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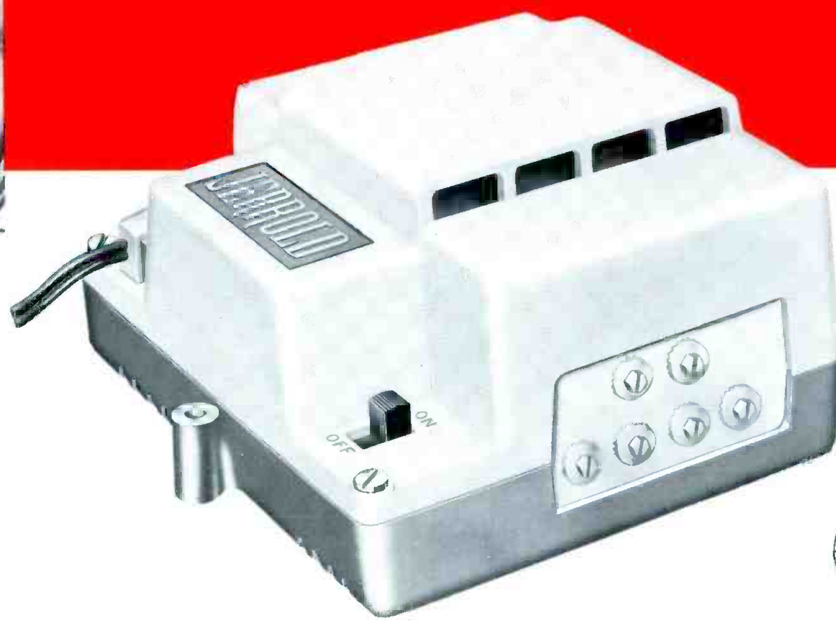

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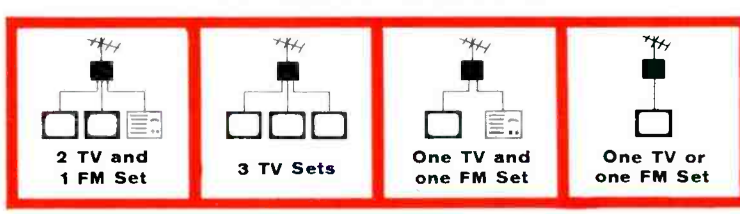

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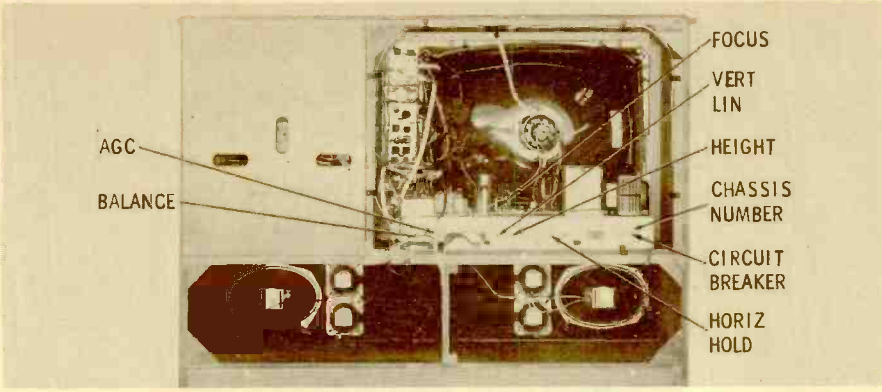
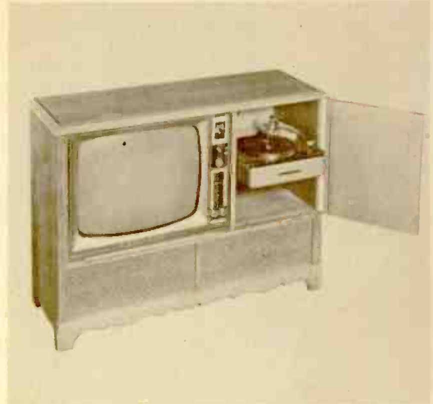
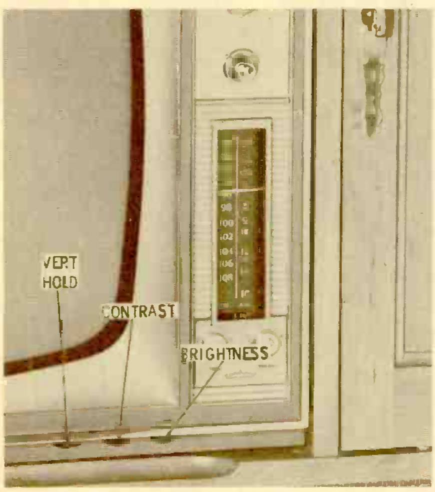
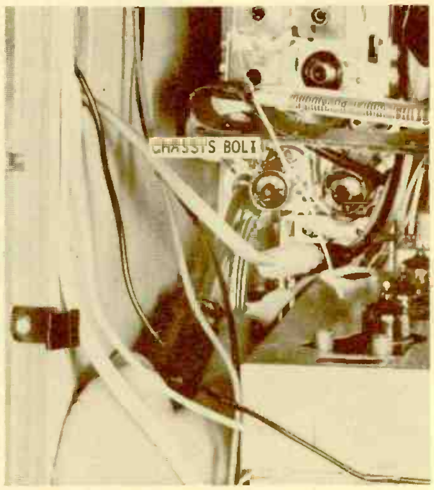
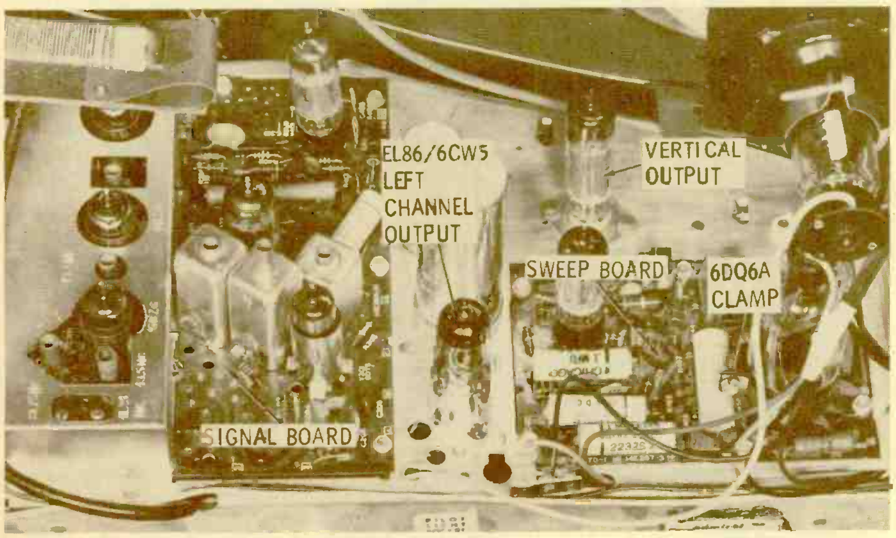
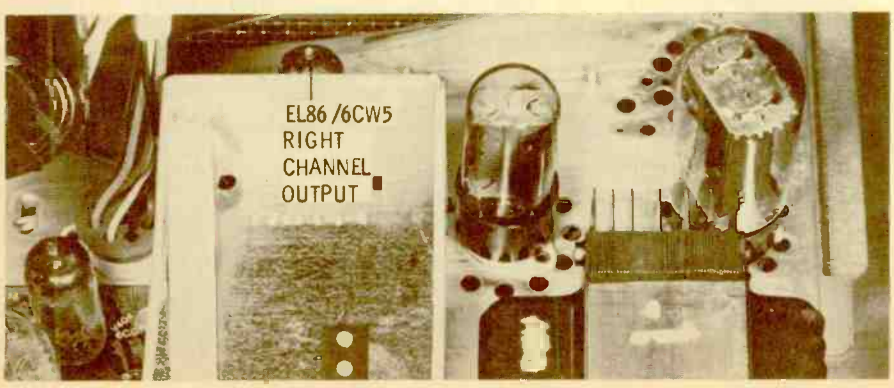












Admiral Model STF 24M169 Chassis 20C7

Admiral's *Stereophonic Theater* group consists of nine models using this chassis. All are equipped with stereo phono, three-tube AM or seven-tube AM-FM radio, and a 23", 110° picture tube with bonded safety shield.

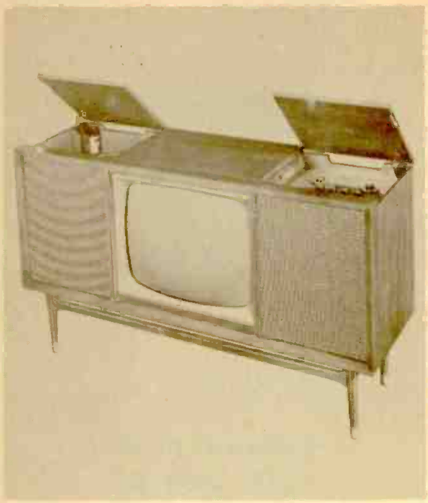
Unmistakably Admiral, the 18 - tube chassis contains a mixture of printed and conventional wiring. All setup controls are mounted on the rear apron, including a screwdriver-adjusted balance control to equalize the outputs of the stereo amplifiers. As in the 1960 chassis, the AGC control is covered with a warning label to discourage do-it-yourselfers from fooling around with this fairly critical adjustment. (If you're not *sure* how to adjust it, follow the directions in the service data.)

The vertical hold, contrast, and brightness controls are mounted very inconspicuously along the bottom of the front, and can be easily overlooked by the unwary serviceman. Beware — lest your customer think you don't know your way around the set.

Nearly hidden by some of the interconnecting cables, the dial-cord drum, and the radio chassis itself, one of the four bolts holding the chassis to the front of the cabinet requires a long-handled ¼" nut driver to remove it. Two other bolts secure the chassis to the bottom board. With all six bolts removed, the chassis can be removed from the *front* of the cabinet.

The printed boards for the signal and sweep sections are separated by a portion of the chassis containing the well-shielded EL86/6CW5 left-channel audio output tube. The vertical output stage is in a conventionally-wired section just in front of the sweep board. Note: The horizontal output tube is mounted on this board and is held in place by a clamp; failure to loosen the clamp when attempting to replace the tube could damage the printed board.

The transformer-powered chassis is equipped with a 5U4GB which is protected by a circuit breaker. Tube filaments are protected by a length of #26 wire. The right-channel audio output tube is located directly in front of the cage. These EL86/6CW5 tubes in the stereo output circuit are the only rare types used in the chassis; however, the 6DT8 serving as the FM radio mixer-oscillator may be new to some in the TV servicing field.



Airline Model WG-6030A

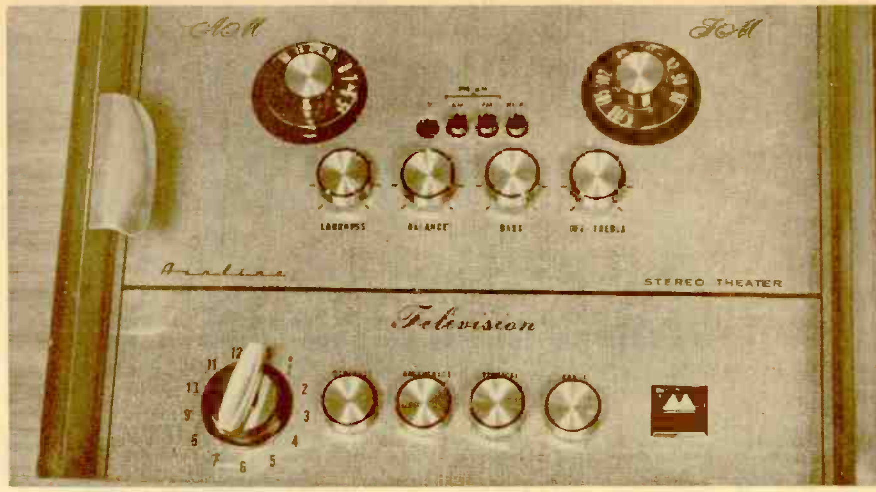
Containing a variety of home entertainment devices, this Airline *Stereo Theater* has a 90°, 23″ picture tube with a bonded safety shield and matching speaker baffles. Hinged lids cover the compartments housing the stereo phono at the left and the control panel at the right.

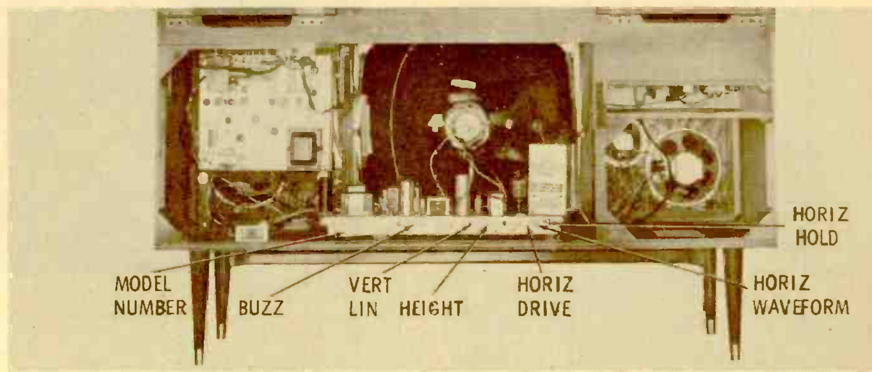
All of the operational controls are located on the control panel. Push buttons control the switching to select TV, AM, FM, or hi-fi. It's possible to depress both the AM and FM buttons for reception of simulcast stereo transmissions. Since the TV section doesn't contain an audio output stage, the sound signal is fed to the stereo amplifiers of the radio section and is regulated by controls common to all modes of operation.

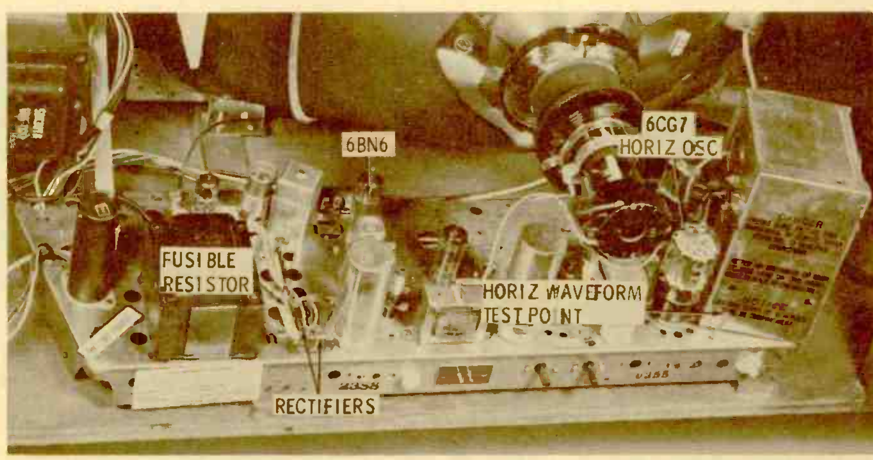
Both the 13-tube TV chassis and 12-tube radio are conventionally-wired units with transformer-equipped power supplies. Setup controls for the TV are mounted along the rear apron and clearly identified. Fixed focus is employed, thus eliminating any focus adjustment. Disassembly instructions are provided on a form glued to the bottom of the left-channel speaker compartment.

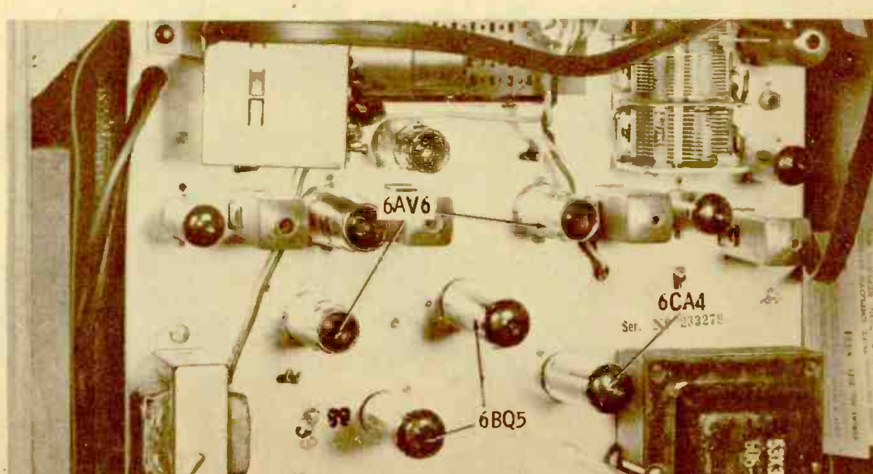
The TV section is powered by a transformer and a pair of silicon rectifiers connected in a full-wave voltage-doubler configuration. The rectifiers are protected by a 4.5-ohm fusible resistor. All tube sockets are identified by either a gummed label or a number stamped into the chassis. The 6CG7 used in the *synchroguide* horizontal oscillator circuit is hidden by the horizontal output tube and can easily escape notice. A test point is brought above chassis for greater convenience in making the horizontal waveform adjustment. A 6BN6 audio detector circuit is employed, and its output is connected via shielded cable to the radio chassis.

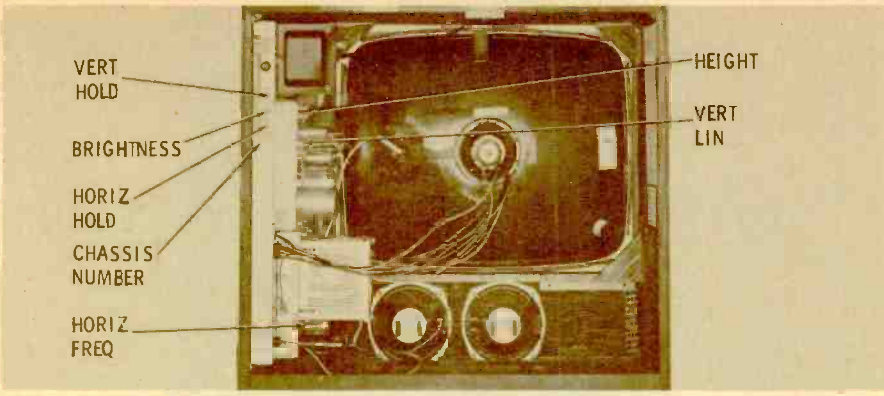
The radio chassis is mounted toward the back of its compartment and completely hides the panel containing the TV controls and tuner. Since the audio and power-supply circuits of the radio are used with the TV, it should be noted that some uncommon tube types are employed. A 6CA4 is used for the rectifier and 6BQ5's for the output stages. A pair of selected 6AU6's fill the audio amplifier demands, but the manufacturer recommends type 7543 (a 6AU6 with a special coil-wound heater) as a replacement.

