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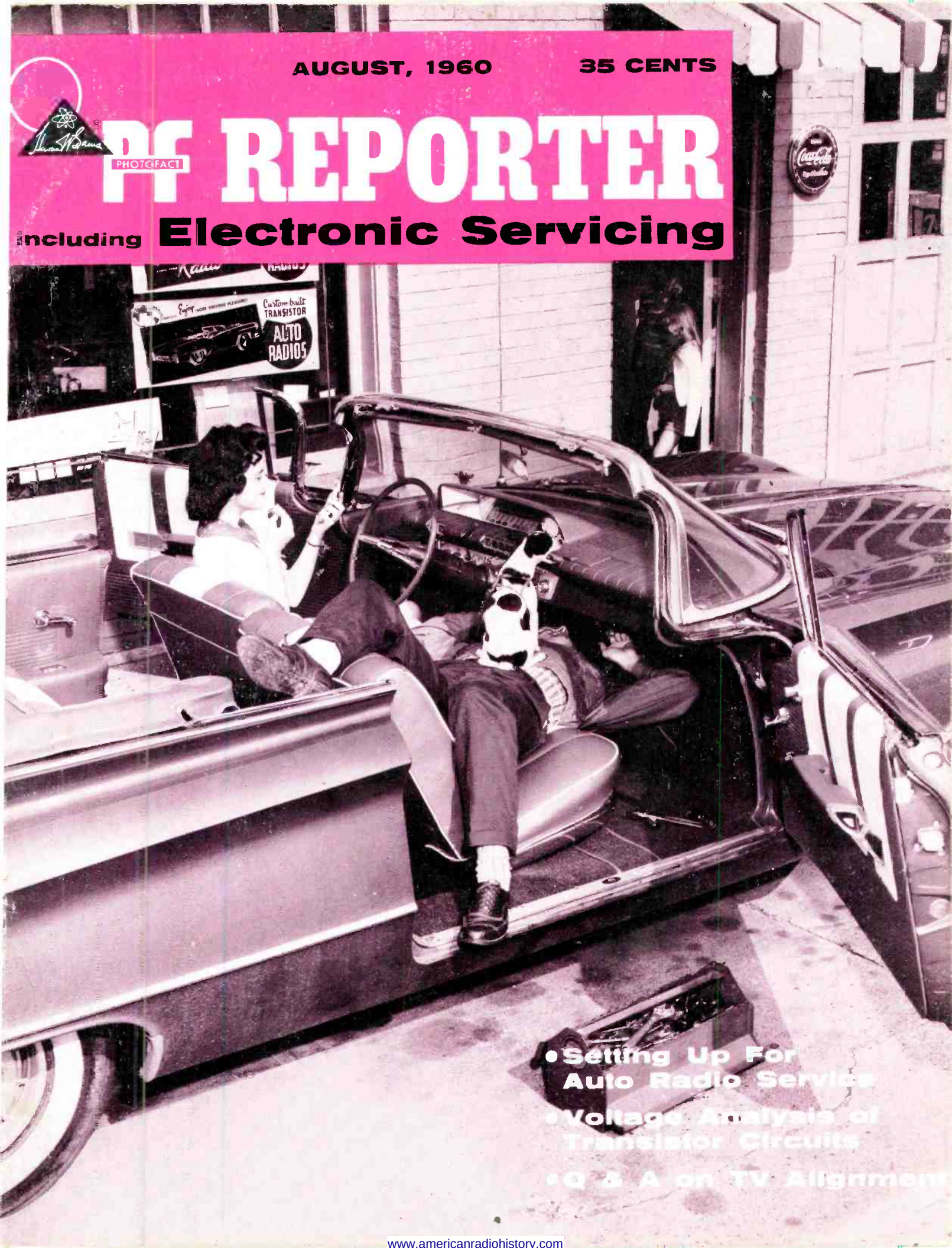

- Setting Up For Auto Radio Service
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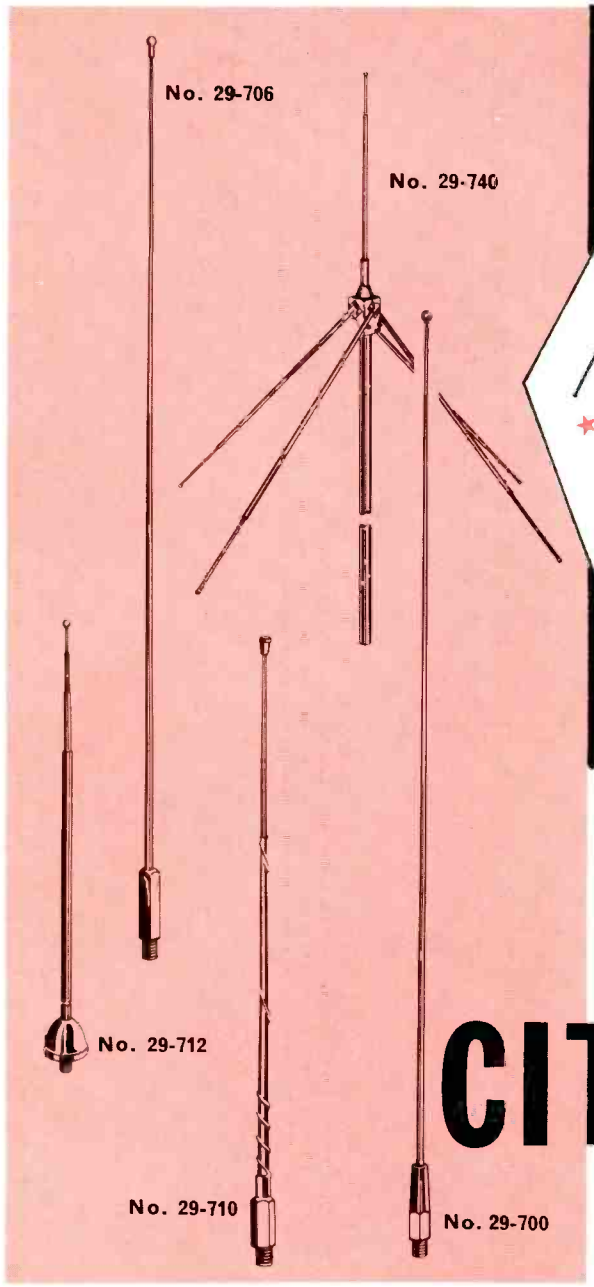

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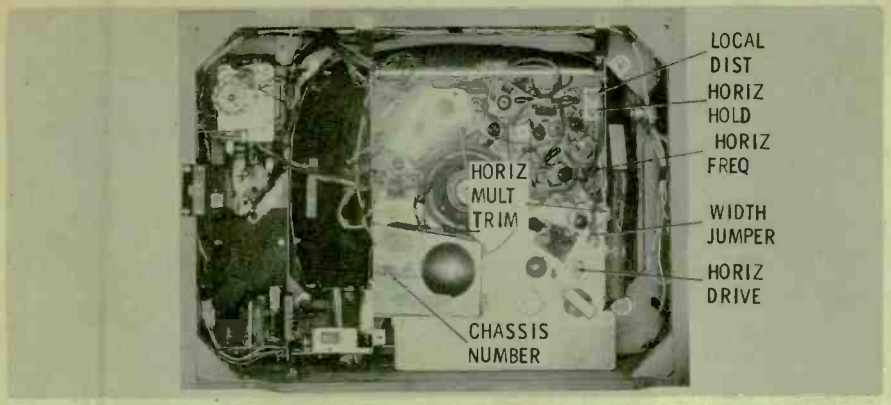
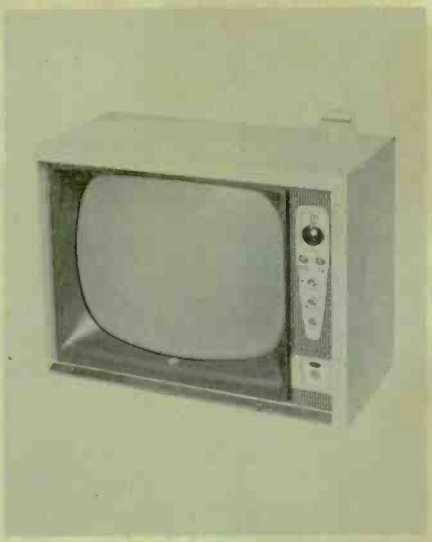
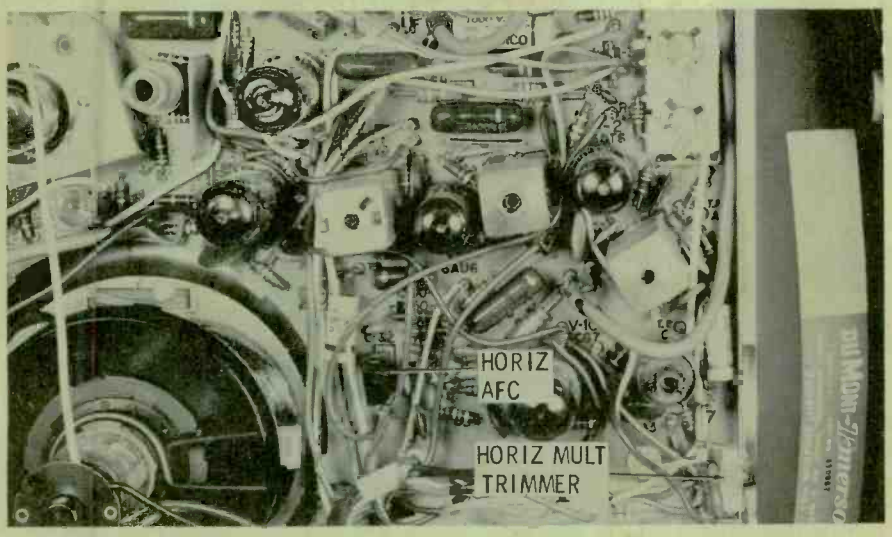
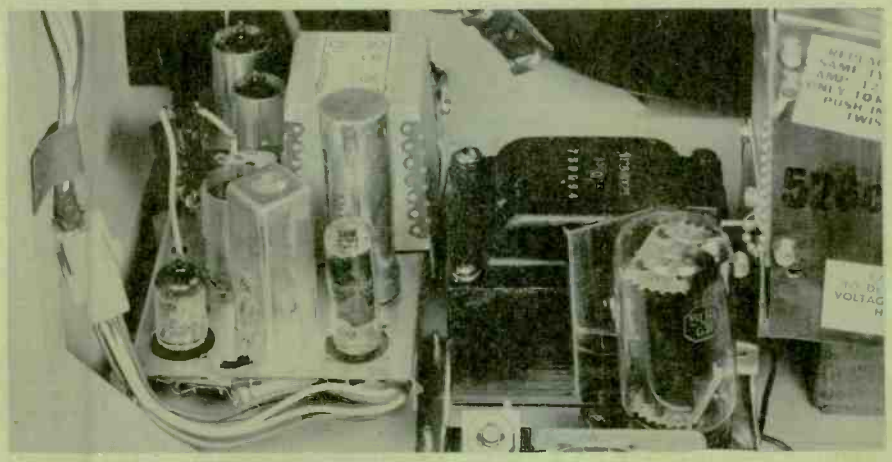
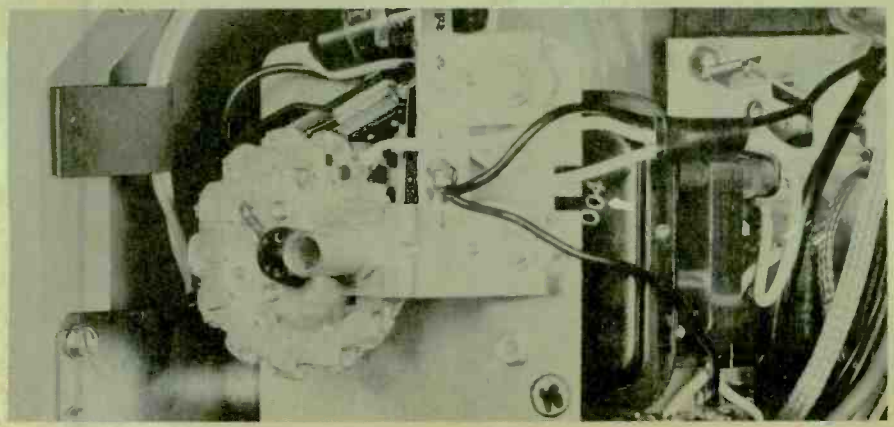
Emerson











Emerson Model 1610 Chassis 120526C

This table model is representative of eleven current models, although there are six minor chassis variations. The 110° series is available in both 17″ and 21″ versions, this one being a 21″ with remote control. The height and vertical linearity adjustments are accessible through the hollow shafts of the brightness and vertical hold controls.

The vertical chassis has been reduced to half the old size, and the top section has been converted to the printed-circuit style. The power supply is off the main chassis, and is part of a subchassis mounted on the left side. The horizontal drive control is connected as an unbypassed variable cathode resistor for the horizontal output tube. On the terminal board just above this control, a width jumper is connected across a 3300-ohm resistor in the horizontal output screen circuit. Its removal reduces picture width.

Most of the chassis circuitry is contained on the printed board; notable exceptions are the audio, horizontal, and vertical output stages and the power supply. The top side of the printed board contains black painted labels showing tube types and test points. In addition, the bottom of the board has white markings to identify tube elements and various voltage points. Besides the conventional horizontal hold control, this chassis is equipped with a horizontal multivibrator trimmer connected in parallel with the multivibrator coupling capacitor to provide a variable RC circuit at the grid of the second half of the stage.

The transformer-powered chassis is protected by an N-type 7/10-amp fuse in series with the B-minus return of the transformer and a length of #26 wire in series with the tube filaments. The 5-tube remote-control receiver chassis obtains its power from the TV power supply. The battery-powered remote transmitter contains two transistor oscillators that supply RF outputs to a transducer which, in turn, radiates supersonic sound waves to the receiver.

Programming adjustments are ble through a guide tube wh through the rear cover provided for each ch clockwise, it will c the channel.

Hoffman Model M3703 Chassis 426 and 1139

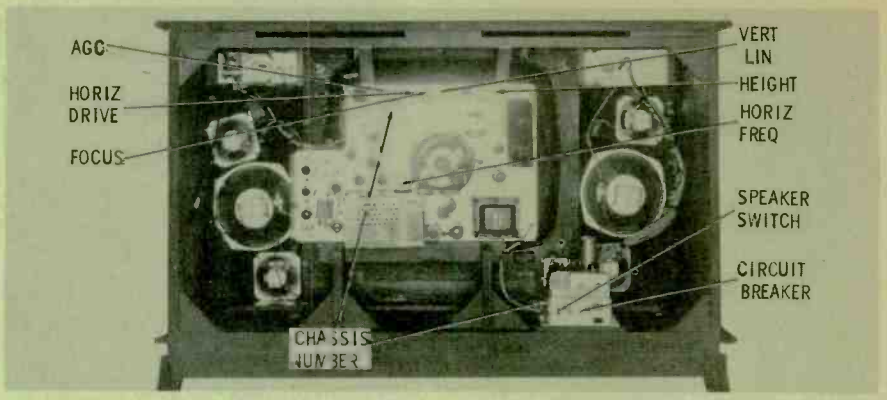
With jacks for stereo and tuner, here's a 23" set with a stereo amplifier chassis and a left-channel bank of speakers—but surprisingly, no phono!

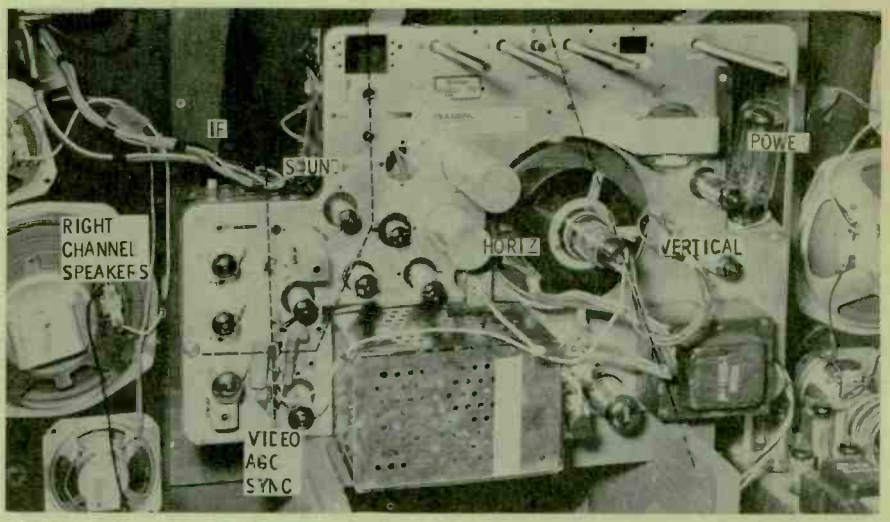
Both chassis are conventionally-wired, each containing its own transformer-type power supply. Both are protected from current overloads by a single circuit breaker in series with the AC line. All setup controls are easily identified by chassis stampings. The TV chassis is an 18-tube, VHF unit containing *no* audio circuits. The output from the audio detector stage is fed to the right-channel amplifiers of the stereo chassis. The newest tube types used are the 6ER5, 6DA4/6DE4, and 6DT5.

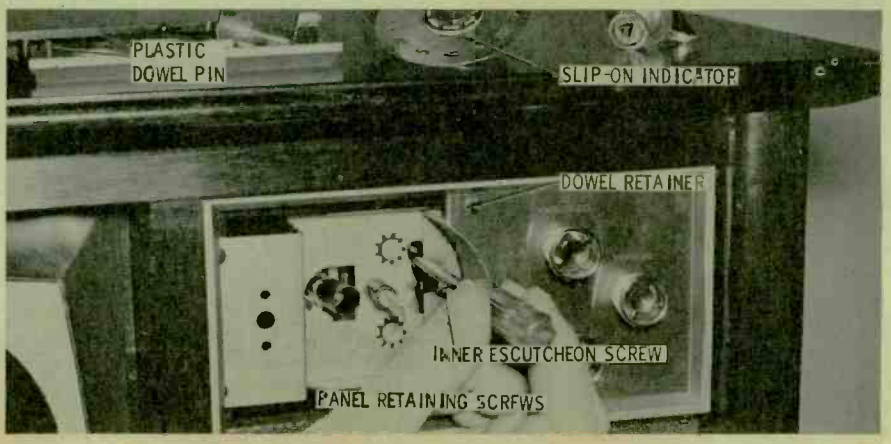
Although schematic diagrams are provided for each chassis (pasted on the inside of the rear cover), the usual tube placement chart is conspicuous by its absence. For your guidance, the photo shows the areas devoted to the various circuits. Another point you'll want to keep in mind is that the right-channel speakers are the only ones used for TV sound.

While there is nothing peculiar about the stereo amplifier chassis, it may be a little strange to those of you who major in TV service. Don't forget that it has its own power supply, and that trouble here can cause loss of TV sound. The tube lineup may be strange, too, and you may not have the correct tubes in stock if not warned in advance. The rectifier is an EZ81/6CA4, and each channel has an ECC83/7025 for an AF amplifier, plus an EL84/6BQ5 audio output. The hum control located on the right side of the chassis should be adjusted for minimum hum with no signal present. You'll find all sockets and switches well labeled to help you find your way around.

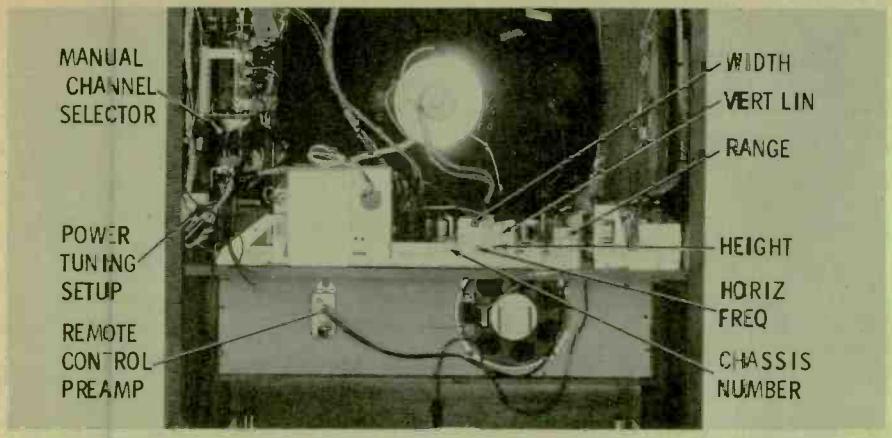
The only thing complicating chassis removal is the mounting of the two control panels. Both are secured to the cabinet from the front, necessitating removal of both control escutcheons. After removing the channel-selector and function-selector knobs, grasp the plastic escutcheons along the inside edge and pull straight out. Be careful not to break the plastic dowels holding this outer part. The remaining knobs and dials can then be pulled from their shafts. The photo shows the VHF tuner being adjusted.

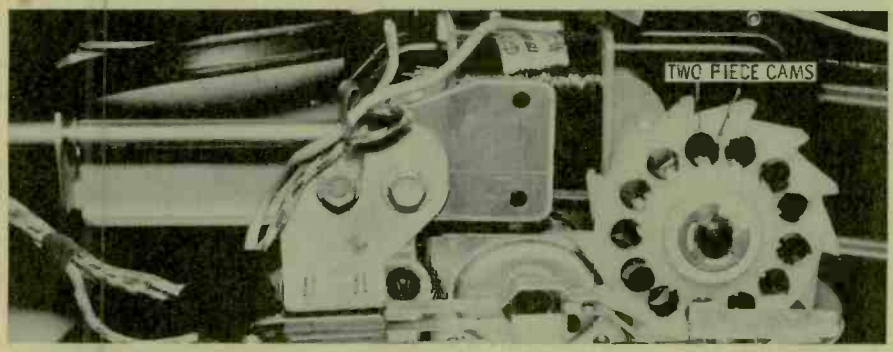


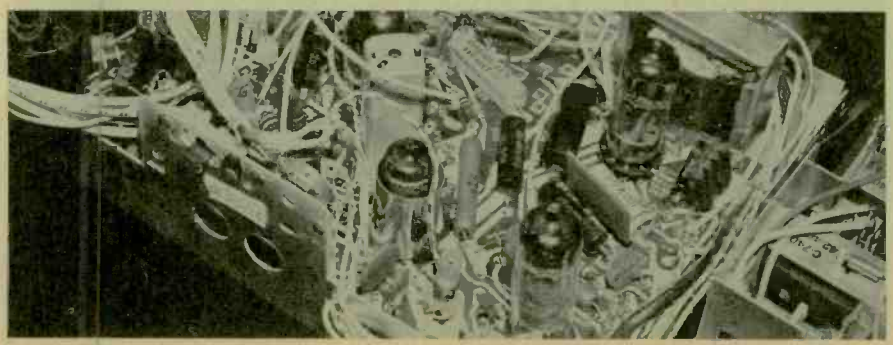




Philco







Philco Model H4673MR Chassis 10L32

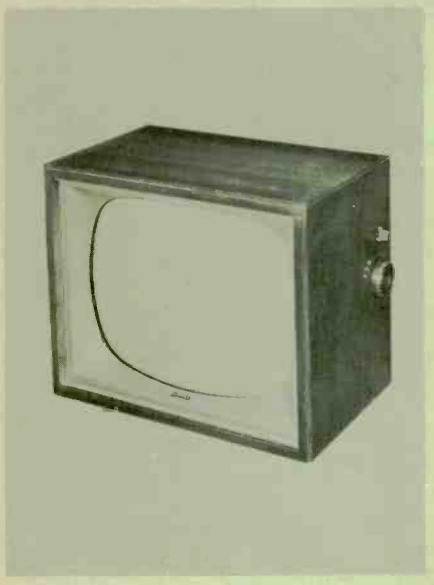
Among the 36 models using the 10L31 or 10L32 chassis is this 21" console. The only difference between chassis is that the latter has remote control; either can be obtained with or without provisions for UHF. Top controls are provided for off-on, volume, contrast, and "do-it-yourself" fine tuning. Thumbwheel knobs protrude through the back for adjustment of brightness, vertical hold, and horizontal hold. To change channels, there's a push-button switch centered in the panel to the left of the picture tube (with a "P" on it for power tuning). A manual channel selector protrudes from the back.

The transformer-powered, 16-tube TV chassis has a 7/10-amp, N-type, slow-blow fuse protecting the B+ supply and a 1 1/2" length of #26 wire for filament protection. Except for the power supply, wiring is contained on two printed boards. All setup controls are mounted on the rear apron of the chassis and are clearly marked.

The remote control system is of unusual design, and provides control for off-on, volume, and unidirectional channel selection. The transmitter uses a type T1605 transistor as an oscillator to produce either of two RF frequencies. These are coupled to an electrostatic speaker shunted by a selenium diode, producing a supersonic radiation. Another electrostatic speaker in the set receives the signal and feeds it to a remote control preamplifier which, in turn, is coupled to the remote receiver. The receiver has its own conventionally-wired power supply with a 6CA4 rectifier. The remaining circuitry is contained on a printed board and employs a 6BJ8 tube.

Channel-programming adjustments are made by means of a push-pull rod protruding through the rear cover, and directions are included. Looking at the "business end" of this mechanism, you'll notice that each cam consists of two pieces of spring steel which are positioned by two push blocks. If for some reason both halves of the cam aren't properly positioned, erratic operation will result.

The printed board contains an outline of the foil connections and many id- fying stampings as an aid t- Practically all of the mounted with suffici- that test instrumen- nected.



Sonora Model S60T211
Chassis 1150-100

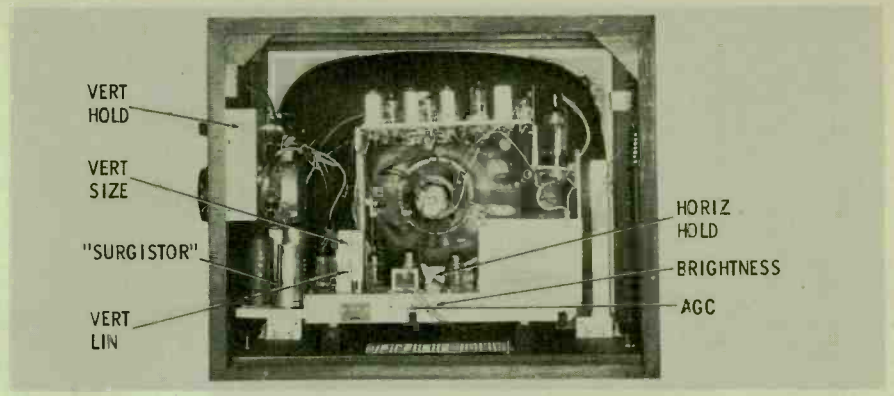
One of the first TV sets to be produced since the Sonora name was purchased by Trav-Ler Radio Corp. is this 21", 110° table model. Operational controls for channel selection, fine tuning, off-on-volume, and contrast are grouped on the right side, while the remaining controls protrude through the rear cover. Removal of four screws holding the trim strip at the top edge of the safety glass permits the glass to be tilted forward and lifted out for cleaning.

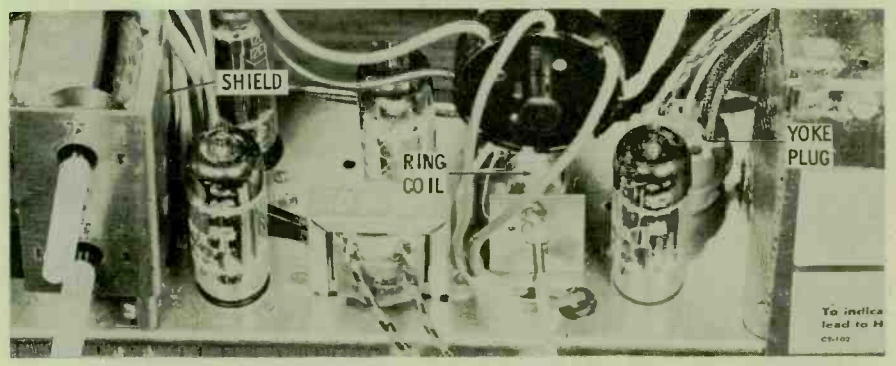
The 16-tube, conventionally-wired, "hot" chassis forms a backward "C" around the picture tube. Although the rear controls are labeled on the back cover, no identification is provided once the cover is removed. A small subchassis attached to the left end of the main chassis contains all the filter capacitors and also a *surgistor* which limits both filament and B+ current surges when the set is first turned on.

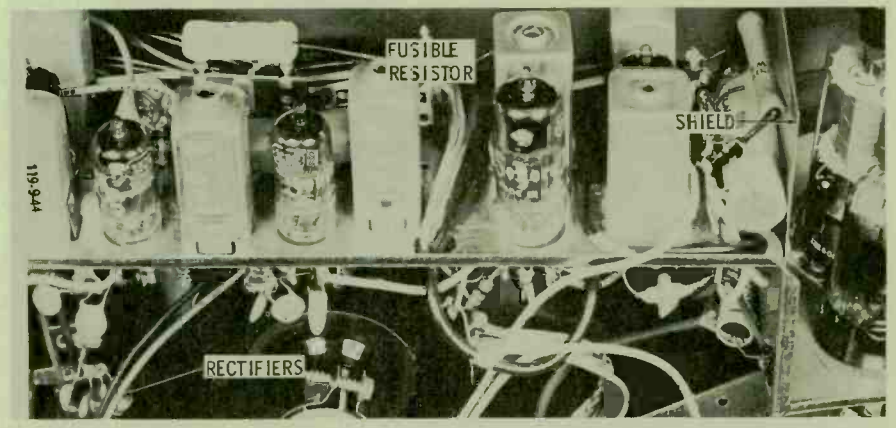
Keyed AGC, sync, vertical sweep, horizontal oscillator and audio output circuits occupy main chassis space to the left of the cage. (Notice the shield isolating the vertical circuit.) The plug-in dual selenium diode in the horizontal AFC circuit is hidden in this photo, but it's directly in front of the ringing coil (the only provision for varying horizontal frequency in this chassis).

