular types of video detector diodes such as the 1N60, 1N64, and 1N295 are available. The company also manufactures other semiconductor products.

CRT Reactivator (59U)

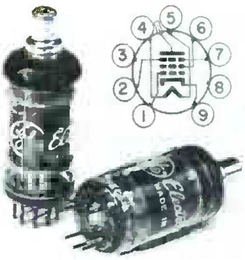


The **Vis-U-All** Model V300 Tester-Reactivator, successor to the Model V200, has a built-in filament-voltage selector switch to permit testing and "shooting" picture tubes with 2.3- and 8.4-volt filaments, as well as conventional 6.3-volt types. A color CRT adapter is also provided. Like the V200, the V300 features a "magic eye" indicator. The unit has a 10" x 6" x 5" steel case with carrying handle. Price is $74.95.

Laboratory Standard Cartridge (60U)

"Cross-checking" and calibration of high-fidelity components, laboratory measurements, and checking master recordings are examples of applications for the new laboratory-standard version of the **Shure** Stereo Professional Dynetic phono cartridge (Model M3LS). Each unit carries a 3-year guarantee, is serially numbered and registered, and is individually calibrated—with the actual response curve furnished to the owner. Net price is $75.

Industrial Tube (61U)

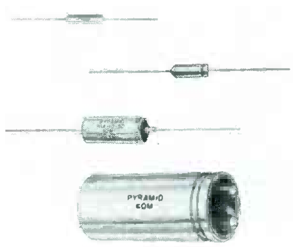


A new 9-pin miniature beam pentode, designed for use in high-voltage pulse amplifiers and shunt regulators, is now available from **General Electric.** This tube, designated as Type 7239, has a 9KH base configuration and a T-6½ envelope. Plate dissipation is rated at 4 watts, peak cathode current is 85 ma, and maximum plate voltage is 2200 volts.

Line-Voltage Adjuster (62U)

The **Vidaire** Model LR-10 Voltage Regulator compensates for high or low power-line voltage when series-connected between the AC receptacle and any load drawing 350 watts or less. Using the 4-position switch on the regulator, the supply voltage can be raised by 12 volts, lowered by the same amount, fed through with no change, or shut off. The device is priced at $4.95 (dealer net).

Specialized Electrolytics (63U)



The following four series of capacitors have been introduced by **Pyramid**: MLE subminiature electrolytics for operation in very critical circuits; CQM (enclosed in high-purity aluminum containers) for computers and related applications; TAK-H wet-electrolytic tantalum units; and TAD solid tantalum capacitors featuring long shelf and operating life.

Electronic Chemicals (64U)

The 3-oz. aerosol spray can of **Injectorall** No. 250 Tape Cleaner has a long, slender plastic applicator nozzle which pinpoints the spray directly on the tape-recorder head for removal of accumulated oxide. Another new product, No. 101 Speaker Cement, is packaged in a 2-oz. plastic squeeze bottle with an applicator spout. The tape cleaner is $1.19 (net); the cement is 51c.

Horn-Loaded Tweeter (65U)

The modified hyperbolic horn design of the **Oxford** Tempo tweeter is said to result in a wide-angle sound dispersion pattern. Other features are a completely shielded, short-path magnetic circuit and a spherical, molded phenolic diaphragm with impregnated Egyptian cotton base. The unit may be used with either an enclosed or an open baffle.

Heavy-Duty Yagis (66U)

The **TACO** Y-54 series of antennas comprises 14 models covering the frequency band from 30 to 88 mc (including TV channels 2 - 6). Each model is a 5-element Yagi with two folded-dipole driven elements connected to a 50-ohm coaxial down-lead. Impedance can be changed to 72 ohms by adding an optional matching transformer. The elements are constructed of ¾" OD aluminum-alloy tubing, reinforced with ⅞" OD sleeves; the cross arm has a 2" square cross-section. Power capacity ranges from 960 to 1900 watts, depending on frequency.

INDEX TO ADVERTISERS

October, 1960

CATALOG AND LITERATURE SERVICE

ANTENNAS & ACCESSORIES

1U. *BLONDER-TONGUE* — New manual entitled "Designing and Installing Master TV Systems"; also literature on Model BTA TV/FM Power Booster. *See ad page 15.*

2U. *JERROLD* — "Products For Better Televiewing," a 12-page catalog of home TV reception aids, TV distribution systems, antenna system test equipment and accessories. *See ad page 81.*

3U. *TACO* — New 1960 Fall Catalog price sheet on antennas and accessories.