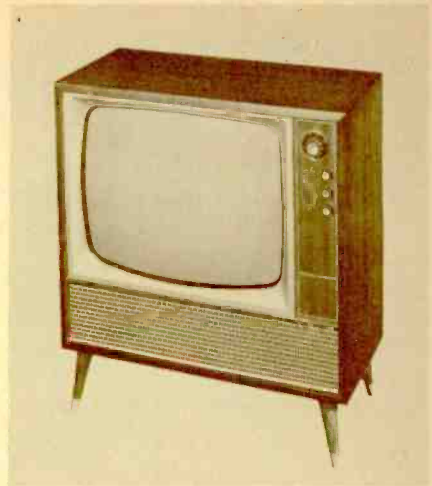


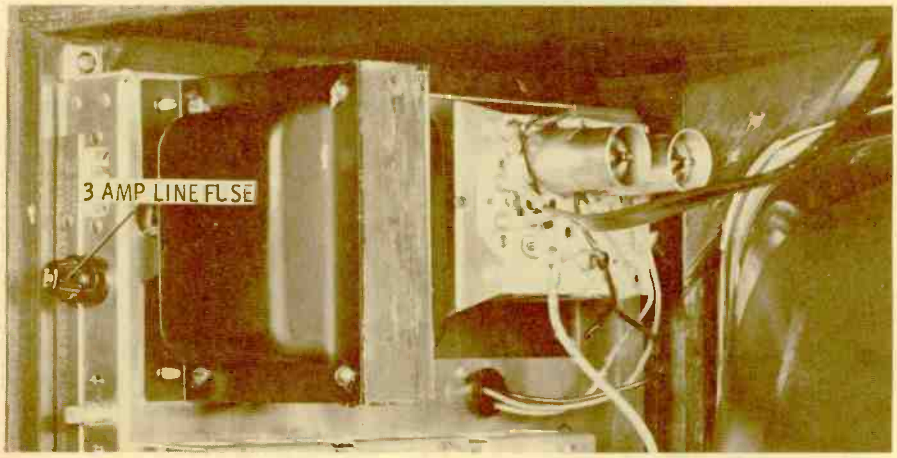


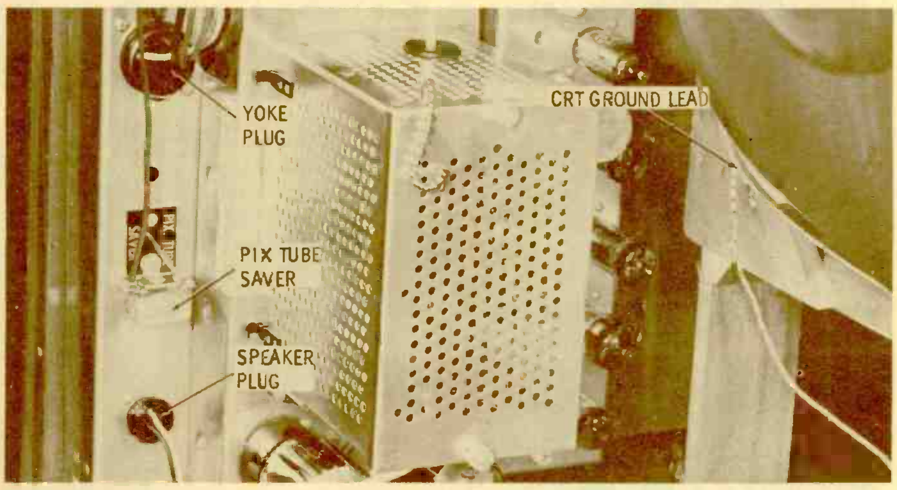


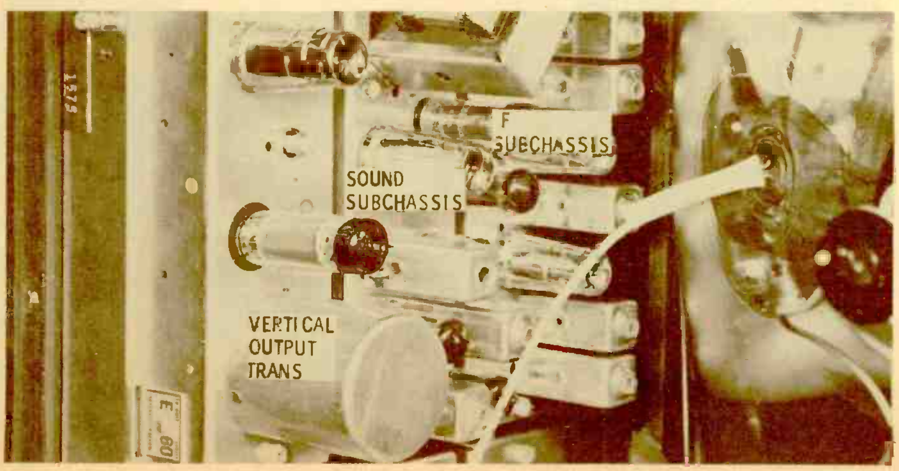












Setchell-Carlson Model 601C Chassis X159

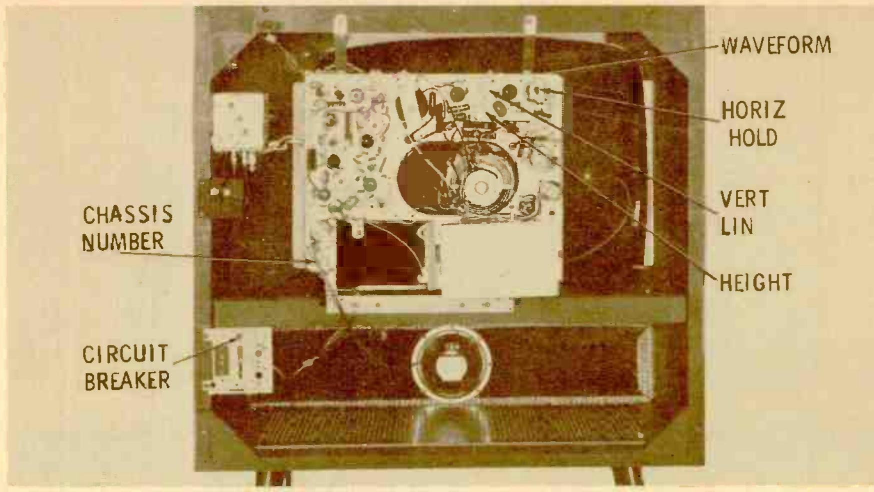
Setchell-Carlson's *Custom* line is represented by this 110° chassis using a 23" picture tube with bonded safety shield. Another chassis that finds its way into this series is the 90° version — Chassis 159. The front-mounted controls grouped along the right side of the picture tube include channel selector, off-on-tone, volume, and contrast.

Both 23-tube chassis are characterized by their *Unit-Ized* construction, with conventionally-wired, plug-in subchassis for each section. Rear-mounted controls are vertical hold, brightness, and horizontal hold; the remaining setup adjustments are mounted on top of their respective subchassis. Fixed focus is supplied directly from B+, eliminating the need for a focus adjustment.

The major difference in the physical layout of the X159 and 159 chassis is the power-supply mounting. In the X159 (shown), it is part of the main chassis wiring, while in the 159 it mounts on a subchassis. The electrical differences are primarily in the horizontal sweep circuits, in the form of minor circuit variations determined by the different requirements of the 110° and 90° deflection systems. The AC input is protected by a 3-amp fuse and a 2-ohm fusible resistor. (The latter is mounted beneath the chassis.) Filament wiring is protected by a length of fuse wire. The B+ supply consists of two silicon rectifiers connected in a half-wave, voltage-doubler configuration supplied from a power transformer.

As in previous versions, the power transformer has an 8-volt secondary tapped at 6.3 volts to supply filament power. The full 8 volts is applied to the picture-tube filament circuit through a 3-ohm series-dropping resistor. Shorting across the resistor raises the CRT filament voltage and thus places the *Picture Tube Saver* feature into use. An unusual means is used in this chassis to provide the ground for the outer coating of the picture tube — it makes its connection through the speaker plug.

The sound section is somewhat unusual, too; it has two stages of IF, a ratio detector, an AF amplifier and phase inverter, and push-pull output. Even more rare is the vertical output transformer — a round "potted" autotransformer with a special tap for the blanking signal.



Silvertone Model 1134 Chassis 528.50356

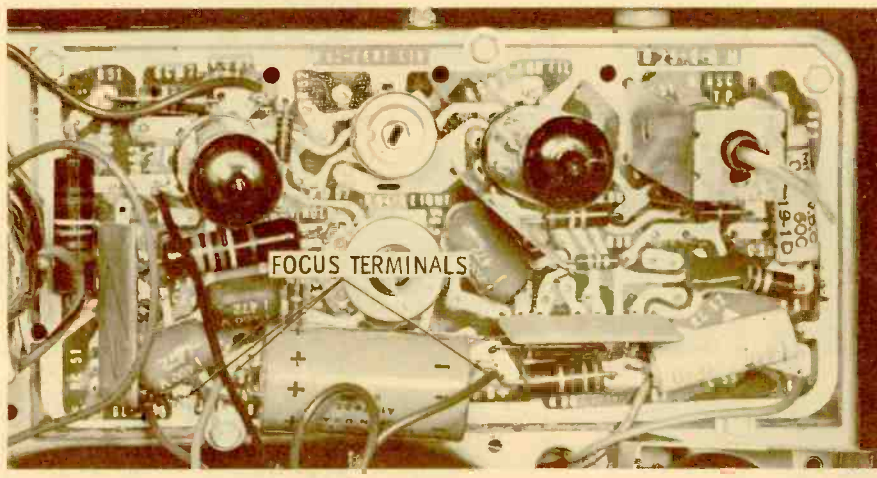
Here's one of Silvertone's lower-priced 23" consoles, available in four different models (1134 through 1137), and using four variations of one basic chassis. The major differences between models are in cabinet finish and tuner types. The 23AHP4 used is a 92° CRT without a bonded safety shield. Removing a trim strip along the top edge of the safety glass enables the face of the tube to be cleaned.

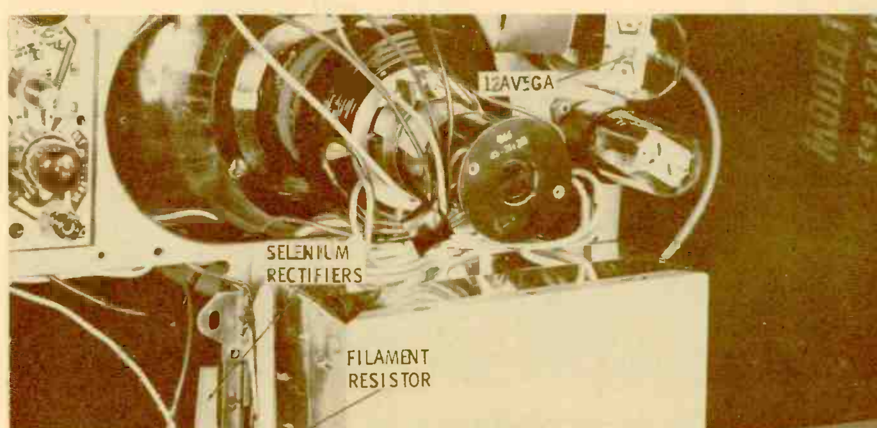
The 13-tube transformerless chassis is mounted vertically near the back of the cabinet, making it easily accessible for service. Height, vertical linearity, and horizontal hold controls are mounted directly on the sweep circuit board. The horizontal waveform slug of the *synchroguide* circuit is located in the bottom of the horizontal hold coil, and is accessible through a hole in the bottom of the printed board. This adjustment can be reached without removing the chassis. The control panel is held in place by two wood screws located under the volume and vertical hold knobs.

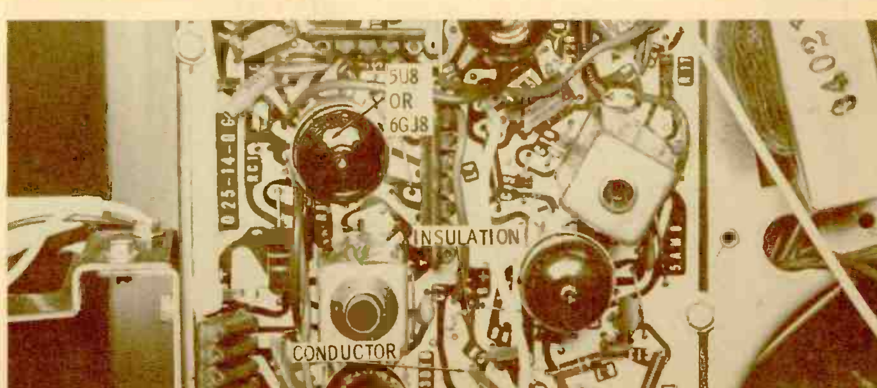
Three different focusing potentials are provided by terminal studs protruding from the sweep circuit board. From left to right, they are ground, boost, and B+.

Located just above the high-voltage cage, the rather rare 12AV5GA tube serves in the horizontal output stage. To the left of the cage a large 60-ohm, 25-watt resistor is connected in the 600-ma series filament string. On the bottom side of the chassis, below the cage, a pair of 300-ma selenium rectifiers are connected in a full-wave doubler B+ circuit. Rectifier protection comes from a circuit breaker in the lower left-hand corner of the cabinet.

Although Silvertone was one of the last users of printed boards to adopt a printed aid for identifying connections and wiring paths, the system they adopted is easy to follow. The wiring pattern occupies almost the entire board and is painted a bright white. The "no conductor" part of the wiring pattern remains a brownish "board color," and without close observation, is apt to be mistaken for the wiring pattern. As in previous years, much of the circuitry employs component combination units having from five to nine leads. You may encounter a new high-gm 6GJ8 in the sound IF-sync separator stages, although some versions use the more familiar 5U8.







See PHOTOFACT Set 502, Folder 1

Mfr: Emerson **Chassis No. 120517E**

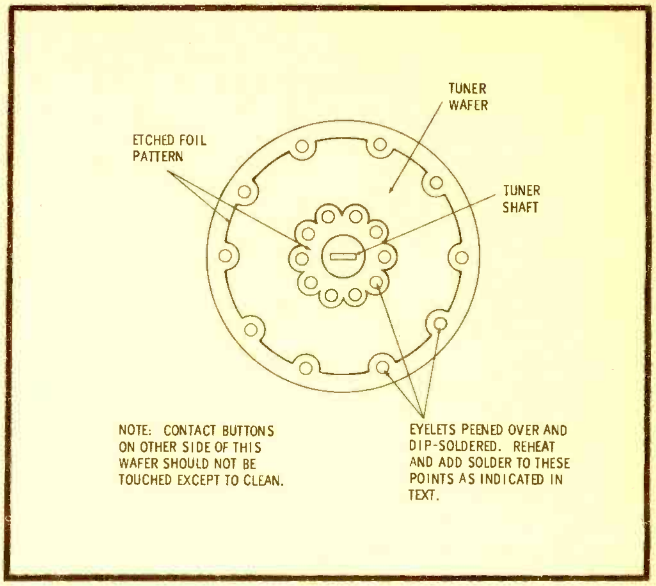
Card No: EM 517-1

Section Affected: Pix and sound (only in models equipped with switch-type tuner).

Symptoms: Intermittent loss of both picture and sound.

Cause: Cold-solder joint on one of tuner wafers.

What To Do: The back sides of all button contacts on each tuner wafer are peened over to make contact with etched connectors or coils and then dip-soldered. Occasionally, a cold-solder connection is made. Heat these connections and apply a small amount of additional solder to insure a good connection. Do not prolong the application of heat, as this might lift the etched foil from the wafer.



Mfr: Emerson **Chassis No. 120517E**

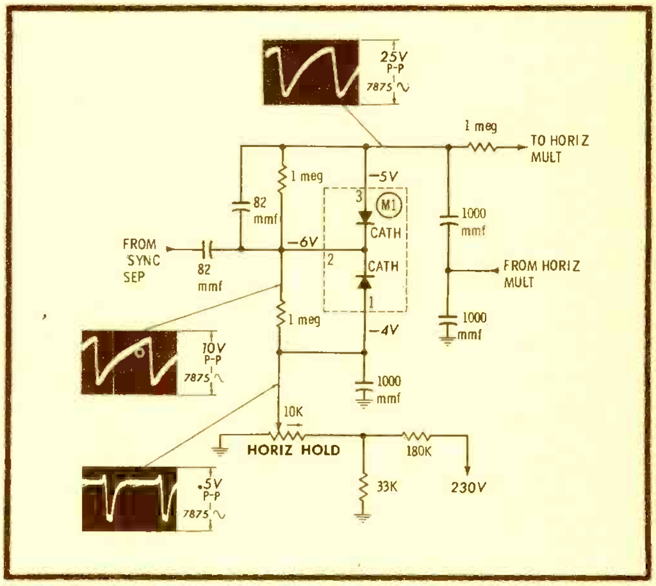
Card No: EM 517-2

Section Affected: Sync.

Symptoms: Critical horizontal hold.

Cause: Unbalance between sections of dual selenium diode in horizontal AFC circuit.

What To Do: Replace M1.



Mfr: Emerson **Chassis No. 120517E**

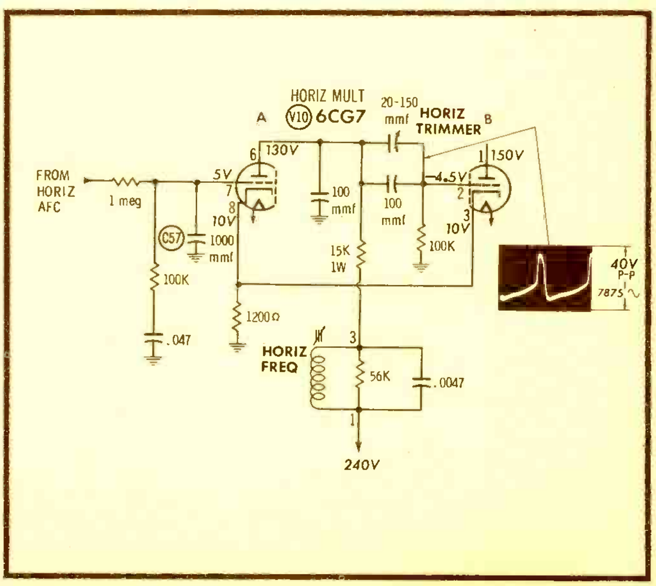
Card No: EM 517-3

Section Affected: Sync.

Symptoms: Intermittent loss of horizontal hold. Incorrect bias on pin 7 of V10A.

Cause: Leaky capacitor in grid circuit of horizontal multivibrator.

What To Do: Replace C57.



See PHOTOFACT Set 502, Folder 1

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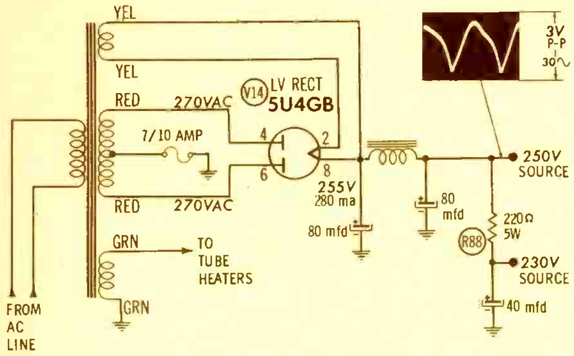
See PHOTOFACT Set 502, Folder 1



See PHOTOFACT Set 502, Folder 1

Mfr: Emerson **Chassis No. 120517E**

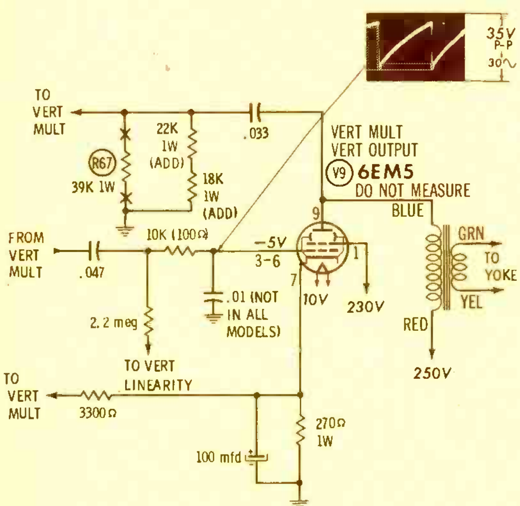
Card No: EM 517-4

Section Affected: Raster and sound.

Symptoms: No raster, no sound. No B+ at 230V source.

Cause: Open wire-wound dropping resistor in power-supply filter circuit.

What To Do: Replace R88 (220 ohms—5W).



Mfr: Emerson **Chassis No. 120517E**

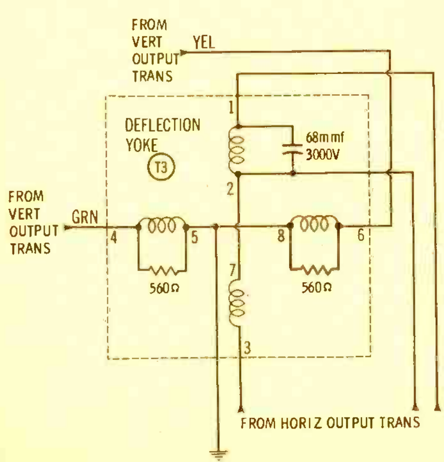
Card No: EM 517-5

Section Affected: Sync.

Symptoms: "One-way" vertical roll — cannot be stopped with hold control.

Cause: Open resistor in feedback circuit of vertical multivibrator.

What To Do: Replace R67 (39K—1W), using 22K—1W in series with 18K—1W.



Mfr: Emerson **Chassis No. 120517E**

Card No: EM 517-6

Section Affected: Raster.

Symptoms: Difficult to center picture without neck shadow.

Cause: Incorrect physical positioning of deflection yoke.

What To Do: Reverse all connections to deflection yoke and also rotate yoke 180° on neck of picture tube. (Sets already incorporating this change are coded with an A enclosed in a triangle.) Yoke should be wired as shown.