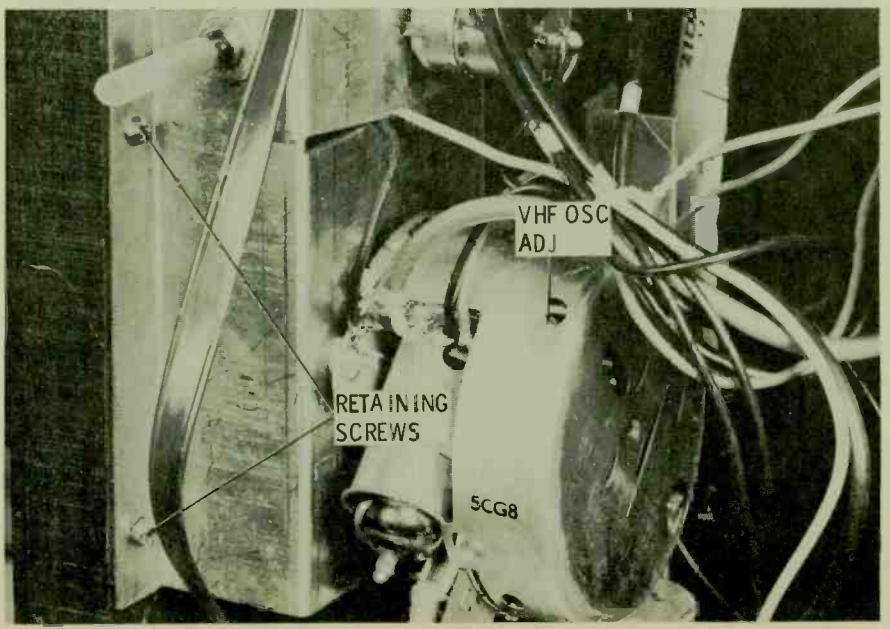
The top deck contains the IF and video output stages. In addition, the plug-in fusible resistor is mounted along the front edge of this chassis. The half-wave, voltage-doubler rectifier circuit is on the left chassis-support bracket where it can be easily reached for service. The offset portion of the chassis to the right contains the horizontal output and damper stages. Notice the additional shield rising above the output tube to reduce radiation into the video circuit.

The tuner mounting effects a nice compromise so that the tubes can be changed without too much difficulty and the access hole for oscillator adjustments is also easy to get to. The two retaining screws shown, and one under the fine-tuning knob, secure the tuner assembly to the cabinet; five bolts hold the board containing chassis and CRT.









See PHOTOFACT Set 467, Folder 1

See PHOTOFACT Set 467, Folder 1

Mfr: Trav-Ler **Chassis No. 1150-19**

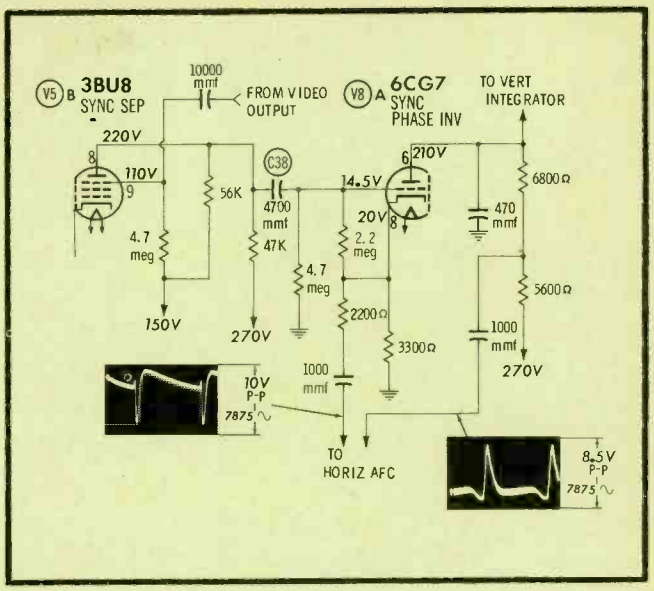
Card No: TR 1150-19-1

Section Affected: Sync.

Symptoms: Horizontal tearing; critical vertical hold.

Cause: Leaky coupling capacitor between sync separator and sync phase inverter.

What To Do: Replace C38 (4700 mmf).



Mfr: Trav-Ler **Chassis No. 1150-19**

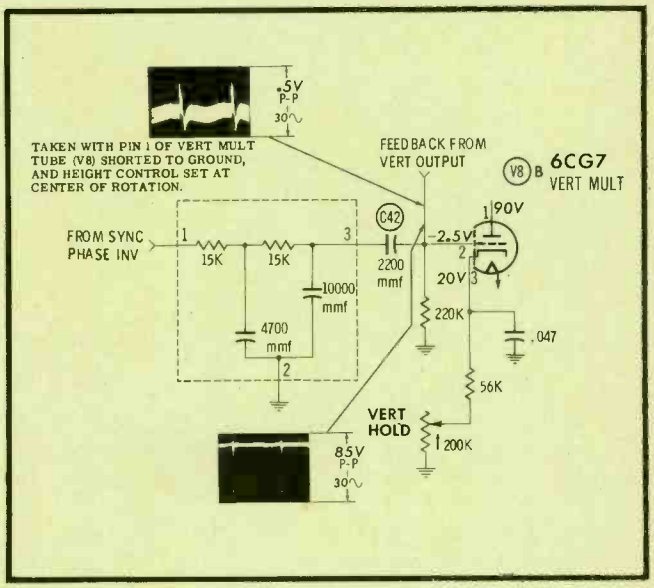
Card No: TR 1150-19-2

Section Affected: Raster.

Symptoms: No vertical sweep.

Cause: Shorted coupling capacitor between integrator and vertical multivibrator.

What To Do: Replace C42 (2200 mmf).



Mfr: Trav-Ler **Chassis No. 1150-19**

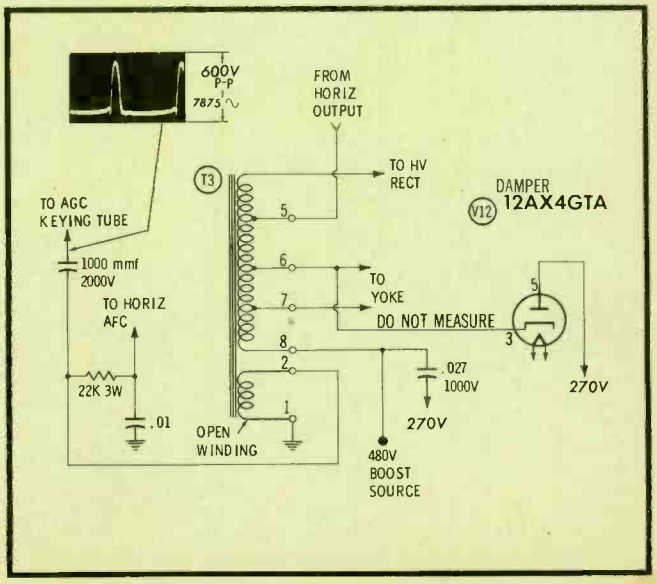
Card No: TR 1150-19-3

Section Affected: Pix.

Symptoms: Loss of horizontal sync; video overloading.

Cause: AGC/AFC winding on horizontal output transformer (across terminals 1 and 2) is open.

What To Do: Replace T3.



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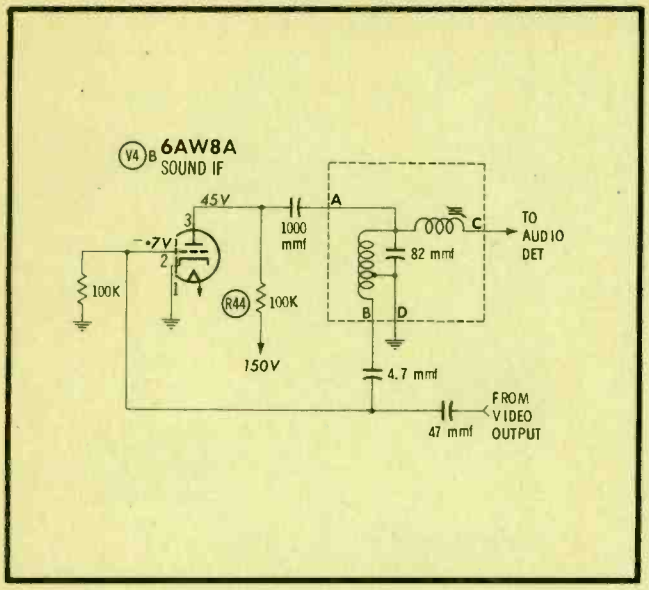
See PHOTOFACT Set 467, Folder 1



See PHOTOFACT Set 467, Folder 1

Mfr: Trav-Ler **Chassis No. 1150-19**

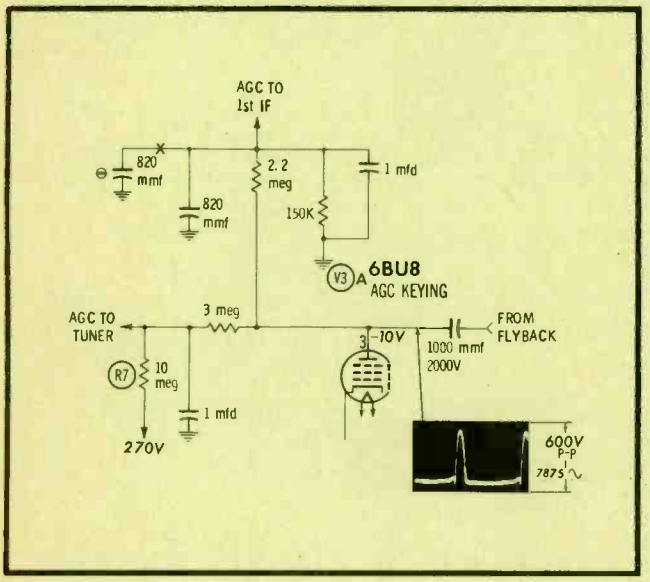
Card No: TR 1150-19-4

Section Affected: Sound.

Symptoms: Sound gets weaker as receiver plays.

Cause: Sound IF plate-load resistor changes value.

What To Do: Replace R44 (100K).



Mfr: Trav-Ler **Chassis No. 1150-19**

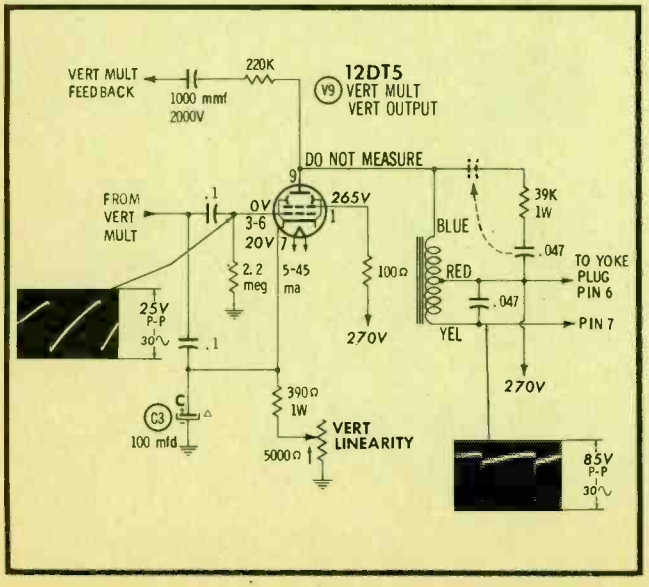
Card No: TR 1150-19-5

Section Affected: Pix.

Symptoms: Snowy picture.

Cause: Open RF-AGC delay resistor.

What To Do: Replace R7 (10 meg).



Mfr: Trav-Ler **Chassis No. 1150-19**

Card No: TR 1150-19-6

Section Affected: Raster.

Symptoms: Poor vertical linearity.

Cause: Open cathode-bypass capacitor in vertical output stage.

What To Do: Replace C3C (100 mfd—50V) or preferably entire C3 (100-60-100 mfd at 300-300-50V).

See PHOTOFACT Set 467, Folder 2

Mfr: Zenith **Chassis No. 16D21**

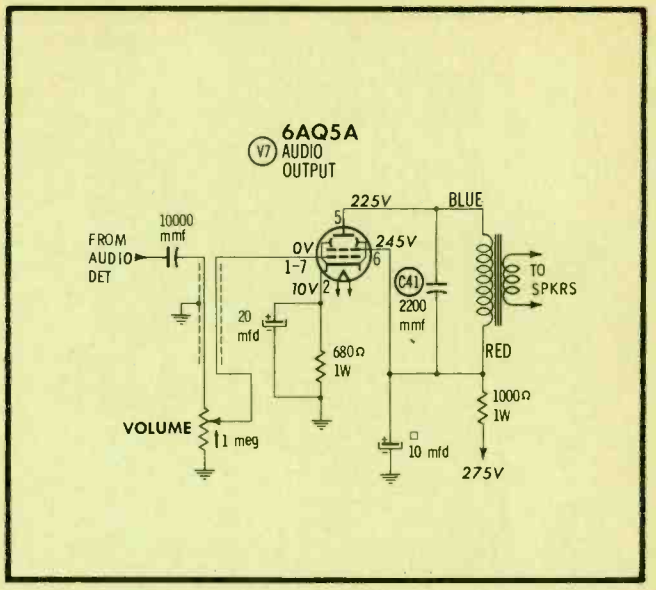
Card No: ZE 16D21-1

Section Affected: Sound.

Symptoms: Sound abruptly "cuts off."

Cause: Shorted plate-bypass capacitor in audio output stage.

What To Do: Replace C41 (2200 mmf).



Mfr: Zenith **Chassis No. 16D21**

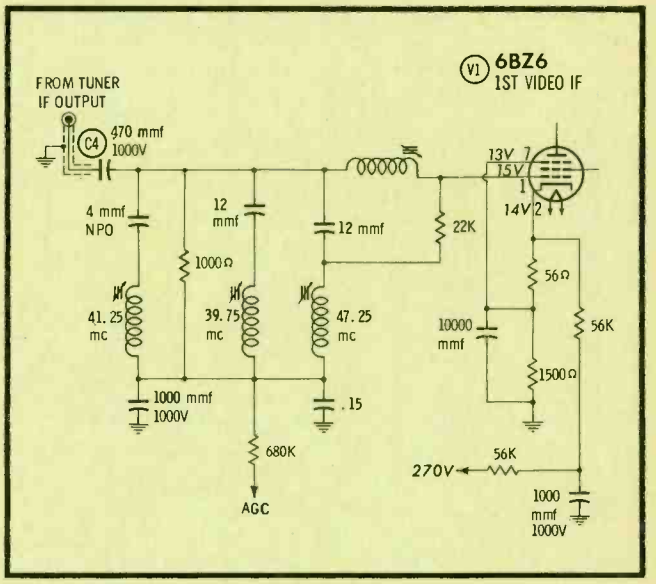
Card No: ZE 16D21-2

Section Affected: Pix.

Symptoms: Video overloading.

Cause: Leaky coupling capacitor between tuner and first video IF.

What To Do: Replace C4 (470 mmf—1000V).



Mfr: Zenith **Chassis No. 16D21**

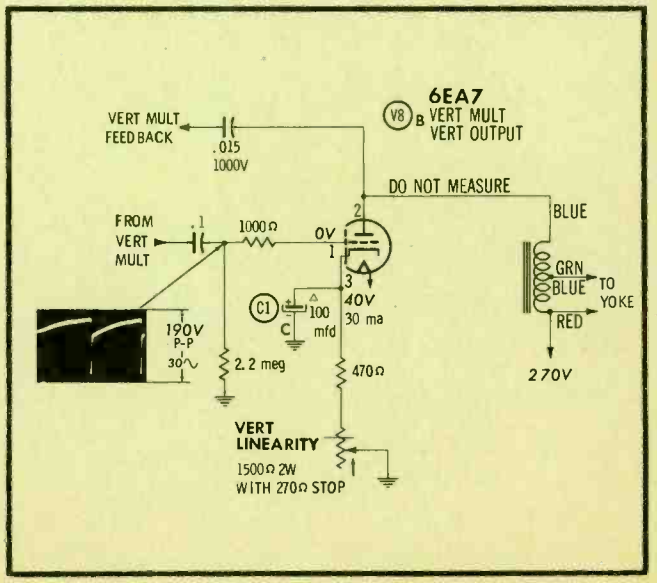
Card No: ZE 16D21-3

Section Affected: Raster.

Symptoms: Vertical linearity very poor.

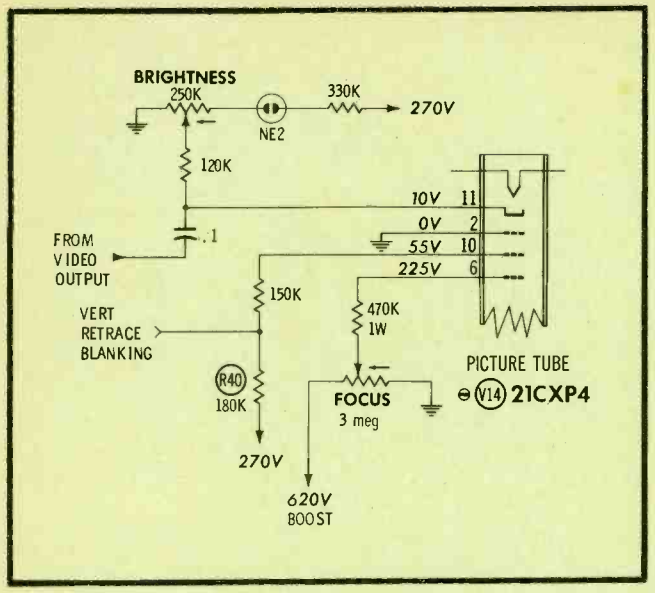
Cause: Open cathode-bypass capacitor in vertical output stage.

What To Do: Replace C1C (100 mfd—50V) or preferably entire C1 (40-80-100 mfd at 400-400-50V).



See PHOTOFACT Set 467, Folder 2

See PHOTOFACT Set 467, Folder 2



See PHOTOFACT Set 467, Folder 2

Mfr: Zenith **Chassis No. 16D21**

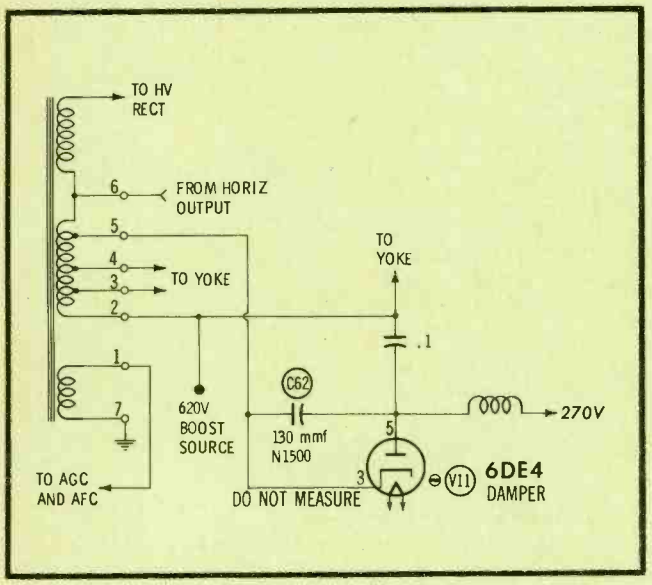
Card No: ZE 16D21-4

Section Affected: Pix.

Symptoms: Brightness diminishes as receiver plays.

Cause: Resistor in accelerating-anode circuit of CRT increases in value.

What To Do: Replace R40 (180K).



Mfr: Zenith **Chassis No. 16D21**

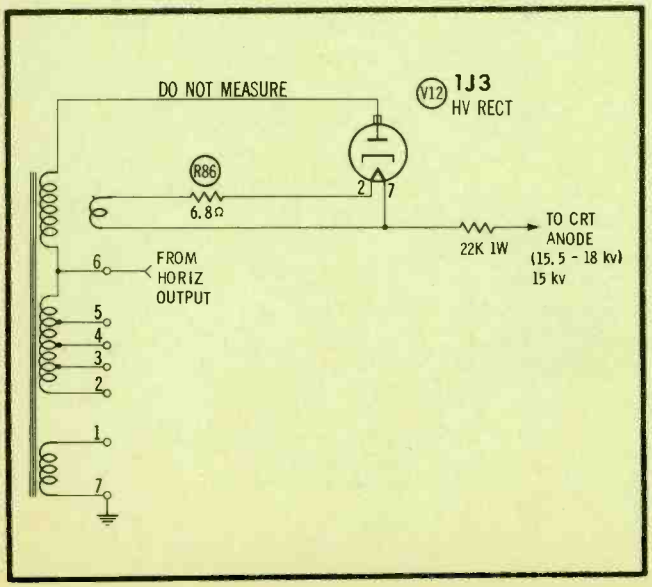
Card No: ZE 16D21-5

Section Affected: Raster.

Symptoms: No high voltage.

Cause: Shorted capacitor across damper tube.

What To Do: Replace C62 (130 mmf—4000V, N1500, 10%).



Mfr: Zenith **Chassis No. 16D21**

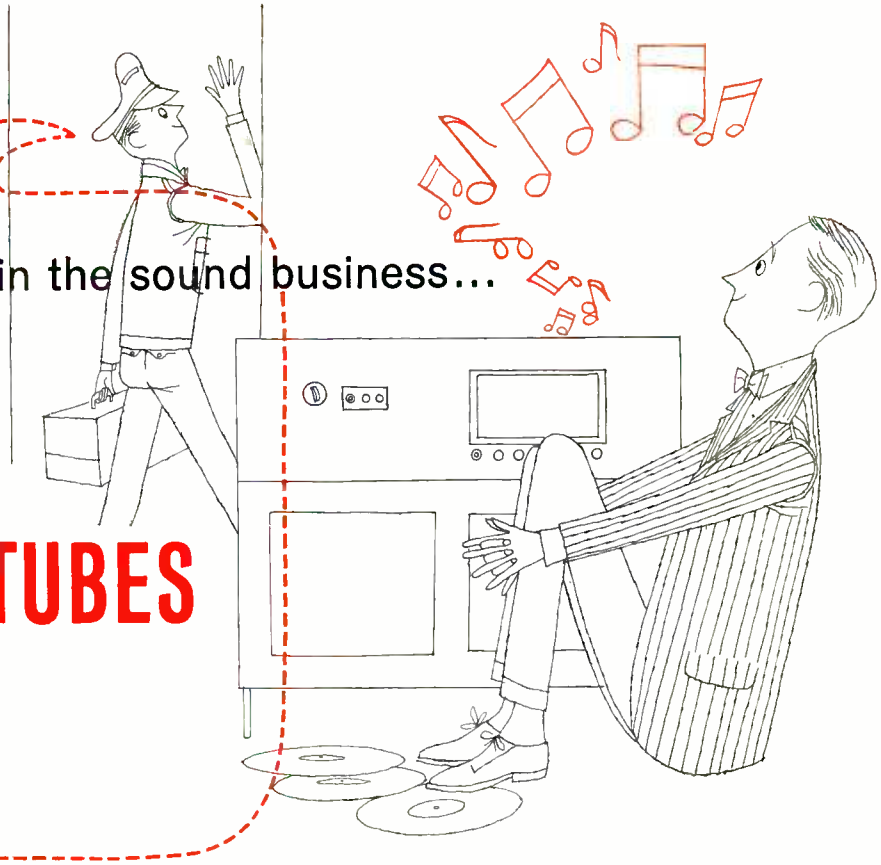
Card No: ZE 16D21-6

Section Affected: Raster.

Symptoms: Intermittent blooming.

Cause: Change in value of series resistor in filament circuit of high-voltage rectifier.

What To Do: Replace R86 (6.8 ohms—Zenith part number 63-3205).



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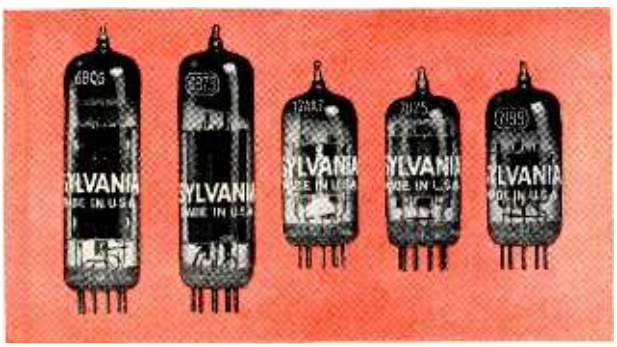

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Here, for the first time, is a precision-made instrument which is specifically designed to *safely* test low-voltage aluminum and tantalum electrolytic capacitors, film and paper capacitors, and ceramic capacitors. *No laboratory or shop working with transistor circuit capacitors can afford to be without one!*

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See the remarkable new TCA-1 TRANSCAP at your Sprague distributor or write for descriptive folder M-792a to Sprague Products Company, 105 Marshall Street, North Adams, Massachusetts.

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San Francisco 5, Calif. Exbrook 2-3365

Address all correspondence to PF REPORTER, 2201 East 46th Street, Indianapolis 6, Indiana

Indexed in Electronic Guide and Lectrodex.
Printed by the Waldemar Press Div. of Howard W. Sams & Co., Inc.

PF REPORTER
including Electronic Servicing

VOLUME 10, No. 8 AUGUST, 1960

ABOUT THE COVER

As if working on a dash-mounted auto radio isn't tough enough, our cover serviceman has to be distracted by an annoying pooch and a somewhat unconcerned female customer. While we can't guarantee you'll be lucky enough to attract customers as pretty as our model, we can say that the feature beginning on page 38 will be a big help to anyone who plans to do any auto radio servicing.

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Letters to the EDITOR

Dear Editor:

My attention has been called to an error in the Zenith 16D25Q chassis description in the March issue of PF REPORTER, and again in the Zenith 18E20 chassis description appearing in the June issue wherein you explain that "dip soldering" is employed.

All Zenith television receivers are not only hand-wired, but also *hand-soldered.* Zenith does not use printed boards, printed wiring, or dip-soldered terminal connections in its chassis.

Since we pride ourselves on our handcrafted construction, we felt we should bring this fact to your attention.

F. E. SMOLEK
General Service Manager
Zenith Sales Corp.
Chicago, Ill.

Sorry. We should have known better, but such neat soldering fooled us completely.—Ed.

Dear Editor:

I wish to thank you for your help in diagnosing the trouble in a Stromberg-Carlson 622 chassis. (You printed my letter and your reply in the April *Troubleshooter* column under the title, "Real Gone.")

Using my demodulator probe and scope to troubleshoot the third IF stage, I found that the signal was almost half as great on the screen grid as on the plate. Replacing the screen-bypass capacitor corrected the trouble.

May I say that yours is the only magazine I can enjoy continuously.

J. M. THURSTON
Thurston TV Service
Ft. Wayne, Ind.

Dear Editor:

I read with interest J. M. Thurston's service problem in the April *Troubleshooter* section, under the heading "Real Gone."

Another Stromberg-Carlson 622 Series chassis was recently on my bench with the same trouble—an extremely high negative voltage on the AGC line—and the case would have reached "tough dog" proportions if it hadn't been for a slip of the test probe. While signal-tracing through the IF strip with a demodulator probe attached to the scope, I accidentally touched the screen terminal of the third IF tube. The sound and picture instantly returned. Of course, your answer contained the clue—an oscillating stage caused by an open 680-mmf ceramic bypass capacitor. This unit, as I remember, was on top next to the fourth IF transformer.

J. VERHARENS
St. Petersburg, Fla.

The Troubleshooter was glad to hear that he rang the bell with this suggestion. By the way, you can obtain a 96-page collection of questions and answers from "The Troubleshooter" with a new, renewal, or extension subscription to PF REPORTER. *For details, see page 66.—Ed.*

Dear Editor:

I've been doing radio and television servicing for oven ten years, and I wouldn't trade my PF REPORTER subscription for all the other magazines combined, *free.*

How about more articles on the recording instruments used in industrial electronics, including the thermocouples employed with such equipment?

PETER STEPHAS
Tele-Tronics
Seattle, Wash.

Recording instruments were described in "Servicing Medical Amplifiers" (October, 1959) and "The Writing on the Wall" (November, 1959). Thermocouples have been described in a number of our industrial electronics features, most extensively in "Heat-Sensing and Temperature-Controlling Devices" (October, 1957).

Ask and ye shall receive . . . many more features on various phases of industrial electronics are on the way.—Ed.

Dear Editor:

I have been a constant reader of your publication since May 1954, and I find the articles very informative.

Looking through my back copies, I came across an item in the May, 1959 issue referring to the availability of a Subject Reference Index. Is it still possible to obtain Indexes for the years of 1957, 1958, and 1959? I would like to use these as a quick reference to help solve troubles.

LLOYD A. TREACHER
Toronto, Ont., Canada

The '58 and '59 editions are yours (and any other reader's) for the asking, but we're completely out of '57.—Ed.

Dear Editor:

Please send me two copies of the 1959 index to PF REPORTER, my most looked for, most read, and most often referenced publication. Other service magazines try hard, but can't match your timely subjects and very readable and understandable presentations.

HAROLD S. VANDEMAN
San Bernardino, Calif.

With those words, you could have asked for two hundred copies and got them without a tussle!—Ed.

Dear Editor:

Every so often, I'm called upon to service a Geiger counter for some mineral-fever Californian. Searching my back issues of PF REPORTER (since early 1953), I find nary a paragraph relating to such units. How come, huh? Or do I need to readjust my bifocals?

LARRY A. STEPPE
Petaluma, Calif.

Among all the specialized subjects clamoring for attention, Geiger counters haven't yet had their turn in PF REPORTER. *However, I'm sure the Howard W. Sams book, "Electronic Metal Locators" (MLR-1), will serve your purpose. —Ed.*

• *Please turn to page 14*

Letters

(Continued from page 13)

Dear Editor:

I was amused at the replies one serviceman received to his request for information on what basic test instruments he needs for a service shop. Not one of them mentioned a capacitor checker, which has saved me many hours on radio repairs. Many pieces of electronic equipment were successfully repaired before a scope was ever used. Another instrument not generally mentioned was a signal generator, even though it is most necessary when installing new RF-IF cans.

I've a hint for anyone planning to install remote speakers, especially if the installation is in a building under construction or is part of a PA system including microphones. Unless you are using shielded cable, be sure the speaker wires are run at least 14" from the mike cable or power line. Sometimes, in new construction, the speaker wiring is put in before other lines are installed. You may end up with a terrific feedback howl or power-line hum, and may not discover it until too late — after the wires have been covered up by stucco or cement. All the profits then go down the drain when you go back and install new speaker wire.

I wish you would publish more on FM-AM tuners, record players, transistor preamps, and radios. However, we can't have everything — and you do a marvelous job on what you do publish.

Name Withheld by Request

Did it take you long to chip away the cement and take out the wires?

The test instruments you need depend largely on the kind of servicing you do. However, we'll agree that a capacitor checker is definitely helpful — not only in radio and audio, but in TV work as well. As for the oscilloscope, we'll agree that you can eventually find a faulty part without it — but why walk when you can ride?—Ed.

Dear Editor:

The letter from Robert Lorch on page 84 of the May issue reminded me of a similar experience I once had with a Muntz Chassis 47A4. After removing the high-voltage cage to make repairs, I decided to give the set a test run. As soon as the picture came on the screen, black vertical lines also appeared. They weren't extremely dark, but they were noticeable enough to be a nuisance. After I replaced the cage, the lines disappeared. Checking the cathode lead of the picture tube, I found that it passed within three inches of the high-voltage transformer. The set obviously needed the shielding provided by the cage.

JOHN H. WILLIAMS
Williams Electronics
Pompano Beach, Fla.

And we thought all worthwhile protective shields were invisible!—Ed.

Dear Editor:

To date, I have found no fault with your magazine — either with the contents or with the method of binding. I was amused with the letters in the June issue from two readers who are having trouble filing the *Previews of New Sets* and *Video Speed Servicing* sheets. I hope they never have such baffling problems with the "dogs" on the service bench.