4U. *WINEGARD* — Descriptive catalog with schematic on Model A-400 distribution amplifier designed to supply signals for up to 30 receivers.

AUDIO & HI-FI

5U. *EICO* — New 28-page 1960 catalog of kits and wired equipment for stereo and monophonic hi-fi, test instruments, "ham" gear, Citizens band transceivers, and transistor radios. Also "Stereo Hi-Fi Guide" and "Short Course for Novice License." *See ad page 44.*

6U. *KARLSON* — Brochure entitled "Stereosonics" outlines the Karlson approach to stereo and includes descriptions, applications, and specifications on unique line of speaker enclosure systems.

COMMUNICATIONS

7U. *GLOBE ELECTRONICS* — "Talkability" pamphlet describing 3 Citizens band tranceivers and the applications for which each is most suitable.

8U. *MOSLEY* — Literature on Citizens band antennas includes form CB-1A on the Deluxe line and form CB-2B on the Standard line. *See ad page 78.*

9U. *RAYTHEON* — Samples of literature available for use by dealers in promoting and selling the new Ray-Tel Citizens band transceiver, with specific suggestions for various applications among physicians, farmers, sportsmen, and businessmen. Also, 4-page brochure covering installation, technical features, and accessories such as crystals, antennas, etc. *See ad pages 18-19.*

10U. *SEISCOR* — Information on new miniature *Telepath* 2-way radio system; also catalog sheets for wired communications units and voice-operated switch for *Telepath* units. *See ad page 20.*

COMPONENTS

11U. *ADMIRAL* — 74-page 1960 sectionalized parts and accessories catalog on tubes, transistors and diodes, batteries, speakers, TV and radio components, TV tuners, record changers and components, indoor and outdoor antennas, and TV receiver stands and bases. Also, large cross-reference wall chart for phono needles. *See ad page 90.*

12U. *BUSSMANN* — 24-page booklet giving detailed information on complete line of *BUSS* and *FUSETRON Small Dimension* fuses and fuse holders — the ones most used in protecting electronic equipment. *See ad page 57.*

13U. *CHICAGO STANDARD* — Form P-60-P, short form part-to-part listing of all TV manufacturer's part numbers with Stancor replacement numbers. *See ad page 64.*

14U. *CLAROSTAT* — Catalog sheet with specifications and prices on VC3D, VC5E, and VC10F axial lead vitreous resistors. *See ad page 47.*

15U. *EASTERN JEWEL* — Catalog 160 describing exact replacement line of printed-circuit electrolytics, and non-polarized types for hi-fi crossover networks; miniature "buzz" controls; ferrite rod antennas; push-push switches; Frozen Yoke Remover. *See ad page 76.*

16U. *PYRAMID* — Hang-on-wall replacement catalog J-10 listing *Twist-Mount* and *Mylar Dip* capacitors. *See ad 94.*

17U. *SPRAGUE* — Distributor Stock Catalog C-613 on line of capacitors, resistors, printed-circuit networks, and test equipment. *See ad page 10.*

PROMOTIONAL AIDS

18U. *SYLVANIA*—18-page "Pennies Folder" catalog covers everything from study-at-home technician courses and sales promotion aids to tube caddies and service-dealer signs. *See ad page 45.*

SEMICONDUCTORS

19U. *STANDARD RECTIFIER CORP.* — 42-page *Silicon Rectifier Handbook* describing line of more than 80 types of silicon power rectifiers; includes basic theory, specifications, and applications.

SERVICE AIDS

20U. *BERNS* — Literature on 3-in-1 repair tool, *Audio Pin Plug Crimper*, and *ION* adjustable beam bender. *See ads 66, 80.*

21U. *CHEMTRONICS* — Dealer price lists 6-1-59 and 10-1-59 outlining applications, prices, and special offer on *TROLAID*, *TUN-O-LUBE*, and several other electronic chemical products. *See ad 92.*

22U. *COLMAN ELECTRONICS* — *Colman Pocket Selector Guide*, handy reference chart which lists 61 specific applications for electronic chemical cleaners under Colman product best suited for the job.