See PHOTOFACT Set 486, Folder 1

See PHOTOFACT Set 486, Folder 1

Mfr: Olympic **Chassis No. JE**

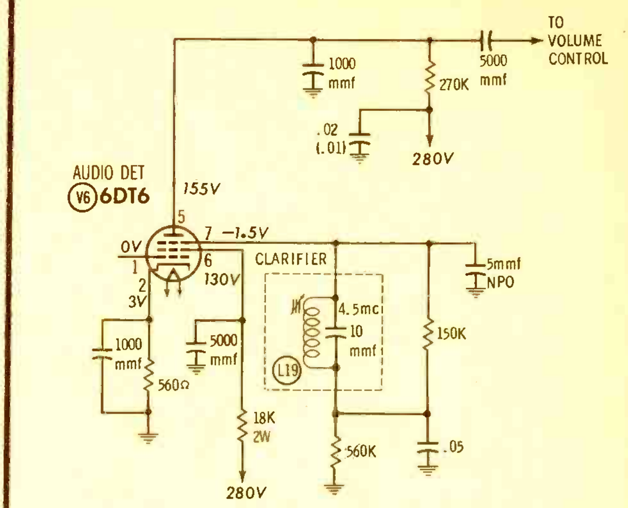
Card No: OL JE-1

Section Affected: Sound.

Symptoms: Buzz in sound.

Cause: Open quadrature coil in sound detector.

What To Do: Resolder open lead on L19 or replace coil.



Mfr: Olympic **Chassis No. JE**

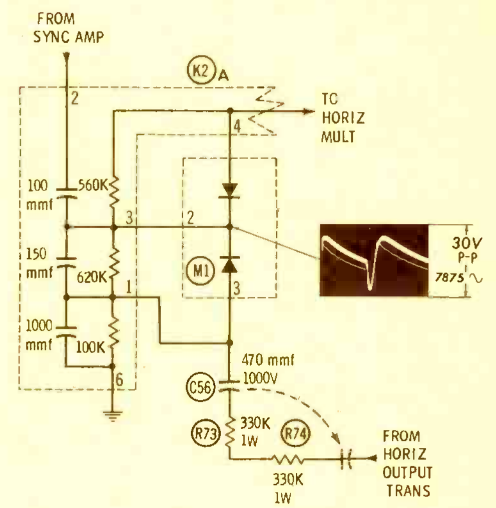
Card No: OL JE-2

Section Affected: Sync.

Symptoms: Loss of horizontal hold.

Cause: Leaky coupling capacitor in feedback circuit to horizontal AFC.

What To Do: Replace C56 (470 mmf — 1000V). Check AFC diode M1 and also R73 and R74 (330K—1W).



Mfr: Olympic **Chassis No. JE**

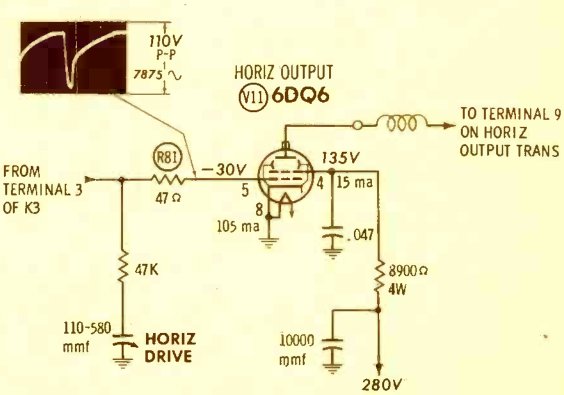
Card No: OL JE-3

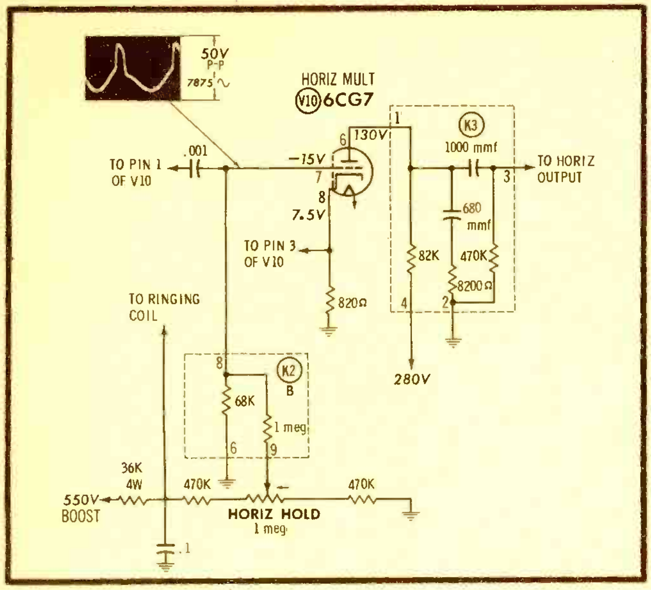
Section Affected: Raster.

Symptoms: Raster flashes off and on.

Cause: Series resistor in grid circuit of horizontal output tube is burned and opens intermittently.

What To Do: Replace R81 (47 ohms).





See PHOTOFACT Set 486, Folder 1

Mfr: Olympic **Chassis No. JE**

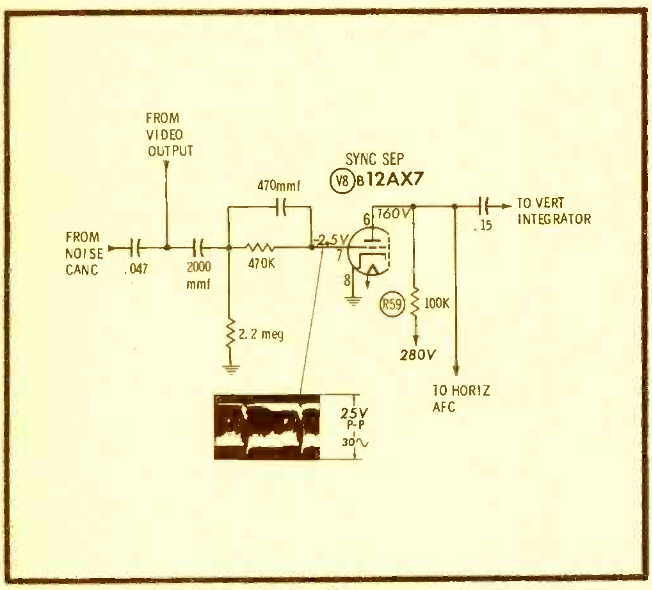
Card No: OL JE-4

Section Affected: Raster.

Symptoms: Insufficient width; flashes in raster.

Cause: Burned plate-load resistor in horizontal multivibrator, caused by leaky coupling capacitor between multivibrator and output stages. Both parts are in component-combination unit K3.

What To Do: Replace K3.



Mfr: Olympic **Chassis No. JE**

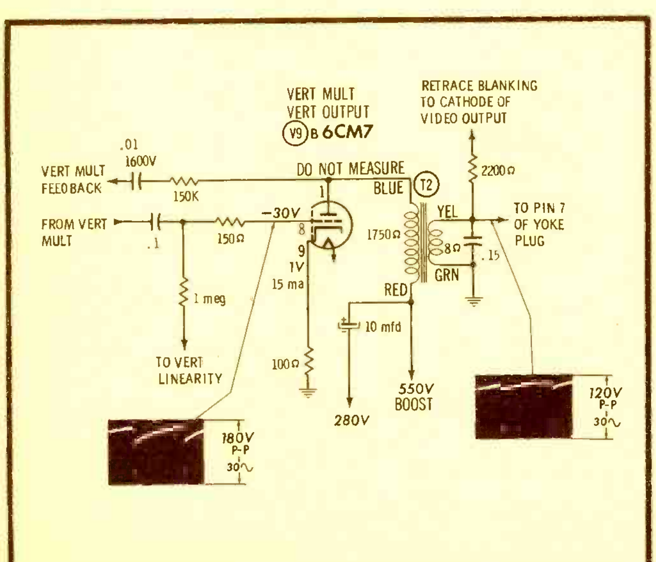
Card No: OL JE-5

Section Affected: Sync.

Symptoms: Poor horizontal and vertical hold.

Cause: Plate-load resistor of sync separator has increased in value.

What To Do: Replace R59 (100K).



Mfr: Olympic **Chassis No. JE**

Card No: OL JE-6

Section Affected: Raster.

Symptoms: Insufficient vertical sweep.

Cause: Vertical output transformer has internal leakage or shorted turns.

What To Do: Replace T2.

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VOLUME 11, No. 1 — *JANUARY, 1961*

CONTENTS

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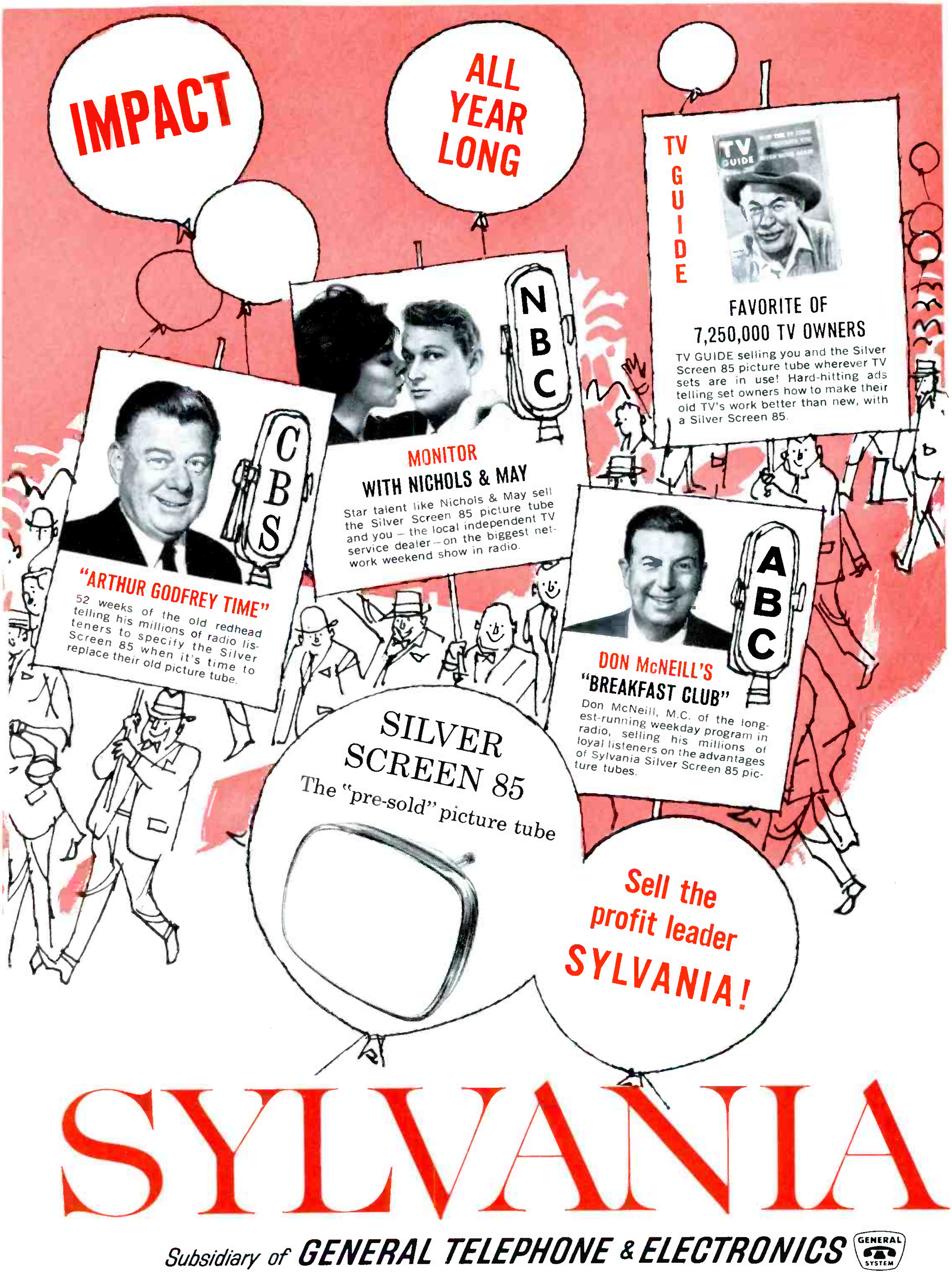
Yes, we're 10 years old this month, and this bonus-packed issue is our way of thanking you readers for your tremendous interest and support during the past decade. Our one birthday wish is that we have helped you as much as you have helped us.

NOW...4 GREAT "SALESMEN" SELLING FOR YOU!

Look at this parade of selling power! Sylvania advertising will make an average of over 9 million sales calls each week—thousands in your area—52 weeks of the year. The top stars of radio, the largest-selling weekly magazine in the country . . . all selling for you in 1961.

Yes, Sylvania is going all out to help you build profits. All new streamers, in-store display and direct mail are available from your Sylvania tube distributor. See him today. Stock up on Silver Screen 85 picture tubes and Sylvania quality receiving tubes. Do it now for a fast start to more profits in 1961.

Electronic Tubes Division, Sylvania Electric Products Inc., 1740 Broadway, Dept. ......, New York 19, New York.


IMPACT
ALL YEAR LONG
TV GUIDE
FAVORITE OF 7,250,000 TV OWNERS
TV GUIDE selling you and the Silver Screen 85 picture tube wherever TV sets are in use! Hard-hitting ads telling set owners how to make their old TV's work better than new, with a Silver Screen 85.
NBC
MONITOR
WITH NICHOLS & MAY
Star talent like Nichols & May sell the Silver Screen 85 picture tube and you – the local independent TV service dealer – on the biggest network weekend show in radio.
CBS
"ARTHUR GODFREY TIME"
52 weeks of the old redhead telling his millions of radio listeners to specify the Silver Screen 85 when it's time to replace their old picture tube.
ABC
DON McNEILL'S "BREAKFAST CLUB"
Don McNeill, M.C. of the longest-running weekday program in radio, selling his millions of loyal listeners on the advantages of Sylvania Silver Screen 85 picture tubes.
SILVER SCREEN 85
The "pre-sold" picture tube
Sell the profit leader SYLVANIA!
SYLVANIA
Subsidiary of GENERAL TELEPHONE & ELECTRONICS
GENERAL SYSTEM

LETTERS TO THE EDITOR

Dear Editor:

Please send me a copy of the 1958 and 1959 Reference Indexes to PF REPORTER.

You are to be complimented on your publication; it is the best in the field.

CHARLES E. BERGER
Nixon, N. J.

Dear Editor:

Would you please send me the '58 and '59 subject reference indexes to PF REPORTER?

Would a request at this early date be effective for a '60 index also, or should I reorder after January?

I obtain PF REPORTER each month, preferring it to the others I have been acquainted with, and I hope this letter plainly shows my opinion of your publication.

K. N. GORSKI
Washington 11, D. C.

Dear Editor:

Would you please send me the new Subject Reference Index? I have all the PF REPORTERS since 1955.

GILLES DERY
St.-Raymond, P.Q., Canada

The 1960 index is in your hands! In conjunction with our 10th Anniversary, we've incorporated it in a 16-page, 10-year Cumulative Index which begins on page 41. With all issues now indexed in one place, you'll no longer have to leaf through several separate indexes for all available information on a given subject.—Ed.

Dear Editor:

I am an independent technician and have held the opinion that operating a television set without a speaker is bad on component parts of the set, but I find others differ with me in the matter.

There are people who cut the speaker wire and insert a switch for a "blab out" to eliminate commercials. Will you clear up the controversy?

I certainly appreciate PF REPORTER better than any other technical magazine for TV technicians.

H. W. HILL
Torrance, Cal.

There's a slight chance that the reflected impedance of the unconnected secondary winding might cause damage to the output transformer. However, this would only occur with full signal applied (volume control fully up) through a fairly high-power amplifier. Most commercially-available "blab-off" units insert a resistor in series with the speaker for reduced volume, and in place of the speaker for complete muting.—Ed.

Dear Editor:

Much of the material in your recent issues—for example, "Three-Point Check-up for a Zenith 19K23," "Q & A on TV Alignment," and "Video Speed Servicing" in the August, 1960 issue—makes me wonder if I am too critical, or if your magazine is aimed solely at beginners. Would you welcome service articles of wider scope?

LES HUCKINS
Les Huckins TV Service
South Gate, Cal.

No, you're not being too critical; an experienced technician like yourself should be bored by a few of the articles. But it's not "old stuff" to a wide segment of our readers. We feel it's part of our job to help newer servicemen to enrich themselves in the fundamentals of trouble-shooting and bench procedures.

Nevertheless, we have not overlooked the need for more advanced material. Articles such as "Understanding Transistor Testers" and "Operation Vertical" in this issue, or "Regeneration in Picture-Signal Circuits" and "Report on TV Radiation Hazards" in the December issue, are designed to add to an already well-established store of knowledge. Expanded coverage of the business side of shop operation—one of the greatest needs at present—is represented by the ad program introduced on page 58 of this issue. If you can contribute material of special interest to the more experienced people in the TV field, we'd welcome the opportunity of reviewing it for publication.—Ed.

Dear Editor:

Once again I would like to express my appreciation for your excellent magazine. The technical information it contains each month is very good and very helpful.

I look forward each issue to *The Troubleshooter* and articles by Messrs. Kiver, Young, Prentiss, and all your excellent staff members.

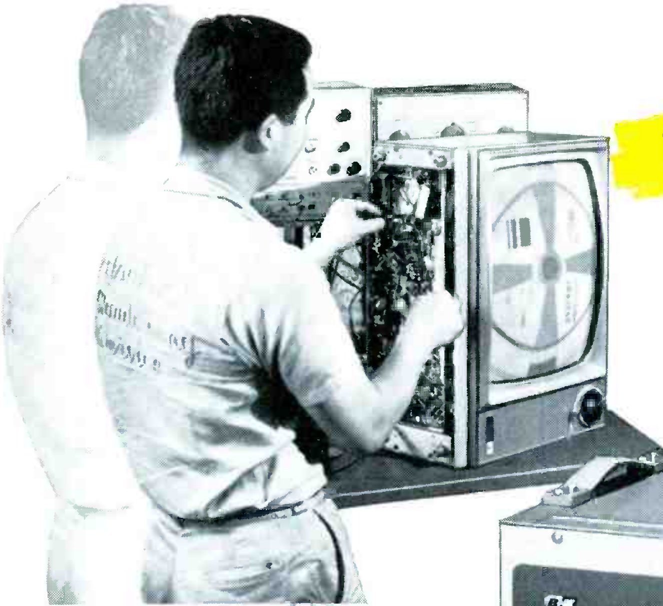
Just recently, I serviced a Granco AM-FM receiver Model 701. The tube lineup on the bottom of chassis identified the ratio detector and AF amp as a 14GT8. Since there was no sound other than a buzz on FM, and the AM was working, I suspected the ratio detector as the trouble. However, I had no data on a 14GT8 tube, and the latest information available at my distributor did not list this particular tube.

Since the schematic in PHOTOFACT Folder 461 showed a 19T8, I installed one and normal operation resumed. This is just one of many occasions where up to date service data has saved the day around my shop.

C. O. WADSWORTH
Wadsworth Radio and T.V.
Midlothian, Texas

Now everyone knows how to fix a Granco 701 with this trouble. Thanks for the tip.—Ed.

DOUBLES YOUR EFFECTIVE MANPOWER



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Save Half Your Time!

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for Black & White and Color

Check all circuits-Pinpoint any TV trouble...in minutes

By Easy Point-to-Point Signal Injection, You See the Trouble on the TV Screen and Correct it—Twice as Fast and Easy!

There's no longer any need to "lose your shirt" (and customers)—and worry about the lost hours you never recover—on "tough dogs" or even intermittents. *The remarkable B&K Analyst* enables you to inject your own TV signal at any point and watch the resulting test pattern on the picture tube itself. *Makes it quick and easy to isolate, pinpoint, and correct TV trouble in any stage* throughout the video, audio, r.f., i f., sync, and sweep sections of black & white and color television sets—*including intermittents.* Makes external scope or wave-form interpretation unnecessary. Most useful instrument in TV servicing! Its basic technique has been proved by thousands of successful servicemen the world over.

The Analyst enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, *and make more money.*

Model 1076. Net, **$299.95**

Available on Budget Terms. As low as $30.00 down.

Combines all the features of both the Model 1075 and Model A107

- COMPLETE R.F. and I.F.
- VIDEO TEST PATTERN
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my customers' satisfaction"

Jimmy Hull owns and manages Hull's Radio & TV Service, Evansville, Indiana, serving an area within 60 miles of the city. An early wireless operator, Jimmy has been in service work from crystal sets to color TV. Before opening his own business, he spent eight years as Sears, Roebuck & Company's only radio service man within 100 miles of Evansville.