I'd like to help anyone who is interested. Taking the PF REPORTER as it comes, if you will just open the front cover of the magazine, use diagonal pliers to cut through the center of each wire staple, and straighten up the ends, you will find that you can lift off the entire green-sheet section very nicely.

Then you can bend down the ends of the staples until they overlap. To get the feeling of a job well done, a little touch of solder to the overlap will keep the magazine safe and secure for the next generation of servicemen.

Once you have the sheets out of the magazine without tearing or resorting to a straight edge (as suggested by the "Ed"), they can be punched to fit an ordinary loose-leaf binder and inserted by *month of issue* rather than alphabetically; then you can make an index, with the brand names listed alphabetically, and insert it in either the front or the back of the binder. Using this system, both the *VSS* data and the *Previews* can be kept together and easily found when neded.

Or, since the *VSS* sheets invariably have information regarding the same make and model of receiver on both sides of any given page, you can simply insert each *VSS* sheet into the specified PHOTOFACT Folder. Then you will never have to look in a special place for it, since it will always be where it is needed, when you need it. (This method is practical only in those shops where all PHOTOFACT Sets are obtained as they are issued — which I strongly recommend.)

DONALD L. BORROR
Ace TV Service
Seattle, Wash.

Now, can anyone think of a better way of removing the green sheets from our magazine? Better be thoroughly briefed on all soldering precautions that apply to printed wiring boards and transistor circuits, however, because soldering the staples is even more delicate.—Ed.

Dear Editor:

In the April 1960 PF REPORTER there was an article entitled "Save Soldering Iron Tips" on page 42. This told how to permanently "tin" your tips. One of the ingredients called for was potassium silver cyanide. Please tell me where I can purchase this. I have tried without success to find it here.

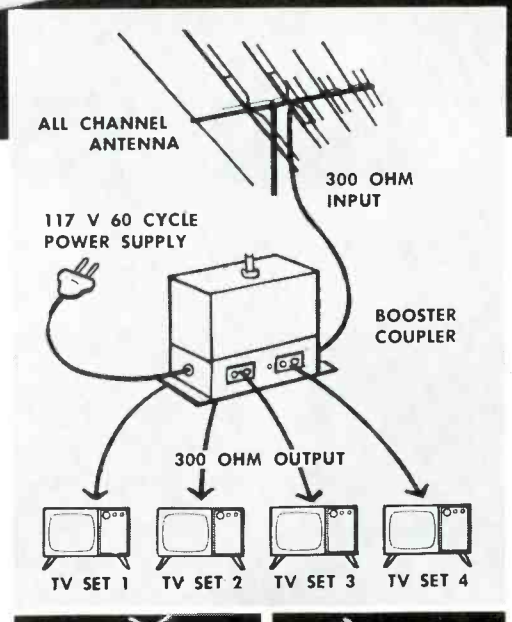
I shall appreciate any help you can give. Thank you.

RALPH DEBERRY
Summerville, Ga.

You'll probably have to make arrangements with a doctor friend and obtain a prescription . . . This chemical is highly poisonous.—Ed.

NEW! WINEGARD BOOSTER COUPLER WBC4

Operates 1 to 4 TV Sets and delivers more signal power. Amplifies all channels 2-13 plus FM.

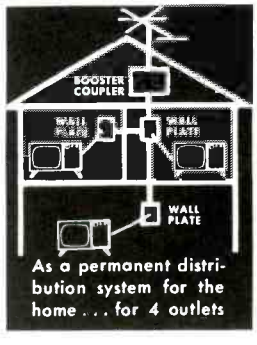


More features, more power, easiest to install

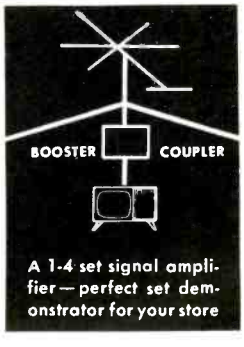
• For operating one set, WBC4 delivers up to 12.5 DB gain all channels, operates 2, 3, or 4 sets with up to 6 DB gain for each set • Powerful frame grid ECC88 tube, shielded and protected (trans-conductance 12,500 micromhos) • Ultra low noise figure • High quality steel housing with baked enamel finish • Compact, only 4¼"x3½"x2½" • Mounts anywhere, behind TV set, in attic, on baseboard • Quick disconnect plug for antenna lead-in • No-strip lead-in terminals • On-off switch • Cord and plug for 117 volt—60 cycle power supply.

Now with one compact package of power, you can install one to four TV sets and get sharper, clearer TV reception even in fringe areas. Ordinary couplers reduce signal going to the set, but the Winegard WBC4 gives the signal power boost you need for perfect television. Installs quickly, easily—4 no-strip terminals, for 4 TV sets, 2 on each side.

$27.50 LIST



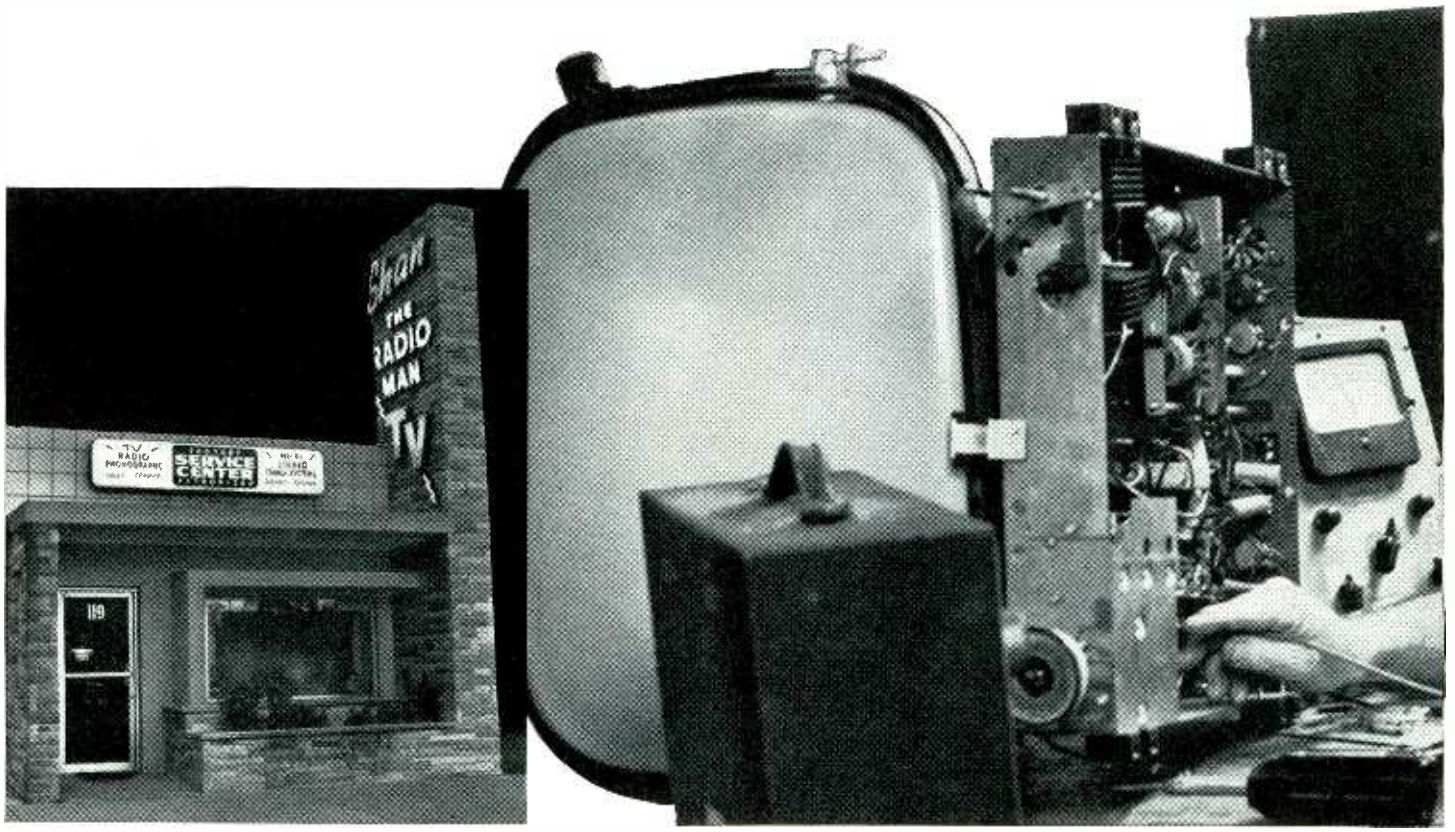
As a permanent distribution system for the home . . . for 4 outlets



A 1-4 set signal amplifier—perfect set demonstrator for your store

Winegard ANTENNA SYSTEMS

THE WINEGARD COMPANY • BURLINGTON, IOWA
3009-6 SCOTTEN BLVD.



Shan the Radio Man says:

"100 years' experience

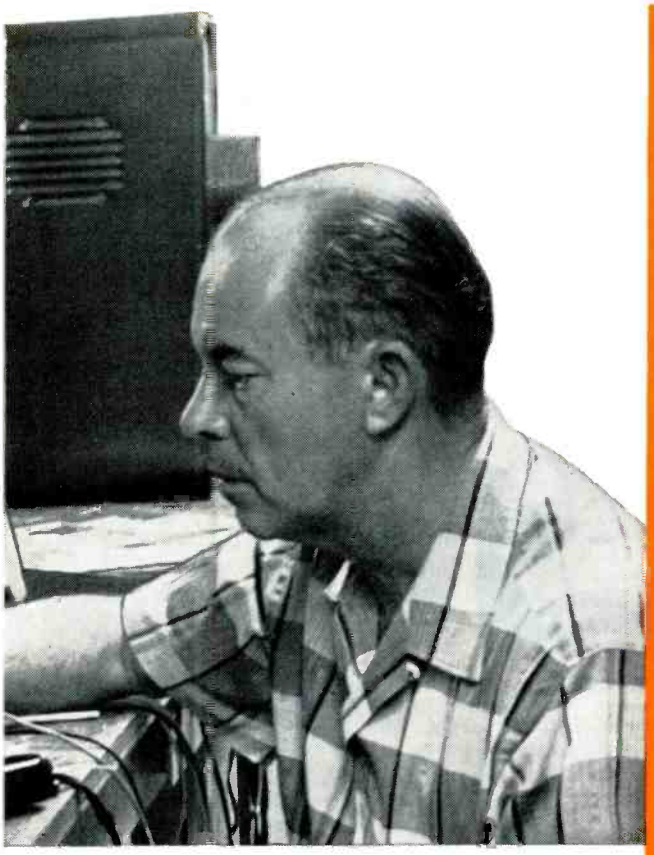
has proved we can depend on Mallory components."

"To be successful, you must make a profit, hire competent technicians, pay a fair salary, give prompt, dependable service and use the best quality components," states Shan Des Jardins, discussing the growth of his business.

"I've used Mallory components since I first started my shop. My shop people and I have a total of a century of experience and we know we can depend on Mallory for top quality components."

Shan runs an exceptional shop . . . the first in Miami to have a complete transistor radio service department, and among the first to service color TV. In all his operations, he relies on quality Mallory components. When electrolytics need replacement, for instance, he knows—as do thousands of other service technicians—that Mallory FP's give extra service in the smaller, hotter cabinets now common for TV and hi-fi . . . or when mounted next to a hot rectifier or output tube, where ordinary replacement filters wilt. They're the original 85°C capacitor. Leak-proof seal and etched cathode construction—available without premium price only in Mallory FP's—assure long life and hum-free performance.

Whatever your component needs, see your Mallory distributor. He carries the widest line of quality Mallory products . . . at sensible Mallory prices.



Shan Des Jardins is owner and manager of Shan the Radio Man Inc. in Miami. A charter member of TESA and Miami Service Association, he also is zone governor of NATESA. In 1928, Shan opened a one-man service shop for battery-powered radios. He now has five technicians and three trucks, handling 20 to 25 calls a day, servicing radio, TV, stereo and hi-fi.

Let's Play Ball!

Over 200 metropolitan New York service dealers and their families recently attended a night game at Yankee Sadium as guests of Leader Electronic Supply Corp., a leading **Sylvania** tube distributor in Elizabeth, N. J. Watching batting practice along with famed Casey Stengel are (left to right) Harry Ellis of Delta TV Service, Marty November of E. J. Korvette, Steve Nagy (son of Del TV employee), Ernie Lazarus of Leader, Bill Shipley of Shipley's TV, and Dave Emmett, Jr. (son of Sylvania tube salesman). Who said servicemen never take time out for fun?

Patent Exposition

Among the 16 electronics equipment manufacturers invited to participate in the Electronics Industry Patents Exposition is **Precision Apparatus Co., Inc.** The government-sponsored exhibit, which shows how the patent system has specifically benefited the electronics industry, will be displayed in practically every principal city in the U.S. In addition to Precision test equipment, the company's display also includes PACE panel meters and PACO kits. All three of these divisions have recently become subsidiaries under the corporate name of PACOTRONICS, Inc.

An "Ear" to the Future

The 1961 **Webcor** line introduced at the Chicago NAMM convention July 11-13 includes nine completely new portable phonos (both monophonic and stereo); six stereo consoles with optional AM-FM stereo radios; six tape recorders, including a 4½ lb., 2" slim push-button operated **Microcorder** briefcase model; and two pocket-sized six-transistor radios, one a SW/AM combination with telescoping antenna.

Capacitor Standards

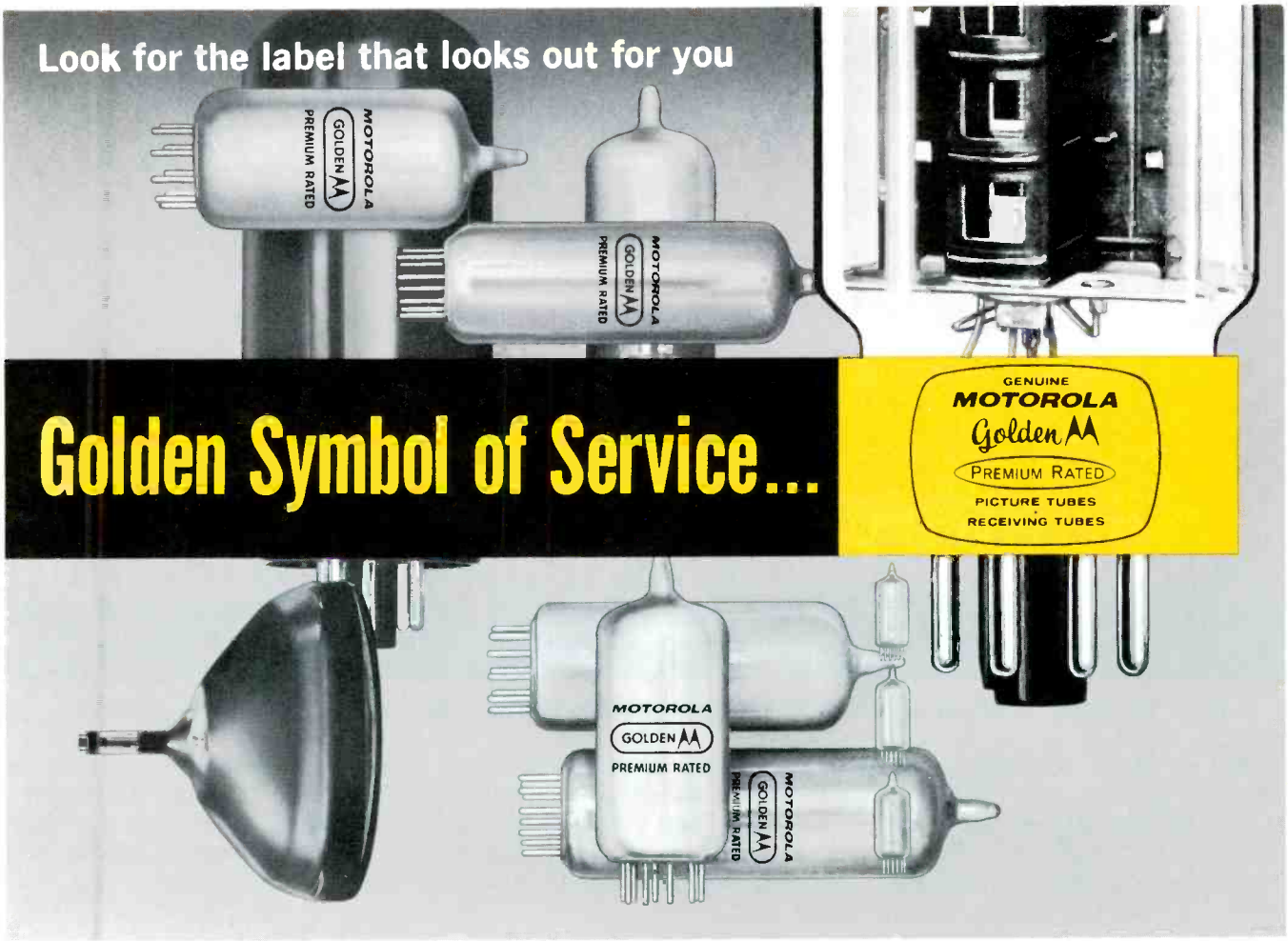
Arco Electronics, Inc., has been awarded Air Force and Naval Ordnance contracts for their SS-32 kits of miniaturized precision capacitor standards. Each kit contains a set of 32 units ranging in values from .0001 to 0.5 mfd. In conjunction with a four-position adapter, up to four units may be combined to provide capacitance values accurate to four significant figures within ±0.1%.

Hear, Hear!

Sonotone's new super-sensitive transistorized hearing aid, weighing only 1/2 oz. with battery, and measuring 1/2" x 11/16" x 1 1/4", contains 153 parts in only a half cubic inch of space. Known as the Model "66," the miniature aid is powered by a 70-hour aspirin-sized battery that sells for about 35¢, and provides amplification of 10,000 times even at temperatures of 120° or more.

More Room for Meters

Triplett Electrical Instrument Co. is expanding plant facilities for the second time in three years, following an over-all expansion program designed to increase and diversify the company's product lines. Scheduled for completion this fall, the new construction will more than double the meter assembly area.



The most reliable tubes ever for every set you service

The circuit tubes that "couldn't be built" are at your service: Motorola Premium Rated Golden "M"® Tubes. They're torture-tested by MOTOVAC (the Motorola-created electronic brain) to TWICE MAXIMUM PUBLISHED EIA RATINGS.

The result: Service technicians everywhere experience far fewer call backs . . . and win increased customer good will by stocking and selling the most reliable receiver tubes ever!

NEW GOLDEN "M" PICTURE TUBES UP TO 10 TIMES MORE RELIABLE THAN TUBES WITHOUT THE "INTRUSION GUN" SYSTEM

New Tube-Saver Electron Gun ends main cause of tube failure. The "intrusion gun" system provides electrons from a 10 times greater effective area on the cathode . . . greatly reducing breakdown of cathode emission area as compared to tubes without the "intrusion gun" system. Peak amperage drops from 2 milliamps to .2 milliamps per unit area. The Electron Gun with its new construction shoots a small picture producing dot for added brilliance and clarity.

Contact your Motorola Distributor today for further details on fabulous Golden "M" Receiver Tubes and Picture Tubes. They're premium-rated at no premium cost to you.

MOTOROLA

CONFIDENCE BRAND NAMES SATISFACTION REG. PENDING

PARTS AND ACCESSORIES, FRANKLIN PARK, ILLINOIS

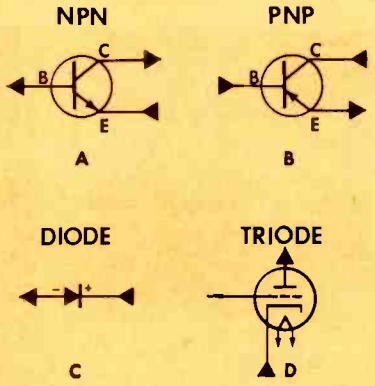


Fig. 1. Electron flow in NPN and PNP transistors, crystal diode, and tube.

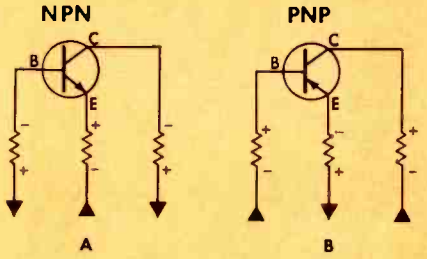


Fig. 2. Voltage drops caused by current flow in NPN and PNP transistors.

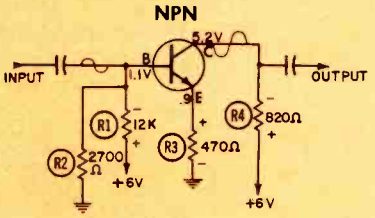


Fig. 3. NPN emitter and collector voltages follow pattern similar to tube.

VOLTAGE ANALYSIS of TRANSISTOR CIRCUITS

How to make maximum use of VTVM readings in troubleshooting . . . *by Joe A. Groves*

Most of us cut our eyeteeth on voltage measurements in radio and TV troubleshooting, so it's only natural for us to think of measuring voltages when confronted with the repair of a transistor radio. Luckily, this type of troubleshooting procedure is made to order for tracking down defects in transistor circuits.

The voltage-analysis method has several advantages over other troubleshooting techniques. The predominant point in its favor is that the test measurements of transistors and other components are made under "in-circuit" conditions. (This advantage becomes even more important when you consider removing or disconnecting soldered-in transistors for testing.) In addition, properly-interpreted voltage measurements indicate positively whether circuit operation is normal or abnormal, whereas in-circuit resistance measurements are often upset because the ohmmeter test voltage causes transistor conduction. Another point is the technician's familiarity with the test instrument itself; a VTVM is a well-understood and widely-used piece of equipment.

Note that a VTVM is specified as a standard for transistor work; the reasons are obvious when circuit impedances and voltage tolerances are considered. Most voltages are read on the lower meter ranges, and variations of even one-tenth of a volt may be important. Therefore, an accurate and well-balanced meter (one that doesn't require zeroing as different ranges are selected) makes the most efficient test instrument.

Voltage Development

A basic requirement for effective voltage troubleshooting is an understanding of how the potentials at the various transistor elements are established. This understanding isn't difficult to master in tube circuits, since current always flows in a consistent pattern from cathode to plate. However, transistor currents do not necessarily conform with this pattern. In order to understand what happens in transistor circuits, we must consider both PNP and NPN configurations.

While this isn't an article on transistor theory, we can't ignore the subject entirely. Since the electronics industry is well grounded in vacuum-tube theory, it has been only natural to liken the transistor's operation to that of a tube, with emitter, base, and collector corresponding to cathode, grid, and plate. This comparison works beautifully — sometimes. It doesn't work so well, however, when applied to circuits including PNP transistors. When we try to understand these in terms of tube-circuit operation, we encounter a terrific mental block because we find current entering the collector and leaving the emitter. (This would be the same as current flowing from plate to cathode in a tube!)

Electron Flow

The direction of electron flow is of primary importance in understanding voltage drops across circuit components. The symbols used to depict transistors are helpful reminders of where the electrons are heading, if you know the meaning of the arrow at the emitter. Remember that the electrons are always moving *against* this arrow(just as in a selenium or silicon rectifier). The heavy arrows outside the symbols in Fig. 1 show the actual direction of electron flow in three common semiconductors and a tube.

The emitter arrow inside each transistor symbol makes it easy to tell one type from the other, if you merely remember that the arrow is "pointing in" for PNP and "not pointing in" for NPN.

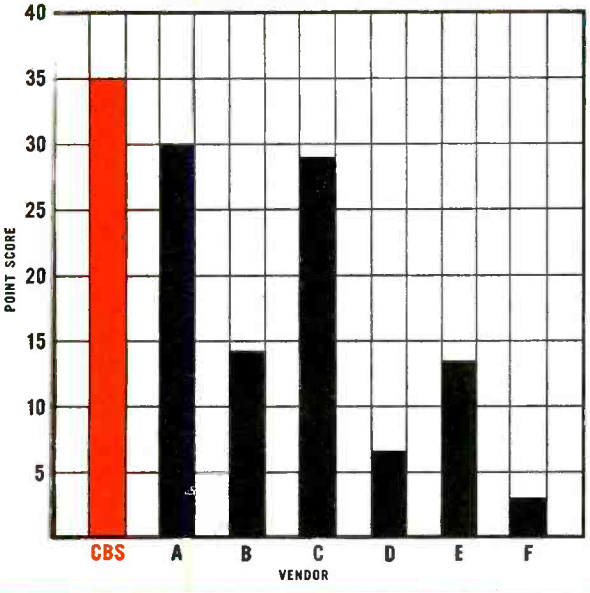
As evidenced by Fig. 1, two major differences must be considered when comparing transistors to tubes: Transistors have base current flowing during normal operation, while a tube doesn't usually have grid current; also, in PNP-type transistors, the collector current flows through the circuit in the op-

• *Please turn to page 57*

Leading set manufacturers RATE CBS RECEIVING TUBES TOPS

. . . IN VENDOR RATINGS

Set Manufacturer X — 30 Tube Types



. . . IN LOTS ACCEPTED

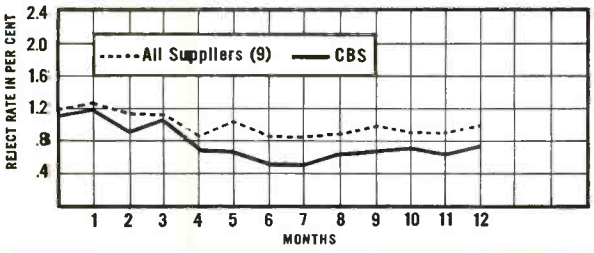
Set Manufacturer Z

Tube Type	Lots Received	Lots Accepted	Lots Rejected	Rating*
A	5	5	0	*Preferred*
B	2	2	0	*Preferred*
C	1	1	0	*Preferred*
D	10	10	0	*Preferred*
E	3	3	0	*Preferred*
F	4	4	0	*Preferred*
G	1	1	0	*Preferred*
H	6	5	1	*Fair*
I	5	5	0	*Preferred*
J	2	2	0	*Preferred*
K	1	1	0	*Preferred*
L	7	7	0	*Preferred*
M	1	1	0	*Preferred*
N	4	4	0	*Preferred*
O	1	1	0	*Preferred*
P	12	12	0	*Preferred*
Total	65	64	1	

**Ratings: Preferred, Excellent, Good, Fair, Poor, Unsatisfactory*

. . . IN LOWEST LINE REJECTS

Set Manufacturer Y



. . . IN LOWEST FIELD REJECTS

Set Manufacturer Z

Tube Type	Per Cent Rejects	
	All Vendors	CBS
1	.7	.3
2	.8	0
3	.9	1.0
4	.5	.5
5	.8	.3
6	1.6	1.1
7	.4	.1
8	.8	.8
9	.5	.5
10	1.7	.8

TOTAL RELIABILITY . . . proved in performance

Receiving, industrial and picture tubes • transistors and diodes • audio components • and phonographs

Yes, CBS receiving tubes are rated tops by leading TV and radio set manufacturers. Any way you want to look at it — vendor ratings . . . lots accepted . . . lowest line rejects . . . lowest field rejects — during 1959 these facts as reported by leading set manufacturers proved CBS tubes superior. This same total reliability . . . continually proved *in performance* by set manufacturers can be yours for the asking. Just ask for CBS tubes . . . always.

CBS ELECTRONICS

Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

Questions & Answers ON TV

Have trouble following written alignment instructions?

Bill, the service manager of a nearby shop, holds an after-hours training session every month for his crew of four technicians. We dropped in one evening last week, and found them getting ready to hash over the subject of video IF alignment. As the sets and test equipment were warming up for demonstrations, we decided to stay and listen in.

BILL: I know you fellows are the same way I used to be — tell you to align a set, and you can't wait to start turning slugs. But it's important to consider first whether the set really needs an alignment job or not.

GEORGE: How can you tell, without going through a complete alignment procedure?

BILL: Well, you'll have suspicions if the picture displays ringing, is smeared, or lacks detail even after you've checked tubes, voltages, etc. You'll actually have to follow part of the alignment procedure, but no more than necessary to obtain an over-all IF response check. This doesn't take long, once you have the equipment all set up.

DAN: Do you use a scope for this check?

BILL: Yes, Dan; take a look at these alignment instructions for the set we're going to check out. [Fig. 1] What equipment are we going to need?

DAN: Uh—sweep generator, marker generator, scope, and—I guess that's all!

BILL: Almost all, but look up near the top; doesn't it mention something about bias voltage?

DAN: Oh, I see. It says, "Connect the negative lead of a 1.5-volt bias supply to point A. Positive to chassis. Connect the negative lead of a 3-volt bias supply to point B. Positive to chassis."

BILL: Okay. This commercial bias pack will supply both voltages.

JOHN: Why do you have to apply bias at two places?

BILL: This set has a keyed AGC system, and so the AGC network has separate RF and IF branches. We've got to control 'em both.

Let's connect up the equipment. The order you follow isn't important, as long as you make sure everything is done properly so you'll have no doubts about the indications you obtain. Never take short cuts; if you don't follow the alignment procedures to the letter, you'll never be positive of the results.

FRED: Is there much difference in the hook-up for various sets?

BILL: What do you mean?

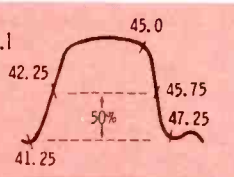
FRED: Do you use different pieces of equipment and connect them up in different ways?

BILL: No; for an over-all response check or sweep alignment, the equipment and the hook-up are basically the same for every set. You'll find minor differences, though, in coupling the generator and scope to the set, biasing different points, and sometimes adjust-

VIDEO IF ALIGNMENT

Set AGC switch to "Local" position
Connect the negative lead of a 1.5 volt bias supply to point (A). Positive to chassis.
Connect the negative lead of a 3 volt bias supply to point (B). Positive to chassis.
Connect the synchronized sweep voltage from the sweep generator to the horizontal input of the oscilloscope for horizontal deflection.
Use only enough sweep generator output to provide a usable pattern on scope.
Use 10MC sweep unless otherwise noted.
Detune Mixer Plate Coil by turning core fully counterclockwise.