23U. *INJECTORALL* — 1960 New Products Catalog lists complete line of electronic servicing chemicals. *See ad page 72.*

24U. *PRECISION TUNER* — Information on repair and alignment service available for any type of TV tuner. *See ad page 82.*

SPECIAL EQUIPMENT

25U. *ACME ELECTRIC* — Catalog 091-BL01 giving detailed information on automatic voltage stabilizers and manual voltage adjustors for TV receivers and other electronic applications. *See ad page 95.*

26U. *ADLER* — Folders describing TV translator systems for educational and unserved community use. Includes equipment specifications, details on how translator station operates, and information on who can own and operate a station.

27U. *ATR* — Data on complete line of emergency lighting and power supply units for use in the event of commercial power-line failure. *See ad 14.*

28U. *McCABE-POWERS* — Bulletin SM-601 picturing and describing *Service-Master* all-purpose truck bodies, designed specifically for on-the-job service work, in 1/2-, 3/4-, 1-, 1 1/2-ton sizes.

29U. *SWITCHCRAFT* — 2-color, 4-page brochure on Language Laboratory components, with illustrations and specifications on amplifiers, remote listening stations, power supplies, phone jack panels, etc.

TECHNICAL PUBLICATIONS

30U. *CBS* — Form PA-276, outlining full details on new 10-lesson Transistor Course. Makes use of 12 do-it-yourself projects so you will learn by doing. *See ad page 99.*

31U. *MOTOROLA* — Complete brochure describing Motorola Institute training course on two-way radio communications, plus sample lesson SA-7 on transistorized receiver circuits.

32U. *RCA INSTITUTES* — 64-page booklet entitled, "Your Career in Electronics," includes complete history and background of the school, plus detailed descriptions of courses offered on Electronic Fundamentals, Television Servicing, Color Television, and Electronics for Automation. *See ad page 21.*

33U. *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, amateur radio, communications, audio and hi-fi, and industrial electronics servicing. *See ads pages 61, 70, 71, 86, 88.*

35U. *WESTINGHOUSE (RECEIVER DIV.)* — Descriptive bulletin and registration card for receiving factory service information and *Tech-Lit News*. *See ad page 29.*

34U. *SYLVANIA* — Information on the availability of service literature on television, radio and high fidelity. *See ad page 73.*

TEST EQUIPMENT

36U. *B & K* — Bulletin AP16-R gives information on new Model 1076 *Television Analyst*, Models 1070 and A107 *Dyna-Sweep Circuit Analyzers*, Models 550, 650, 675, and new 685 *Dyna-Quik* dynamic mutual conductance tube testers, new Model 610 Test Panel, new Model 160 Transistor Tester, and Model 440 CRT rejuvenator-tester. *See ads 9, 56.*

37U. *HICKOK* — Folders describing Model 209A VTVM, plus line of tube testers, oscilloscopes, transistor testers, VOM's, and signal generators. *See ads 50, 51.*

38U. *MERCURY* — Catalog on complete line of test equipment; also information on Model 500 component substitutor, Model 600 power rectifier tester, and Model 700 transistor tester. *See ad 80.*

39U. *SECO* — Latest information on communications radio test set, and grid circuit tester with full TV tube coverage. *See ads pages 92, 93, 95.*

40U. *SENCORE* — New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter*, plus brochure on complete line of *time-saver* instruments. *See ad pages 40-41.*

41U. *SUPERIOR* — Bulletin 107 with complete specifications on combination transistor/transistor radio tester, plus complete line of VOM-VTVM units, tube testers, and picture tube tester-rejuvenator. *See ad page 76.*