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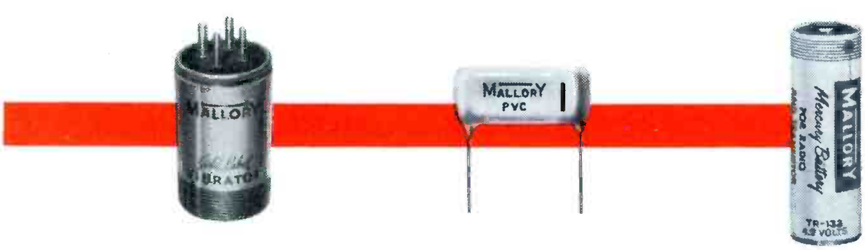
MALLORY



GOLD LABEL® VIBRATORS
Quietest vibrator ever made . . . for the best in auto radio servicing. Buttonless contact design gives longest life, surest starts.

MALLORY PVC CAPACITORS
New, blue Mylar* coupling and by-pass capacitors. Dunk 'em, bend 'em, overload 'em, overheat 'em . . . they can take it.

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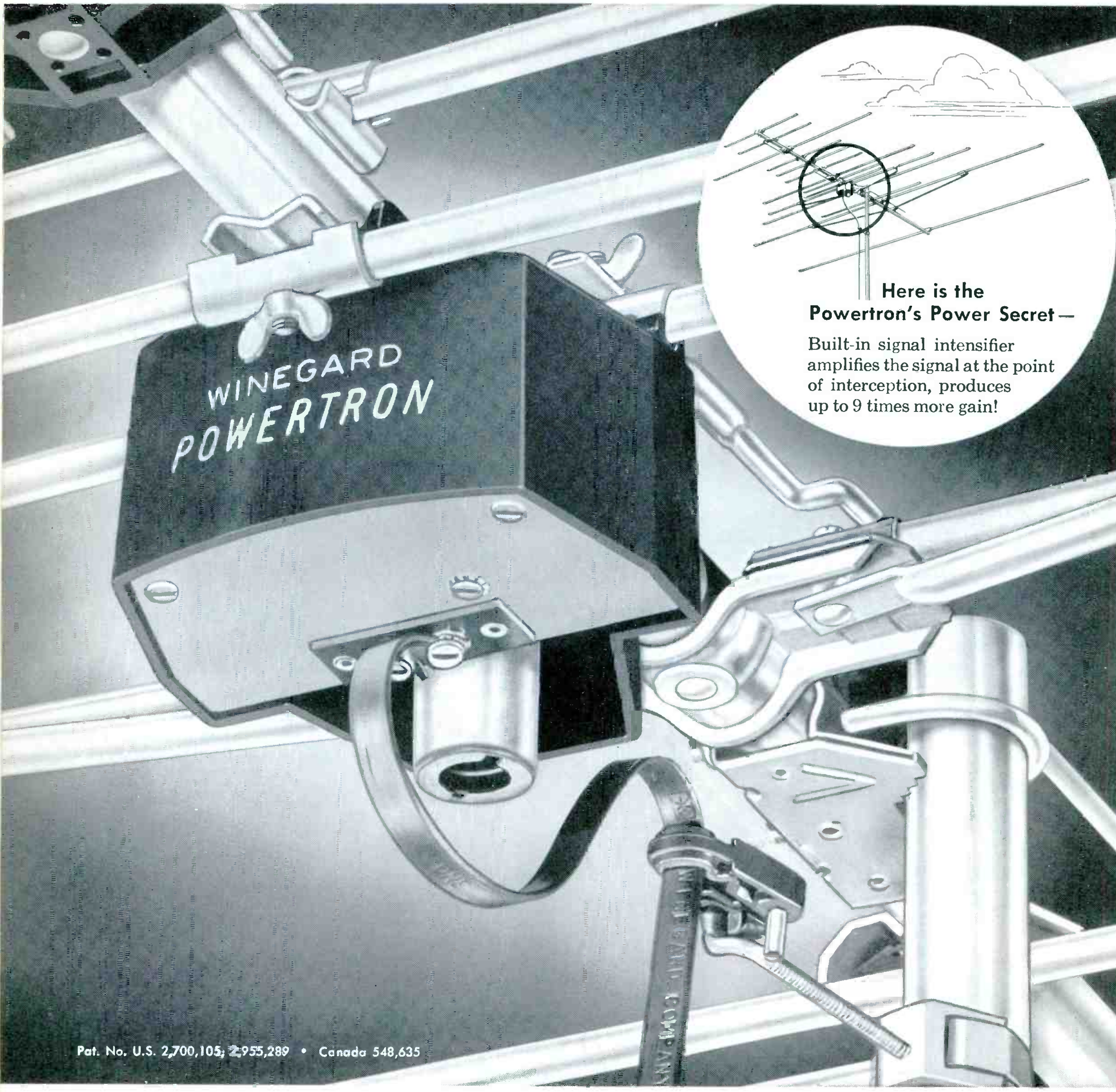
MALLORY MERCURY BATTERIES
Unmatched for transistor radios . . . give steady power, last up to 3 times longer, stay "alive" for years when idle. Guaranteed against leakage.

World's first Electronic TV Antenna . .



NOW AN ANTENNA WITH 5-9 TIMES MORE GAIN

THAN ANY TV ANTENNA EVER MADE!

Here's the antenna that will obsolete tens of thousands of old-style antennas, will give new life to old TV sets, will build new profits for TV Service Technicians.

TEN YEARS LATER

A Personal Message from Howard W. Sams

"PF INDEX has one primary purpose:
To provide the Service Technician with
useful, informative data that will
help make his work easier, quicker, more
profitable."

These were the words I used to describe the aims of PF REPORTER (then PF INDEX) when the magazine made its first appearance in January, 1951.

The ten years since then have been full of change, but this primary purpose has been served constantly and faithfully by PF REPORTER. This magazine will always continue to provide you with *practical* help in all the important technical and management areas of your business. And as always, the articles and features we bring you are based on actual research, study and experience in our own labs and in the field.

Working in your behalf is the largest full-time editorial staff of any publication in the industry, made up of experts who have been practicing servicemen themselves. They are backed by the unequalled facilities, equipment and technical resources of the entire Sams organization.

You will see the proof of their accomplishments in the special 10-year cumulative editorial index which begins on page 41 of this Anniversary issue. It is the actual record of the thousands of significant articles and features which have appeared in PF REPORTER over the years. We continue to serve your needs with ever-new help and services, typified by the announcement on page 58 of the first professionally-designed advertising program for servicemen—a PF REPORTER exclusive.

The decade just ended has seen great growth and change in our economy. When our first issue was published in January, 1951, there were only 10,000,000 TV sets in use; today there are over 50,000,000. Only 18,000,000 auto radios were in use then; today there are almost 50,000,000. Servicing labor and installation fees (exclusive of parts) were $350,000,000 in 1951 . . . in 1960 they reached over $1,350,000,000 . . . an increase of a *billion dollars* in ten years.

Yes, the changes have been startling, but far greater growth and opportunities are yet to come. The electronic maintenance industry is on the threshold of unparalleled potential.

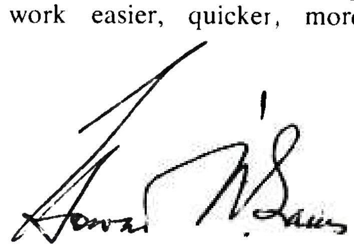
Here are the facts: About 10,000,000 new American households will be formed in the next ten years. This obviously means 10,000,000 potential new purchasers of home-entertainment electronic devices. These new sales build upon the tremendous accumulation of all types of home-entertainment equipment sold in the past decade, to create a huge market for service sales.

With the standard of living at an all-time high, the average American family is becoming a multiple TV-radio set home, with every indication of growing multiple ownership of other electronic home entertainment devices.

Our quickest growth potential, however, lies in the widening applications of electronics in home and industry. Color TV is now an important and growing factor. Tremendous increases in the sale of hi-fi, stereo, electronic organs and tape recorders are building vast demands for service. The new markets are even more promising: Citizens band radio; marine electronics; mobile electronics; electronic safety devices, ovens, appliances — are creating challenging opportunities. Educational electronics alone (closed - circuit TV, teaching machines, audio-visual equipment) represents a potential of staggering proportions.

Increasingly, progressive service dealers are widening their activities into new fields, such as commercial sound, 2-way mobile radio, testing and measuring, electronic controls, and computers.

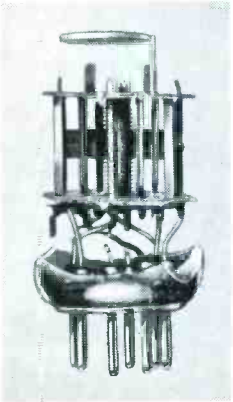
Yes, the future is bright, promising and rewarding. We will do our full share in these pages to point out the opportunities, to help you realize them through the kind of practical, proved help we have consistently given you. In whatever area you choose to operate, we reaffirm our pledge to help make your work easier, quicker, more profitable.



see how CBS 6BZ6 and 3BZ6

POSITIVELY CUT CALLBACKS!

Here's Total Reliability



In the CBS 6BZ6 and 3BZ6, you get . . .

NEW! PRECISION WOUND CONTROL GRID assures proper set operation under the widest variety of signal conditions.

NEW! ANTI-GAS BULB COATING stops gas leakage caused by electron bombardment of bulb. Eliminates degradation of i-f gain.

NEW! HIGH TEMPERATURE ANTI-SAG SCREEN is made of molybdenum . . . like transmitting tubes. Can't deform, short and burn out screen resistors.

NEW! DIRECTIVE RING GETTER prevents undesirable current leakage caused by deposits on mica and elements. Eliminates residual gas, lengthens tube life.

PROVE the superiority of CBS tubes right on the job! Try out your free CBS 3BZ6 and discover for yourself what CBS Electronics means by Total Reliability.

These new CBS tubes are the closest you can get to complete callback protection! They have been specifically engineered for utmost dependability. And CBS Electronics wants you to prove this to yourself at its own expense.

You get a free 3BZ6 with every purchase of four 3BZ6 and five 6BZ6 tubes . . . a total of ten tubes, *but you pay for only 9*. Call your CBS distributor now! Offer expires January 31st.

CBS ELECTRONICS
Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

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

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as
a
"bell"...

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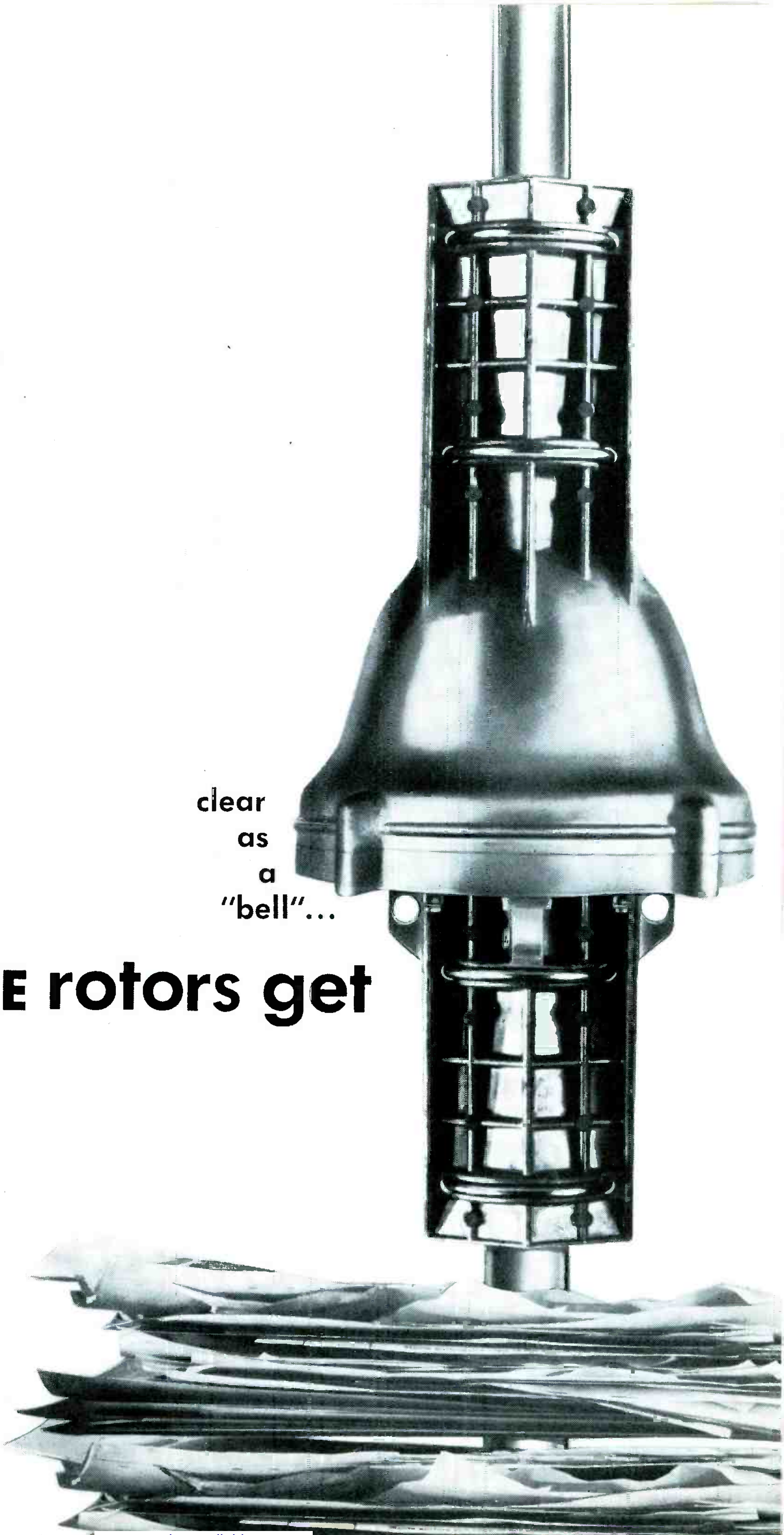

by Milton S. Kiver

understanding TRANSISTOR TESTERS

Part 2

In the November column, we examined transistor test circuits for detecting shorts and leakage, as well as some of the simpler gain measurement configurations. This month, we'll examine some additional gain-measuring circuits, plus some interesting means for making preliminary evaluations and in-circuit tests.

The principle of the gain-test circuit shown in Fig. 1 is to provide a beta reading based on a ratio of total current to base current. A 30-volt battery is connected between the emitter and base in series with a 33K-ohm resistor and a 100K-ohm potentiometer. The 200-microampere meter movement is connected into the base circuit. With the calibration switch closed, the meter is shunted by a 500-ohm resistor, and a short circuit is placed between emitter and base. Thus, no current passes through the transistor at all; it all flows through the meter and the 500-ohm shunt. The calibration control is then adjusted until the meter needle lines up with a calibration mark that indicates a 500-ua current is flowing through the circuit.

With the calibration switch open, most of the current from the 30-volt battery will flow in the collector circuit (providing the transistor is normal). Only about 3 to 5% of the current will be diverted through the base circuit. The meter will indicate the actual current flowing in the base circuit, which is the difference between the emitter and collector circuit currents. Obviously, the less current there is in the base circuit, the more there is in the collector circuit, and the higher the beta of the transistor will be. Consequently, the meter scale will have the beta values increasing to the left. The lower the base current, the higher the beta gain of the transistor.

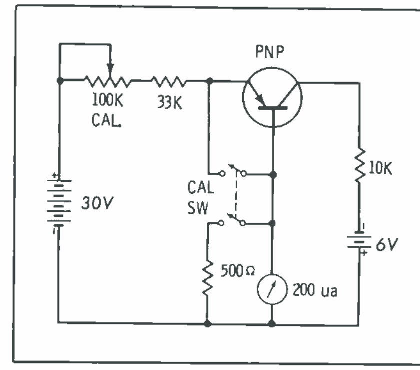

Fig. 1. DC beta is determined by current ratio with switch open and closed.

It is interesting to analyze the design philosophy behind this transistor-measurement circuit. If all the emitter current flows in the base circuit, the transistor will have no gain. As the current passing from emitter to collector increases, the gain of the transistor should increase, because it takes less and less base current to produce a given collector current. For a gain of infinity, it would be possible to control changes in collector current with no current change at all in the base circuit. Obviously, this will never happen, but it does show what the upper gain limit conceivably might be. Generally speaking, a gain of 5 is considered the minimum usable value, while gains of 30, 40, or 50 are considered good. Some transistors have been designed with gains in excess of 100.

A somewhat different method is used to measure gain in the circuit of Fig. 2. In part A, current is supplied from a 9.5-volt battery, and the 100-ua meter movement in the collector circuit is shunted so that it will take a maximum current of 500 ua. The potentiometer in the base circuit is adjusted until the meter indicates a predetermined current value (shown by a calibration mark at the extreme right-hand side of the scale). For the actual beta reading, the meter is switched into the base circuit and a 625-ohm resistor takes its place in the collector circuit. At the same time, the meter shunt is removed to provide a 100-ua indicating device. Obviously, a lower base current means a higher beta value; therefore, the meter scale

• Please turn to page 92

Transistor-Tester Function Chart

MFR.	MODEL	Iceo	Icbo	SHORTS	GAIN TEST	OTHER TESTS	PNP/NPN	MISC. NOTES
B & K	160		√	√	actual AC beta		switch	transistor power supply
	650			√	relative DC beta		2 sockets	part of tube tester
	675			√	relative DC beta		2 sockets	part of tube tester
EMC	210 & 210A			√	actual DC beta	checks diodes	switch	
HICKOK	610	√	√		good-bad scale		2 sockets	
	850P	√	√	√	actual DC beta		switch	
	870	√	√	√	actual AC beta		switch	
	890	√	√	√	actual AC beta	input & circuit Z		for in-circuit testing
MERCURY	700	√	√	√	actual DC beta and GOOD-BAD		switch	
MOTOROLA	67T65		(1)	√	oscillator (2)	checks opens	switch	
PACO	T-65	√	√	√	actual DC beta	checks diodes	switch	kit or wired
PRECISION	960	√	√	√	actual DC beta	checks diodes	switch	manual gives instructions
APPARATUS	660	√	√	√	actual DC beta	checks diodes	switch	for Icbo, Icbs tests
	10-60	√	√	√	actual DC beta	checks diodes	switch	"
SECO	100			√	osc.: go—no go		switch	for in-circuit testing
SENCORE	TRC4	√	(3)	√	actual DC beta	checks diodes	switch	"hi-normal-lo" quick test
	TR110	√	(3)	√	actual DC beta	in-circuit AC gain; diodes; tetrodes; determines polarity		also signal tracer, voltmeter, milliammeter
SIMPSON	650				incremental DC beta at 1ma Ic	Ico test	switch	ADD-A-TESTER unit for Model 260 VOM
SUPERIOR	88		√		actual DC beta	Icbo resistance		signal injector & tracer
VIS-U-ALL	GC 36-512	√		√	DC beta compared with Iceo		2 sockets	part of tube tester
	GC 36-560	√	√	√	direct Hfe current gain		switch	transistor test set
WINSTON	620	√	√	√	actual DC beta	breadboard setup	switch	chart list avg. beta, Ico

(1) Leakage results in excessive meter reading
(2) Relative gain indicated by frequency of audio output tone
(3) Indirectly

Why throw up your hands

EVERYTIME A POWER RESISTOR OPENS?

SAYS SENCORE SAM

You can't smell em, you can't hear em, you can't see the open spot, but you can restore circuit to normal fast with the BIG 20

20 BIG POWER RESISTORS AT YOUR FINGERTIPS FOR ON THE SPOT SUBSTITUTION

SENCORE *Big 20*

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Have you ever . . .

- Started to replace a B plus dropping "sandohm" resistor to find that you couldn't determine the value because your ohmmeter reads infinity and the resistor value is not stamped on the side? The Big 20 will help you determine the value to replace.
- Started to replace a 2- or 4-watt carbon dropping or horizontal output screen resistor so burned that you couldn't read the color code? The Big 20 will help you.
- Wanted to lower B plus slightly on call back TV sets but couldn't determine the value of the power resistor to use? Just insert Big 20 and substitute values until you have the desired voltage.
- Wanted to shunt the focus coil to get an old set to focus or tried to determine the value of a burned out 4-watt focus pot? It's a breeze with Big 20.
- Substituted a resistor or fuse resistor before finding the actual trouble and wound up blowing it out again? The Big 20 is husky enough to withstand up to 20 watts for normal testing time.
- Shorted a fuse resistor with a screwdriver instead of another resistor and blown out a silicon rectifier? You should have used the Big 20.
- For these examples and hundreds of others, we're sure you can use the Big 20.