FIG. 1



DUMMY ANTENNA	SWEEP GENERATOR COUPLING	SWEEP GENERATOR FREQUENCY	MARKER GENERATOR FREQUENCY	CHANNEL	CONNECT SCOPE	ADJUST	REMARKS
.001mfd	High side to pin 1 (grid) of 1st Video IF Amp. Low side to chassis.	43.5MC (10MC Swp)	47.25MC	Any non-interfering high band channel	Vert. Amp. thru 10K to point (C). Low side to chassis. (Across Video Det. load)	A1, A2	Adjust to place 47.25MC marker in trap notch. If two points are found to do this, use the one with slug farthest from chassis.
"	"	"	42.25MC 45.0MC 45.75MC 47.25MC	"	"	A3, A4, A5	Adjust for maximum gain and symmetry of response similar to Fig. 1 with markers as shown. Tune A3 for maximum gain, A4 to place 45.75MC marker at 50% and A5 to place 42.25MC marker at 50% on other side.
Direct	Place a thin insulated metal strip between the Mixer-Osc. tube (V202), and tube shield. Connect the high side of sweep generator to the metal strip. Low side to chassis.	"	41.25MC	"	"	A6	Adjust to place marker in trap notch. If two points are found to do this, use the one with slug farthest from chassis.
"	"	"	41.25MC 42.25MC 45.0MC 45.75MC	"	"	Mixer Plate Coil & A7	Adjust Mixer Plate Coil for maximum gain with 45.75MC marker at 50%. Adjust A7 for maximum gain and proper tilt. Repeat until proper response (Fig. 1) is obtained.

Fig. 1. Full instructions for aligning a three-stage video IF strip by the sweep method.

ALIGNMENT

Join this training session

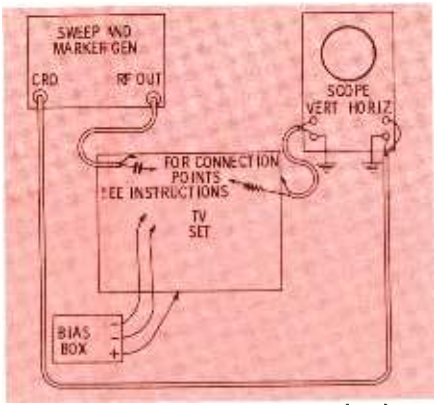


Fig. 2. Basic test equipment hook-up for performing a sweep alignment.

ing TV controls to certain positions.

GEORGE: Would you mind explaining each connection as you make it?

BILL: Sure will—that's what I think you fellows really need. Dan, what does it say about the generator?

DAN: Uh—"connect the synchronized sweep voltage from the sweep generator to the horizontal input of the oscilloscope for horizontal deflection."

BILL: All right, notice the horizontal trace on the scope. To get ready for alignment, I flip the scope's sweep selector to the *external horizontal* position—or, in some scopes, it would be called the *horiz amp* position. This kills the horizontal sweep, and the line collapses to only a dot on the screen. Now I take the cable leading from the *CRO* output terminal on the generator and connect it to the horizontal input terminals of the scope. Notice how the trace appears again! I can also vary the width of the trace by adjusting the scope's horizontal gain control.

JOHN: Why do we have to use a special sweep from the generator? I mean, how come the scope's own internal sweep isn't usable?

BILL: The problem has to do with the *waveform* of the sweep voltage. The *CRO* output of the generator is a sine wave, while the scope's internal sweep signal is sawtooth-shaped. You see, the *CRO* output is a sample of the 60-cycle sine-wave signal which frequency-modulates the RF output of the sweep generator.

FRED: 60 cycles?

BILL: Yes—this represents the number of times each second the generator's RF output is swept back and forth across the frequency band being covered. As the output frequency varies according to the 60-cycle modulation, the scope trace follows exactly in step with it. The result is a response curve—actually a graph of IF gain versus output frequency.

But if we tried to use the scope's own sawtooth sweep to view a response curve, it would be something like measuring the length of a coiled rope with a straight ruler. We'd get a pattern, but it would be badly distorted; some parts would be bunched up and others spread out. Now, John, do you see how it is?

JOHN: Yes, I get the idea.

FRED: In the first column of the alignment instructions, what does the "dummy antenna" mean?

BILL: This term has nothing to do with an actual receiving antenna; it just tells you how to couple the signal generator to the receiver. For the first couple of steps in the procedure, I'll attach a .001-mfd capacitor to the hot lead of the generator, and connect the other side of the cap to the grid of the first video IF. Next, I clip the ground lead to chassis. Notice that I put it very close to the first IF tube; this helps to prevent odd effects due to circulating RF currents in the chassis.

GEORGE: Where do you connect the scope?

• *Please turn to page 65*

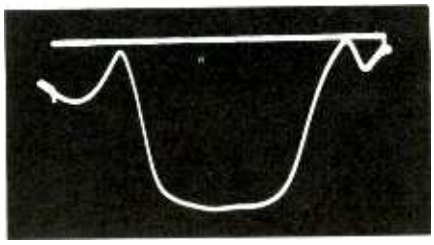
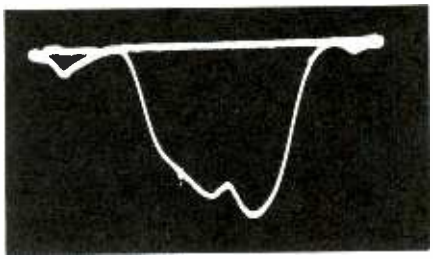
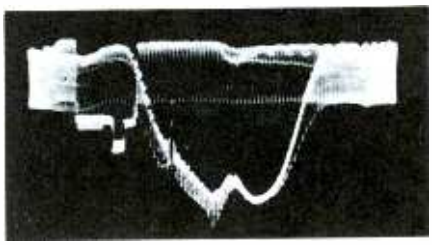


Fig. 3. Overloading produces deceptively flat bottom on response curve.

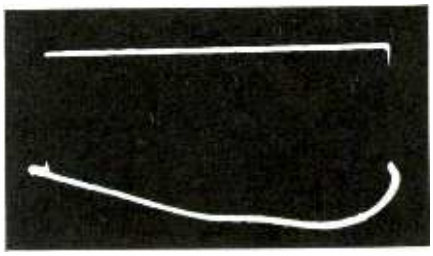


(A) Interference from oscillator.

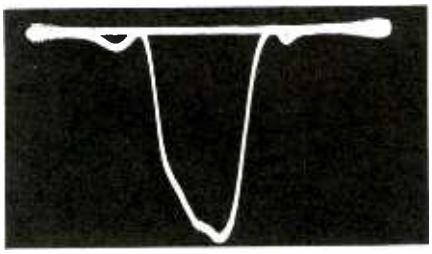


(B) Interference from video signal.

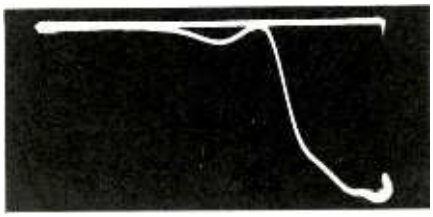
Fig. 4. Distortion due to wrong setting of the channel-selector switch.



(A) Insufficient sweep width.

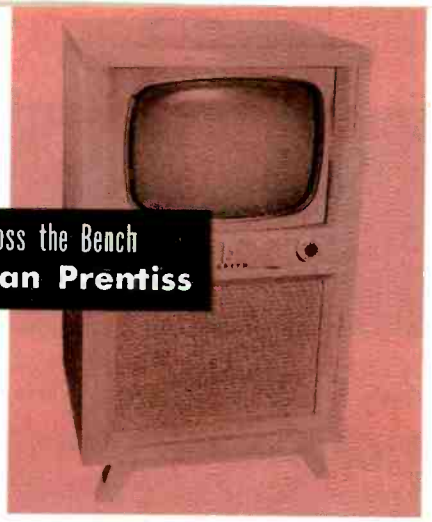


(B) Excessive sweep width.



(C) Dial set at wrong frequency.

Fig. 5. Distortion due to incorrect setting of sweep-generator controls.



Across the Bench
by Stan Prentiss

3-Point Checkup for a ZENITH 19K23

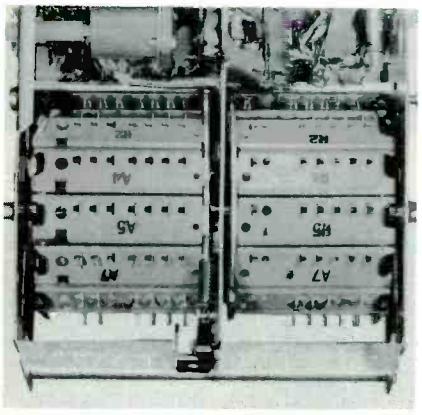


Fig. 1. Turret strips of the Bull's Eye tuner have rows of blade-like contacts.

"Whenever we change stations, it's getting so we have to wiggle the channel knob back and forth several times before the station will come in," the customer told me. "Even then, if the set is jarred a little bit, sometimes the picture will disappear completely — and we have to work the knob again to bring it back. We've put up with this for some time, but lately it's been happening several times every evening."

The set was a seven- or eight-year-old Zenith — a K2258R, using Chassis 19K23 — and I knew right away what to suspect. Most of the circuits in these old-time Zenith sets perform very well and give little trouble; however, the blade-like contacts on the turret strips of the *Bull's Eye* tuner (Fig. 1) are known to become tarnished with age so that they make poor connections.

With this trouble in mind, I asked the customer's permission to take the set to the shop so that I could clean and tighten the contacts, in addition to giving the set a complete checkup. She agreed, and said, "While you're at it, would you see if you can take that buzzing noise out of the sound?"

I replied that I would, since I remembered that the set had an early version of the 6BN6 gated-beam sound detector (Fig. 2), probably long past due for realignment.

"Oh, and one other thing," she added. "The picture flips every now and then. It hasn't bothered us enough to have you make a special call, but we'd like to have it taken care of now."

I'd noticed a few frames of vertical rolling after the set had been playing for several minutes, and I recalled that the vertical sweep circuit (Fig. 3) was one of the few peculiar trouble spots of this chassis; so I made a mental note to check a few things in the vertical section when I got the set on the bench.

Tuner Tuneup

Back in the shop, I went to work on the tuner contacts with a cleaning solvent. Then, taking a soldering aid, I carefully tightened up some loose lugs on the tube sockets. The stationary wipers which make contact with the movable "knife edges" seemed to be properly positioned, so I left these alone. By the way, if you ever work on one of these tuners, keep in mind that it's very important *not to spread apart or "spring" the wipers*. By all means check to be sure they make firm contact with the "knife edges," but use extra caution if you attempt to adjust their spring tension. You may find some of these tuners with very dirty, gummy contacts; if you do, you can speed the cleaning job by scrubbing the "knife edges" with a

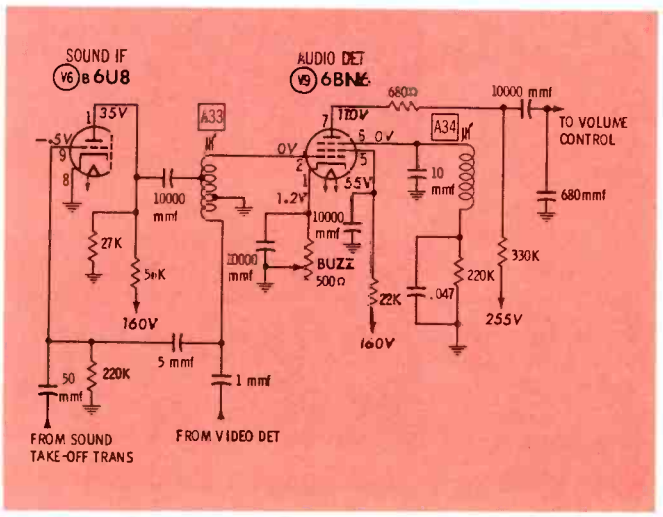


Fig. 2. Buzz control adjusts operating point of tube.

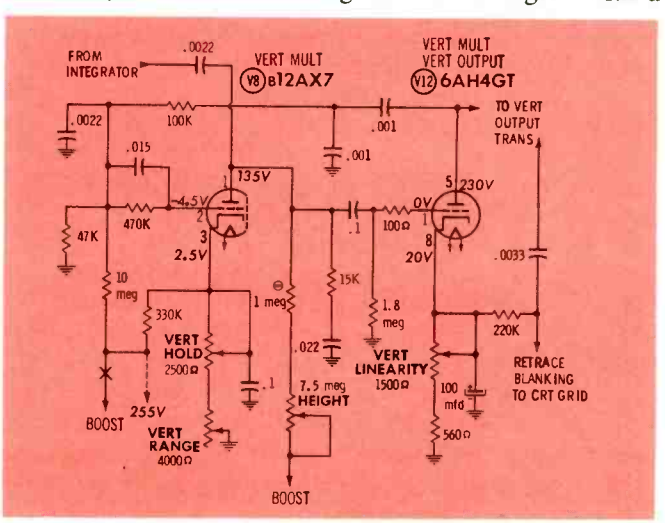


Fig. 3. Output tube is second half of multivibrator.

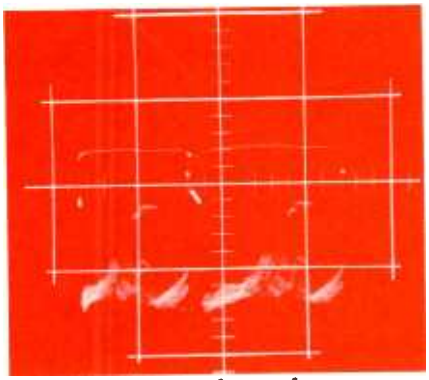
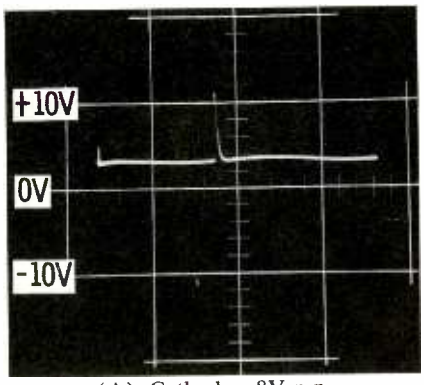
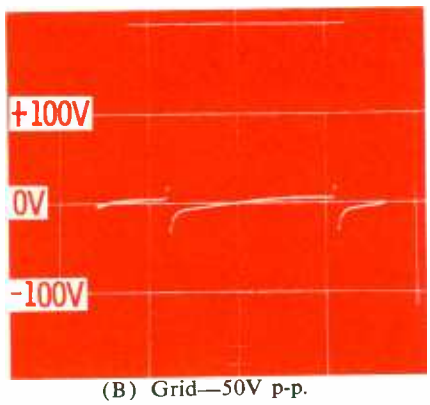


Fig. 4. Input waveform of sync separator showed slight pulse compression.



(A) Cathode—8V p-p.



(B) Grid—50V p-p.

Fig. 5. Waveforms on tube V8B.

lint-free cloth such as a scrap of an old bedsheet.

This cleaning job turned out fine, but I didn't consider it completed until I'd touched up all the oscillator adjustments and checked the AGC-control setting. After doing all this shop work, I couldn't afford to have the customer see a fuzzy picture and think, "He didn't get the trouble all fixed."

Buzz Eradicator

The gated - beam audio - detector circuit in this set (Fig. 2) is relatively simple and trouble-free, and the 6BN6 tube generally has a long life. However, the buzz control R12 needs adjustment from time to time in order to set the correct operating point of the 6BN6. To help explain the importance of this control, let's take a moment to see how the detector circuit works.

The plate current of the tube is concentrated into a narrow beam which can be closely controlled by both the limiter grid (pin 2) and the quadrature grid (pin 6). The input from the sound IF, a frequency-modulated 4.5-mc signal fed in at pin 2, sets up fluctuations in plate current. These induce a corresponding signal in the quadrature-grid circuit, which is tuned to 4.5 mc.

Remember I said that the input signal is frequency-modulated; in other words, the audio signal "riding" on the sound carrier wave will cause the carrier frequency to fluctuate above and below 4.5 mc. As the input frequency varies, the amount of phase difference between the limiter - grid and quadrature - grid signals also varies. (The signal at pin 6 lags the one at pin 2 by 90° at exactly 4.5 mc; this angle of lag increases at frequencies below 4.5 mc, and decreases at frequencies above 4.5 mc.) These phase changes govern the tube's operation by causing the *average* plate current to rise and fall at an audio-frequency rate. Actually, the plate current consists of 4.5-mc pulses which vary in strength according to the audio modulation of the sound carrier. These pulses are integrated by an RC network in the plate circuit to produce a pure audio signal.

Frequency modulation is thus detected by the 6BN6; however, the tube must reject amplitude modulation, which consists mainly of noise ("static") and sync pulses not completely eliminated from the sound IF signal by the sound take-off circuit. If not removed by the detector, these pulses will cause an unpleasant buzz. The 6BN6 circuit, when properly adjusted, automatically eliminates amplitude modulation. The limiter grid has a very sharp cutoff characteristic, and an input signal of only a few volts peak to peak will drive the tube into saturation on positive signal peaks, and into cutoff on negative peaks. This clipping action eliminates any amplitude modulation very nicely.

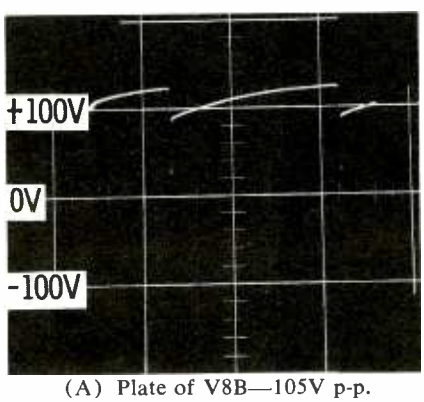
There's one caution: The bias on the 6BN6 must be properly set to insure that even a weak signal will be able to achieve full limiting. With too much or too little bias, the clipping of either negative or positive peaks may be incomplete. The buzz control is intended to take care of this problem. It was easy to find the correct setting; I just listened to the results while adjusting the control. Tuning in a regular station signal, I disconnected the antenna in order to reduce the signal strength, causing a noticeable hiss to appear in the sound. (This indicates that the input signal isn't quite strong enough for complete limiting.) Next, I adjusted quadrature slug A34 (Fig. 2) for clearest sound, and rotated the buzz control for minimum hiss and buzz without any decrease in audio level. The detector-input slug A33 also needed a slight touch-up; I tuned it in the same way as I did A34.

The alignment instructions for some newer sets specify a slightly modified technique using a strong signal for quadrature-coil adjustment. But the procedure is still simple, can be done with minimum effort, and pays off in clearer sound.

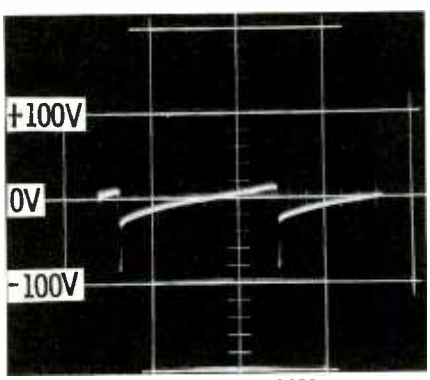
Roll-Stopper

With the tuner and sound troubles solved, I turned my attention to the intermittent vertical rolling. The

• *Please turn to page 62*

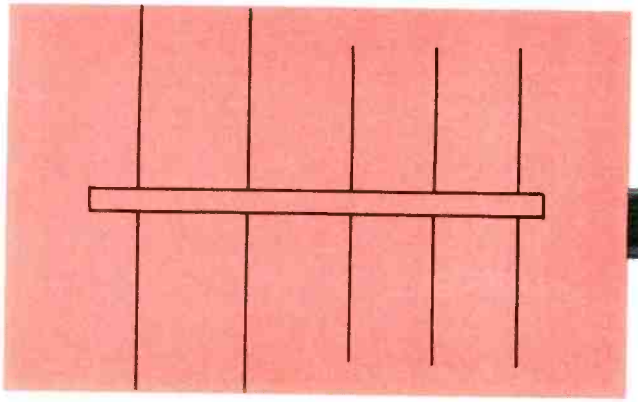


(A) Plate of V8B—105V p-p.

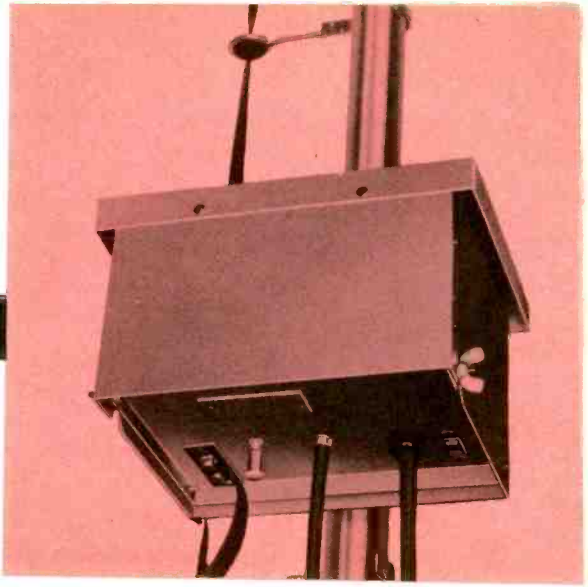


(B) Grid of V12—100V p-p.

Fig. 6. Vertical drive waveform.

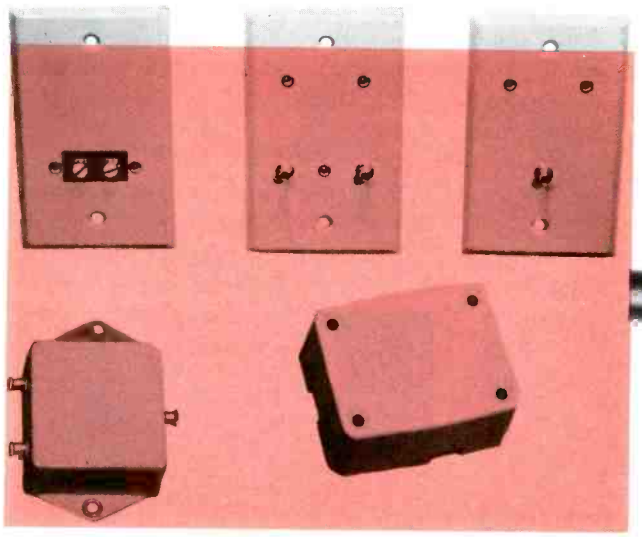


Choosing the antenna or antennas is the first step. High band, low band, all-channel, UHF, FM — what you install depends on the area. Remember, the customer is going to want good reception on all available channels. Multiple single-channel antennas are often preferred, where needed, to reduce ghosts, increase signal-to-noise ratio, etc., but some installations require only one all-channel model.

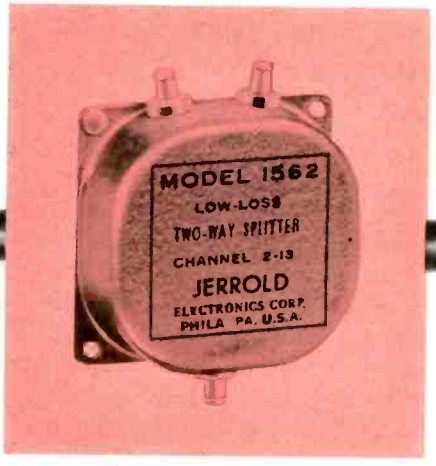


This mast-mounted single-channel amplifier matches a 300-ohm antenna to 75-ohm coax. In addition to providing roughly 16 db gain. Some installations may call for an attenuator or a simple passive matching unit in this spot, while smaller systems may require no unit at all.

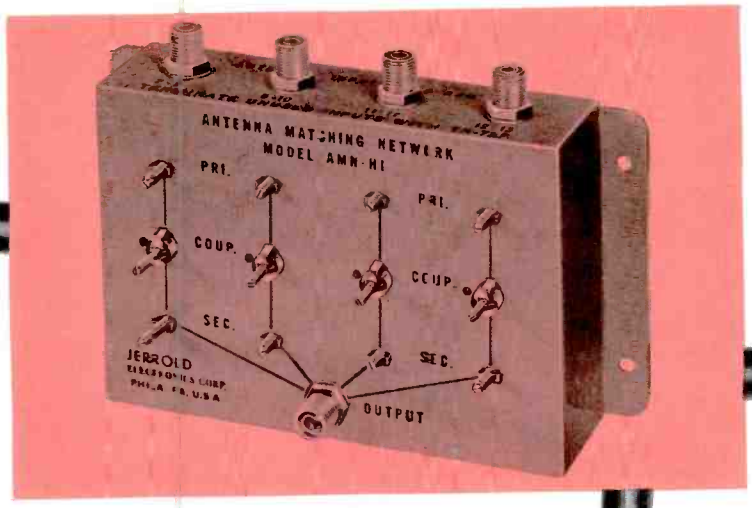
Components for MASTER ANTENNA SYSTEMS



At each receiver location, the signal must be taken off with minimum attenuation and maximum isolation, and the line must be matched to the receiver input. A wide variety of tap-off and matching devices for one or two receivers are available to meet any requirement. The stub end of each feed line must be terminated with a 75-ohm resistor, or terminating assembly, to prevent the development of standing waves.



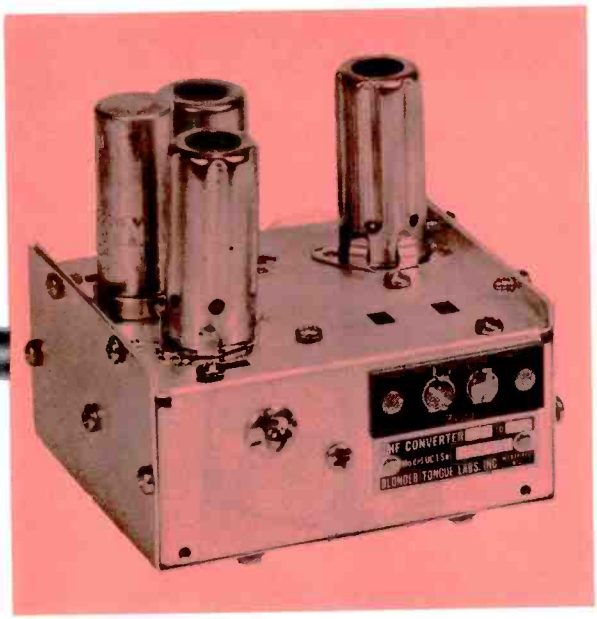
In the distribution lines running from the amplifier to the various receivers, splitters are used to divide main lines into additional branches. Minimum signal attenuation and maximum isolation are the important characteristics of these units.



Some sort of mixing or matching unit must be used when two or more antennas are connected to the same "down line." If additional signal strength is required, you can get it from a mixer amplifier — if not, a low-loss, non-amplifying coupler (as shown) can be used.

Potential sales of master antenna systems exist almost everywhere — in cities, towns, villages, and even rural locations. Practically every area has a hotel, motel trailer park, hospital, institution, nursing home, school or apartment house that can improve reception with master system installation.

This pictorial block diagram shows typical components selected at random from major suppliers' lines. The captions explain the purpose of each unit and include some tips about the technical aspects of planning a system. To be sure, requirement will vary from job to job— a 20-space trailer park is a lot different from a four-apartment dwelling or a hundred-bed hospital. But knowing what is available in the way of equipment as well as how it is used, will make planning an installation much easier.

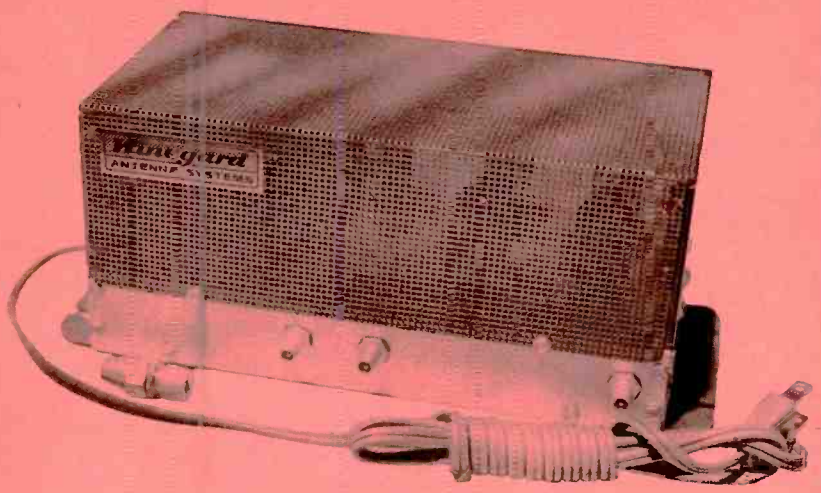


Live in a UHF area? Units such as this are used to convert any given UHF channel to a VHF channel of your choosing. Although each UHF channel requires its own converter, use of this type of unit eliminates the need for individual converters at each set.

TRANSMISSION LINE	IMPEDANCE IN OHMS	ATTENUATION IN DB/100'		
		50MC	100MC	200MC
RG-59/U	72	2.5	3.5	5.8
RG-11/U	72	1.4	2.0	3.2
TUBULAR TWIN LEAD	300		1.4*	2.05*
FLAT TWIN LEAD	300		1.1*	1.7*
HEAVY DUTY TWIN LEAD	300	.7*	1.1*	1.7*

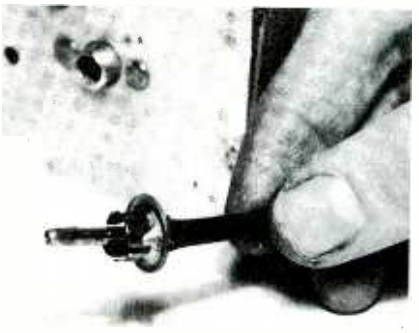
*LOSS OF FLAT LINES INCREASES UP TO 6 TIMES WHEN WET

To determine the system's signal requirements, all losses must be calculated. Every matching, splitting, and tap-off unit is rated at a certain db attenuation; also, line losses must be computed. RG-11/U coax has less attenuation than RG-59/U and is normally used for trunk lines, while lower-priced RG-59/U is usually used for short runs. All losses and amplifier-gain figures are given in db, where 0 db equals 1000 microvolts. Once the losses are added, the total is subtracted from the measured figure for the signal at the antenna. The result shows the amount of signal remaining and the amount of amplification required.



The heart of most master antenna systems is the broad-band distribution amplifier, which may be the only amplifier in the system. Its purpose is to provide signal amplification over the entire VHF band at a low noise level, with sufficient isolation between the various outputs to prevent interaction. Normal gain figures range from 15 to 25 db.

TIPS for TECHS

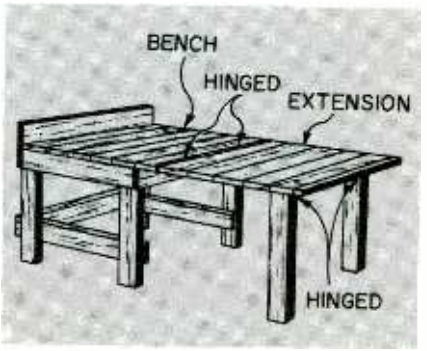


Washer Eliminates Phono Plug Trouble

The cable attached to a phono pin plug eventually pulls loose. Why? Because the plug itself is very difficult to get hold of, and the natural (and about the only) thing to do is to grab the wire cable and pull it. Why not give phono plugs a handle by soldering on a 3/16″ metal washer?