TOOLS

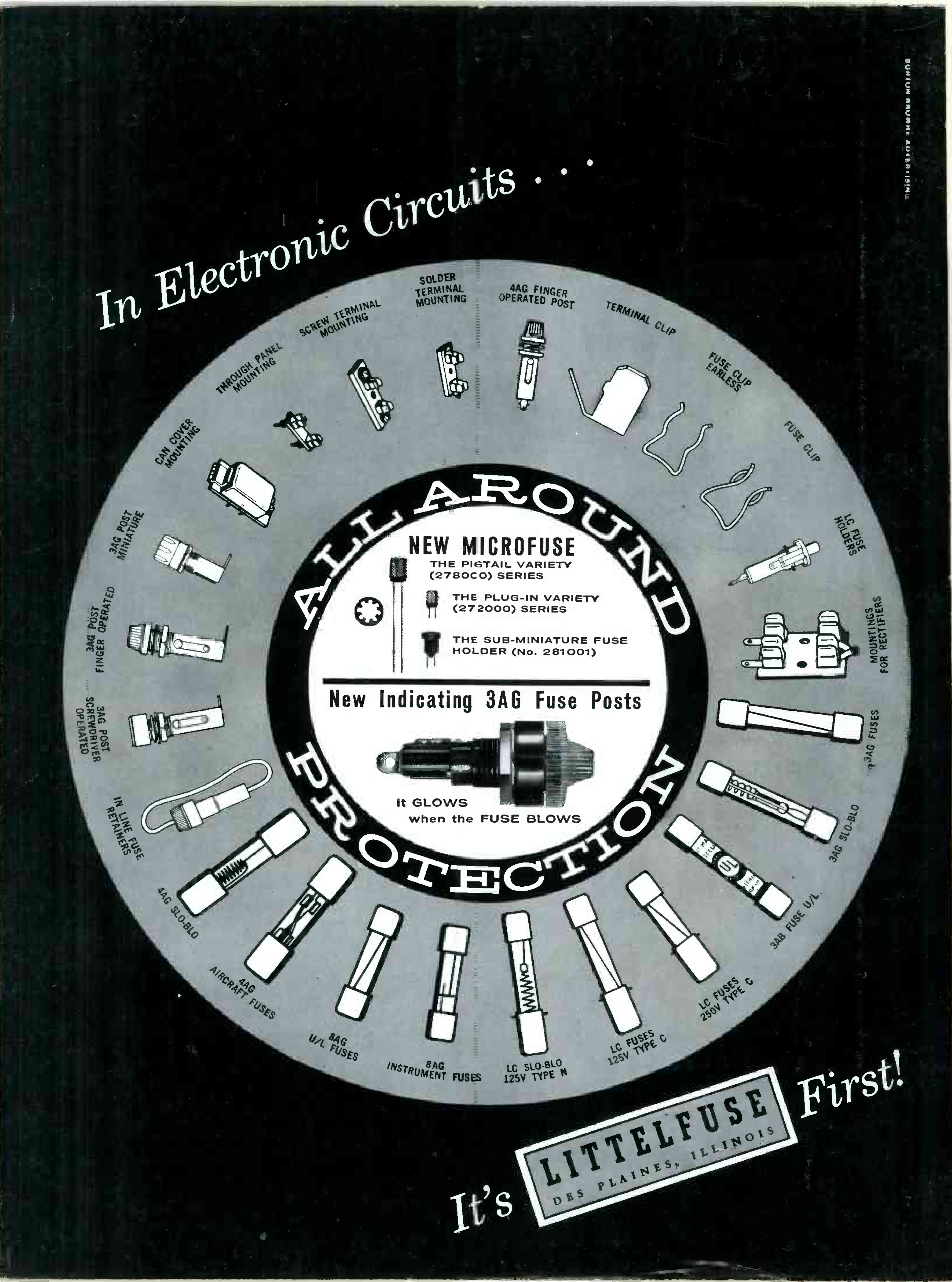
42U. *VACO* — New catalogs on handy service tools for the electronics industry. *See ad page 93.*

43U. *XCELITE* — Newly issued condensed catalog picturing and describing hand tools most often used by servicemen. *See ad page 52.*

TUBES

44U. *INTERNATIONAL ELECTRONICS*— New folder showing specifications of *Preferred* receiving tubes together with cross-reference guide. *See ad page 60.*

6CG7
RCA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THE PLUG-IN VARIETY (272000) SERIES
THE SUB-MINIATURE FUSE HOLDER (No. 281001)
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it GLOWS when the FUSE BLOWS
SOLDER TERMINAL MOUNTING
4AG FINGER OPERATED POST
TERMINAL CLIP
FUSE CLIP EARLESS
FUSE CLIP
LC FUSE HOLDERS
MOUNTINGS FOR RECTIFIERS
3AG FUSES
3AG SLO-BLO
3AB FUSE U/L
LC FUSES 250V TYPE C
LC FUSES 125V TYPE C
LC SLO-BLO 125V TYPE N
8AG INSTRUMENT FUSES
8AG U/L FUSES
4AG AIRCRAFT FUSES
4AG SLO-BLO
IN LINE FUSE RETAINERS
3AG POST SCREWDRIVER OPERATED
3AG POST FINGER OPERATED
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