(Less than the cost of twenty 20-watt resistors.) Model PR111 Dealer Net . . . . . ONLY $12⁷⁵

Ask your distributor for the substitution box with 20 big power resistors . . . The "Big 20"

ALL PARTS MADE SENCORE IN AMERICA

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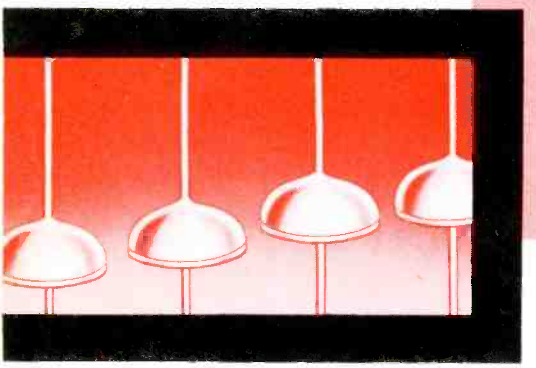


SOLID STATE DIODES IN TV

by Les Deane

Useful facts about video-detector crystals, silicon rectifiers, selenium AFC diodes, and other semiconductors

Selenium, germanium, and silicon semiconductors have been and are continuing to replace vacuum tubes in modern television receivers.

Except for completely transistorized sets, the solid-state units used in TV receivers are all diodes. Diodes, as we know, conduct much more readily in one direction than in the other, and are therefore useful in performing as signal demodulators, AC voltage rectifiers, and DC voltage clampers.

Video Detectors

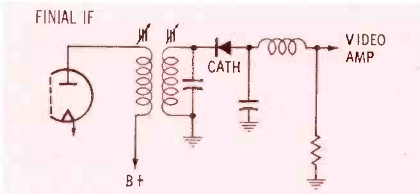
The purpose of the video detector is to demodulate the IF signal and obtain the video portion of the signal. Germanium diodes have been used extensively in this application for many years.

In Fig. 1A, the diode is connected in series with the signal path. Since input is to the cathode, the output signal has a negative polarity.

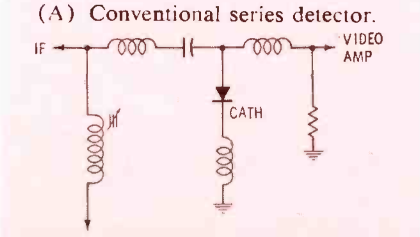
Although the circuit of Fig. 1A is the most popular, you'll sometimes find the diode connected as in Fig. 1B. It is connected in shunt (rather than in series) with the signal path. Although the input signal is applied to the plate, as opposed to the cathode as in the series configuration, we again come up with a negative output signal. Incidentally, the diode in either circuit could be connected in the reverse polarity, but it is generally preferable to produce a negative video signal at the detector output.

Some of the germanium diodes used in this application are the 1N34, 1N60, 1N64, 1N87, and 1N295. Very often you'll find the diode hidden within the final IF transformer housing as pictured in Fig. 2. Such units may have pigtails soldered to the terminals of the transformer, or they may simply plug into small clips on a mounting board at the top of the transformer. You also may find this pigtail variety positioned on top of a printed wiring board, or soldered in the underside circuitry of a conven-

• *Please turn to page 86*



(A) Conventional series detector.



(B) Lower gain shunt detector.

Fig. 1. Typical video detector circuits.

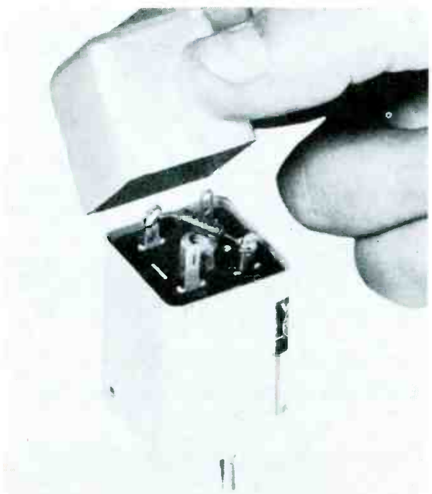
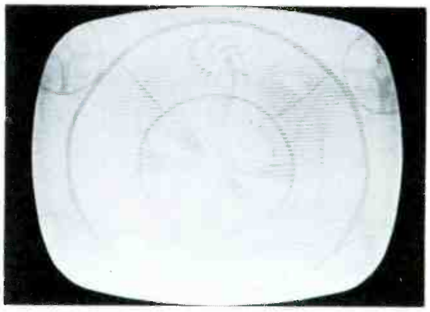
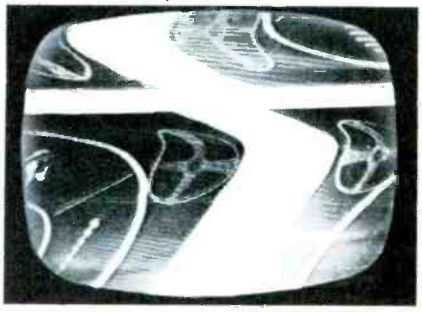


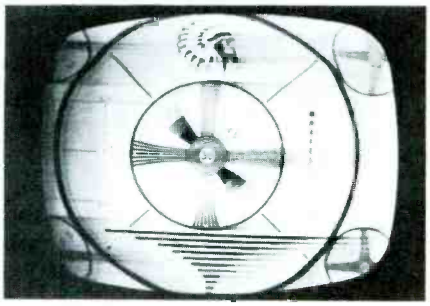
Fig. 2. Conventional video detector diode mounting within IF coil housing.



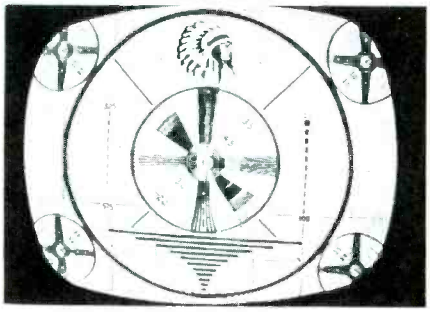
(A) Weak picture.



(B) Negative picture.



(C) Smeared picture.

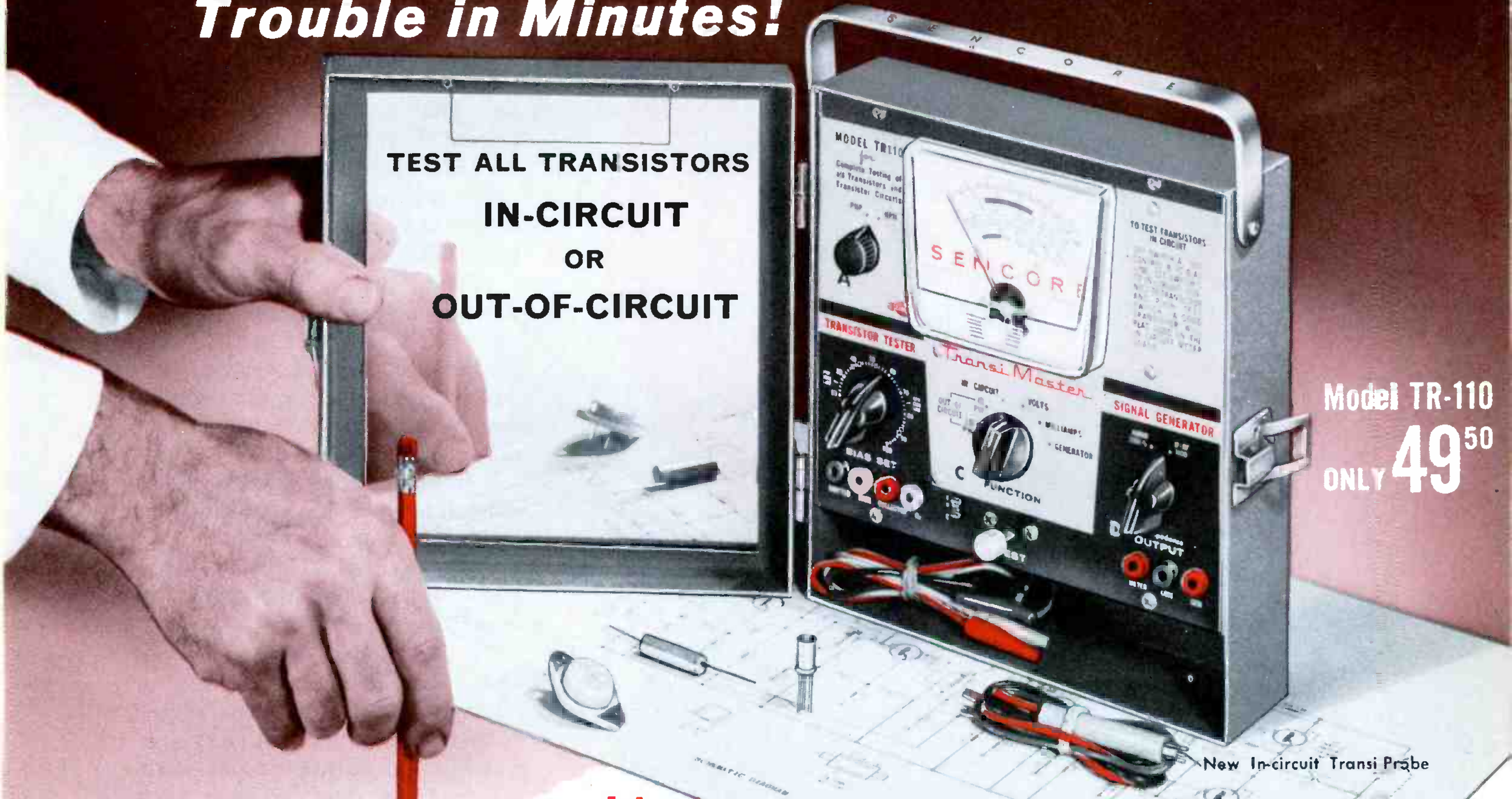


(D) Overloaded picture.

Fig. 3. Visual symptoms attributed to troubles in the video detector diode.

NEW SENCORE TransiMaster

Analyze Every Transistor Circuit Trouble in Minutes!



Model TR-110

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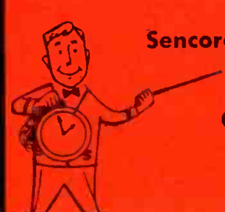

Sencore Sam says, "You'll save hours servicing transistor circuits. Only 49.50, see it at your distributor."

EXCESSIVE AGC LEADS TO WILD GOOSE CHASE

Don't discount the importance of proper DC voltages on an AGC keying tube.

By HAROLD DAVIS

I hadn't seen my friend Gibbons for some time. Since I was in the neighborhood, I dropped into his shop to see how he was doing. By the time he turned around, I was looking over his shoulder. His expression registered relief.

"Boy, am I glad to see you," he greeted. "I haven't had over 3 or 4 cases of AGC trouble since I've been in business, but when I do get one, it's a lulu!"

He was working on a split-chassis Philco and had cables strung all over the place.

"Look," he said, touching the VTVM probe to pin 1 of the first video amplifier. The needle stood straight up.

"What's wrong with that?" I asked.

"What's wrong!" he echoed. "— that's nearly 50 volts bias. I'm using the 100-volt scale."

"Gosh," I mumbled, "That's enough to block the Panama Canal. Pull the AGC tube." He yanked the 6AU6, and the negative voltage disappeared.

"Aw, you haven't got much trouble — probably just a resistor or capacitor or something . . . Have you checked any tubes?"

He assured me he had changed the tubes religiously, and looking at the pile of empty boxes lying around, I believed him.

"How about voltages?" I asked.

He explained that, except for a couple of low readings, they seemed to be OK.

"Show me," I directed. He touched the probe to the cathode of the AGC tube. (See Fig. 1.) "Here, for instance, we have about 65 volts. The diagram calls for 125. Same on the first video plate — that's a section of the 6U8."

I picked up the diagram. It was difficult to trace these points back to the supply source.

"This is keyed AGC," I reminded him. "What does the scope say about the pulses?"

"It hasn't said anything to me, and I wouldn't know what it was talking about if it did," he laughed.

"Well, fire it up and let's see."

While the instrument was warming up, I went over the major points of keyed AGC operation.

The AGC tube operates as a controlled rectifier, receiving pulses from the high-voltage transformer. Some sets like this Philco have a special winding. You can usually detect the pulses' presence with a screwdriver. In the dark, a faint spark will be seen when the plate of the AGC tube is touched. According to the diagram, pulse amplitude should be about 500 volts.

He touched the plate, pin 5, and even through a low-capacitance probe to a low-gain scope with the vertical gain control turned well back, the pattern spread all over the face of the tube.

"Would you say that's 500 volts?" I asked.

"I'd say it was nary a volt," he jibed. "When you dig out a scope, you lose me."

"You can get a good indication by sticking the end of the probe in one side of the AC outlet. That will give you around 325 volts peak to peak. Compare that to the size of the pulse reading." By comparison, the pat-

•Please turn to page 99

It's taking the country by storm

THE MIGHTY MITE

With thundering applause ... here's what they say ...

- *"It is the best tube tester I have ever owned."* F. M., MONROE, LA., TV TECHNICIAN
- *"It's a real asset to any serviceman." (35 years in servicing)* C. H. W., EAST PRAIRIE, MO., TV TECHNICIAN
- *"This is the best checker I have ever used."* E. L. R., HASTINGS, MICH., TV TECHNICIAN
- *"A must for every serviceman. A real Time Saver at a reasonable price."* W. P., ERIE, PA., TV TECHNICIAN
- *"The most complete and reliable instrument I ever bought for this price."* H. P. R., QUEBEC, CANADA, TV TECHNICIAN
- *"I already own one. This is my second Mighty Mite."* PHILCO DISTRIBUTOR, ST. LOUIS, MO.
- *"Mighty Mite has paid for itself the first month."* W. C., UNIONTOWN, PA., TV REPAIR
- *"I have found the Mighty Mite all that you say it is and more. It tests tubes that my other tester, costing twice as much, will not test."* L. K. E., W9PWQ, CHICAGO, HAM

Don't be misled ... there's only one Mighty Mite!

MAGAZINE TEST LABS SAY ...

PF Reporter, Nov., 1960, page 65 ...
"When putting the Model TC109 to work in the lab, I tried to 'trip up' the tester by throwing a few curves at it. Using my prized collection of rejected tubes that have mostly 'tough dog' defects, I proceeded with the tests given in the Sencore instructions." The results: The Mighty Mite found every trouble, even the toughest.

Les Deane

Electronics World, Jan., 1961, page 103 ...
"We checked two dozen tubes known to be defective. Many had been passed as 'good' by other testers. Each failed at least one of the three tests provided by the TC109. On the other hand, every new tube previously known to be in good condition checked good on the Mighty Mite."

Sencore Sam says

In a nut shell... here's why the Mighty Mite finds them all. It checks tube grid circuits with the same high sensitivity as the indispensable Sencore LC3 Leakage Checker; yet it checks emission, leakage and shorts just like the big, expensive testers. That's why we call it the Mighty Mite ... you can't miss!

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It's so easy to carry on every service call. The Mighty Mite is the smallest, most compact complete tester made. Smaller than a portable typewriter and with an all-steel case to protect it. Weighs less than 8 lbs.

A BUSY DECADE

Most of us, preoccupied with our daily work, haven't fully realized how much the home entertainment electronics industry has changed in only 10 short years. Television has become such an integral part of our lives that we tend to forget its relative newness; yet most people didn't have a set at the beginning of the last decade. The public had scarcely heard of hi-fi, let alone stereo—and the transistor was still a laboratory curiosity.

Feel like reminiscing? Then join us while we review the high spots of the industry's progress since 1951, as chronicled in the pages of PF REPORTER.

1951

The 24th bimonthly issue of SAMS PHOTOFACT INDEX (January, 1951) was reinforced with several technical articles, and PF INDEX was born. Early issues furnished circuit information on the many types of TV tuners then in use, and gave details on conversion of "old" small-screen TV sets to the then new 16" and 19" sizes. (The 17" rectangular tube was just evolving, and the 21" size had not yet come on the scene.)

The TV industry already had 108 stations and some 10 million receivers; however, an FCC "freeze" halted further station construction, leaving large areas of the country still unserved by TV. Thus, the initial postwar surge was playing itself out, and in 1951 we reported the first known "summer slump" in TV sales.

The Korean conflict created just enough materials shortages to hinder TV production. This stunted the growth of the field-sequential color TV system, which had just been okayed by the FCC. Before it could take hold, compatible color came along—and all we have left of the former system is an occasional color-converter socket on an old set.

1952

With the end of the FCC "freeze" in sight, there was much speculation on the expansion of TV into a nationwide system. We quoted a prediction (now a fact) that there would be over 50 million TV sets in use, and about 5 million new-set sales a year, by 1960. The UHF band, soon to be put to use, drew plenty of attention. It was recognized that there would be some reception problems, but the industry generally was optimistic about taking these in stride. It was freely predicted that most medium-sized communities would have their own stations, and that some viewers in the largest metropolitan areas would have a choice of 25 or 30 stations.

PF INDEX had already launched several regular columns, many of which became so popular they're still with us today. *Shop Talk* explained how to analyze TV troubles, and how to use bench test equipment to best advantage. *Examining Design Features* (forerunner of *Servicing New Designs*) explored circuits in the newest TV sets. *Audio Facts* examined component hi-fi equipment, though not yet tagging it with this name. *Quicker Servicing* dealt with specific field-service problems such as tracing hum and checking interlace.

1953

With the new year, the first handful of UHF stations came on the air—and our staff was on the spot to make field surveys on all aspects of their performance. Our crew gathered enough data to fill dozens of pages, and the information was eagerly received as the post-freeze boom got underway in earnest.

On another front, the first article on transistors appeared—and everyone wondered how soon these wondrous units would see commercial use. (They didn't have long to wait.) With compatible color just over the horizon, still more coverage of new developments was needed, so we prepared to launch a full-fledged monthly magazine in 1954.

1954

Volume 4, Number 1 (in January) had five special features on the compatible color TV system being deliberated by the FCC. With the final acceptance of NTSC color standards in the spring, we began the *Color TV Training Series* (installments ran for 16 consecutive months and served as the foundation for one of the basic books on the subject). With more editorial space available, we answered a long-standing request from servicemen to provide detailed information on new test equipment by introducing the *Notes* column. *Audio Facts* took note of the emerging hi-fi trend, and advertisements appealed to servicemen to turn in old selenium rectifiers to ease the critical selenium shortage.

Later in the year (October) we changed the name of the magazine to PF REPORTER to more accurately reflect its broader service to the industry. UHF was running into rough sledding by this time. The public was unwilling to go to the extra expense of an all-channel installation, and the effect of more sensitive tuners and antennas expanded VHF fringe areas. Many stations found, to their surprise, that they had a substantial audience 60 or 70 miles from the transmitter —while many small UHF stations couldn't attract enough viewers to stay in business. Yet, the number of receivers steadily rose (to about 30 million), as did the number of areas served by at least one TV station.

1955

Really big-screen television was on the market by this time, but 24" and 27" sizes were not selling well because people were "waiting for color." The 21" set, small enough to use as a second set if color was eventually bought, accounted for over 80% of new-set sales. Sensing that buyers would not invest in expensive sets while expecting an imminent "breakthrough" of

IN REVIEW

color. manufacturers strived to bring down the cost of receivers. The newly-introduced 600-ma series-string tubes advanced this aim by making transformerless receivers more practical; another factor was the lightweight, simple vertical chassis. A new 14" portable set caught on and paved the way for a bevy of compact portables in sizes down to 8". Even smaller were the transistor radios which began to appear on the market.

PF REPORTER continued to center its interest on radio and TV servicing, introducing a tremendously-popular series of "Servicing Guide by Symptoms" articles, as well as a new series on TV antennas.

1956

Transistors had really "arrived"; *Shop Talk* presented a detailed series on transistor theory, and the first hybrid auto radio (with transistor output) was introduced.

In the TV field, 90° sweep systems had become commonplace, and new tubes such as the 6CU6 and 6DQ6 were being introduced to handle the heavier power requirements. Other innovations also resulted in more tube types, and servicemen often found they needed two tube caddies on home calls. To help alleviate this situation, we compiled a *Tube Substitution Guide*. Late in the year, a series of articles presented servicing procedures for the printed-wiring boards that were becoming commonplace in radio and TV sets.

1957

By this time, the coverage of transistor radios had proceeded from the circuit-description stage toward advanced troubleshooting techniques. The spotlight was very much on innovations such as silicon rectifiers, 110° picture tubes, and automatic TV tuning. Another article introduced our readers to the field of commercial sound. An important servicing trend was duly noted in the September issue, with the appearance of the first article of the *Servicing Industrial Electronics* series. At year's end, *The Troubleshooter* appeared, and began bending a sympathetic ear to readers' service problems.