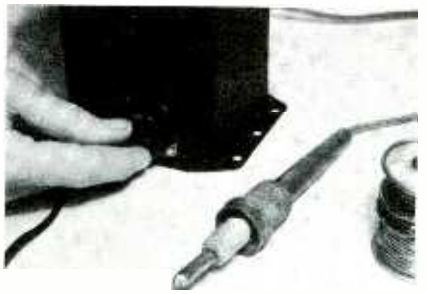
Protector for Soldering-Gun Light

Have you ever tossed some tools into your toolbox and discovered later that you accidentally broke the bulb of your soldering gun? This can be a very disgusting experience, for it is very difficult to remove the remains of the bulb so a new one can be inserted. Inexpensive insurance against bulb breakage and wasted time is a rubber grommet slipped over the bulb as shown. A touch of service cement may be needed to hold the grommet in place.



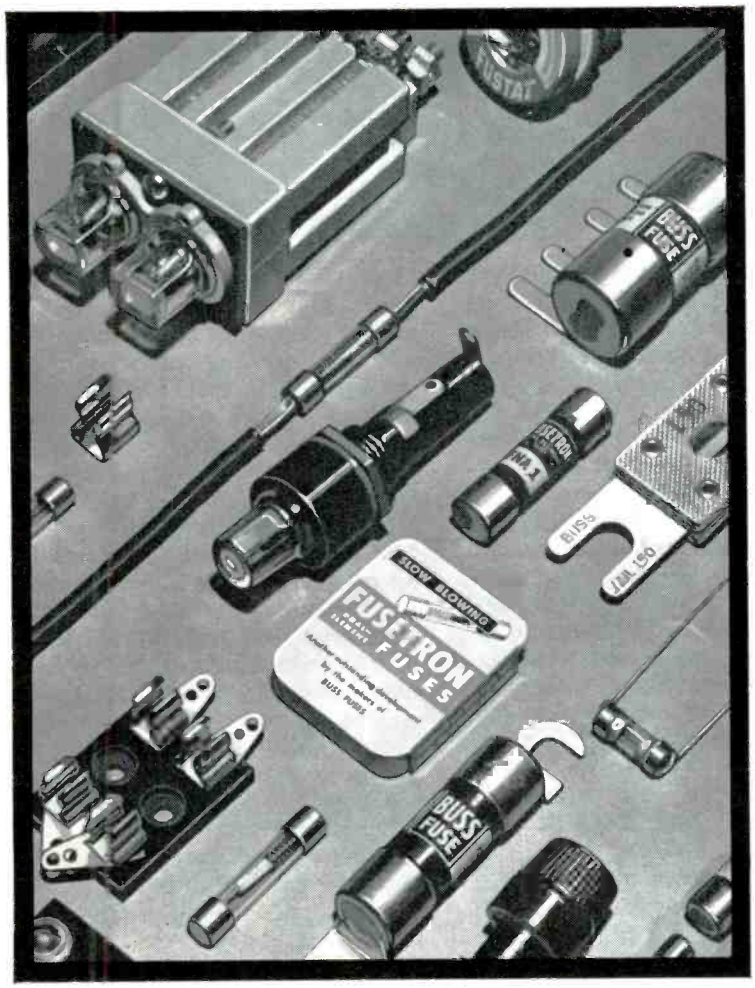
Service Bench Extension

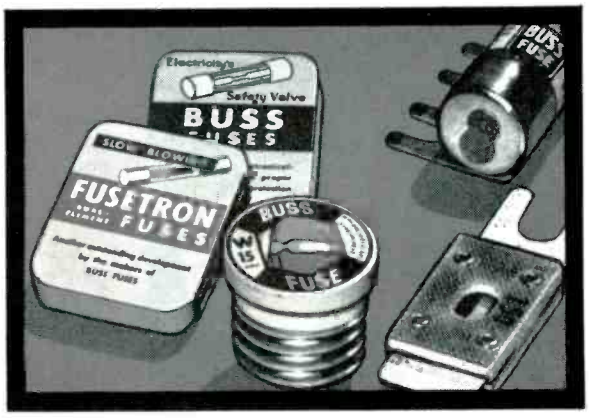
To service sets efficiently in a small shop where space is at a premium, utilize the bench-extending setup shown in the sketch. This way you will have enough space for an ordinary volume of repair work, with about twice as much space "on call" when needed for large-volume servicing. When activity is normal, simply fold down the extender. The two front legs are hinged to fold in towards each other, and are placed so the extension can lie flat against the front of the bench when not in use. To keep the extension from accidentally collapsing when raised, be careful to keep from kicking the legs in toward each other. (Small blocks of wood nailed to the floor will prevent this.) You'll find this expandable bench to be a real convenience.



New Life for an Aged Iron

If you have used your pencil iron for quite some time and have never replaced its heating-element tip, chances are it is working at reduced heat because of an aged filament. To boost the tip temperature, plug the iron into an isolation transformer and set its switch for a 10% higher voltage output. This gives the tip a longer useful life — otherwise, the aged element would have to be discarded.





In the *complete* BUSS line...

you can quickly find the right fuse and fuseholder to meet every demand!

Dual-element "slow-blowing", single-element "quick-acting" and signal or visual indicating type fuses . . . plus a companion line of fuse clips, blocks and holders . . . are available from one source — BUSS. You'll save time and trouble by turning first to BUSS when you need fuses and fuseholders.

To safeguard against 'kicks' or complaints, every BUSS fuse is tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected to assure dependable protection under all service conditions.

Your customers know and prefer BUSS fuses. The universal trade and consumer acceptance of BUSS fuses is based on the millions upon millions of BUSS fuses used in homes, on farms and in industry over the past 46 years. Handling Known brands, such as BUSS fuses, helps protect your reputation for service, — and the dependability of BUSS fuses safeguards you against costly, unnecessary call-backs.

For more information on BUSS and FUSETRON small dimension fuses and fuseholders . . . Write for bulletin SFB. 860

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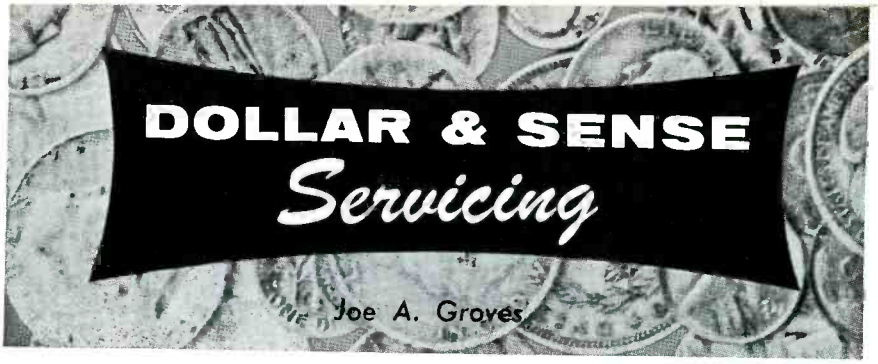
BUSS fuses are made to protect - not to blow, needlessly.
BUSS makes a complete line of fuses for home, farm, commercial, electronic, electrical, automotive and industrial use.

FUSETRON BUSS — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — McGRAW EDISON



Nerves of Steel? Do you have enough self-confidence and servicing ability to do good bench work while your every move is being scrutinized by a watchful customer? If so, you might consider adding a "While-U-Wait" service to your operation for handling portable radios, auto radios, and even TV portables.

The promotional aspects of such a service are almost unlimited. The slogan, "See your set being serviced," would have an especially strong appeal to the public, combining the fascination of seeing a craftsman at work and the assurance of honest repairs. Some other usable themes are, "Save pickup and delivery costs." "Bring your set in for service while you're shopping." "Planning an outing? We'll fix your portable While-U-Wait."

If you're reluctant to work in a goldfish-bowl atmosphere, but still don't mind hearing a customer pace back and forth in front of your counter, you could retire behind a curtain (or into a back room) and still perform While-U-Wait jobs.

Of course, if you add this service, you must be prepared for it. You'll have to have adequate servicing facilities to handle all types of problems which may arise. Don't fail to anticipate stock requirements, either; there'll be no time for a dash to the distributor.

$ & ¢

The "PEET" Story. With news of the recently-introduced "PEET" program reaching all corners of the nation, inquiries asking for more details have reached an all-time high. Many of the questions seem to fall into the general category of "How do you go about becoming a member?"

Thousands of "PEET" members from every state in the Union have already passed the rigid requirements which confirms them as men of integrity, in addition to being well-equipped and qualified electronics technicians.

The first step toward becoming a member requires that you fill out an application blank (available from your local electronic parts distributor). This gives a complete account of yourself, your business, and character. This application must then receive the approval of your distributor. It is *not* necessary to join *any* organization in order to qualify.

Once the application is received by Howard W. Sams & Co., Inc., the processing wheels start turning. (All the information on your application, and that gained during processing, is held strictly confidential. As a matter of fact, it's kept in locked files.) Everything pops at once — your credit standing is checked with national credit bureaus. At the same time, letters are sent to the people you have listed as character references. The right answers to the questions asked identify you as a reputable, responsible, and competent businessman.

While all of this is going on, somebody else goes out to get the facts on your business operation from local sources. If you get a clean bill of health from them, you get an OK on your business record.

When the "PEET" examiners are thoroughly convinced that you are running a reputable service business, and that your investment in test equipment, technical literature, and other capital equipment is sufficient to prove you *mean* business, you are approved as a member of "PEET."

What's the cost to you? Nothing, provided your shop is already equipped to meet specific standards. What's the advantage? *You* have been proven to have the highest standards of competence and business ethics by a completely impartial organization serving every segment of the electronics industry. *You* can carry this message to your people. (The program furnishes you with the material free of charge.) *You* can be proud to advertise what you've been proven to be—strictly top-notch from the word go. (Don't slip, though — your membership comes up for review at the end of each year.)

$ & ¢

Profit Redeemer. If you sell TV's as well as service them, you've surely encountered the prospective new set buyer who's shopping around for the best deal. Usually,

The clue that points to profit!

All the skilled deductions of a super sleuth will only confirm what servicemen already know — that a caddy full of Tung-Sol tubes is the clue that points to profit. Made to industry's highest standards, Tung-Sol tubes provide original equipment performance for all radio, tv and hi-fi service. Fewer callbacks mean more profit. Tung-Sol tubes mean fewer callbacks — so use more Tung-Sol tubes! Tung-Sol Electric Inc., Newark 4, N. J.

Tell your jobber you'd rather have

TUNG-SOL®

Blue Chip Quality TUBES • TRANSISTORS • DIODES

he's concerned only with the "difference" price. He can get a 23" table model somewhere else for so much and his old set; it's up to you to meet it or beat it. Then all of your profit (maybe more) is wrapped up in a trade-in.

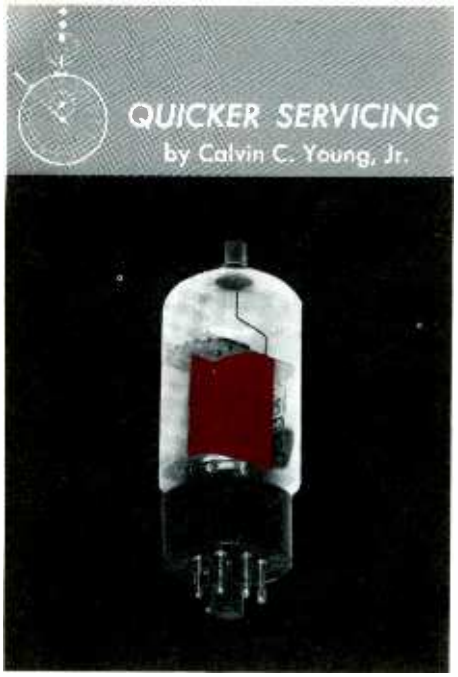
With competition as keen as it is, here's an approach that can help you stay on the right side of the profit margin in cases like this (although there's nothing to prevent you from using it on every sale).

On a trade-in deal, you can counter with something like "OK, let's go see your set." The whole idea is to get out to the house so you can give the antenna a look-see—in addition to looking over what you have to take in trade.

Your next move will depend on what you find, but here's one example: "This new set you're considering is capable of providing a much better picture than your old one ever did, but to obtain the best possible picture, you need the best possible signal. I glanced at your antenna on the way in, and it looks like you could use one of the new modern types. As a matter of fact, I'll bet the present antenna system was put in before Channel 9 came on the air. You'd be much more satisfied with the new set if you had the proper antenna installation. Along with the new set, I'll make you a package deal on a new antenna and lead-in wire, with a rotator that will let you point the antenna to get the best possible picture."

The idea is to take stock of what he really needs in the way of additional or new items for a quality antenna system. (Your customer wouldn't use kerosene to power his new car, would he?) Then sit down and work out a deal that's good for both of you. This might include dual antennas or a rotator, whichever is best for the location, and a new lead-in. You might even offer to fix up his old set and sell it back to him (at a special price) along with the necessary antenna distribution system. This would call for additional signal outlets throughout the house (don't forget the porch or patio) so the customer can have good TV reception wherever he wants it.

From the top of a tower right down to the antenna-input terminals, you've at least a half a dozen chances for additional profit. With an honest and straightforward approach, and a strong reminder that you're ready, willing, and able to service what you sell, at reasonable prices, you'll close a lot of profitable deals—*without* giving away your markup on the new set!



FIRST AID FOR CHERRY RED TUBES

The presence of a bright, cherry-red glow in some portion of a vacuum tube's plate structure is an indication that its current-handling capabilities are being exceeded. Unless the circuit is properly fused, the tube may be ruined or a circuit component damaged. Thus, special troubleshooting techniques must be employed if the serviceman hopes to correct the trouble before other components are affected. The following analysis of typical current-overload situations may help you out of a "hot" spot.

Horizontal Output Tube

Contrary to a popular belief, a red glow at the plate of a tube doesn't always indicate the lack of a grid signal. However, loss of grid drive is a common cause of a glowing plate in a stage controlled with grid-leak bias, such as the horizontal output tube. One of the first things to do on a home call, when you see "hot spots" in the horizontal output tube, is to check for failure of the horizontal oscillator. If a drive trimmer of the type shown in Fig. 1 is provided, also be sure to check its adjustment. It may have been tightened down too much, thus increasing its capacitance and reducing the drive-signal amplitude.

If these checks fail to solve the problem, don't cling to the assumption that insufficient drive signal has to be the cause. The trouble could be something else, such as a gassy output tube. Substitute new output and damper tubes, but be prepared to cut power immediately in case the plate of the new tube begins to overheat. If all home-call techniques fail to produce a cure, shop analysis is required.

Your first move, after hooking up the set on the bench, is to check the drive-signal waveform at the output-tube grid (point A in Fig. 1). It should have the familiar modified sawtooth shape and, in the majority of sets, it should have an amplitude of from 75 to 125 volts peak to peak. (Lacking a calibrator for your scope, you can still measure the signal amplitude by using a VTVM with a peak-to-peak AC function.) If the drive waveform looks normal, proceed to check the screen-grid signal (at point C in Fig. 1). The amplitude should be very small. An abnormally large signal indicates that the screen-bypass capacitor may be open. Temporarily connect a new unit of the same value between the screen terminal and chassis; if the waveform diminishes to only a few volts peak to peak, a replacement capacitor should cure the trouble.

Following the signal checks, you are ready to make a few voltage measurements. Switch the meter to one of the higher ranges, and measure screen voltage. Anything lower than 125 or higher than 175 volts with respect to cathode (except in a 6BG6, where a much higher value is normal) probably indicates trouble. However, take note that an abnormal screen voltage may be a *result* of the defect rather than its cause.

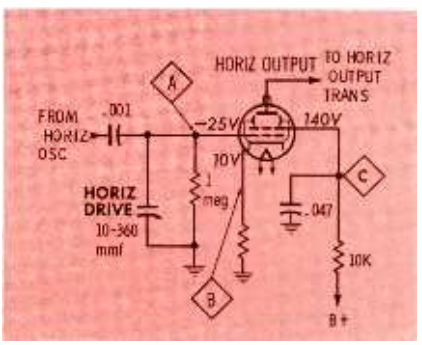
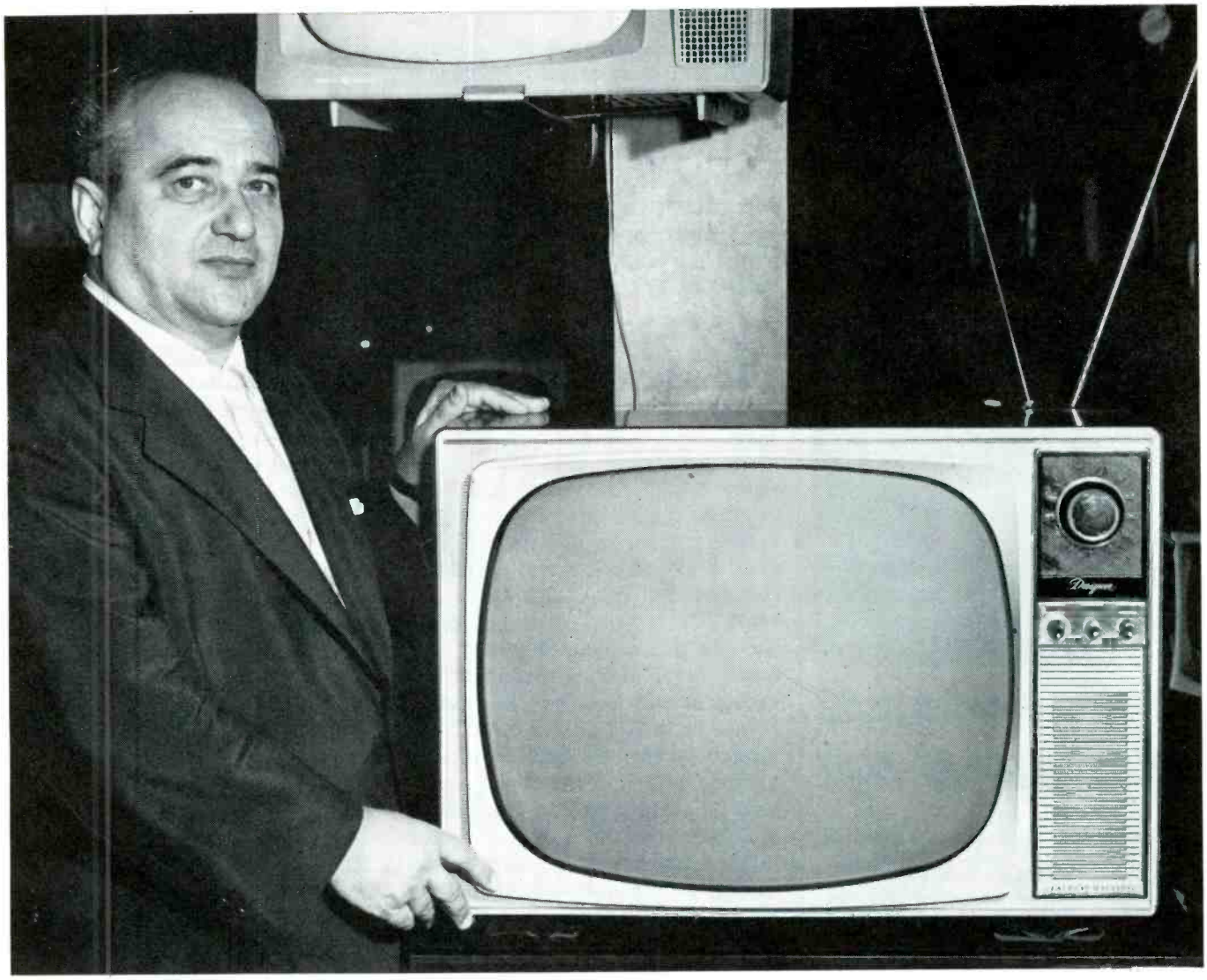


Fig. 1. Loss of horizontal drive signal is usual cause of "red-hot" tube.

If the screen grid passes inspection, your next move should be measurements of the cathode and control-grid voltages. The actual bias voltage (between grid and cathode) should be something between 15 and 50 volts, depending on chassis design.

The value of the voltage at B in Fig. 1 depends on two factors — total tube current and cathode-circuit resistance. A quick calculation, using the measured resistance and voltage between cathode and ground, will tell you the value of cathode current within 5 to 10%. Knowing the actual value of tube current lets you determine the magnitude of the defect. Warning — don't depend on the marked value of the cathode resistor, but measure it with an ohmmeter. Current which is heavy enough to make the tube plate glow is also likely to change the value of the resistor.

If the drive signal and cathode voltage seem to be normal, and yet the total bias is low, look for a defective coupling capacitor between the oscillator and output stages. Leakage current through this unit flows from ground to B+ through the grid resistor, and it can lower the negative DC grid voltage without greatly affecting the drive signal.



"YOU'LL SELDOM FIND

a General Electric 'Designer' in for service,"

says Henry Feldman, Manager of Burk's, a leading television and servicing dealer in Long Beach, California.

"Our men seldom have to pull the chassis of a General Electric 'Designer'. They do practically all of the repairs in the home on the few calls necessary. You seldom find one of these sets in the shop. This is because most key check points are easy to get at when you take the back off."

Mr. Feldman is also kind enough to say: "The entire General Electric Line moves fast and is one of our top profit lines. The fact that it requires very little service has a lot to do with this."

Here's why the "Designer" is such a particular hit with service men all over the country:

You can leave the "Designer" chassis in the set and still get at *both sides* of the printed boards. All tubes are easily replaceable. Fuses are accessible and you can get at key check points.

Precision Crafted Circuitry is the name General Electric gives to its reliable, uniform circuitry. Each board has a *painted* schematic so that you can find your way through it easily. Service one and you'll be thoroughly familiar with it.

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

Progress Is Our Most Important Product

GENERAL ELECTRIC

Usually, the only effect on the sawtooth waveform is a slightly increased flattening of the positive peaks and perhaps some reduction in amplitude. With the oscillator and output tubes removed from the circuit (or with the oscillator-plate and output-grid leads both disconnected, if the set has a series heater hookup), the presence of *any* voltage across the output grid resistor indicates a leaky coupling capacitor.

Audio Output

An audio output stage typically operates class A, with only a very slight change in plate current between no-signal and maximum-signal conditions. Therefore, a loss of drive signal does not cause excessive current in this stage. However, one particular type of audio output circuit does occasionally develop a "cherry-red plate" symptom. This is the hookup in which the audio output tube is connected between the high and low B+ source points, as in Fig. 2. The "load" indicated by the box consists of numerous other circuits such as the video IF, sync separator, and sound IF. Plate current from all these stages is returned to the main power supply through the audio output tube, which functions also as a bleeder resistor in the B+ system. Excessive loading of the low B+ circuit, such as might be produced by a shorted component, can lower the resistance between the cathode of the audio output tube and ground. When this happens, the cathode voltage decreases. However, the grid voltage of the tube is held at a fixed positive potential by a voltage divider across the power supply. The final result is a positive bias on the output tube, which causes excessive conduction. If the effect is severe enough, the tube can pass sufficient current to make the plate red-hot. This symptom could also develop if the voltage-divider resistors in the grid circuit changed value so as to increase the grid voltage.

To pinpoint the cause of the trouble, measure the DC voltage to ground from the low and high B+ lines (points A and B in Fig. 2). Low voltage at A, but normal voltage at B, indicates an overload on the low B+ supply. The most likely culprits are shorted or leaky bypass capacitors, gassy or shorted tubes,

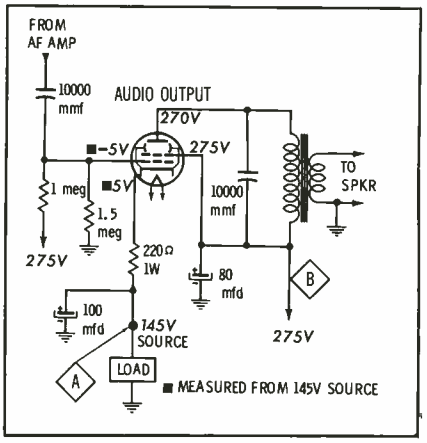


Fig. 2. Overloaded low B+ line may cause red glow at audio-output plate.

defects in the AGC system, etc. If the voltage at point A is at or above its normal value, check the grid voltage of the audio output tube. It may be at an even higher positive level. If so, check the grid circuit for off-value resistors or a leaky coupling capacitor.

To minimize the risk of excessive plate current in the audio output tube, a few manufacturers have used circuits in which a self-biasing arrangement is substituted for the fixed grid voltage. This is accomplished by omitting the resistive voltage divider in the grid circuit and replacing it with a single resistor of about 470K ohms, wired between grid and cathode. Although this hookup does prevent a positive-bias condition (assuming no gas or shorts in the tube), it has the disadvantage of requiring the tube to draw grid current on positive signal peaks in order to maintain the necessary grid-leak bias. The result, a slight clipping of the positive peaks in the audio waveform, causes a small amount of distortion — which is possibly why this circuit arrangement is not more popular.

If a cherry-red plate is noticed in an IF or other voltage amplifier tube, some of the most likely trouble sources are shorts or gas in the tube itself, an AGC defect causing a positive voltage on the control grid, and improper screen-grid voltage. Leaky interstage transformers or coupling capacitors can also cause excessive plate current by placing a positive potential on the control grid of the affected tube.

Too Clean

That was the lament of a "pro" recently, after helping a student

track down a dog!

The case history concerns a set equipped with a Standard Coil tuner and a complaint of no sound on Channel 13, although the picture came through in beautiful shape. Adjusting the oscillator slug failed to bring in the sound.

Suspecting an "over-eager" screwdriver and a broken slug, the student removed and checked the Channel 13 strip. The slug was intact. Upon close observation, it was noted that two turns on the oscillator coil had been shoved together at time of manufacture, apparently to obtain proper alignment. At the moment, these leads were still nestled close together, but none of the original insulation remained to prevent a short. A slight separation of the coils, re-installation of the strip, a touch of the slug, and the job was done.

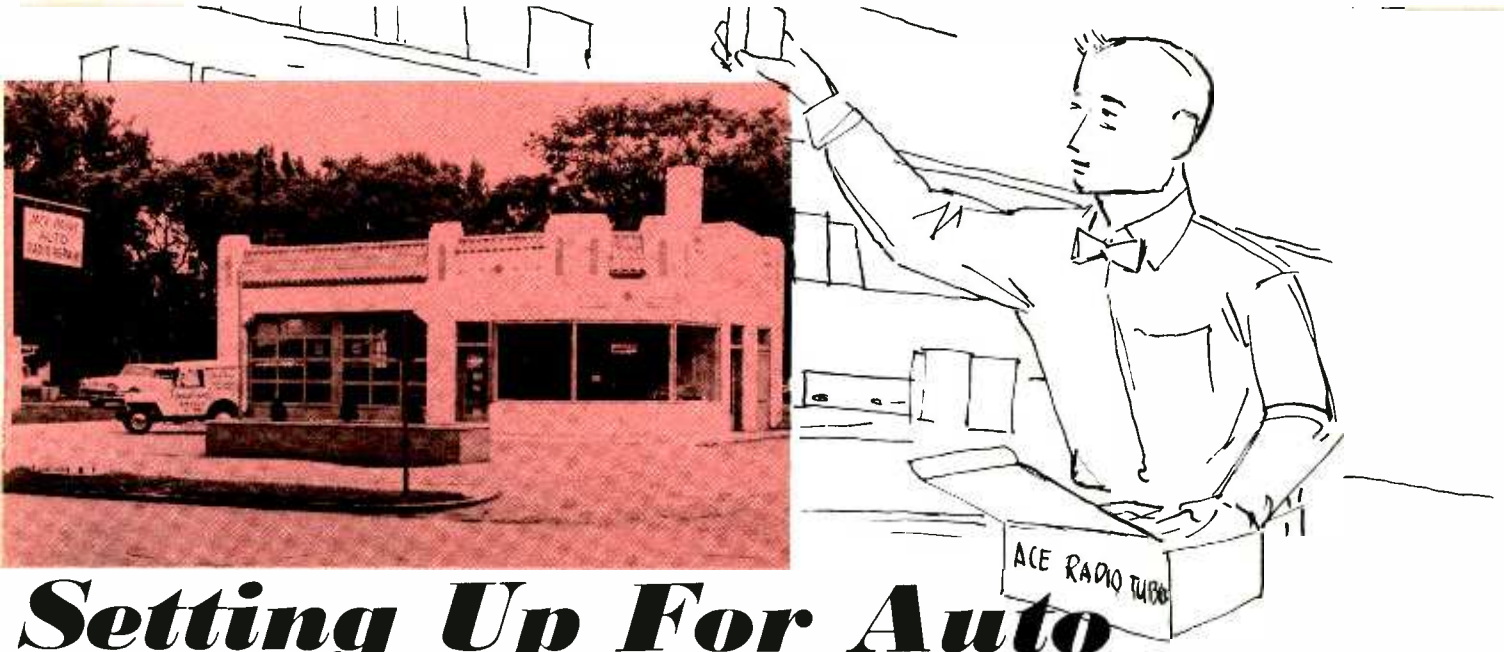
Upon inquiry, it was found that the student had been overly zealous in the use of some kind of cleaning solvent which had seeped down into the turret and eaten off the varnish. (We never did find out what he used.) However, it goes to prove the point that cleaning solvents should be used sparingly—not in quantities sufficient to completely saturate the surrounding area.

Number Please?

by George D. Philpott

Thanks to the thoughtfulness of some unknown serviceman, one of the most practical service tips of the year recently presented itself on the rear apron of a TV brought into the shop for repair. One glance at the receiver told a familiar story: Here was a nameless clunker which had made the rounds—one of those weary veterans that was no stranger to the service bench. A hurried examination disclosed an interesting fact which would help assure that *this old soldier might never die!* The large, red letters scrawled on the back of the chassis and clearly visible through the tarnish said "SAMS 132-11."

If every technician using PHOTOFACT Folders would mark chassis of all repaired sets in this way before replacing the back, it would be a personal contribution toward "Quicker Servicing." ▲



Setting Up For Auto Radio Service

By William C. Caldwell*

Pointers on equipping a shop and attracting customers.

Did you ever stop to think why some businesses flourish while others, even though they *appear* to be providing the same type of services, are just barely able to keep their doors open? We feel the answer is in that word *services* ,which may turn out to have entirely different meanings in two seemingly similar organizations . . . when you take a good look at their shop practices and policies.

Why Auto Radio Service?

Some people in the auto radio service business specialize in it, do very little else, and perform a good job for their customers. To this type of shop (Fig. 1), *service* means prompt, thorough, and cheerful radio repairs. They have to be prompt because their customers and car dealers expect it (there's no emptier look than that hole in the dash); they must be accurate and thorough because it is not a particularly pleasant job to remove and reinstall a radio in a car the second time; and they must be cheerful because human beings are involved. The only other products (aside from antennas) an auto radio specialist will usually handle are closely related to the automobile, such as automatic headlamp dimmers, garage door operators, and possibly home radios. But he is really providing several "services"—car radio repair, repair of related products, promptness, thoroughness, and cheerfulness. All he has to do is forget one of these and his business will suffer.

Other shops provide auto radio service for different reasons. A TV sales and service organization may do this type of work, for example, to provide more complete service for their TV customers. Or they may want to do it to assist in getting new TV customers. Or they may want to help offset seasonal slumps — auto radio service usually takes a jump upward in good driving weather, when TV viewing tends to drop off. Or, perhaps, they realize that auto radio servicing (and sales) is a good business in its own right, *provided* it is set up properly, and that sound practices are followed.

Location

The best location for a car radio service facility depends on several factors, including the size of the town, the types of service offered, and the climate in the area.

In smaller cities and towns, location isn't as important as it is in larger cities. If a man does unusually good work in a fairly small city, everyone eventually hears about it, and many will seek him out. In larger cities, it is important to be near a business area, or on a main thoroughfare between residential and business areas. Again, the importance of this depends on the type of shop rendering the service; location means less to the TV dealer who is doing auto radio service for the convenience of his TV customers, because he is obtaining his customers in a different manner than the auto radio specialist. On the other hand, even some auto radio specialists are not as dependent upon location as others. An example of this is a shop doing work for car dealers and offering daily pickup and delivery service.

In certain climates, it is almost imperative to have drive-in facilities. The technician who has to tread through snow, or dash out in a downpour to reach the car is usually not a happy technician — so it is difficult for him to render cheerful service.

Tools and Equipment

Test equipment for auto radio service can be very simple. A combination 6- and 12-volt battery eliminator, capable of supplying 10 amperes continuously and 20 amperes intermittently on the 12-volt range, is recommended. This unit will handle the very large current requirements of signal-seeking radios. Its output voltage should be adjustable so that various on-the-road operating conditions can be simulated.

*Author of the new Howard W. Sams book, "Practical Transistor Servicing."

A vacuum-tube voltmeter, battery-operated VOM, and signal generator should be available. A signal tracer and small pencil-type noise generator are sometimes helpful, too. Tubes are usually checked by substitution, so a tube tester is not an absolute necessity for the auto radio specialist unless he just wants to provide a general tube-testing service for his customers. Most transistor defects can be discovered through use of an ohmmeter and voltmeter. (See "Voltage Analysis of Transistor Circuits" in this issue.)

The following is a list of handy tools for auto radio repair:

- Set of socket wrenches, ratchet-type, 1/4" square drive.
- Deep socket wrenches or spark-plug wrenches, various sizes (especially 3/4" and 5/8").
- Set of hex-head nut drivers.
- Set of small allen wrenches (for knobs).
- 7/16" open-end wrench (small).
- 9/16" open-end wrench (large).
- Stubby straight screwdriver.
- Stubby Phillips screwdriver.
- Offset Phillips, ratchet type.
- Adjustable crescent wrench.
- Cord-reel light, or portable spotlight which plugs into cigar lighter in car (for working under dash).
- 1/4" electric drill.
- Flexible bench light, adjustable.
- Tube puller.

Chart I—Stock Guide for Auto Radio Components

TUBES	
0Z4	12AT7
12AD6	*12AV6
12AE6	*12BA6
12AF6	*12BE6
12AJ6	12BL6
*12AQ5	12DL8
*12AT6	*12X4
*6 volt equivalents required for older sets.	
TRANSISTORS	
2N155	2N235B
2N157	2N236B
2N176	2N242
2N235A	2N399
BUFFER CAPS	
1600-volt tubulars from .005 mfd to .01 mfd	
VIBRATORS	
6 volt, 4 prong	
12 volt, 3 prong	
SPEAKERS	
Mostly 6" x 9"	
Some 5" x 7"	
A few 8" round	

Usual assortment of screwdrivers, pliers, and soldering irons (gun and pencil types).

It is also important to have a supply of parts on hand. Tubes, vibrators, speakers, transistors, IF coils, and electrolytics are those most often needed. Some power transistors use a special fuse resistor which fails along with the transistor; you should have some of these on hand, too. A general assortment of resistors and capacitors, as well as a supply of antenna and rear-seat speaker kits are other items you'll want to stock.

If a large amount of work is done on certain brands, you may find it advisable to stock some of the most often used parts for the current models, such as volume controls, knobs, and tuner parts. Chart I lists the more popular tubes, vibrators, and speakers.

Obtaining Business

One advantage of auto radio work is that sufficient business can be obtained through contact with fewer customers than in the TV field. The car dealer, who is in contact with many of your potential customers, can be your best salesman. He will usually send all of his radio work to the service shop he finds most

dependable, and your exposure to those customers can even mean other business for you.

The car dealer, like any other customer, must be treated properly. He should be personally contacted at regular intervals to assure good relations and to prevent misunderstandings. As Jack Parry (the owner of the shop in Fig. 1) tells them, "My shop is at your service. Consider it one of your facilities, and sell car radios with the assurance that they will be efficiently serviced should trouble arise." Don't forget the used car business — it will often be a "foot in the door" for the new car business.

In appealing to the ultimate consumer, it's advisable to identify your shop properly on the outside (see sign in Fig. 1), and occasionally try different forms of advertising to determine their effectiveness in your locality. A listing in the yellow pages of the telephone directory is a good way to get new business. Auto Radio Wholesale in Detroit runs spot radio ads — "Drive your car by on the way to work; we'll remove your radio and have it ready for you on your way home."

Warranty Policies And Procedures

We have already mentioned that used car business can lead to new car business. This also often works the other way; that is, new car warranty business can lead to additional business from car owners whose warranties expire.

Most automobile radio manufacturers have a warranty policy which allows you, once you are authorized, to do new car warranty work at their expense. This usually includes any operation performed on the radio for the first 90 days or 4000 miles, including parts and labor. The labor allowance depends on the operation performed, with typical rates ranging from $2.50 (for tube replacements and other simple repairs) to $7.00 for more complicated jobs. For example, $3.50 might be allowed for capacitor or volume-control changes, $5.00 for coils and transformers, and $7.00 for certain time-consuming tuner repairs. The parts used in warranty repairs are replaced with good equivalent units, or else credit is issued. Labor for removing and re-

The "Big Picture"

... informative shop talks

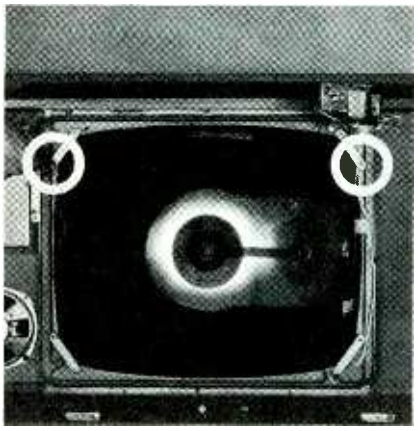
by AL MERRIAM

Sylvania National Service Manager

How to avoid that "strapped" feeling!

I'm talking about the way ordinary picture tubes are strapped into the TV set. Boy, I've felt "strapped" more than once . . . and bet you have, too . . . but now there's an "easy out."

And that's Sylvania Bonded Shield 23". Mounting or removing a Bonded Shield picture tube is easier and faster simply because there are no old-fashioned straps. The mounting "ears" are a strong part of the shield, and the door-latch mounting clips are easy as pie. How easy is that? Look...



Take out one screw on the two top clips...loosen the rest of the screws.

That's all there is to it . . . the tube is removed that easily!

What's more, Bonded Shield picture tubes are much safer . . . both for you and the people "out front." This tough, "contoured cap" makes the *whole* tube stronger and implosion-resistant . . . *and*, no mounting hardware ever contacts that highly stressed picture tube! I'm sure you'll like the idea.

And here's another service tip. A discriminator transformer drift may be causing a low level buzz in the audio, and you can clear it up with a quick and easy readjustment to the transformer. Our tests indicate that many transformers "age" in the first few hours of operation, and the drop in frequency causes the buzz. Sylvania Home Electronics Corp., Batavia, N. Y.

SYLVANIA

Subsidiary of GENERAL TELEPHONE & ELECTRONICS

Fig. 2. Assistant works in car while Jack examines radio at service bench.

installing the radio in the car is usually not covered in this manner, but is the responsibility of the car dealer. If the radio service dealer does it for him, the car dealer is expected to pay a reasonable amount for the job.

Chevrolet and Ford have a different method of handling their warranties. The service dealer simply bills the car dealer for the entire job and turns the defective parts over to him; the car dealer then makes out the warranty form which goes to the factory.

Technical Training

This is one of the most important points in providing good auto radio service. Without proper training, this type of work should not even be attempted. This does not mean that auto radios are complicated, but there are some tricks which should be learned before entering the field.

Training should consist of a general knowledge of electronics (including transistors), and specific training on auto radios. A good place to get the latter is from manufacturers of the products, who hold periodic service schools and clinics. An example of this is the General Motors Training Center Program, where free one-week "factory" courses are held at 30 locations. These courses include laboratory work on the equipment. A general background, some specialized training, and some actual experience all help to mold a capable technician.

Complete service literature, of course, should be available at all times.

General Shop Practices

It is important to follow good operating procedures. Neatness of the shop and personal appearance of the serviceman are two items by

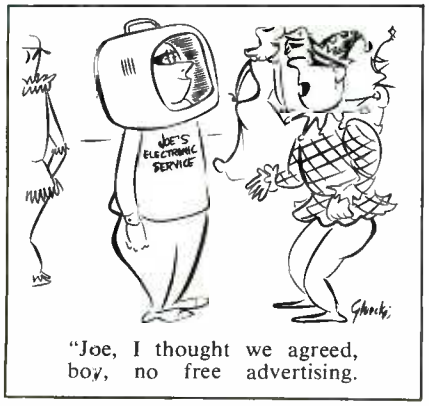
Fig. 3. Test equipment is placed on shelf to keep bench tops uncluttered.

which customers are prone to judge your capabilities. Fair or unfair, shop neatness is bound to be associated with your professional quality in the customer's mind, because he doesn't have the background to judge your technical ability.

Lightweight white shop coats — the type worn in laboratories—help give the shop that professional atmosphere, as well as keep the customer's car seats and the technician's clothes clean. This is not a "must," however, since some people prefer clothes which permit more freedom of movement—neat cotton sport shirts, for example.

Other items of importance are a good bookkeeping and accounting system (any good accountant can set one up for you); to drive customers' cars safely when necessary to move them; to have proper insurance coverage; and to make out reports, job tickets, invoices, or other paper work accurately and promptly. Successful proprietors will tell you all of these fall into the category of "standard operating procedures."

Quality repair work is not the only "service" you render the customer, because he also judges you by the practices you follow in dealing with him. If he is sold, he will sell others, and *this* is the secret of any successful business. ▲



"Joe, I thought we agreed, boy, no free advertising.

THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

How Now?

Would you please explain the operation of the AGC circuit in the RCA Chassis KCS83 shown in PHOTOFACT Folder 242-8? I don't understand the connection of R42 to the video detector, nor the method of feeding composite video to the AGC keyer.

PETER GUTIERREZ

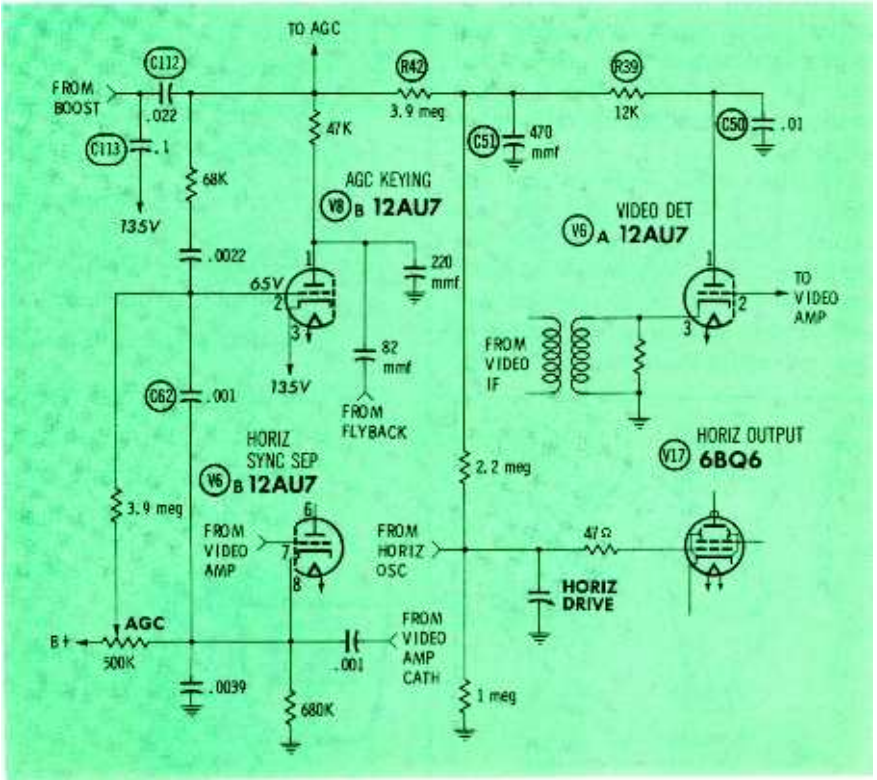
Topeka, Kan.

The input signal reaches the grid of the AGC keying tube (V8B) by an indirect route. A composite video signal is coupled to the grid of the horizontal sync separator V6B. For AGC, this tube acts as a cathode follower; a signal consisting mostly of horizontal sync pulses is taken from the cathode and coupled through C62 to the grid of the keying tube. The amplitude of these pulses changes according to signal strength, thus providing sensitive control over AGC action. DC bias on the keying tube is adjustable with the AGC threshold control, thereby setting the range over which the AGC system operates.

The hook-up including R42, C51, the horizontal output grid circuit, etc., is mainly for the video detector's benefit. A more-or-less fixed negative potential is obtained from the horizontal output grid, and this is mixed with a variable negative potential fed through R42 from the AGC line. After filtering by C50 and R39, the negative voltage is applied to the plate of the detector. When the signal strength increases, more AGC voltage is produced, and this causes the detector plate to become somewhat more negative than before. This provides more linear operation of the detector circuit.

Distorted Recording

I have a Revere Model T1100 tape recorder that works fine on "play" and "erase," but sounds weak and distorted when I play back anything recorded on it. What is a systematic troubleshooting procedure for tracing a trouble like this? I have a scope, a VTVM, and a signal



generator with a 400-cycle note.

WILLIAM HIGHTOWER
Washington, D. C.

There are various ways to go about tracing the source of this problem. One of the best is to use your scope to trace the distortion from the output stage back to its point of origin. With the recorder in the "Record" position, connect the scope to the plate of the output tube; with no input to the recorder, there should be no output. However, if the distortion is the result of a spurious signal generated within the recorder, you should be able to use your scope to trace back into the preceding stages to find the source of the signal.

Another method is to inject a signal from your generator into the input jack. Measure the AC input level—it should not exceed 1 volt. Then use your scope to trace through the switching, preamplifier, amplifier, and output stages in order to determine where distortion is entering the circuit. Once this stage has been located, additional component checks should disclose the source of trouble.

Pops Out

A Motorola Chassis TS-74 has intermittent vertical deflection whenever the contrast, channel-selector, or fine-tuning shafts are touched. Collapse of the raster to a thin line is accompanied by a pop from the speaker, and the voltages on the vertical oscillator and output stages go to zero. I've changed every part in the vertical circuit without success.

DAMON MCDANIEL
Los Angeles, Calif.

Sounds like an intermittent short in one of the B+ circuits. This would account for the pop, since this unit uses the field of an electromagnetic speaker as a filter choke.

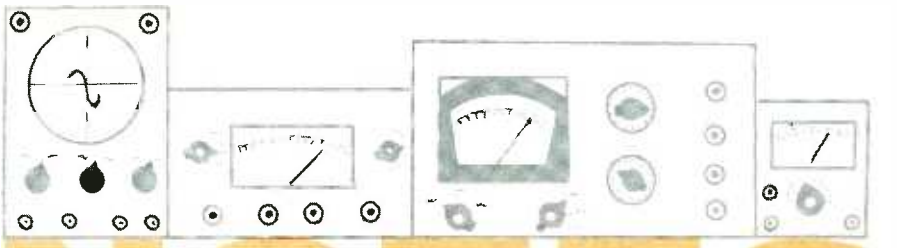
The fact that it happens when switching channels, or adjusting fine tuning or contrast, could arise from the fact that all of the mentioned shafts are rather long, and protrude from the same side of the chassis. Sufficient leverage on these shafts, when making the adjustments, could move the chassis. In a receiver as old as this one, such a slight movement could easily cause a short in some wire with deteriorated insulation. I think if you'll look for an intermittent short, you'll locate the trouble.

Bounce and Squeal

I've had two Trav-Ler sets recently — both Model 1722 — that have developed poor vertical sync. In addition to this, the set produces a loud squeal whenever it's turned off. The sync circuit checks out OK. How could the sound circuit affect vertical sync?

DALE N. BORDNER
Orlando, Fla.

The only possible ties shown in PHOTOFACT *Folder 414-3 are the common B+ source and tube V6. My guess would be interelectrode coupling within the tube itself, since one section serves as a sync separator and the other as audio output. If tube substitution doesn't solve your problem, use a scope to check for random signals on the B+ line.*



NOTES ON TEST EQUIPMENT

by Les Deane

Sines and Squares

Precision Apparatus Co., Inc., of Glendale, L. I., N. Y., manufactures a test instrument that has become quite popular in the service industry. Pictured in Fig. 1, the Model E-310 is a combination sine- and square-wave signal generator designed for signal-tracing applications in audio and video systems of home entertainment equipment.

Specifications are:

1. *Power Requirements — 110/120 volts, 50/60 cps; power consumption approximately 55 watts; line-isolation transformer and 1-amp fuse provided.*
2. *Output Signals — sine or symmetrical square wave; maximum output at minimum load (600 ohms), 10 volts rms for sine waves and 10 volts peak-to-peak for square waves; output constant within 1 db on all bands; step attenuator and level control provided.*
3. *Frequency Range — five overlapping bands from 5 cps to 600 kc; square-wave rise time .15 microsecond with negligible overshoot; 6" panel dial with direct and 12-to-1 drive ratios provided.*
4. *Accuracy — over-all calibration correct within 1 cycle (or 2%) from 5 to 60 cps, and within 2% from 60 cps to 600 kc; distortion less than 1%; maximum hum and noise less than .1%.*
5. *Other Features — waveform-selector switch and meter-monitoring jacks provided on panel.*
6. *Size and Weight — portable case 9" x 11½" x 15", 20 lbs.*

Fig. 1. Square-wave generators have uses in radio, TV, and hi-fi servicing.

In my preliminary examination of the E-310, I noticed that it is well constructed in a heavy-gauge louvered steel case, with all controls and jacks positioned on the aluminum front panel. The line fuse is accessible from the rear of the case.

Although the instrument is not equipped with output cable or leads, it has universal binding posts suitable for spade-lug, alligator-clip, pin-plug, bare wire, or banana-plug connections. Using an AC voltmeter of suitable range and frequency response, the two pin-jack outlets labeled METER can be used to monitor output signal level. In order to find the actual value appearing across the output terminals, however, voltage readings taken at these jacks must be multiplied by the attenuation factor of the OUTPUT switch.

A sine- and square-wave generator with a frequency range like that of the Model E-310 is extremely useful for checking the operation of AC signal amplifiers. This means that, by using the generator in conjunction with an oscilloscope, accurate measurements can be made to determine the amount of frequency, linearity or phase distortion present in either an audio or video stage (or for that matter, an entire system). A few simple tests, for example, can map out the frequency response of a video amplifier or pinpoint the source of distortion in hi-fi apparatus.

When actually working with the Precision unit in the lab, I uncovered several other applications pertaining to television troubleshooting. Setting up the generator for either a sine- or square-wave output at a convenient test frequency of from 400 to 600 cps, I found that I could signal-trace the entire video section from detector load to picture tube. A scope was not needed; I monitored the test signal by simply viewing

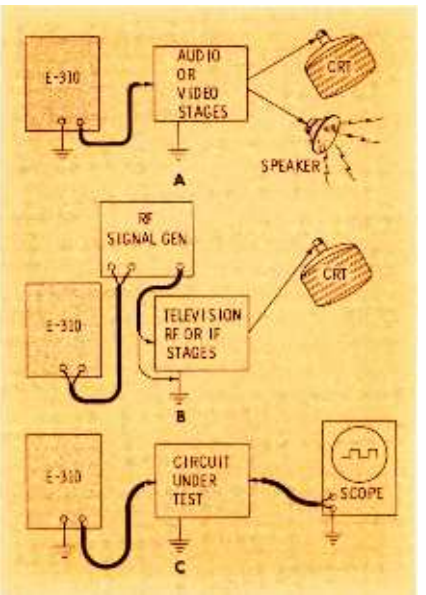


Fig. 2. Basic arrangements for signal-tracing with Model E-310 Generator.

the horizontal bars modulating the CRT screen. The audio section of a receiver from sound detector to speaker voice coil can also be traced in a similar manner, with the test signal monitored through the set's speaker (see Fig. 2A).

Another use I made of the instrument was to modulate a conventional RF signal generator so as to signal-trace stages ahead of the video detector. As illustrated in Fig. 2B, I applied the E-310's output to the external modulation jacks of the other generator and adjusted the higher-frequency generator for a desired RF or IF output. Again, I was able to monitor results on the TV screen. Incidentally, this arrangement also works fine on any AM radio, using the speaker as an indicating device. I also found the Model E-310 of value

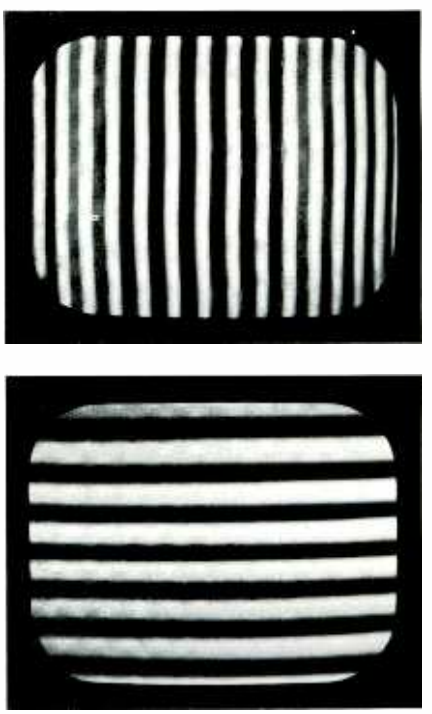
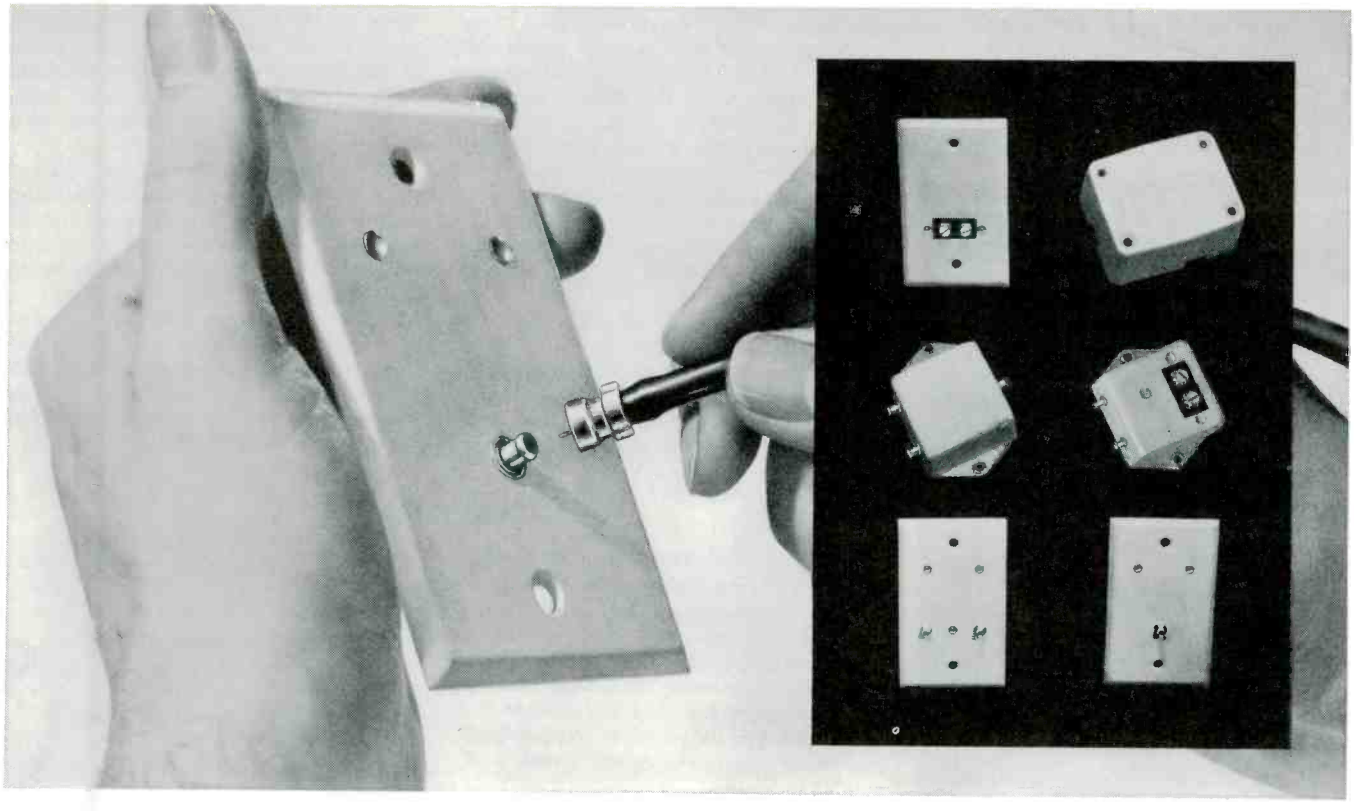


Fig. 3. Precision's square-wave generator produces these bar patterns on CRT.



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TS-771B	surface	75	75	17 db	less than 1 db	4.30
TF-772B	flush	75	(2) 75	17 db	less than 1 db	5.85
300 OHM STRIPLESS TAPOFFS						
A-331A	surface	300	300	11 db	less than 1.5 db	2.65
TF-731B	flush	75	300	17 db	less than 1 db	3.00
TS-731B	surface	75	300	17 db	less than 1 db	4.30
75 OHM SOLDERLESS SPLITTERS						
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TS-774	surface	75	(4) 75	11 db	6.5 db	7.50
75 TO 300 OHM MATCHING DEVICES						
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in signal-tracing the sync-amplifier, sync-separator, and noise-limiter stages of a TV receiver. Here, I checked circuit operation by using the square wave as a test signal at both 60 and 15,750 cps. I could vary the output level of the generator and also examine circuit functions by viewing the resulting output signal on a scope (see Fig. 2C). Naturally, this simple arrangement can be used on any amplifier or circuit configuration.

Since the application of a square wave to a video amplifier results in sharply defined black and white bars on a TV screen, I found that the Precision instrument can also serve as a linearity-pattern generator. For example, a square wave of 252 kc will produce a synchronized pattern of vertical bars as shown in Fig. 3A. Applying the signal at a multiple of 60 cycles, on the other hand, causes horizontal bars to appear (Fig. 3B).

While I had a couple of test receivers fired up, I also tried a signal-substitution experiment on the vertical sweep circuits. I found that a 60-cycle sine wave from the E-310 could be used as a sweep-driving signal at any point from the vertical output-tube grid to the yoke windings themselves. The raster produced was nonlinear; however, this simple technique can quickly localize sweep failure to either the oscillator, output tube, output transformer, or yoke.

Short-Wave FSM

Shell Electronic Mfg. Corp., of Brooklyn, N. Y., is currently producing a field-strength meter and modulation monitor especially designed for detecting transmitted signals from Citizens band, ham, and other short-wave equipment. Shown in operation in Fig. 4, the *Test-O-Matic* Model FS-3 is a portable self-powered instrument providing both visual and audible indications.

Specifications are:

1. *Power Requirements — one self-contained 1.5-volt penlite cell for modulation monitoring.*
2. *Frequency Range — six overlapping RF bands from 2.7 mc to 148 mc; also detects AF modulation; capacitance-tuned input circuit; individual plug-in coils supplied.*
3. *Panel Meter — built-in 2" unit with 1-ma movement; linear 0-100 scale provided for relative power readings; connected in diode load circuit of RF detector.*
4. *Other Features — 36" retractable antenna for close-range pickup;* METER-MOD *switch and earphone provided.*
5. *Size and Weight — plastic case 6 1/4" x 3 3/4" x 2", 1 1/4 lbs.*

Since many of you may be called upon to service, or at least test-monitor Citizens band transceivers in the near future, I knew you would be interested in an instrument that can give you a helping hand with this task. Basically, the Model FS-3 is used to measure radiated carrier power and audio modulation of short-wave transmitters. From these relative indications, one can determine field intensity, operating frequency, modulation or distortion level, and harmonic content of transmitted signals.

The compact unit looks much like a grid-dip meter with a car radio aerial projecting from its top. Coils furnished with the instrument plug into the front panel as pictured in Fig 5. The individual coils are used to select a specific tuning range within the entire band. The input circuit is capacitivly tuned by adjusting a small knob, also located on the front panel. The knob is calibrated only in a relative scale of from 0 to 10; however, settings for different frequencies can be

Fig. 4. Shell Field Strength Meter checks transmitter's output and tone.

noted and accordingly marked on the panel scale, if desired.

Circuit design of the Model FS-3 is shown in the schematic of Fig. 6. Slide switch S1 is a spring-loaded device shown in its normal resting position. Under this condition, the instrument operates as a tuned RF diode detector. A five-section telescopic antenna pulls in the desired signal and feeds it to the high-Q tuned circuit composed of a low-loss plug-in coil and capacitor C1. The single-gang tuning capacitor has a range of approximately 20 to 60 mmf. The 1N69 crystal diode detects the RF signal and applies it to the meter, which acts as a load to ground.

With S1 held in the MOD position, battery voltage is applied to the PNP

Fig. 5. Tuning coils for Model FS-3 plug into socket on the front panel.

transistor X1. This stage is a grounded-emitter amplifier that drives a dynamic earphone. The miniature earphone mounts on the side of the instrument's case and is partially visible in Fig. 5. The diode load now consists primarily of R1, and the detected signal developed across this resistor is coupled to the base of the transistor via capacitor C3. AF modulation is thus amplified and aurally monitored.

From several experiments in the lab, I found the *Test-O-Matic* an excellent test unit for checking the output of short-wave transmitters right at the service bench without the necessity of radiating signals for any great distance. When checking CB transceivers, for example, I employed a dummy load in place of the antenna, but was able to monitor RF power as the transmitter switch was keyed on and off. I also tested audio modulation for tone quality and distortion by simply tuning the instrument and holding the small output phone to my ear as illustrated in Fig. 4.

When determining frequency of transmission, I first tuned the meter for a maximum power indication; then, switching the transmitter off without touching the tuning knob, I positioned the instrument's antenna close to the output cable of an RF signal generator. After adjusting the generator to the proper band, I carefully rotated its tuning dial for maximum needle deflection. Thus, with an accurately calibrated generator, you can pretty well pinpoint the operating frequency. Obviously, this procedure can also be used to check the RF and modulation output of any signal generator within the tuning range of the FS-3.