1958

This period brought few far-reaching changes in TV, so we concentrated on describing new refinements (such as wireless remote control) and keeping readers up to date on practical servicing procedures. Older sets were reaching the end of their normal life span, but some models were showing an amazing longevity; thus, *Across the Bench* was born. We also presented service information on such diverse equipment as air-conditioners and garage-door openers. The 45/45 stereo disc reached the market in midyear and was duly introduced in our pages.

A major milestone in PF REPORTER's history was reached in September, when we absorbed *Electronic Servicing* magazine (with its *Video Speed Servicing* feature) and began issuing a combined and enlarged publication. Also introduced in September was our pictorial TV service-data feature, *Previews of New Sets.*

1959

The general trend in TV seemed to be toward more elaborate and somewhat more expensive receivers. Screen sizes smaller than 17" in new sets were rare, although portable-TV cabinets were still fairly small because of the "slim-line" styling made possible by shallow 110° picture tubes. Power transformers and horizontal chassis reappeared in many lines.

Realizing that millions of TV antennas were ready for replacement, we published the unique 16-page *Homeowners' TV Antenna Handbook* in our February issue to help servicemen stimulate their antenna business among consumers. Over 350,000 copies of this booklet were distributed.

Hi-fi was rapidly moving out of the specialized audiophile area and becoming a generally-accepted consumer product. To help meet the need for more service knowledge on these units, we ran a series of *Audio Facts* articles on troubleshooting and testing hi-fi systems.

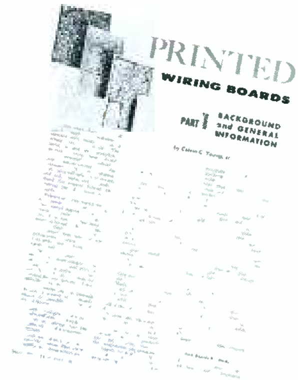
1960

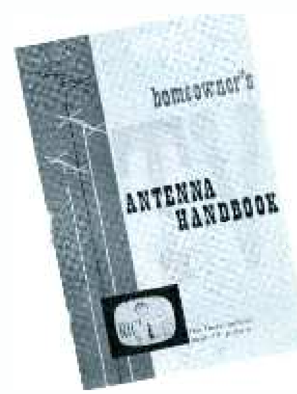
During the past year, the pages of PF REPORTER have continued to reflect new developments—notably the square-cornered 23" and 19" picture tubes, all-transistor TV sets, advanced types of TV tuners, center-bass stereo sound systems, and on and on. Servicing articles, while holding to the same "why plus how" format, have emphasized new slants on the toughest service problems. In the midst of fast-paced electronic developments, the humble AC-DC radio still had its share of attention, but the emphasis was on how to make radio servicing economically possible.

In September, we published the *TV Service Pricing Guide* to help service dealers establish competitive price schedules and make a reasonable profit.

Although keeping readers posted on developments in such diverse fields as industrial electronics, Citizens radio, and PA work, PF REPORTER continued to concentrate on the main interests of the professional radio-TV serviceman. As his needs have changed, so has the magazine —a practice which will continue throughout the coming years.

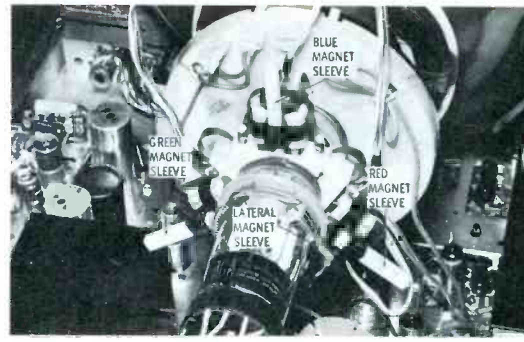
Having met and overcome the many challenges of the past decade, the electronics industry has become an important and respected segment of our national economy. While it is apparent that the next decade will be even more challenging, electronics servicing will reach even greater stature, entering into practically every phase of daily life.



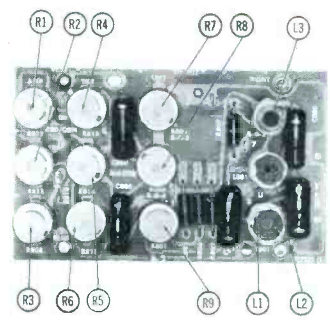


how to converge the new color sets

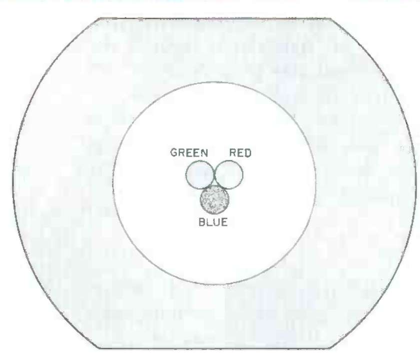
Proper adjustment is half the servicing job on color sets, and the most critical and difficult adjustments are for convergence. To give you an opportunity to study up on the procedure before you actually have to use it, here's a step-by-step rundown on the adjustments for modern-day sets.



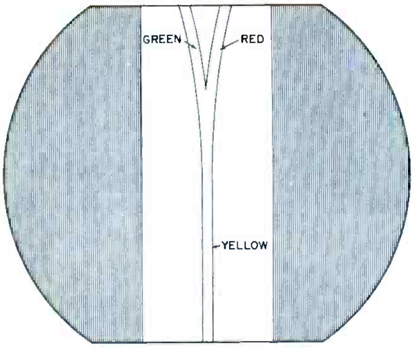
You'll find all of the static adjustments for converging the center of the screen mounted on the yoke assembly. Adjustment for each color gun is accomplished by sliding the plastic sleeve in and out of its metal retaining clip. If beam movement is unsatisfactory, the entire sleeve may be removed, turned 180°, and reinserted. The lateral magnet is adjusted by turning its metal sleeve in either direction; howver, make sure you don't move the whole assembly.



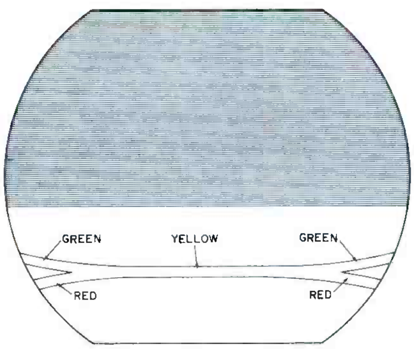
Dynamic adjustments are usually grouped on a portable 6" x 7" panel which can be easily attached to the top back edge of the cabinet as shown. In the arrangement pictured, the two vertical rows of adjustments on the left are employed for vertical convergence, while those remaining are used for horizontal convergence. A single hex alignment tool is used to adjust all of the controls, although a wide-bladed screwdriver may be used on the potentiometers.



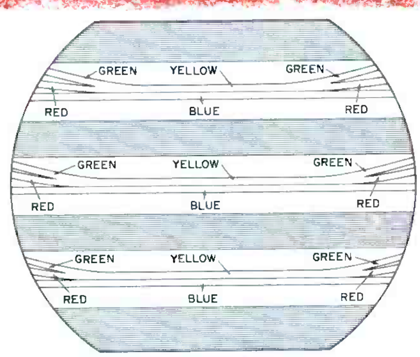
The first step in the setup procedure is to converge the beams to form a white dot in the center of the screen. Preset all adjustments on the convergence panel to mid-range, and adjust the four magnet sleeves until you become familiar with the movement of each dot pattern. After checking focus and positioning the color dots as shown here, superimpose the red, green, and blue dots until white is achieved.



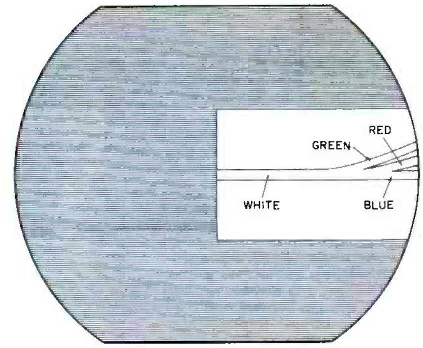
For vertical convergence, a vertical-bar pattern is recommended. Disable the blue beam by shunting the grid of the blue gun (solid blue lead from CRT socket) to chassis ground through a 100K-ohm resistor. Adjust panel control R2 so that the green and red vertical bars at the bottom center of the screen converge into a single yellow bar. Next, converge the red and green bars at the top center of the screen by adjusting control R5. Touch up both controls for best convergence along the entire center vertical bar.



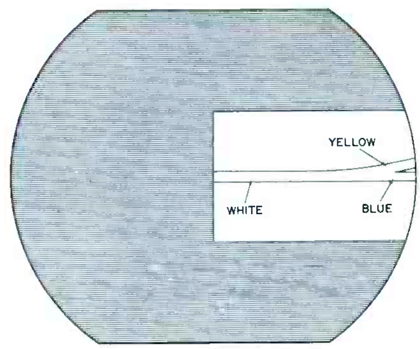
Switching to a horizontal-bar pattern, adjust control R1 to produce a yellow bar across the bottom center of the screen. Adjust R4 to obtain the same condition across the top center of the screen. Touch up both controls for best convergence of all horizontal bars along the center portion of the screen. Changing to a dot pattern, adjust the red and green magnet sleeves to reconverge the green and red dots at the center of the screen. Then remove the shunt from the grid of the blue gun.



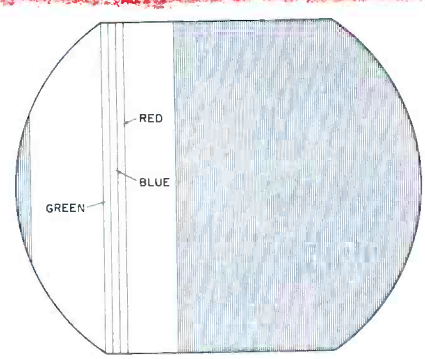
Observing a horizontal bar pattern, advance control R3 to move the blue bar below the yellow bars at both the top and bottom of the screen. Adjust R6 and retouch R3 until equal displacement of the blue horizontal bar is achieved along the entire vertical-center area. Converge the center bar, which should require only slight movement of the blue magnet. Adjust R3 and R6 to form white bars all along the vertical center portion of the screen (from top to bottom).



For horizontal convergence, use a horizontal-bar pattern and adjust coil L1 until the right side of the blue bar is as straight as possible. Adjust control R9 so that the blue bar at the left center of the screen is also straight. At this point, the three colors needn't be converged at the right and left edges of the screen. Switching to a vertical bar pattern, adjust coil L2 so that the vertical bars on the right half of the screen converge from top to bottom. You may find it necssary to compromise slightly between red and green.



Viewing a horizontal bar pattern at the right center of the screen, adjust coil L3 so the green and red bars blend into a single yellow bar. Readjust coil L1 so the blue bar converges with the yellow bar in this area. Switching again to a vertical bar pattern, retouch coil L2 to converge as many vertical bars on the right half of the screen as possible. At this point, check center convergence again, using a white dot pattern.



With a vertical bar pattern, adjust control R7 to converge the bars on the left until they are as nearly white as possible. Then, with horizontal bars on the screen as in step 6, adjust R8 to superimpose the green and red bars at the left center of the screen. Following this, retouch R7 as needed to improve convergence of the vertical bars in this area. Finally, refer once again to the horizontal bars and adjust R9 so the blue bar falls on the yellow bar at the left center of the screen. Check over-all convergence with a monochrome signal, and repeat the entire procedure if color fringing is objectionable.

OPERATION

A plan of attack for the combined

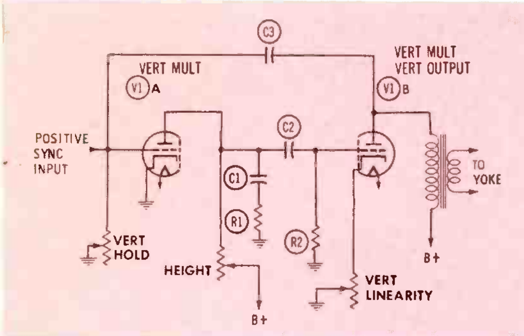


Fig. 1. Simple form of combined vertical multivibrator - output circuit.

There's no question about it—the combined multivibrator and output circuit has become the most popular vertical deflection system in use today. Its popularity has steadily grown since the early '50s, and variations of this combined circuit are now found in roughly 90% of all TV sets produced. The logic behind this trend is simple—the system is inexpensive, efficient, and dependable.

However, in spite of long experience with millions of receivers equipped with these circuits, the service industry still ranks them second only to horizontal circuits in the "difficult to service" class. The reason given by many servicemen is, "When I'm up against a vertical trouble, I'm not quite sure of where to start looking for what." Even the simplest of these circuits *looks* complex (there are so many parts that *could* be bad!), but a well-planned approach can do wonders in shrinking this problem down to conquerable size.

Master Strategy

Preparedness is a major factor in waging a successful war on vertical troubles. Knowing all you can about the circuits will help you dispose of troubles more quickly.

Do you know exactly what each stage does in the simplified circuit of Fig. 1? Of course, the output circuit provides the power to produce sufficient scanning current for the yoke; but if you temporarily ignore the yoke circuit, you'll see that the two stages constitute a simple plate-coupled multivibrator.

To produce the proper sawtooth scanning voltage, one stage must conduct much longer than the other. The prolonged period of conduction occurs in the output stage (V1B in Fig. 1). Discharge section V1A must therefore remain in cutoff during this period—conducting only during vertical retrace time. While it it cut off, C1 charges through R1 and the height-control circuit, developing the sawtooth-shaped drive waveform. It should be noted that the grid-circuit components C2 and R2 are used simply for coupling and have no appreciable effect on the running speed of the multivibrator; this is one important difference between the combined vertical circuit and the "classic" type of plate-coupled multivibrator. Both C2 and R2 influence the bias on the output tube to some extent, but the most important factor is the adjustable cathode bias determined by the setting of the linearity control.

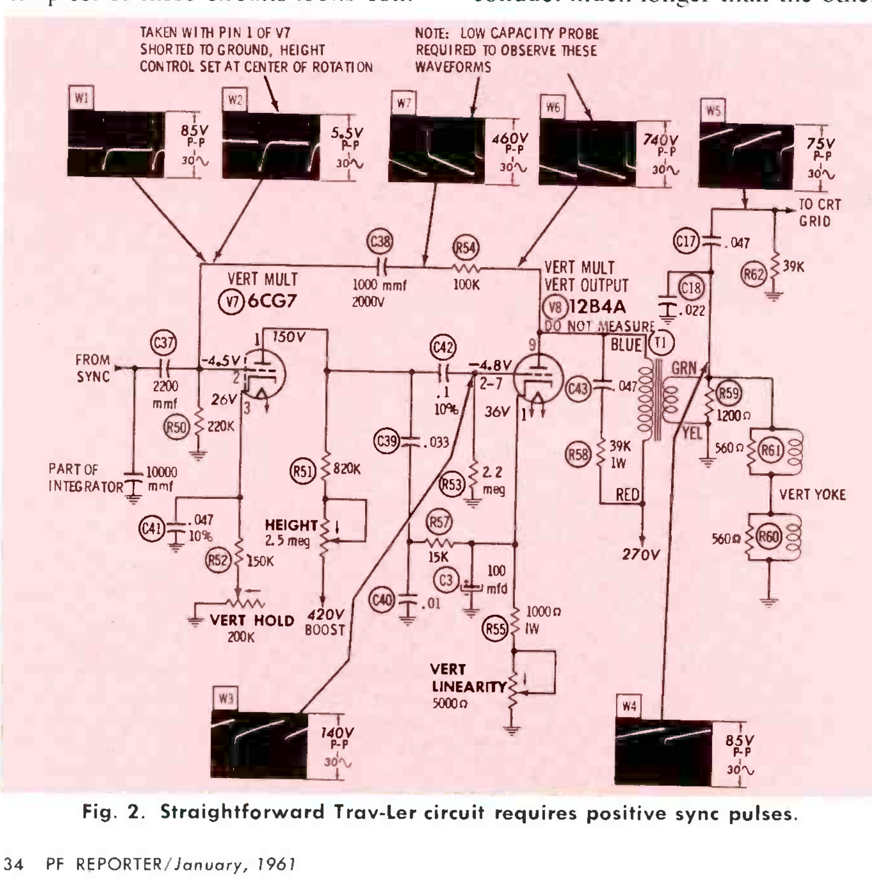


Fig. 2. Straightforward Trav-Ler circuit requires positive sync pulses.

When a positive sync pulse is applied to the grid of V1A, the tube is triggered into conduction, in turn cutting off V1B. (In absence of a sync signal, V1A will periodically come into conduction of its own accord, mainly as a result of bleeding off its grid-leak bias through the hold-control circuit. The timing, in this case, is not as precise as when sync pulses are supplied.) In any event, driving V1B into cutoff produces a positive-going pulse at its plate, and this is coupled back to the grid of V1A through C3. The grid of V1A then draws current, charges C3, and drives V1A back into cutoff. The output stage then resumes conduction, its plate voltage falls, and the resultant negative-going pulse coupled through C3 drives V1A more deeply into cutoff.

The hold control provides for adjustment of the grid circuit's RC time constant; thus, the discharge rate of C3 can be regulated so that the next sync pulse can easily key

VERTICAL

multivibrator-output circuit .

the tube into conduction at the correct moment to keep the multivibrator in step with the station signal.

Typical Circuit With Positive Sync

Having analyzed the basic framework of the CVC (combined vertical circuit), we're ready to consider actual circuits. As might be expected from such a widely-used design, the CVC has undergone various changes and refinements over the years. The variations fall into three major categories, depending on where the sync signal is applied and where the hold and linearity controls are located. We'll compare the different versions of the circuit in Part 2 of this article; but first, let's concentrate on mastering the CVC which corresponds most closely to the basic arrangement of Fig. 1. Once we thoroughly understand its behavior—both normal and abnormal—we'll be better equipped to deal with all types of vertical circuits.

Turning our attention to the vertical circuit of the Trav-Ler Chassis 1150-39 (Fig. 2), we find only minor deviations from the basic circuit of Fig. 1. One noticeable difference in the first stage is that the RC circuit at the grid (R50, C37, and C38) contains a fixed value of resistance. The hold control has been transferred to the cathode circuit of V7, where it varies the cathode-bias voltage developed during this tube's short conduction period. As in the previous circuit, positive-going sync pulses are fed to the grid from the sync section to trigger V7 into conduction.

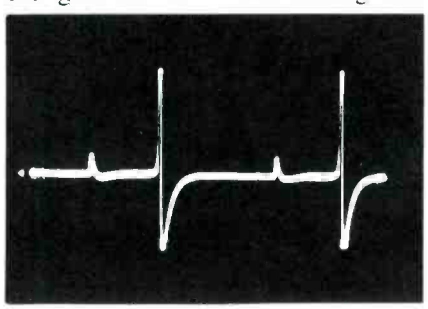
A drive signal of 140 volts peak to peak (W3) is developed by C39 and C40 charging through R51 and the height control. The strong negative pulses which give W3 its trapezoidal waveshape are produced across R57, which roughly corresponds to R1 in Fig. 1. C42 and R53 form the coupling circuit to the output stage. V8 operates with cathode bias developed across R55 and the linearity control; this voltage is filtered by C3 to prevent degeneration in the stage. The RC circuit paralleling the output transformer alters the Q of the winding and provides a slight increase in scan. In addition to a coupling capacitor C38, the feedback circuit includes a resistor R54 which reduces the amplitude of the signal presented to the grid of V7. Yoke-driving and retrace-blanking signals are taken from the isolated secondary winding of the output transformer.

Planning the Attack

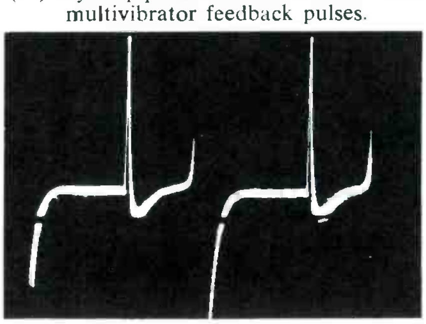
Trouble in this type of circuit can be categorized into three groups: No sweep, improper size and/or linearity, and vertical roll. Even though the circuits are interdependent, the general trouble area can normally be determined by logical thinking and a few quick checks. When you have roll troubles, look for defective sync or for component faults in the discharge stage; if there's no sweep, either the multivibrator isn't functioning or you have trouble in the output circuit; if you have size or linearity problems, the trouble centers in the drive-signal components or in the output stage. When trouble develops, it's going to show up as affecting one stage long before the other.