For surveying an antenna site, the instrument comes in handy as a field-strength meter. Provided the transmitted signal is strong enough, it can also be used to help you position and orient the antenna during installation. Undoubtedly, we will soon see more test instruments designed for servicing Citizens band equipment — but here's a reminding *caution:* You must hold a first- or second-class radiotelephone operator's license before making adjustments or repairs to CB transmitters in any way that could cause the frequency of transmission to change. ▲

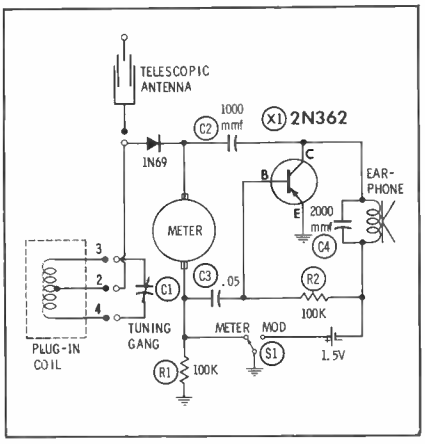


Fig. 6. Complete schematic of Model FS-3 reveals its transistor stage.

AUDIO FACTS
BY
ALAN ANDREWS

MUSIC CAN AID IN HI-FI TROUBLESHOOTING

"It sounds fine on chamber music, but it makes a lot of crashing noises when I play a symphony."

"Hear how gargly his singing is? And this set makes Roger Williams sound like Crazy Otto! Funny thing, though—my favorite Dixieland records seem to come through okay."

"Lately there's been a sort of scraping sound on violin numbers, as though the violinist didn't rosin his bow."

"Sounds like they're playing in a tunnel, the music is so jumbled up."

"Like this hi-fi is goofin', man—that snare drummer comes on like slappin' a flapjack with a wet noodle."

Translations:

"The amplifier is generally distortion-free at low to medium signal levels, but doesn't seem to have sufficient reserve power to avoid being driven into distortion by a strong signal with a complex waveform."

"There is a slight amount of mechanical flutter or wow in the changer or tape deck—just enough to be annoying on certain types of music which are highly susceptible to this trouble."

"Something has happened to increase the high-frequency response of the set."

"All program material suffers from fairly serious distortion, such as would happen if the records were played with a worn-out needle or if one of the amplifier stages were badly overloaded."

"High-frequency response is 'way down—like, man, the tweeter ain't tweetin'."

All the above quotations are intended to emphasize a single point: If you're aware of the basic characteristics of music, you can turn many of the hi-fi owner's strangest complaints into useful troubleshooting clues. Even if you don't particularly "appreciate" music, it pays to develop an ability to analyze musical faults in terms of circuit performance. This knack can greatly improve your efficiency in diagnosing and correcting audio system troubles, and it can help you tremendously in reaching an understanding with your customers.

What Is Music?

From a technical standpoint, music consists of a number of different audio frequencies, simultaneously produced in such a way that the results are pleasing to the ear. It has three primary characteristics—*volume, pitch,* and *tone* — all of which must be faithfully reproduced if audio equipment is to meet high-fidelity performance standards. Let's study these fundamental properties of music in the light of their importance to hi-fi operation.

Volume

All sound is produced by the vibration of some physical object, and these vibrations are carried through the air as rapid fluctuations of air pressure. As the strength of the vibratory movement is increased, the changes of pressure become greater; the result is an increase in the loudness of the sound, or a greater volume.

The Fletcher-Munson curves of sound intensity versus the ear's frequency response (see *Audio Facts,* December, 1959) show that our ability to hear the lowest and highest audio frequencies is poorer for soft sounds than for loud sounds. No doubt this is the reason why many audiophiles turn up the volume on their sets. The effect of sound intensity on frequency response also gives rise to a number of complaints—for example, "Why doesn't my system sound as good for the lower volume levels?" In such cases, you may be able to reach a satisfactory solution by instructing the customer to advance the treble and bass controls when reducing the volume. Or, to simplify set operation, you might replace the volume control with a

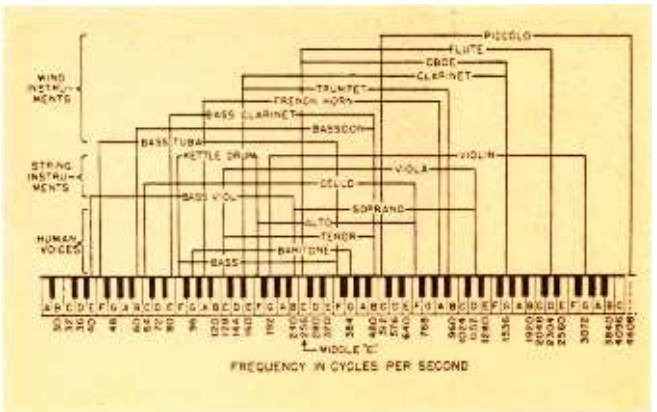


Fig. 1. The fundamental frequencies of most musical notes lie within the relatively narrow range of 40-4000 cps.

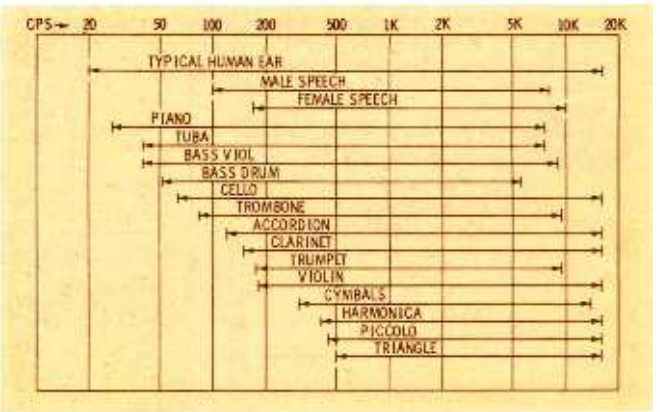
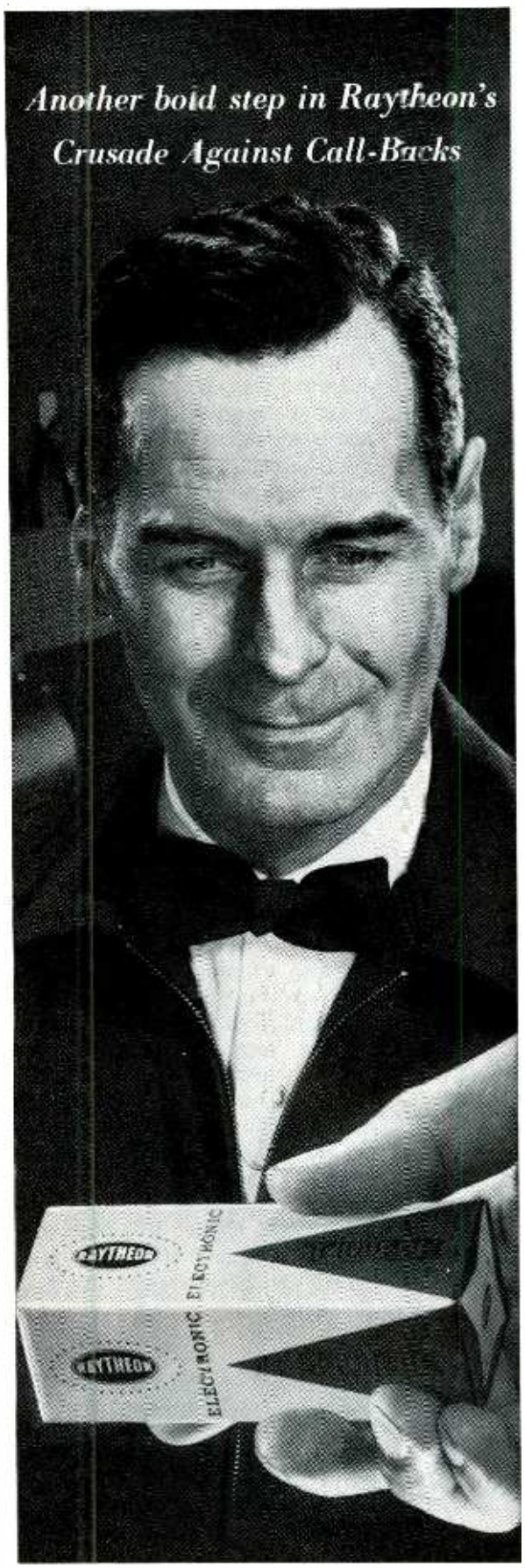


Fig. 2. Musical instruments produce many harmonics, some extending to or beyond the upper limit of human hearing.



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loudness control which automatically performs the needed frequency adjustments.

Other problems related to volume may also crop up. For example, what does the listener want to hear? A case comes to mind of a series of church broadcasts several years ago. Two complaints were received on the same Sunday. One said that the organ was too loud, the other that it was too soft. Further investigation revealed that the one who wanted to hear the organ more clearly was himself an organist. The other complaint was from a lady whose son sang in the choir; she couldn't hear him! Beware of "troubles" based on the listener's personal preferences, for these certainly cannot be blamed on the system. Readjusting the controls may produce better results in some cases, but it is hopeless to try to reproduce something which was not recorded in the first place.

Another type of volume trouble occurs when the volume changes suddenly. For example, an annoying interruption of music may occur when a bass drum is hit, or when any other loud sound is produced in an abrupt manner. This symptom may indicate a circuit unbalance which causes the sharp signal pulse to set off momentary oscillations. If this unbalance is in a push-pull final stage, adjusting the balance control or installing balanced output tubes may clear up the condition.

Such parasitic oscillations do not always block the system, but may produce other results. They may simply increase the signal amplitude enough to drive some stage into both saturation and cutoff. Amplitude distortion then occurs on the positive swing of the grid signal as grid current is drawn, and also on the negative alternation as plate current is briefly interrupted. The parasitic oscillations may sometimes be above the audio range, but these can still beat with audio signal components to produce intermodulation distortion. Then, too, the parasitics rob the system of some of the power which should go into signal production.

Strong, abruptly-produced signal components may also create other problems besides oscillations. Definite types of distortion are sometimes observed on sudden loud bursts of sound produced by instruments with a "sharp attack." (The beat of a drum is the most common example of such a sound, but similar effects can also be produced by some of the brass wind instruments, such as a trumpet.) In some of these cases, the B+ varies with the music—a sign of insufficient power-supply filtering. The filter capacitors may be all right for "average" conditions, but the strong musical attack momentarily places an excessive drain on the power supply and lowers the B+ voltage. (Note: This effect may simply be a case of attempting to exceed the power-output rating of the amplifier.)

Pitch

When a vibrating object changes its fundamental frequency of operation, the resulting sound is said to change in pitch. Certain frequencies, related to each other by simple mathematical ratios, constitute the notes of the musical scale. Besides the seven basic tones, A through G, there are various intermediate frequencies called sharps and flats. The second harmonic of any note (twice the fundamental frequency)

sounds markedly similar to the fundamental, but is noticeably higher in pitch. It carries the same letter designation as the fundamental; however, it is in the next higher *octave* of the scale. A standard 88-key piano covers a span of 7 1/2 octaves, or a frequency range from below 30 to above 4000 cps (Fig. 1). Few other instruments are playable over such a wide range of the musical scale; most tend to be restricted to either the low, middle, or high group of fundamental frequencies. Fig. 1 gives you an idea of the ranges covered by a number of instruments and voices.

Note that the highest fundamental frequency in the chart (from the piccolo) is below 5000 cps. Therefore, an audio system with a rather limited frequency range can still reproduce practically all fundamental notes. This raises the question, "Why are higher frequencies necessary to produce high fidelity?" The answer lies in the third characteristic of sound.

Tone

Also called *timbre* or *tone quality,* the tone of a sound is determined by its harmonic content. In terms of electronics, the tone may be referred to as the waveform. Two different instruments may play the same note, yet may sound differently. This is due to the difference in the number of harmonics contained in the notes and their relative amplitudes with respect to each other. Musicians usually call these harmonics overtones, although in some cases they may be called partials. Some musical tones may contain as many as 25 or more harmonics; many times, a harmonic may have greater amplitude than the fundamental frequency of vibration.

Fig. 2 illustrates the frequency response needed for reproducing the natural tone of several instruments and voices. Note that the required range for most of the higher-pitched instruments extends to the upper limit of hearing (between 15 and 20 kc). Some instruments also generate higher harmonics, on up into the ultrasonic range, but these need not be reproduced in a system designed for human listening!

Problems affecting the tone of music may show up in various ways. One common complaint is that the

system does not reproduce the tones created by bells, chimes, triangles, tambourines, etc. These sounds may be eliminated from the output by any system defect (or shortcoming in design) which tends to attenuate high frequencies. Playing the same record on different audio systems can be an amazing revelation, since there is often music on the record which is not reproduced at all by some systems.

At the opposite end of the audio spectrum, poor low-frequency response weakens the bass tones produced by organs and the larger instruments of an orchestra. Another defect associated with low frequencies is a "one-note" effect produced by a resonant condition in the speaker or its enclosure. Bass notes set up vibrations at the resonant frequency; as a result, they all seem to sound alike instead of varying noticeably in pitch. Volume is reinforced, rather than attenuated, by the resonance — so the untrained ear may consider this to be a sign of excellent bass response..

Full frequency response, with good "lows" as well as "highs," results in clear sound reproduction without fuzziness or blurring. Flatness of response over the whole audio spectrum is also important. If a hi-fi owner complains of shrill output, look for the possibility of too much amplitude at high frequencies. On the other hand, look for excessive low-frequency amplitude whenever the output is "boomy." Muffled reproduction is likely to be caused by a deficiency in some particular portion of the audio range, often in the treble region. Many complaints involving response may be attributed to improper setting of the equalizer or tone controls. The service problem then consists of merely adjusting the controls correctly and instructing the customer in their functions and proper usage.

Strangely enough, frequency distortion can seemingly improve bass response in some cases. For example, a system may not be able to reproduce a very low tone of, say, 40 cps; but if it produces strong second and third harmonics of this note, these may heterodyne to re-create the original frequency. Our ears have this same characteristic of resupplying a fundamental by beating

together harmonic components. The lowest note of a violin does not actually contain the fundamental frequency, because the violin body is too small to resonate at that frequency; however, we can supply the fundamental with our own hearing mechanism.

Distortion

There are several distinct types of distortion, which can affect the musical output of a hi-fi system in a number of ways.

Spurious frequencies produced by harmonic distortion can change the tone and balance of music, but no discordant sounds are created because the added frequencies are equivalent to harmonics of the desired tones. Harmonic distortion is easily confused with simple unevenness of frequency response, since both these conditions alter the tone of various instruments so they do not sound natural.

A definitely discordant effect is created by intermodulation distortion, which produces spurious frequencies not having a close harmonic relationship with the desired frequencies. This type of distortion is often more noticeable for music played in a minor key (for instance, the chorus of *St. Louis Blues*) than for a major key (*My Country 'Tis of Thee*); for some reason, the spurious frequencies seem to fit in better with major chords than with minor ones. However, serious intermodulation distortion will show up on almost any type of music.

We cannot always depend on our hearing to give us information about the exact type and amount of distortion, but we can rely on special instruments which are available for this purpose. Besides being useful for defining distortion, test measurements are valuable in determining just where it is being introduced. A single point in the system is usually at fault, and signal-tracing techniques can be used to good advantage.

As we have previously implied, various forms of distortion can be generated when parasitic oscillations occur. Although the entire musical output may be affected, this trouble is more likely to appear only on certain types of sounds—such as the "sharp attack" of instruments like trumpets, trombones, drums, and chimes.

Improper damping in the speaker system may produce similar results. When a sharp pulse in the audio signal sets the speaker cone vibrating, insufficient damping may allow it to continue the motion after the original musical tone has stopped. This gives the music a muddled effect, especially following loud passages.

In general, any type of high-frequency distortion can be recognized rather easily. On the other hand, low-frequency distortion more or less blends in with the music, sometimes giving the impression of increased bass response.

Noise

One of the greatest potential sources of objectionable noise in a high-fidelity system is the phono turntable or record changer, which can contribute hum or vibration-induced noises in addition to the hisses, cracks, and pops produced by the stylus as it travels along the record groove. Most phono noise stems from either a worn stylus or a worn record, or both. Proper record care, and prompt replacement of styli when necessary, are two of the most important habits for a hi-fi owner

to cultivate, and ones which you should bring to his attention.

A worn record may actually sound better on a poor system than on a good one. Noise contains mostly high frequencies, which are usually eliminated by the poorer systems. This explains why a customer may complain that his old 78-rpm recordings are too noisy when played on his new wide-response system.

A fair amount of noise and hum can be covered up by strong orchestral passages, and mild troubles may be noticeable only on specific recordings containing soft music or frequent pauses. Therefore, the serviceman should not be too hasty in blaming noise on the condition of the records, as trouble might exist somewhere in the system itself.

Excessive high-frequency amplitude gives an effect similar to a combination of noise and distortion. In some cases, the results are similar to the crackling sound of a bad connection. When this type of distortion occurs, check for incorrectly-set tone controls; also see if equalization is correct for the type of phono pickup and records being used.

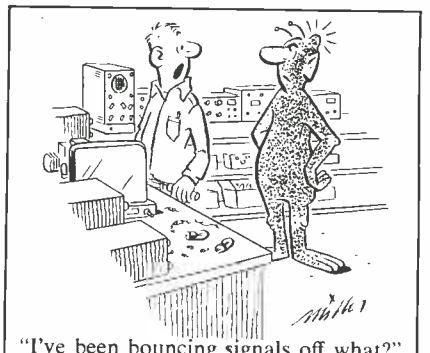
Bass frequencies can also appear to break up the music, especially at high volume levels. This behavior is often caused by physical vibrations of the speaker cabinet being carried to the phono turntable. Shock-mounting the phono is an effective remedy; or if it is more convenient to move the phono to a different location, this can be done. We have already mentioned that bass notes occurring at the resonant frequency of the speaker system tend to cause vibration of the speaker cabinet. If this effect becomes objectionable, the simplest cure is to reinforce the cabinet walls or add insulation to the inside of the enclosure. Surrounding objects, such as pictures, may even be set into vibration and may have to be padded or moved.

Tough-Dog Customers?

Some complaints involve the acoustic properties of the area where the system is being used. I recently heard of an installation including a 70-watt amplifier driving two 15″ speakers, all located in a 9′ x 12′ living room. If the owner had problems, it's no wonder!

Other cases of dissatisfaction arise when a hi-fi owner envies the performance of someone else's system. In such instances, no amount of repairs or adjustments seem able to bridge the gap between "dream performance" and reality. A similar complaint is that the system sounds differently in the home than in the store. Considering the differences in surroundings, this is undoubtedly true; but it doesn't have to mean that the performance in the home is inferior.

There is no set rule to work by in any of these touchy situations, but knowing how to translate customers' complaints into concrete facts should help you solve the majority of your hi-fi servicing problems. ▲



"I've been bouncing signals off what?"

Transistor Circuits

(Continued from page 20)

posite direction from that followed by a tube's plate current.

In order to better understand what happens to the voltages in a transistor circuit, let's take samples of both NPN and PNP stages and apply suitable DC potentials to produce normal operation. We can see the polarity of the voltage drop across the load component of each transistor element as a result of current passing through that component.

In the simplified schematics of Fig. 2, the voltage sources have been omitted to avoid confusion, and each transistor element has been connected to a resistor representing a load component. Once again, as in Fig. 1, the heavy arrows indicate the direction of electron flow through each transistor lead. Here we see amazing things happening (especially in the PNP transistor) if we continue to think of the tube while attempting to understand the operation of a transistor. Keep in mind that the polarity marks on the resistors indicate the voltage drops resulting from normal electron flow and do not represent applied voltages. Also remember, base current must flow in order to produce collector current.

NPN Circuits

Voltage and current relationships within an NPN transistor circuit come the closest to what we are accustomed to finding in tubes, so let's consider this arrangement first. Fig. 3 is a simplified NPN circuit with typical power-supply voltages applied, and with the polarity of the voltage drop across each load component indicated for no-signal conditions.

To establish the correct *average* value of emitter-to-collector current, a certain bias must be set up between base and emitter — just as a tube requires grid-to-cathode bias. For this purpose, a resistive divider network (R1 and R2) is wired across the power supply, and the transistor base is connected to the junction of the two resistors. Besides this fixed-bias source, there are additional factors in determining the bias. One is the low resistance which exists between base and emitter inside the transistor; the series combination of this internal resistance and R3 shunts R2 and lowers the total base - to - ground resistance. Another factor is the development of a small positive voltage across emitter resistor R3 by the combined emitter - collector and emitter - base currents of the transistor. (This effect is similar to cathode bias on a tube.) The final result is a .2-volt difference between base and emitter voltages — a typical value for many transistorized amplifiers. This bias establishes a specific level of collector current, which in turn causes a certain voltage drop across the collector load R4 and thus determines the collector voltage. Any positive change in the base voltage of an NPN transistor will increase the collector current. Your first impression may be that this action is exactly the same as in a tube — but there is an important difference. Since the base is already more positive than the emitter, the rise in base voltage produces an increase in base-emitter bias voltage, which is just what a transistor needs in providing more collector current. This is exactly the opposite of what you would expect in a tube circuit.

A zero-bias condition in a transistor does not drive the device into saturation, but is actually likely to produce collector-current cutoff!

When an input signal is applied to the base-emitter circuit, the instantaneous changes in base voltage cause slight changes in the emitter-to-base current. This influences the emitter-collector circuit as symbolized by the sinusoidal patterns in Fig. 3. Since a positive shift in base voltage increases both the base current and collector current, it will cause the voltage drop across the load to increase; thus, the collector voltage will go down. Likewise, a decrease in base voltage will result in an increased collector voltage. The signal consequently undergoes a 180° phase inversion in passing through the transistorized amplifier.

PNP Circuits

To understand the "goings-on" in a PNP circuit, let's run through one in the same manner as we did for the NPN arrangement; but this time let's use the typical driver stage shown in Fig. 4. Here's where tube theory must be disregarded. Fortunately, though, Ohm's law isn't repealed, and the voltage readings follow the pattern established in Fig. 2 for a PNP circuit. The base-to-emitter current, in combination with the 10-to-1 voltage-divider network of R1 and R2, establishes a DC base voltage with respect to ground of 7.7 volts. The base-to-emitter current regulates the flow of collector-to-emitter current in the same manner as in an NPN circuit — the big difference being the reversed direction of electron flow in both input and output circuits.

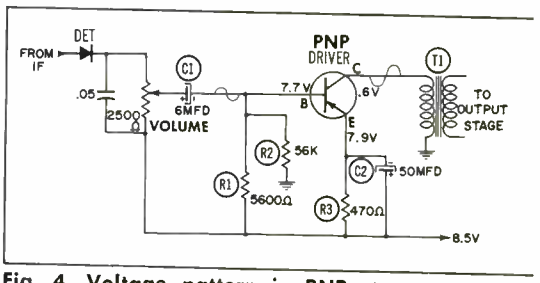


Fig. 4. Voltage pattern in PNP stage is reverse of that in NPN circuit.

When a signal is applied to the base, a positive swing of base voltage decreases the base-emitter bias, thereby reducing the current from base to emitter. The consequent reduction of collector current produces less voltage drop across the collector load (transformer primary), and thus a lower collector voltage. The amplified signal which appears at the collector is then 180° out of phase with the base signal. The PNP circuit therefore accomplishes the same thing a tube does, but in a considerably different manner.

Voltage Analysis

Having just reviewed electron-flow and voltage-drop theory as it applies to transistor circuits, let's see how we can use this knowledge to "put the finger" on a defective component — be it transistor, coil, capacitor, or resistor. Speaking of putting your finger on something — try resting your index finger on the metal tip of your VTVM probe while making your voltage tests. The low DC voltages encountered in transistor circuits certainly won't "bite" you, and you'll end up with the best little signal injector you ever saw. Using this trick, you can work all the way back through the IF and RF stages, getting a louder output as you go.

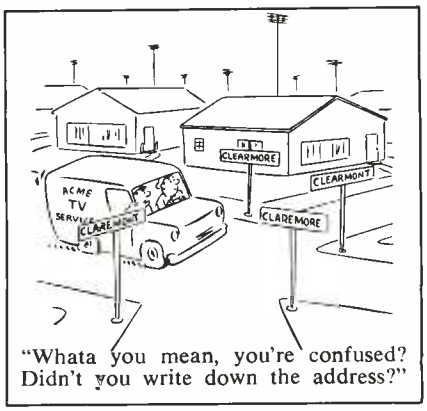
Leaky Coupling

One very common trouble in any

type of electronic equipment is capacitor failure. This fault can generally be pinpointed through voltage analysis; for example, take the case of a leaky coupling capacitor C1 of Fig. 4. The audible symptom is a highly distorted output. As with any radio, the first reaction is "trouble in an audio amplifier stage." A voltage check of the PNP driver reveals the following voltages: emitter 8.3, base 8.2, and collector .2. All of these readings deviate enough from the normal values to make us suspect trouble in (or affecting) the driver stage. A quick check of the other voltages in this set shows all of them to be normal; therefore, a deeper analysis of the voltages in the driver stage is in order.

The reduced collector voltage (.4 volts below normal) means a reduced voltage drop across the collector load. This could indicate either of two things: Collector-emitter current is less than it should be, or the impedance of the transformer primary is abnormally low. To gain further information, we can check the emitter voltage. We find it higher than normal — in other words, closer to the source-voltage level. The most probable cause is a reduction in emitter current, which suggests a lack of collector current rather than failure of the collector transformer. A leaky C2 or a decrease in the value of R3 could also have caused the higher-than-normal emitter voltage in this PNP stage, but these troubles would have been accompanied by higher collector voltage. In the present case, we can give the collector and emitter components the "OK" stamp and go looking for other reasons why collector current is inadequate.

Having analyzed the collector and emitter circuits and found no reasons to suspect trouble in them, we're left with either the base circuit or the transistor itself as possible causes of the trouble. To consider the transistor: If it opens, there will be no output signal at all, and both base and emitter voltages will approach that of the supply while the collector will approach zero. If the transistor is leaky, the bias will go down, but base and collector current will go up. If *beta* (comparable to the amplification factor of a triode tube) goes down, so will the output-signal amplitude. None of these conditions exist, so we stamp the transistor "OK" and head for the base circuit. Here we had an increase of .5 volt over the normal value, while the emitter voltage increased by .4 volt. Since the transistor is a PNP unit, and the emitter is now only .1 volt positive with respect to base (instead of the normal .2 volts), we can see that we have a decreased base-emitter bias. This would explain the reduction in collector-to-emitter current, and definitely indicates trouble in the base circuit. Either the base voltage-divider network of R1 and R2 has changed in value, or cou-



"Whata you mean, you're confused? Didn't you write down the address?"

pling capacitor C1 has developed a leaky condition. Measuring the voltage on the base as the volume control is rotated will tell us where the trouble is. When we vary the control, the base voltage changes; therefore, the coupling capacitor has to be the defective component.

Voltage Tolerances

Needless to say, voltage readings for any particular stage will vary from one piece of equipment to another; this is true even when two identical chassis from the same model run are considered. How, then, can we make sure our voltage analysis is based upon facts of circuit deviation rather than normal voltage - tolerance variations? For one thing, we can use a regulated supply voltage or a battery of known quality when making the tests. If any other type of power supply is used, it's important to monitor the supply voltage as the load varies. A change in the operation of any stage will put a "different from normal" load on the supply and may cause voltages throughout the equipment to vary greatly. This is especially noticeable when the current drain of the output stage fluctuates. Another way to avoid being misled by tolerance variations is to consider *relationships among all voltages within a certain stage,* in the same manner as when analyzing circuits employing tubes. This is what we did in the case of the leaky coupling capacitor.

Voltage tolerances will range within roughly 10% to 20% of the values shown in the service data. We must remember that we are dealing with normally small voltages. In light of this fact, we can also expect small variations to be significant, and so our readings must be accurate.

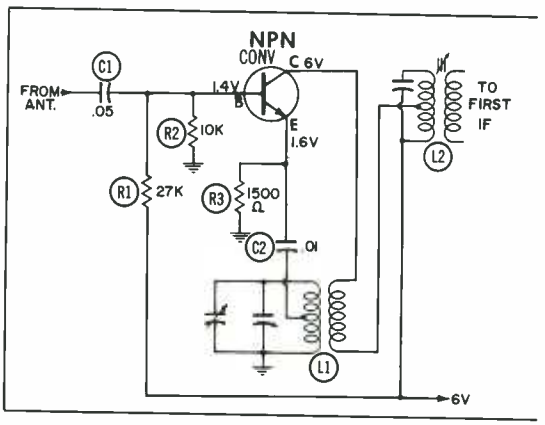


Fig. 5. Tuning gang must be rotated in order to check oscillator voltage.

Voltages Normal — Set Defective

The following symptoms lead us to troubleshooting the NPN circuit shown in Fig. 5: Set is dead, but *all* voltages check normal, and a finger on the voltmeter probe produces a nice loud buzz from the speaker when touched to the emitter or base terminal of the NPN converter. The logical assumption is that all stages are amplifying normally, but the oscillator isn't oscillating. A quick check of the components reveals an open oscillator-coupling capacitor C2.

Why, you might ask, is such a trouble mentioned when voltage analysis didn't pin down the trouble? The answer is simple. Voltage analysis of the radio *did* pinpoint the failure to the oscillator section of the converter stage. To explain this analysis, we must turn our attention to all the things we actually do when making voltage tests. In addition to having the radio connected and turned on, the service information laid out, and the VTVM at hand, we must set up other definite conditions in order to obtain

useful voltage readings. This set-up process includes shorting the antenna or using some means of creating a no-signal condition. In addition, it's normal procedure to turn the tuning gang to one spot (usually, any point in its range will do) and leave it there throughout the whole procedure. In the case just described, however, the final "nail-down" to prove the oscillator wasn't functioning came from measuring converter voltages as the tuning gang was turned from one end of its range to the other. There was no variation in the voltage readings, even with the signal applied. Had the oscillator been functioning, there *would* have been variations. (Only minor changes should appear when no signal is applied — but the voltages definitely should vary.)

NPN Driver and PNP Output

The circuit shown in Fig. 6 is still rather unusual at this time, but there are growing numbers of circuits wherein both NPN and PNP transistors are used in the same piece of equipment. Such a circuit is ideally suited for comparing the differences between the two transistor types. Take, for example, the positive swing of the driver's base voltage as a signal is applied. This change results in greater emitter-to-base current, and a corresponding increase in emitter-to-collector current. As collector current increases, the voltage at the collector decreases. Since the PNP output transistor's base is directly coupled to the collector of the NPN unit, the base of the output stage becomes less positive. This negative-going swing of base voltage causes increased base-to-emitter and collector-to-emitter current in the PNP transistor, thus increasing the signal current through the output-transformer primary.