What about thermal problems that develop as the set warms up? Again, concentrate on the nature of the trouble and then determine

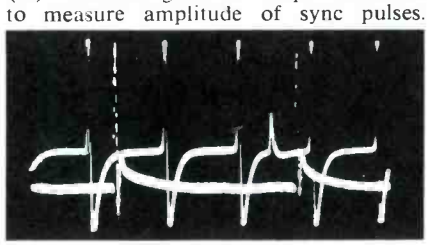
• *Please turn to page 78*



(A) Sync pips are much smaller than multivibrator feedback pulses.

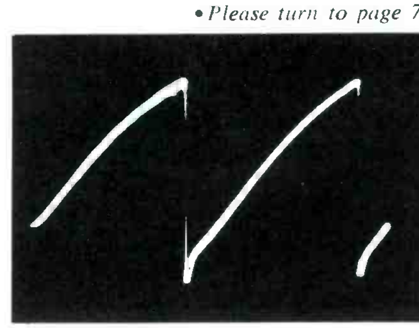


(B) Vertical gain of scope advanced to measure amplitude of sync pulses.

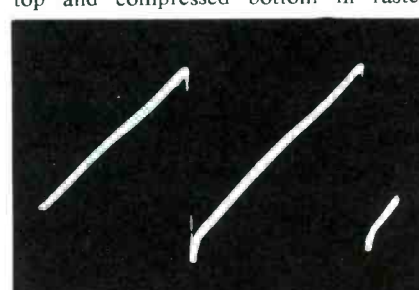


(C) Sync pip shows up even when vertical frequency is almost 180 cps.

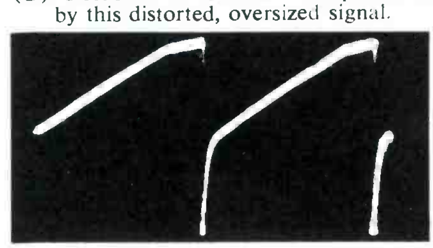
Fig. 3. Sync input to vertical circuit is visible when picture is rolling.



(A) This distortion caused stretched top and compressed bottom in raster.



(B) Foldover at bottom was produced by this distorted, oversized signal.



(C) Leaky cap or gassy tube causes grid current — flatted peaks — foldover.

Fig. 4. Drive signal at grid of the output tube provides valuable clues.

SERVICING INDUSTRIAL ELECTRONICS
BY ALAN ANDREWS

synchros & servo systems

A synchro is a small, motor-like device containing a stator and a rotor. When several such units are connected together, all of the rotors line up at the same angle of rotation. If one rotor is turned, all the other synchros follow the movement and align their rotors at the same angle. These units are used to align meters, dials, valves, antennas, direction indicators, and many other similar rotating devices.

An example of a specific use is in controlling the position of a small antenna (Fig. 1). One synchro has its shaft mechanically coupled to the rotating support of the antenna. The other synchro has some type of positioning handle connected mechanically to its shaft, and is also equipped with a dial to indicate antenna direction. Through the electrical connections between the two units, the antenna follows every movement of the dial setting.

"Synchro" is the general name for these devices, but most manufacturers also have their own trade names to identify their products. Possibly the best known of these is *Selsyn,* the name used by General Electric. The term "sýnchro" should not be confused with "servo", which will be defined later.

Construction

Schematically, synchros can be represented by either of the two symbols shown in Fig. 2. All of the coils are indicated in Fig. 2A, while 2B is an abbreviated type of symbol usually found in schematic diagrams. In this article we will use the former symbol because it better illustrates the device's basic operation. The stator consists of three coils, wound so that their fluxes are concentrated at three points 120° apart. These coils are Y-connected; i.e., they have a common center tap. Three terminals (labeled S1, S2, and S3) are provided—one for each stator coil. For reference purposes, the direction of S2 is considered to be zero degrees, and all rotation is measured with respect to it. Positive rotation is considered to be counterclockwise; negative rotation is clockwise.

The rotor consists of a single winding with terminals at each end (R1 and R2). The pointer on the indicator dial corresponds to R1, and the angle R1 makes with respect to S2 is used to express the angle of rotation. Usually 115-volt AC is applied across the rotor terminals, and this alternating current in the rotor causes a voltage to be induced into each of the stator coils. The amplitude of each of these voltages depends upon the rating of the unit and the angle between the rotor axis and the axis of the stator coil.

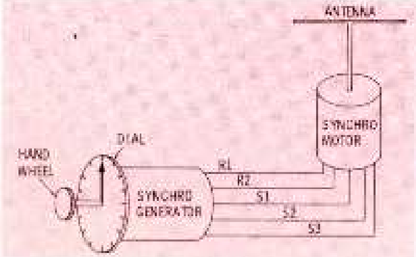


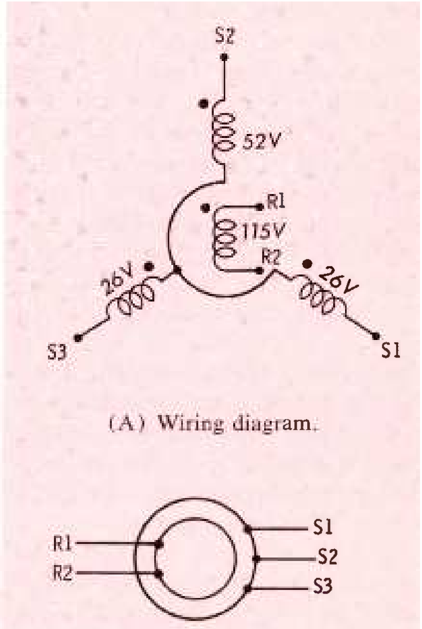
Fig. 1. A pair of synchros could be used to control small, light antenna.

Ratings

Synchros are rated with two numbers—for example, 115/90. This indicates that a 115-volt input is applied to the rotor and that the maximum voltage across any two stator terminals (thus, across two coils in series) is 90. With this rating, the maximum voltage which will occur across any one coil is 52. This condition arises when the rotor and a stator coil are in alignment, as in the case of S2 in Fig. 2A. The dots on the diagram indicate that the R1 and S2 voltages are in phase with each other. In general, the phase of any stator voltage is stated with reference to the phase at the R1 end of the rotor. The S2 voltage in Fig. 2A is in phase with R1, but the S1 and S3 voltages are 180° out of phase with it. Only these two opposing phase relationships are found (with no intermediate phase angles such as 120°), since only single-phase AC is applied. A synchro is not a three-phase circuit, even though it superficially looks like one in a schematic drawing.

In addition to specifying voltages, synchro ratings also include frequency—usually 60 or 400 cps.

The voltage across any stator



(A) Wiring diagram.

(B) Usual schematic symbol.

Fig. 2. Synchro generator or motor.

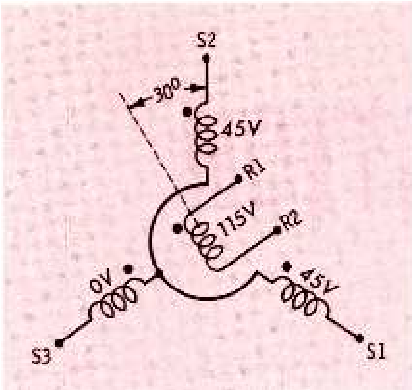


Fig. 3. Voltages on synchro stator windings when the rotor is turned 30°.

coil may be determined by:

$Es = Em \cos \theta$, where
Es = the stator voltage,
Em = the maximum single-coil voltage, and
θ = the angle between the rotor and stator coils.

In the example of Fig. 2A,

$Es_1 = 52 \cos 120° = -26v$
$Es_2 = 52 \cos 0° = 52v$
$Es_3 = 52 \cos 120° = -26v$

indicating that maximum voltage is being induced into S2 in phase with R1. Smaller out-of-phase voltages are induced into the other two stator coils, as shown by the calculations.

Maximum terminal voltage does not occur at this rotor setting, however. The terminal voltages for a zero-degree setting are as follows:

Es_1 to s_2 = 78 volts
Es_1 to s_3 = 0 volts
Es_2 to s_3 = 78 volts

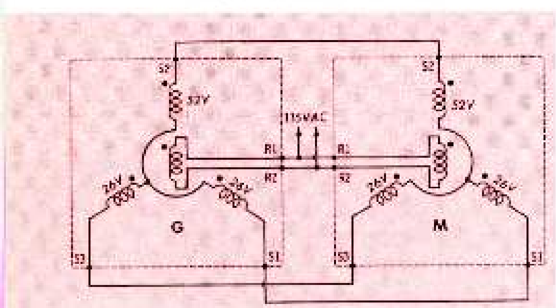


Fig. 4. Synchro generator-motor hookup "at rest" (both rotors zeroed).

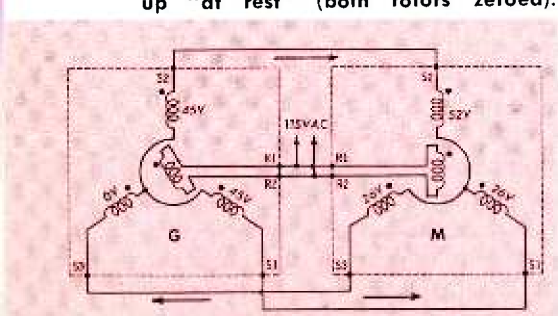


Fig. 5. Current flow through system when generator rotor is turned left.

When the terminal polarities are different, the two voltages (for example, S1 and S2) are series aiding and additive. When the polarities are the same, the voltages are series opposing and subtractive as with S1 and S3. With the rotor at zero degrees, as shown, the total flux in the stator coils is also in that direction.

If the synchro rotor is turned 30° counterclockwise as shown by Fig. 3, the induced stator voltages are as follows:

$Es_1 = 52 \cos 150° = -45v$
$Es_2 = 52 \cos 30° = 45v$
$Es_3 = 52 \cos 90° = 0v$

The total flux is now in the direction of 30° because the distribution of the stator voltages has been changed. Note also that the S1+S2 voltage is 90, the maximum obtainable.

The above example shows that a synchro is a position transducer, changing physical rotation into corresponding electrical voltages, with a different set of voltages for each angle of rotation.

Operation

A simple synchro system is shown in Fig. 4. A synchro generator (G) is connected to a synchro motor (M) with voltage applied to both rotors connected in parallel. Both units are identical electrically and physically except that the motor shaft is friction-damped so that it will come to a smooth stop after being turned. Generators and motors are sometimes called transmitters and receivers, respectively.

To see how these units align to each other, let's assume at first that AC is applied to the generator but not to the motor. In this case the motor stator coils act as loads for the generator stator, and the voltages across corresponding coils are identical. The soft-iron rotor of the motor lines up with the total stator field so created. If the generator rotor is turned to 30°, the stator field of the motor does the same, and the rotor follows this action. However, there are three disadvantages here: The action may not be positive enough, the torque created by the motor is small, and there is a chance that the motor may line up 180° away from where it should.

To offset these disadvantages, the AC voltage is also applied to the rotor of the synchro motor. With both units at zero degrees, conditions are as shown in Fig. 4. Each stator coil of the motor has induced into it the same voltage as its counterpart in the generator. As far as the interconnections are concerned, these voltages are equal and opposite; therefore, there is no current. This condition will always be true as long as the two rotors are in corresponding positions, regardless of the angle between stator and rotor.

In Fig. 5 we are assuming an instantaneous condition in which the generator rotor has been turned to 30°, but the motor has not begun to move. The stator voltages are now different, so there is current between the two units in the direction indicated by the arrows. Torque is then exerted on the motor rotor, and it moves toward 30°. As this position is approached, the voltage difference between stators is decreased, as are also the current and torque. At 30°, the induced motor-stator voltages are the same as those shown for the generator stator, and again the current becomes zero. There is no longer any torque, so the motor rotor remains at 30°.

We are assuming in this example that the generator is being used as a command or master unit and that the motor is a following or slave unit. This means that the generator rotor can be turned only by applying mechanical motion to the rotor

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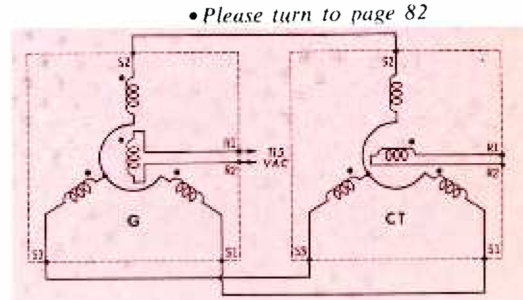

Fig. 6. Diagram of connections from generator to control transformer.

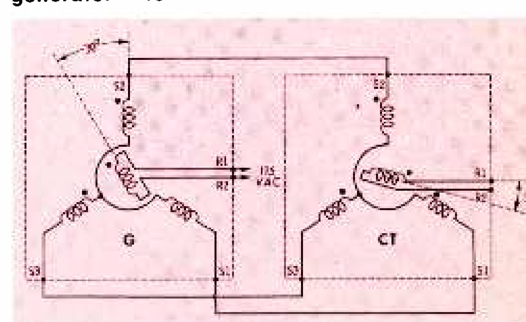

Fig. 7. Output of CT can be changed by mechanically turning its rotor.

Servicing New Designs

by Thomas A. Lesh

THE LATEST IN HI-FI:

REVERBERATION

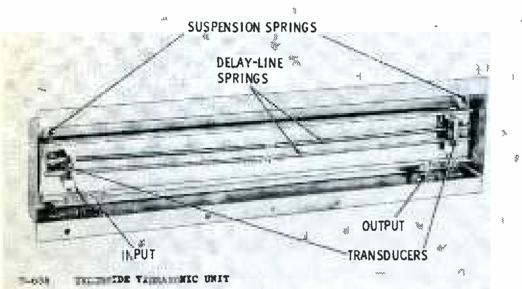

Fig. 1. Delay-line unit developed for electric organs — now used in hi-fi.

As sound waves spread through an auditorium or hall, they repeatedly bounce off walls and other objects, producing complex patterns of reflected and re-reflected waves. Since sound travels at only about 1100′ per second, the reflections arrive at the listener's ear noticeably later than the waves which travel over a more direct path. In extreme cases, a distinct echo is produced. This annoying effect, which garbles the sound, can be largely brought under control by using acoustical tile, draperies, and rough-surfaced or irregularly-shaped walls to absorb sound energy and scatter the reflections. However, total elimination of sound reflections is seldom practical, and the public is generally accustomed to a series of very close-spaced echoes or *reverberations* which give a "ringing" quality to sounds. An auditorium with unusually few reverberations is likely to give you the curious sensation that sounds are being blotted up.

Since reverberation is such a common condition, isn't it normally picked up along with the music on hi-fi recordings? Not necessarily. Many recordings are made in rooms acoustically designed to minimize the reverberation level. Take a record produced under these special conditions, play it in a well-upholstered living room, and you have a hi-fi sound that is pure in tone but lacks the authentic sensation of a live performance.

This brings us to the most-talked-about new feature in many of the '61 hi-fi consoles—an electromechanical reverberation generator which artificially creates the "live" acoustics of a typical large room with surprising realism.

Hi-Fi for Lo-Brows?

The comments greeting the introduction of this device have been both pro and con. Some feel that artificial reverberation detracts from the purity or faithfulness of music reproduction—a backward step in the audiophile's search for perfection. But, on the other side of the ledger, the reverberant effect has already proved to be pleasing (even thrilling) to many people, including quite a few with well-developed musical tastes. So, as far as its emotional effect is concerned, reverberation might well be considered as an advance in the audio art. If it helps people to enjoy music, that's all the justification it needs.

Just as with garlic, however, a little reverberation goes a long way. The results are meant to be subtle; if the "reverb" control is turned up too high, the results sound like someone shouting down a deep well. Frequent use of the control is necessary, because personal tastes differ, and also because varying amounts of reverberation will be desired on different records. Many old 78-rpm discs, for instance, give very pleasing results at a high level of reverberation that would sound horrible on a new jazz LP. Actually, the chance to experiment with different degrees of "liveness" adds greatly to the fun of using the reverberation unit.

Syncopated Springs

The electromechanical delay-line unit in Fig. 1, developed by the Hammond Organ Co., is used as a reverberation generator in all presently-available systems. This device contains two 14½″ coiled springs suspended between a pair of transducers. The input signal is fed to the field coil of one transducer (Fig. 2), producing an alternating magnetic field which causes rotation of the cylindrical ferrite magnets attached to the springs. As a result, a twisting force is applied simultaneously to both springs. This force is transmitted through their entire length, finally rotating a similar pair of magnets in the output transducer and thereby generating a signal in the output field coil. In addition, some of the torsional force is not absorbed by the output transducer, but is reflected back to the input end of the spring. This reflected energy continues to travel up and down the line until it dissipates; thus, each element of the input signal results in a train of reverberations. Their amplitude decreases logarithmically (rapidly at first, then tapering off)—a decay characteristic which closely imitates the actual behavior of sound waves in a large room.

The first and strongest reverberation takes .029 sec. to travel through one spring and .037 sec. through the other; additional and weaker reverberations appear in the output at odd multiples of these two time intervals. The use of dual delay lines gives a more realistic effect, since the two trains of reverberations

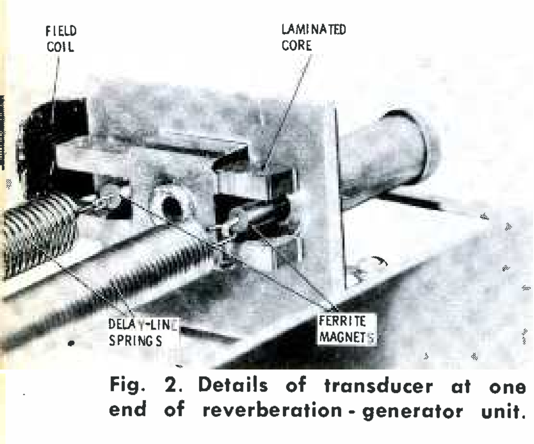

Fig. 2. Details of transducer at one end of reverberation-generator unit.

blend together to create a stronger sensation of multiple sound reflections. The dual system also minimizes the problem of signal cancellation at certain frequencies, which might be bothersome if only one set of reverberations were generated.

Each delay line actually consists of two short springs, wound in opposite directions and connected "back to back." Therefore, a force that tends to wind up one spring will tend to unwind the other. This does not prevent torsional forces from traveling the entire length of the assembly, but it does mean that a stretching or compressing force applied to one spring will be opposed by the other spring. This feature helps to prevent the springs from picking up lengthwise vibrations or "bouncing"; thus it neutralizes a potential source of distortion in the reverberated signal.

The degree of reverberant effect is controlled simply by adjusting the amplitude of the delayed signal with respect to that of the original signal. For this purpose, some sort of control is always included in the amplifier circuitry following the Hammond unit. Every manufacturer now using the reverberation feature has designed his own style of amplifier, and an interesting variety of circuits has evolved.

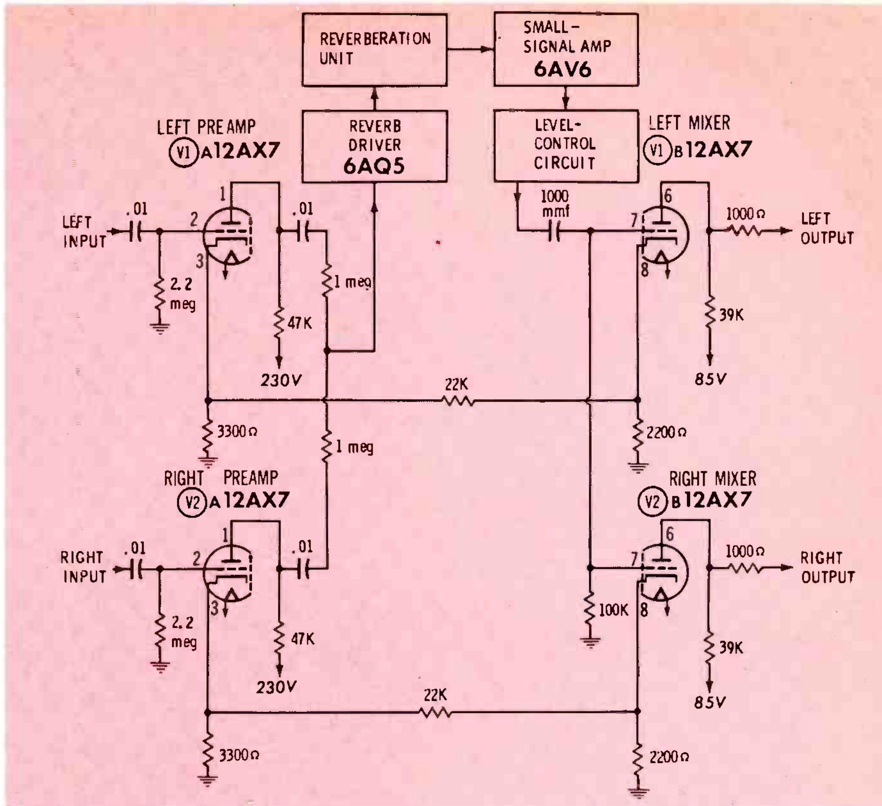

Fig. 4. Common-cathode preamp-mixer circuitry of Curtis Mathes Chassis 20.