Obviously, any defect in the driver stage will affect not only its output signal, but also that of the output stage. If, for example, the NPN driver develops an open element, there will be no collector current through the 120-ohm load resistor; therefore, the collector voltage will rise toward the supply-voltage level of 6 volts. The base voltage of the PNP transistor will do likewise; this puts reverse bias on the PNP stage and cuts it off. The emitter voltage then rises to that of the supply, and the collector voltage drops to zero — or it may even go negative as a result of reverse leakage currents in the transistor.

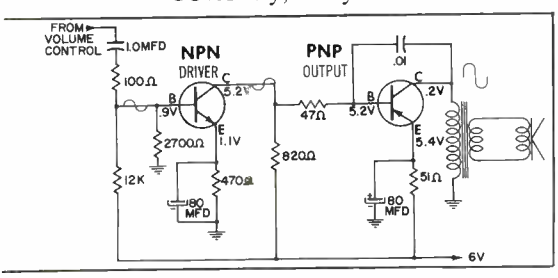


Fig. 6. Circuit using both NPN and PNP transistors is ideal for analysis.

Summary

Regardless of what trouble may develop in a transistorized unit, you'll practically always find that some voltage will deviate from the normal value. Build up an understanding of the effect of voltage changes at each transistor element. Make a careful analysis of each case, and with a little practice, you'll pinpoint troubles in the least amount of time and with the highest possible degree of accuracy. ▲

3-Point Checkup

(Continued from page 25)

behavior of the set made me suspect an occasional loss or distortion of vertical sync rather than a fault in the vertical sweep section, so I began my attack by scoping the 6BE6 sync separator. At the input grid, I found a waveform like Fig. 4, with apparent compression of sync pulses. Measured from blanking level to tip, the pulses should normally account for at least 25% of the total signal amplitude — probably even more. The plate waveform of the 6BE6 *looked* reasonably normal, but there was no telling what would happen to it if the input signal were further distorted by noise or other interruptions.

Back to the video section I went in search of a clue. This old-time receiver has not one, not two, but *three* video-amplifier stages; however, the last two are not involved in sync-stability problems, since the sync input is taken from the plate of the first video amplifier. Checking this tube (a 6U8), I found interelement leakage. When I put in a new tube and checked the sync-input waveform again, I found it much improved — but would this cure the trouble? A few minutes later, I found out that it wouldn't, as the picture began its frame-slipping antics again.

Maybe the trouble was in the vertical circuit, after all. Before plunging in, I glanced over PHOTOFACT Folder 184-15 to refresh my memory on its operating theory. (See Fig. 3.) This type of circuit should already be familiar, since a "souped-up" version of it is now very popular for driving 110° yokes.

The output tube V12 not only develops a sawtooth current for the yoke, but also forms part of the vertical multivibrator. It produces a feedback signal which returns to the first section of the multivibrator (V8B) to keep the circuit oscillating. V12 conducts throughout the trace period, while V8B is held in cutoff by the RC grid-leak networks in its grid circuit. The retrace period begins when VB8 goes into conduction, in turn cutting off V12. The latter action is aided by a negative sync pulse fed to the plate of V8B.

When I checked the waveforms

in the vertical circuit, they all indicated normal operation. The conduction pattern of V8B was clearly shown by the cathode waveform (Fig. 5A), with its positive 8-volt spike indicating tube conduction during each retrace period. Between pulses, note that the cathode voltage comes to rest at a positive 2.7 volts, very close to the DC value given on the schematic.

As shown by the positive peak in the grid waveform (Fig. 5B), the grid draws current at retrace time in order to charge up the RC networks. These slowly discharge during the following trace period, creating a gradual rise in grid voltage which gives the waveform a sawtooth-like shape.

Conduction of V8B produces a negative pip in this tube's plate waveform (Fig. 6A). Note that the average value of V8B's plate voltage is well over 100 volts between pips (while the tube is cut off), but that the plate voltage is momentarily driven down to about 30 volts during the conduction period. The slow rise in plate voltage from one negative spike to the next is due to the charging of the .022-mfd sawtooth-forming capacitor through its 15K-ohm series resistor and the height-control circuit.

This sawtooth signal is coupled through a large capacitor (.1 mfd) to the grid of V12, arriving with practically the same waveshape (Fig. 6B) and reduced only slightly in amplitude. The only thing changed is the DC level, which averages about zero volts at the grid. This is good news; a waveform riding at a higher level, or a flattening of the positive peaks, would indicate leakage in the coupling capacitor.

How about that! To all appearances, the circuit is operating as though it had just been built by the factory — so where do we go from here? Well, note that there are *three potentiometers* in the circuit of V8B. One of them (the vertical range control) is a rugged one-watt unit that doesn't give much trouble; but the other two (height and vertical hold) are half-watt carbon units of the type which frequently change value with age. Further complications arise from the frequency-determining RC networks associated with these controls. An increase or de-

crease in the value of any of these parts can cause a shift in the operating frequency of the vertical multivibrator. You can compensate for this to some extent by adjusting one or more of the three controls, but there's a limit to how far you can go.

The most likely offender in the whole circuit, as I've learned from experience, is the height control. One end returns to the B+ boost source of 460 volts, and the voltage drop across the active part of the control is usually in excess of 200 volts. The vertical hold control is not subjected to such high voltages, but it does receive a *sharp pulse* of voltage each time V8B conducts. It's entirely possible that this might eventually cause trouble.

Since I strongly suspected trouble in these carbon controls, I checked them both. Sure enough, each one had increased in value; in addition, the height control had a small "skip spot" where the slider had been in contact with the carbon element. With a rather shaky contact being made at this point, it was no wonder the set had developed intermittent vertical trouble. I replaced both pots and was rewarded with a solidly locked-in picture — no roll, no flutter, no flopover, and no more annoyance to the customer.

Is This the End?

Servicemen often ask, "Do you let the set 'cook' after you've finished repairs?" In an instance such as this, the answer would be *yes*. I'd allow the receiver to run for at least a half hour and then check the action of the new controls. If the set was going to "intermit" again, it most likely would have done so by the end of that time.

For more routine repairs, however, you can usually conclude that the job is complete when your scope tells you the defect has been corrected. Learn to trust your oscilloscope, keep it in good condition so you can depend on the accuracy of its DC input and amplifier circuits, and use a low-capacitance probe for practically all measurements in circuits following the video detector—this is my recipe for speeding up servicing time. With a calibrated DC scope, you can measure both AC and DC voltages at once, while simultaneously checking the waveshape of the signal. ▲

Q & A on TV Alignment

(Continued from page 23)

BILL: I was just coming to that. The hot lead of the vertical input cable goes through 10K to point C—the "high" end of this 3900-ohm resistor close to the video detector can. Then the ground lead goes to chassis—and we've finished connecting the scope across the detector load. Now, I'll connect up my bias network, and we'll have all the equipment set up. [Fig. 2] Let's turn the set on and see what we get.

DAN: I don't see anything on the scope yet!

BILL: Well, we have to adjust the generator. I'll set the center frequency to 43 mc, the *sweep width* switch to 9 mc, and the RF output at close to maximum for the time being. Notice how I can see a curve when I vary the sweep frequency? I'll set the frequency dial so I can see the response curve in the center of the scope screen. There are really *two* curves, aren't there? I'll turn the *phasing* control until they merge into one, and then I'll throw the *blanking* switch on. This kills one of the curves and forms a straight trace across the top of the curve as a "zero reference" or base line. [Fig. 3]

DAN: The curve's upside down!

BILL: Won't be, if I flip the *polarity* switch on the scope. But it really doesn't matter which way it appears. We can check the curve shape just as well either way.

GEORGE: That curve looks pretty good to me.

BILL: Probably too good to be true! The bottom of the curve looks too flat, so we may have an overloading condition. In other words, the peaks of the curve may be mashed down by driving some amplifier stage into saturation. Let's see what happens when I turn the generator gain down. Ha—this looks more like what I expected. [Fig. 4A] Overloading will usually occur if the generator's output is too high or if the set isn't fed sufficient bias. In some cases, the scope itself may be overloaded, and its gain control will have to be adjusted.

DAN: Now it looks as if the curve's got a dip in the middle.

BILL: Let's see if the local oscillator in the tuner is giving us trouble. You see, we can get rid of that dip

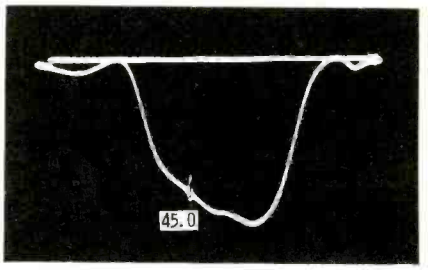


Fig. 6. If marker output is properly adjusted, pip will appear as shown.

by switching to one of the unused high channels. Notice what happens to our curve when I turn the channel selector to an active station. [Fig. 4B] The curve is plenty distorted, and you can even see the sync pulse. When you run into this kind of trouble, try switching the tuner to a position that gives you the least interference.

FRED: You got a response curve right away, but whenever I try it I have to fiddle for a half hour.

BILL: Let me go back over this sweep-generator adjustment. Suppose I reduce the sweep width by placing the switch in the 3-mc position. You'll get a curve [Fig. 5A], but it won't resemble the one in the alignment instructions. This means the frequency band being swept is too narrow, and you can't see all of the curve on the scope screen.

Suppose I now increase the sweep width to 18 mc. Here the response curve covers only a small portion of the total scope trace. [Fig. 5B] When the sweep width is too great, you have a tough time trying to compare the curve to the example given in the instructions. Another trouble you may run into is misadjusting the center frequency of the sweep generator. For example, when I turn the dial away from the 43-mc calibration mark, I can see only a small portion of the curve at one end of the scope trace. [Fig. 5C] Frequency calibrations on the generator dial are not as important as actual results. Once you're in the proper range, you merely tune the generator back and forth and watch the scope screen for your response to appear. Now that we have the response curve, what else do we need to do to see that the curve is correct?

JOHN: Won't you have to throw some markers in there to see what frequencies are represented by different points on the curve?

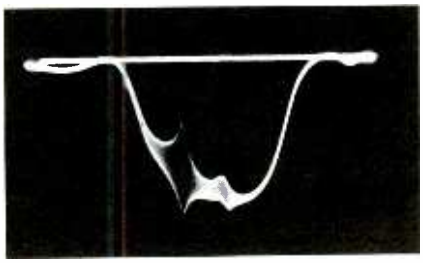


Fig. 7. Excessive output from marker generator seriously distorts curve.

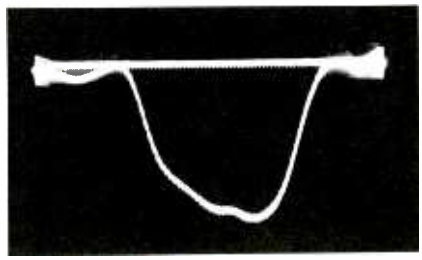


Fig. 8. Radiation from horizontal sweep circuit causes "hash" on curve.

BILL: Right! Since our sweep generator has a built-in marker section, all I have to do is place the marker switch in the *variable* position and adjust the marker dial for the desired frequency. I'll set the dial at 45 mc and turn up the marker output slightly. See the pip that occurs on the curve? [Fig. 6] Now, by varying the marker frequency, we can determine the bandwidth of the response and see that the markers occur at the proper levels as shown in the instructions. You see, the curve would be of no value unless we could determine the frequencies that correspond to various places on the curve.

The marker generator can give you trouble, though. When I turn its gain up too high, look at the distortion on the curve. [Fig. 7]

DAN: The last time I tried to perform an alignment, I had hash something like that all over the curve.

BILL: It was probably due to radiation from the horizontal sweep section. Let me see if I can duplicate this condition so we can find out what to do about it. First, I'll try removing the high-voltage cage. There! Notice the slightly shaggy appearance of the curve? [Fig. 8]

GEORGE: It doesn't look too bad, even now. Couldn't you go ahead and align the set, using this curve in this condition?

BILL: You might, but the hash would be likely to slow you down by making the marker pips harder to recognize.

With the cage in place, we're lucky enough not to be annoyed by hash in the present setup. On some other alignment jobs, you'll find a much higher radiation level—depending on receiver design and the test-equipment hook-up you use. If rearranging leads doesn't remove the hash, you'd be well advised to clean it up some other way.

DAN: For instance?

BILL: For instance, there's the 10K isolating resistor between the scope probe and the detector circuit. We could replace it with a somewhat higher value—up to about 47K—and get a certain amount of filtering which would reduce the hash. We don't want to increase the resistance too much, however, as this would cut down the amplitude of our response curve. As a rule, we don't have much signal to spare!

Another way to reduce the interference is to connect a small capacitor—not over 2000 mmf—directly across the scope's vertical and ground terminals. It also tends to sharpen the marker pips, in addition to filtering out the horizontal radiation.

FRED: If horizontal sweep is causing trouble, why can't we just disable the horizontal oscillator by pulling

the tube?

BILL: John, you know the answer to that one, after the rough time you once had with an open plate resistor in the oscillator stage.

JOHN: I sure do. The output tube lost its drive signal and ran "wide open." I must have ruined three tubes before I caught on to the trouble.

BILL: Some sets have a cathode resistor to protect the output tube in cases like this; but, if you removed the drive signal, you could cook this resistor in the time it takes to perform an alignment.

JOHN: Say—why not pull the output tube itself? That would disable the sweep just as well.

BILL: This would be safer, but there's still a pitfall. If you remove the output tube, the current drain on the power supply will decrease quite a bit. This can raise the B+ voltage to the tuner and IF's enough to change their frequency response.

If the instructions suggest pulling the output tube, it's okay to do so; otherwise, better see if it has any noticeable effect on the response-curve shape. The same warning applies to the other anti-hash methods.

FRED: If you were aligning a series-string set, you couldn't pull a tube anyway.

BILL: That's right. But you could install a dummy tube, with no active elements except the heater. Of course, you still might run into the problem of lowered B+ drain.

DAN: I've seen another item in alignment instructions from time to time—a direction to tape the high-voltage lead securely away from the chassis. Is this another way of cutting down on horizontal radiation?

BILL: Not necessarily so; this instruction has a different purpose. It is usually given in a situation such as you find in vertical-chassis sets, where you're likely to perform the alignment with no CRT connected to the chassis. Taping the HV lead keeps it out of the way and prevents accidental shorts. You'd disregard this instruction if you were using a small check tube with the set, as we are doing right now.

Fellows, the curve looks pretty good right now, but we might be able to improve its shape if we proceed through the complete alignment.

DAN: If it's all the same to you, Bill, I'd rather see another run-through of the procedure for setting up the over-all curve. I'd like to be sure I know how to hook up all this equipment before I start worrying about how to make the slug adjustments.

FRED: Me too—the directions look easy on paper, but the results never seem to turn out like they're supposed to.

GEORGE: Like my wife trying to bake a cake!

BILL: So that's why they call you "Slim"! What would *you* rather do now?

GEORGE: It would suit me fine to go through the over-all setup again, if you're willing. I know I could use some more practice on this.

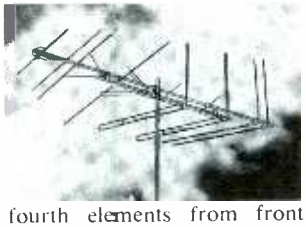
BILL: Well, to be truthful, you all look ready for a cup of coffee — and I know I could use one myself. Let's take a break, and afterwards I'll show you how to make an over-all alignment check of this other set over here.

For all you readers, this coffee break will be a month long. (Pleasant thought, isn't it?) The whole gang will be back in the September issue for another bench session on alignment techniques.—Ed.

PRODUCT report

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

All-Channel Antennas (39S)



TACO has announced a new *T-Bird* series of antennas designed for high gain and almost complete elimination of side lobes in the polar response pattern. The new line has several novel electrical features such as the *T-Match system* (note "struts" on third and fourth elements from front of antenna in photo), which provides better efficiency over the whole VHF band. Mechanical features include improved types of brackets for holding the elements at the correct angle and for clamping the antenna to the mast.

Three models are available, all fully preassembled. The 707-5, for suburban service, has five parasitic and two driven elements; list price is $26.95 in plain aluminum or $31.95 in gold-anodized finish. The 707-6, for near-fringe locations, has six parasitic and three driven elements; price is $37.95 (plain) or $43.95 (anodized). The 707-8 (shown), for extreme fringe reception, has six parasitic and four driven elements, plus a truss-braced boom; price is $54.95 (plain) or $61.95 (anodized).

VHF Aircraft Radio (40S)

A VHF-FM aircraft radio for two-way air-to-ground communications, the COMCO *Flightcom*, operates from a 12- or 24-volt power supply. Two models are offered—the 580, with 35-watt transmitter output on the 25- to 54-mc band, and the 582, with 25-watt output on the 144- to 174-mc band. Both are available for either broad- or narrow-band operation. Weight of the complete equipment shown in the photo is under 18 lb.

Speaker-Baffle Combination (41S)

The slim-profile Utah *Magni-Magic* speaker, an inverted unit with a front-mounted pot-and-magnet assembly, is used in four series of speaker-baffle combinations. Baffle size is the same for all models—12" wide and 9 1/2" high, with a depth of 4" at the top and 2 1/4" at the bottom. Units may be furnished with either or both of two optional accessories, a built-in volume control and a 70-volt transformer.

Tube Assortment (42S)

A "starter" assortment of 37 *Golden M* receiving tubes, available from Motorola distributors, is stocked with all new types appearing in Motorola's 1961-model TV, stereo, and radio sets—namely, the 3DG4, 5GH8, 6AL3, 6DQ6B, 6GH8, 6EZ5, 6GK6, 12DQ6B, ECL82, HCC85, and ECC85. Also included is a supply of 5 other types: 5U4GB, 6BQ7A, 6CB6A, 6SN7GTB, and 6U8A.

Antenna Display (43S)

JFD's *Exact Replacement Antenna Dealer's Stocking Assortment* (Kit No. PA515) includes a wrought iron merchandising rack, a selection of antennas including 13 newly-released models, a 1960 *Exact Replacement Antenna Reference Guide*, and window streamers to help the service dealer promote installations of replacement antennas for portable and "toteable" TV sets. Dealer cost for the complete kit is $48.50.

Frame-Grid RF Triode (44S)

The Mullard EC97/6FY5 tube has been made available to the replacement market. This triode, which features frame-grid construction, is employed as an RF amplifier in a new switch-type tuner found in several '61 Zenith TV sets. It has a rated transconductance of 13,000 micromhos, and an amplification factor of 70.

Audio Accessories (45S)

Among the items included in Robins' new extensive line of phonograph and tape recorder accessories are a round turntable level (which detects a tilt in any direction), metal 45-rpm disc adapters, a VU meter, tape-reel holders, an indoor dipole antenna for FM radio, a strobe-and-light kit for checking phono speed, splicing tape in 1/4" and 3/4" widths, a full line of drive wheels and belts, numerous patch cords and adapters, plus an assortment of 16 types of M/M tape heads.

White Soldering Gun (46S)

A new addition to the *Shop-mate* line of soldering guns and irons by Portable Electric Tools, Inc., is the Model SG-125 *Shop-Shooter* — a transformer-type gun with white nylon housing, a trigger extending the full length of the handle, and a screw-in 5" tip. Extensions and special tips are also available. Heating time is 2 1/2 sec; input current is 1.3 amps at 115 VAC; weight is 1 3/4 lb; and price is $6.95.

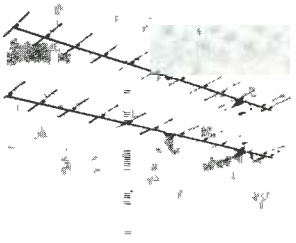
Remote Preamp (47S)

Signal losses in long cable runs between a turntable and a control preamplifier can be overcome by installing a Shure M60 stereo preamp underneath the turntable. This unit provides 17 db gain per channel, and has low-impedance outputs (5000 ohms) to permit use of cable lengths up to 50'. Operating voltages are furnished by a self-contained selenium-rectifier power supply. Price is $19.95.

Multiple-Socket Tube Tester (48S)

Equipped with 21 tube sockets, the Mercury Model 102-P portable tube tester is designed for quick checking of emission, shorts, leakage, and gas in receiving tubes. It also has a "neon-glow" test for filament continuity, and checks fuses, pilot lamps, crystal diodes, and power rectifiers. Price is $59.50; a Model AD-1 adapter, for testing black-and-white picture tubes, is $3.95.

FM Yagi Antennas (49S)



A new series of Winegard Yagi antennas for FM radio receivers comprises 42 different models, including both broad- and narrow-band types with 3, 6, or 12 elements. Preassembled *Transcoupler* stacking bars provide an over-all impedance of 300 ohms for a two-bay antenna. All models feature a gold anodized finish.

Inconspicuous Microphones (50S)

Long, slender necks of semi-rigid tubing are attached to the Electro-Voice Model 652 and 652A dynamic microphones in order to bring them close to the user's face without creating a "hiding behind the mike" effect. A clear plastic baffle, encircling the mike head, increases directivity and slightly boosts frequencies in the 6000-cps region for greater "brilliance" of sound.

Transistorized Inverter (51S)

You or your customers can operate TV sets and other AC-powered devices from a 12-volt auto or boat battery by using the Arkay Model 2-120W *Transistor Inverter,* which can handle a continuous load of 125 watts (with intermittent peaks of 200 watts) at 115 VAC. The 12-volt primary circuit is protected by a 15-amp fuse. Weight is 5 1/2 lb; price is $29.95 (kit) or $35.95 (wired).

Silver-Mica Capacitors (52S)

A kit of 45 miniaturized, dipped silver-mica capacitors, including values ranging from 56 to 680 mmf, has been announced by Cornell-Dubilier. All capacitors are rated at 500 volts and have a value tolerance of ±5%. Called the "Sweet Deal" assortment, the kit is packaged in a compartmented plastic case and is priced at $10.20.

Battery With Extra Life (53S)

An alkaline manganese battery developed by Mallory is said to give two to three times longer service than conventional dry cells in portable radios, and five times longer in flashlights. Size "AA" cells are now on the market, and sizes "C" and "D" will soon be available. Prices are slightly higher than for conventional batteries, but less than for mercury types.

New TV Tubes (54S)

The 6GN8, a triode/pentode used in '61 Zenith sets and some Motorola portables, has been added to Sylvania's line of replacement tubes. This new type is similar to the 6EB8 except that the pentode section (used as a video amplifier) has an improved mechanical design featuring a cooler-operating cathode. Two other newly-available tube types are the 2ER5, for series-string versions of the *Guided Grid* tuner, and the 6EA7 dissimilar double triode for vertical sweep circuits.

Attic Antenna (55S)

The Jerrold *Magic Carpet* antenna, composed of printed-circuit conductors on a flexible backing, is electrically somewhat similar to a VHF conical outdoor antenna. However, it provides a closer impedance match to a 300-ohm lead-in, thereby furnishing better over-all gain and lower VSWR. Attic installation (either laid flat on the floor or hung from rafters) is recommended for most satisfactory results; under typical conditions, the useful range of the antenna extends approximately 30 miles from the transmitter. List price is $9.95.

INDEX TO ADVERTISERS

AUGUST, 1960

ANTENNAS

1S. BLONDER-TONGUE—Master TV System Design and Installation Manual with 24 pages of tips on planning and installing master TV antenna systems for hotels, motels, apartment houses, institutions, etc. *See ad page 47.*

2S. JFD—1960 Exact Replacement Antenna Guide for Portable and Toteable TV Sets (20 pages), compiled and edited by Howard W. Sams & Co., Inc. Gives TV receiver model number, manufacturer's antenna part number, and model number of corresponding JFD exact-replacement antenna. Also Form No. 71 brochure illustrating and describing 1960 line of natural silver and gold anodized Hi-Fi Helix antennas, and Form No. 66 covering 1960 series of natural silver and gold anodized Hi-Fi Fireball antennas.

3S. JERROLD — Technical publications CSMMKI and MCA-21 on new *Magic-Carpet* antenna, the out-of-sight device with performance characteristics of an outdoor VHF antenna. *See ad page 65.*

4S. SOUTH RIVER — Newly-revised catalog illustrating company's expanded line of antenna mountings and accessories. *See ad page 62.*

5S. WINEGARD — Literature on Model WBC-4 Booster Coupler, which amplifies TV and FM radio signals for operation of one to four receivers. *See ad page 15.*

AUDIO & HI-FI

6S. FANON—Data on new line of public-address equipment, including 10- and 20-watt transistorized mobile amplifiers as well as various other systems (both fixed and portable) rated at 10, 20, 35, 45, and 70 watts. *See ad page 36.*

7S. MOSLEY—Form AA-1 on audio and hi-fi accessories; Forms CB-1A and CB-2B on deluxe and standard line Citizens band antennas. *See ad page 58.*

8S. SWITCHCRAFT — 4-page catalog of molded cable assemblies, including various combinations of phono plugs and jacks, microphone connectors, etc. *See ad page 49.*

BUSINESS AIDS

9S. HOWARD W. SAMS — Literature with complete details of PEET program. *See ads pages 14, 44, 45, 49.*

COMMUNICATIONS RADIO

10S. COMCO—Data on new Model 582 *Fleetcom* VHF-FM two-way mobile radio for police, taxi, and business radio service. *See ad page 56.*

COMPONENTS

11S. BUSSMANN — Three-color bulletin on two types of *Stak-Pak* fuse assortments, showing TV servicemen how new packaging idea provides convenient way to carry a complete line of fuses at all times. *See ad page 29.*

12S. CENTRALAB—Catalog sheet on 46 new push-pull and push-push switches with controls for radio, TV, and hi-fi use — with complete specifications and list prices. *See ad page 32.*

13S. CHICAGO STANDARD — Pocket-size cross-reference guide for transformers, showing original-equipment manufacturers' part numbers and correct Stancor replacements; also 28-page catalog describing full line of coils. *See ad page 18.*

14S. CORNELL-DUBILIER — 20-page catalog of electrolytic capacitors for replacement use by servicemen. *See ad page 39.*

15S. MERIT—New 30-page 1960 catalog of replacement transformers and components for radio and TV. *See ad page 63.*

16S. J. W. MILLER—176-page No. 61 *General Catalog and Coil-Replacement Guide*, listing complete line of nearly 1500 coils, with cross-reference charts of replacement coils for home radios, TV sets, and auto radios.

17S. SAMPSON—Catalog No. 558 of *Hitachi* components; full-color folder describing line of *Hitachi* radios. *See ad page 28.*

18S. SARKES TARZIAN (Tuner Div.)—Informative literature on TV and FM tuners. *See ads pages 43, 71.*

19S. SPRAGUE—36-page Catalog No. C-613 of service-type capacitors, transistors, and test equipment. *See ad page 10.*

KITS

20S. 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 ads pages 48, 49.*

21S. PACO—New 24-section catalog showing 11 new test-equipment and stereo hi-fi kits.

SEMICONDUCTORS

22S. SYLVANIA—8-page booklet, Form 9028, listing electrical characteristics of Sylvania transistors, diodes, and silicon rectifiers. *See ad page 54.*

SERVICE AIDS

23S. CASTLE TUNER — Leaflet describing fast overhauling service on television tuners of all makes and models. *See ad page 58.*

24S. PRECISION TUNER — Information on repair and alignment service available for any type of TV tuner. *See ad page 60.*

25S. TACO — "Out — Will Be Back At ———" door hanger, free to TACO antenna dealers (mailing charge to others).

26S. WALDOM—Informative bulletin on the economies and advantages of speaker reconing; referral to a local reconing station on request. *See ad page 60.*

TECHNICAL PUBLICATIONS

27S. GENERAL ELECTRIC — Registration card ETR-2223 for receiving bimonthly Techni-Talk bulletin. *See ad page 35.*

28S. 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 14, 44, 45, 49.*

TEST EQUIPMENT

29S. B & K—Bulletin ST25-R, digest of information on Model 1075 *Television Analyst*, Models 1070 and A107 *Dyna-Sweep* circuit analyzers. Models 550, 650 and automatic 675 Dyna-Quik mutual conductance tube and transistor testers, and Model 440 CRT rejuvenator-tester. *See ad page 52.*

30S. ELECTRO PRODUCTS LABS — Information on Model PS-3 low-cost regulated DC power supply for servicing transistor circuits. *See ad page 70.*

31S. JACKSON—Catalog sheet on Model 605 Sine-Square Wave Audio Oscillator, giving specifications and suggested uses. *See ad page 72.*

32S. SECO — Literature on new Model 500 *Crystalignmeter* test instrument which cuts installation and servicing time on Citizens band and other crystal-controlled two-way radio equipment. *See ads pages 67, 69, 71.*

33S. SENCORE — 4-page brochure on complete line of time-saver instruments, plus information on the TC109 *Mighty-Mite* tube tester. *See ads pages 55, 57, 59, 61.*

TOOLS

34S. BERNS—Data on 3-in-1 picture-tube repair tool, *Audio Pin-Plug Crimper*, and *Ion* adjustable beam bender. *See ad page 60.*

35S. CBS — Catalog of servicing aids and tools. *See ad page 21.*

36S. XCELITE—Literature describing *Seizers* (clamp-on tool) in straight-nose and curved-nose styles. *See ad page 30.*

TUBES

37S. MOTOROLA — Brochure on *Porch 'n Patio* furniture ensemble offered free with quantity order of *Golden "M"* receiving tubes or picture tubes. *See ad page 19.*

38S. WESTINGHOUSE Electronic Tube Div.—Consumer booklet, "A Rescue Job for Tony," explaining how receiving and cathode-ray tubes are manufactured to high quality standards.

How do your customers rate you?

Your reputation is based largely on what happens *after* you leave the scene of each service call. For this reason the name on the tubes you install makes a world of difference. RCA tubes are designed and manufactured to assure customer confidence in you as well as in RCA.

RCA tube quality is your best insurance against call-backs due to premature tube failure.

RCA tube performance puts your workmanship in the best light and protects it through rigid quality control.

RCA's trademark symbolizes a name and reputation customers have respected for decades.

Your customers know that those red-white-and-black RCA tube cartons in your tube caddy represent the most trusted name in electronics. Remember, customer confidence is the cornerstone of your business.

To protect your service reputation before, during and after every service call, make sure your next tube order specifies . . . RCA TUBES.

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dealer-serviceman's fuse rack . . .

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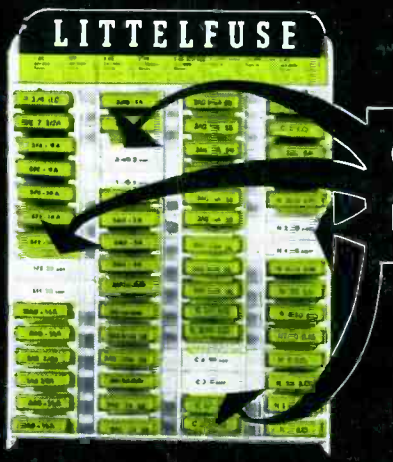
. . . the FUSEMASTER!



dealer-serviceman's fuse requirements at a glance