Amplifier Features

There are several possible ways for a reverberation subchassis to perform its required functions of feeding a suitable input signal to the Hammond unit, amplifying the reverberated output, and mixing it with the undelayed signal. Some manufacturers combine equal portions of the left and right stereo signals, delay the resultant wave, and feed it equally into both channels of the main stereo amplifier. Others use a simpler system in which a signal is taken from only one stereo channel, reverberated, and then injected into the other channel. (This is said to minimize undesirable effects such as cancellation between the original and delayed signals.) Motorola features a system which differs from all others in that the delayed signal is not fed back into the main amplifier channels, but is applied to an independent "reverb amplifier" which drives a separate speaker.

Note that none of these systems attempt to provide a "sense of direction" in the delayed signal. It is not strictly necessary to do so, since the reverberatory effect is supposed to

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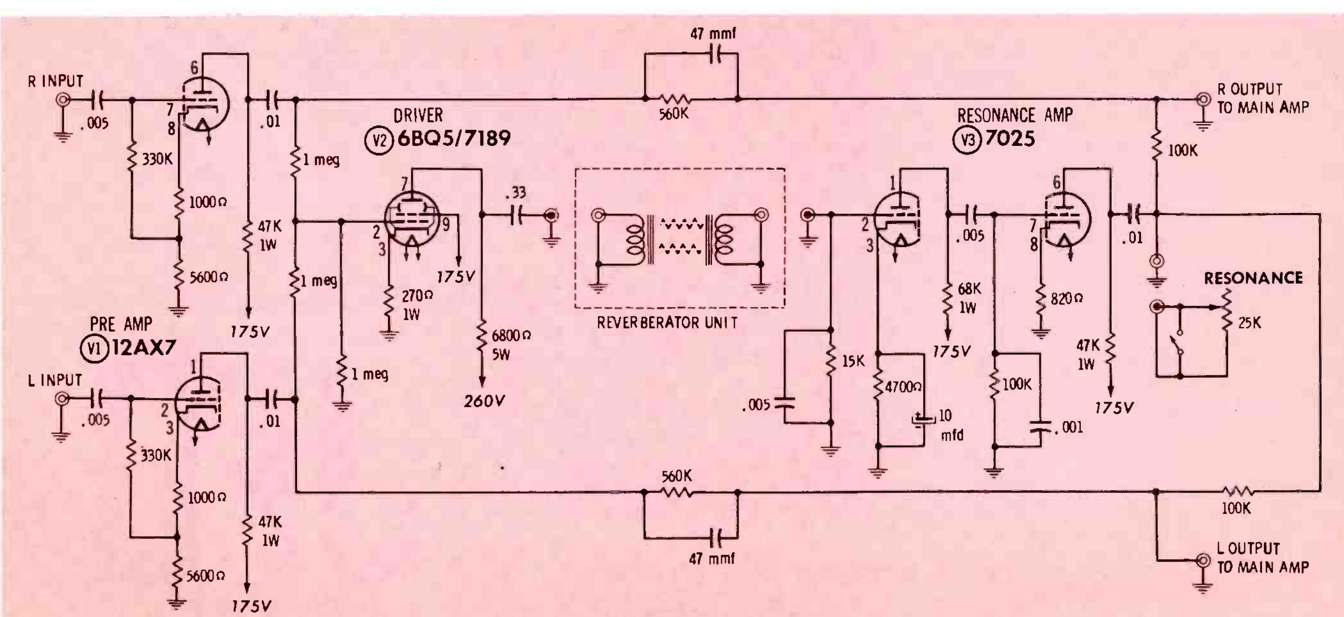
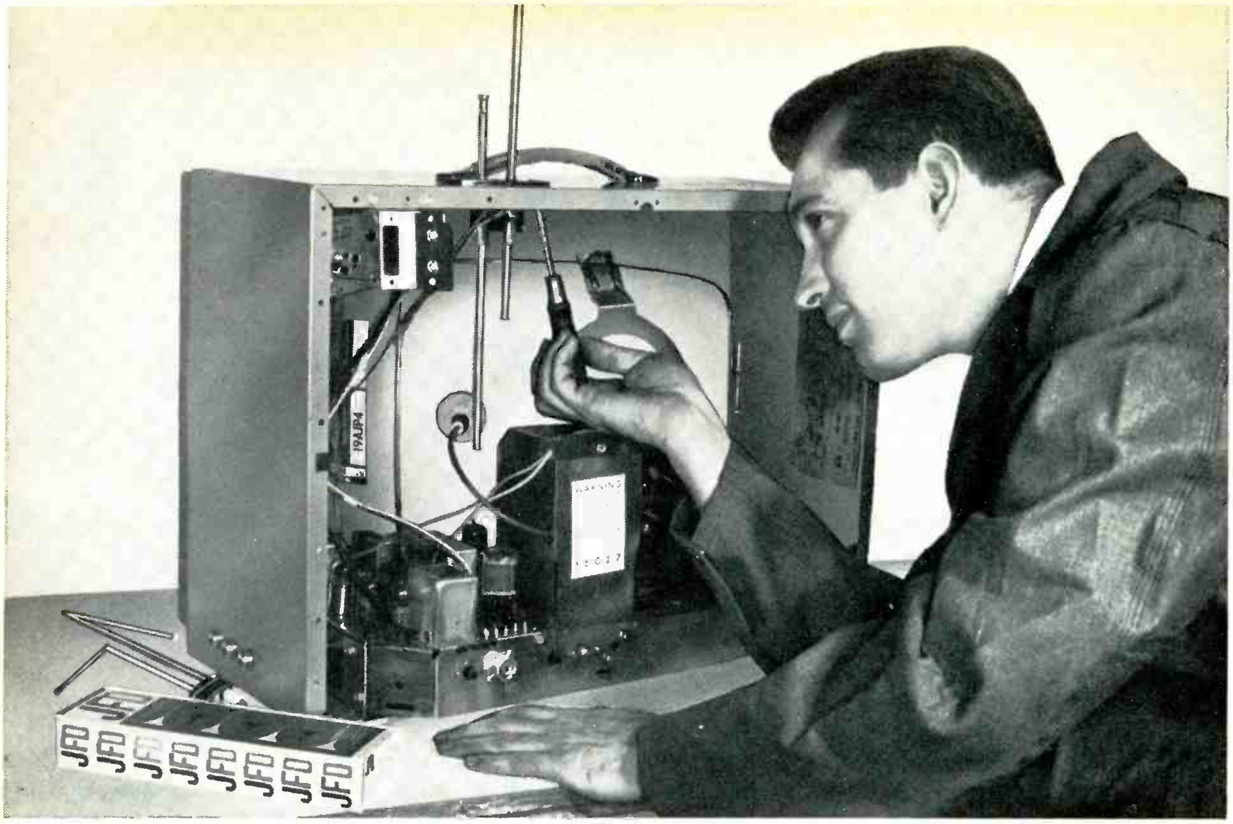


Fig. 3. Complete schematic of General Electric *Resonant Stereo* chassis, except for omission of power supply.



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PF REPORTER *including Electronic Servicing*

10-YEAR CUMULATIVE SUBJECT INDEX 1951-1960

This index has been prepared to provide you with a ready reference to all PF REPORTER articles published to date.

Each item is indexed according to the *page on which the article begins,* together with the month and year of publication. Where there is more than one entry for a certain subject, the most recent coverage is usually shown first.

Where a *dash* precedes the entry, it refers to the key words (ahead of first comma) in the preceding entry. Example:

Selenium diodes, replaced with germanium ....38, Mar 59
—trouble symptoms ......56, Sep 58

Major types of test equipment (oscilloscopes, CRT testers, etc.) and major components (capacitors, tubes, etc.) will generally be found in their own separate sections of the alphabetical listing. "Previews of New Sets" and "Video Speed Servicing" coverages are listed under "P" and "V" respectively. When looking for discussions about a specific TV trouble symptom, refer to the section of the TV receiver (tuner, sync, etc.) where this trouble is most likely to originate.

To help you further in finding the information you seek, you'll find listings of major feature articles for the past 10 years, categorized by subject, at the end of the main index section.

Copies of many back issues can be obtained at 50c each. Lists of available issues appear periodically in PF REPORTER.

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SUPPLEMENTARY INDEX TO MAJOR ARTICLES

Since the preceding main index section does not include article titles, this supplementary index has been prepared to further guide you in locating the information you're looking for.

In addition to the articles, PF REPORTER contains many regular columns and departments, most of which are detailed in the main Index. Thumbnail sketches of these departments follow:

ACROSS THE BENCH—A departmental feature which has appeared bimonthly since June, 1958 to the present. Mainly discusses restoration techniques for the more durable models of older TV receivers, including pertinent points of troubleshooting.

AUDIO FACTS—A regular column since November, 1951, now appearing bimonthly. Earlier subjects concentrated on hi-fi components, including some construction projects; later articles emphasized troubleshooting and testing all types of audio and hi-fi systems.

DOLLAR AND SENSE SERVICING—A regular department since the very first issue, containing thought-provoking items on business, sales, and related topics.

NOTES ON TEST EQUIPMENT—Since February, 1955, has analyzed the specifications and applications of test instruments designed for electronic servicing.

PRODUCT REPORT—A monthly feature since February, 1956, giving condensed descriptions of new products available to servicemen.

PREVIEWS OF NEW SETS—A monthly pictorial feature since September, 1958, pointing out design features of the newest TV receivers.

QUICKER SERVICING—Began in November, 1951, appearing in every issue to the present. Topics discussed include servicing short cuts, case histories of unusual troubles, various troubleshooting suggestions, and reviews of products which help servicemen increase their efficiency.

SERVICING INDUSTRIAL ELECTRONICS—Beginning in September, 1957 as a basic coverage of various industrial electronic systems, this column has become a regular bimonthly department. Its purpose is to provide servicemen with the background knowledge needed to service all types of industrial equipment.

SERVICING NEW DESIGNS—First appeared in November, 1951, as "Examining Design Features"; now a regular bimonthly department. Subject matter is focused on circuit-operating theory combined with servicing hints; another frequent topic is unusual chassis design, usually in the TV field but occasionally dealing with radio or audio.

SHOP TALK—A monthly feature from the first issue until May, 1958; since then a bimonthly department. Its popularity stems from down-to-earth discussions of basic troubleshooting techniques, transistor theory and circuit design, test-equipment applications, antenna design, and similar subjects.

STOCK GUIDE FOR TV TUBES—Since July, 1953, has appeared from two to six times yearly to give servicemen information on relative usage of different TV tube types. Recent issues have included a listing of a recommended caddy stock of 350 tubes for home calls.

THE TROUBLESHOOTER—"The serviceman's Ann Landers"—began in December, 1957, to answer readers' specific questions on service problems. Most of these items are listed under the appropriate headings in the main index.

TROUBLESHOOTING WITH GEORGE—This series of features ran frequently in the period from November, 1956 to September, 1958, giving case histories of odd and difficult TV troubles.

UHF (Circuits and Equipment for Ultra-High-Frequency Reception)—Appeared in most issues between May, 1952, and April, 1954, presenting data on UHF converters and tuners of the early post-freeze era.

VIDEO SPEED SERVICING—Since September, 1958, this department has passed along service hints based on actual field experiences with specific models of TV receivers.

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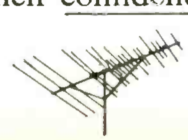
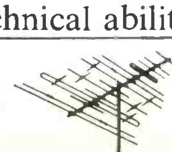
HI-FI HELIX



HI-FI BANSHEE



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Why don't service shops advertise more than they do? In talking to, and corresponding with, literally thousands of service dealers, we've received answers ranging from "It doesn't pay" to "I can't afford it." However, practically all of them admit that a certain amount of advertising is absolutely necessary. Having witnessed the power of advertising time and time again, we're the first to agree with this. We also agree, however, that service dealers can't afford advertising which doesn't pay. Advertising *must get results* . . . and to obtain results, you must reach an interested audience with a convincing message.

If your advertising is seen by a sufficient number of people, and if it is convincing, the results will automatically follow.

Until now, the major advertising problem facing service dealers has been the lack of an effective program—ads designed specifically for the service business, and offering the flexibility needed for the wide range of services performed. Certainly, most service shops, because of their limited advertising funds, cannot utilize the services of an advertising agency. And, most of the syndicated ad programs we've seen really don't apply specifically to electronics servicing.

Recognizing this problem, the Editors of PF REPORTER have taken the bull by the horns, so to speak, and have commissioned a special series of 60 copyrighted ads which meet the advertising needs of service dealers. The five ads on this page are a representative selection. Each month throughout 1961 we'll offer you five new ads so you'll always have a wide selection to choose from. Produced by topnotch copywriters and artists who are familiar with your problems, some of the messages are seasonal; others emphasize specialized service on hi-fi, auto radios, antennas, color TV, etc., and there are even a few which make special offers.

These ads have been carefully developed and field-tested *to make sure they will get results.* Each one is available to you at cost in two forms — durable newspaper mats at $1.75 per set of 5 or reproduction proofs printed on fine quality glossy paper at only $1.00 per set. The latter will serve as finished artwork for offset printing of handbills, postcards, doorknob hangers, direct-mail pieces, etc., or even for poster-size blowups which you can use in store windows on the side of your truck, and in many other places.

Every ad in this series is extremely flexible. In most cases, you'll probably use them exactly as they are (with your own company name, address, and phone number inserted), but you can easily have the wording changed to suit your needs.

To make sure your ad is seen, place it where people who need the kind of service you offer are most likely to look. The radio and TV program page in your local newspaper is one good place, especially if your services are available to most of the readers. On the other hand, if you prefer to confine your calls to specific areas, place your ads in neighborhood papers, church bulletins, shopping-center news sheets, etc. Or, if these aren't suitable, you can have handbills, doorknob hangers, or direct-mail pieces printed up for distribution as you see fit. Another excellent place for your ad is in the "Yellow Pages" of your phone directory.

A cardinal rule of advertising is consistency. Plan your program and your budget for 3 to 6 months or more, so that your ads appear regularly — perhaps once or twice a week for newspaper ads, once or twice a month for handbill or direct-mail programs. Newspapers generally give special rates based on the number of times you advertise. Printers may give you special prices if they realize you intend to be a repeat customer. Also, the cost per piece decreases as the size of the printing order increases.

Sold? Good — just fill out the convenient order form on page 96, and we'll send your ads postpaid by return mail.

Remember, advertising doesn't cost — it pays!

ES-48: 3 3/4" x 2 7/8"
If you offer complete home-entertainment service, this ad will help establish your shop as headquarters for often-overlooked services.

ES-32: 3 3/4" x 2 5/8"
Very attention-getting, this ad ties in with a well-known TV program. Particularly appropriate for the many "western" viewers.

ES-15: 1 7/8" x 3 3/4"
An introductory offer always pulls well — encourages the reader to clip the ad because of its value.

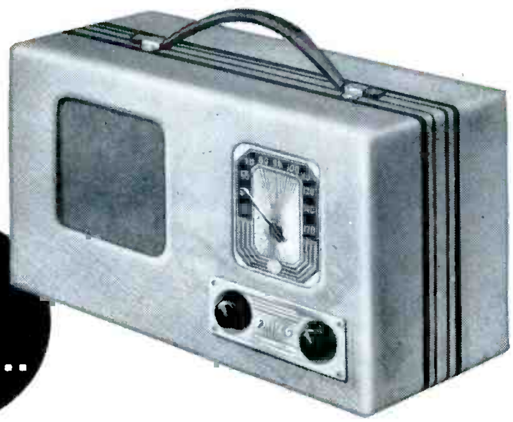
ES-27: 1 7/8" x 2 3/4"
Here's one that's suitable for practically any use — newspaper, "yellow pages," handbills, doorknob hangers, etc. Good for back-of-the-set stickers, too.

ES-42: 1 7/8" x 4 1/16"
To recapture lost tube sales, you need something convincing for "do-it-yourselfers." This message indicates they'll save money by calling you.

The growth of the entire Electronic Service Business is reflected in famous

PHILCO Industry Firsts

Here's just one example...



1st Portable Battery Radio Introduced by Philco in 1938

Philco opened up a whole new business by inventing the first self-powered Portable Battery Radio, introduced 22 years ago. Today, 30 million portables in use represent a giant service market that is typical of the many increased profit opportunities for you, resulting from famous Philco Firsts! Similarly, the proven reliability of Philco parts, tubes and accessories protects your profits, and builds good will.

For all your servicing needs, look to PHILCO

THE FIRST NAME IN ELECTRONICS... THE LAST WORD IN QUALITY

SEE YOUR PHILCO DISTRIBUTOR

PHILCO Accessory Division

WORLD-WIDE DISTRIBUTION

Service Parts • Power-Packed Batteries • Universal Components • Long-Life Tubes • Heavy-Duty Rotors • Star-Bright 20/20 Picture Tubes • Long-Distance Antennas • Appliance Parts • Laundry Parts • Universal Parts and Accessories

PHILCO®

Famous for Quality the World Over


PHILCO
Sweetheart Offer!
FOR YOUR VALENTINE
TRIFARI
Interlude Hinged Bracelet AD3811
Interlude Clip-Ease Earrings AD38 3
Interlude Safety-Clasp Pin AD3812
EACH ITEM INDIVIDUALLY GIFT-BOXED
FAMOUS TRIFARI JEWELRY FREE WITH YOUR PURCHASES OF PHILCO TUBES
White Madrid Hinged Bracelet AD3808
White Madrid Clip-Ease Earrings AD3810
White Madrid Safety-Clasp Pin AD3809
TRIFARI jewelry—the perfect Valentine gift! Both sets designed with matchless quality in new fashion-first styling! INTERLUDE, at top, features the soft glow of richly-textured satin gold finish. WHITE MADRID set sparkles with the beauty of gleaming white and brilliant gold finish. Use only genuine quality-first Philco tubes—thrill your sweetheart with both sets!
Either Set of Earrings FREE with your purchase of 50 PHILCO TUBES
Either Pin FREE with your purchase of 50 PHILCO TUBES
Either Bracelet FREE with your purchase of 75 PHILCO TUBES
LIMITED TIME ONLY! SEE YOUR PHILCO DISTRIBUTOR

QUICKER SERVICING

HAVE RASTER—NO PIX

Frequently you'll encounter a TV with a perfect raster but no sign of a picture. There are so many possible problem areas—so many components that could cause this symptom—that it's important to take full advantage of all available know-how and test equipment to pinpoint the trouble as quickly as possible.

Checking the visual symptoms, and noting the amount and quality of the sound output, will normally get you started in the right direction. A snowy screen accompanied by a "rushing" sound from the speaker should send you scurrying to the antenna and RF circuits. A clean raster with no trace of snow and no sound literally shouts "mixer, IF, detector, or AGC trouble." If you are wondering why video-amplifier failure was omitted here, it is only because the sound-signal path often does not include the video stage. This gives rise to the third telltale symptom—good sound and raster but no picture. It's advisable to try all available channels, and to note the results with the station selector turned to an unused channel, before making a firm diagnosis.

Once you've decided what section is most likely harboring the trouble, what's the best way to prove your hunch? (It's important to prove your theory early in the game; if you don't, precious time will be wasted sooner or later.) Of course, you'll substitute tubes first, to be sure none of them are at fault; but from there, your best approach will vary — depending on your original diagnosis. Let's make a "dry run" to see how you'd verify a suspicion of trouble in the front end.

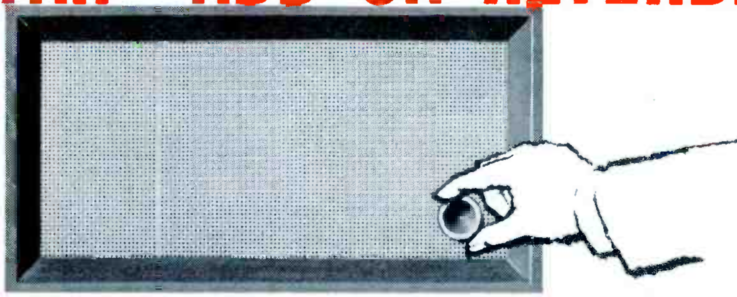
Tuner Troubles

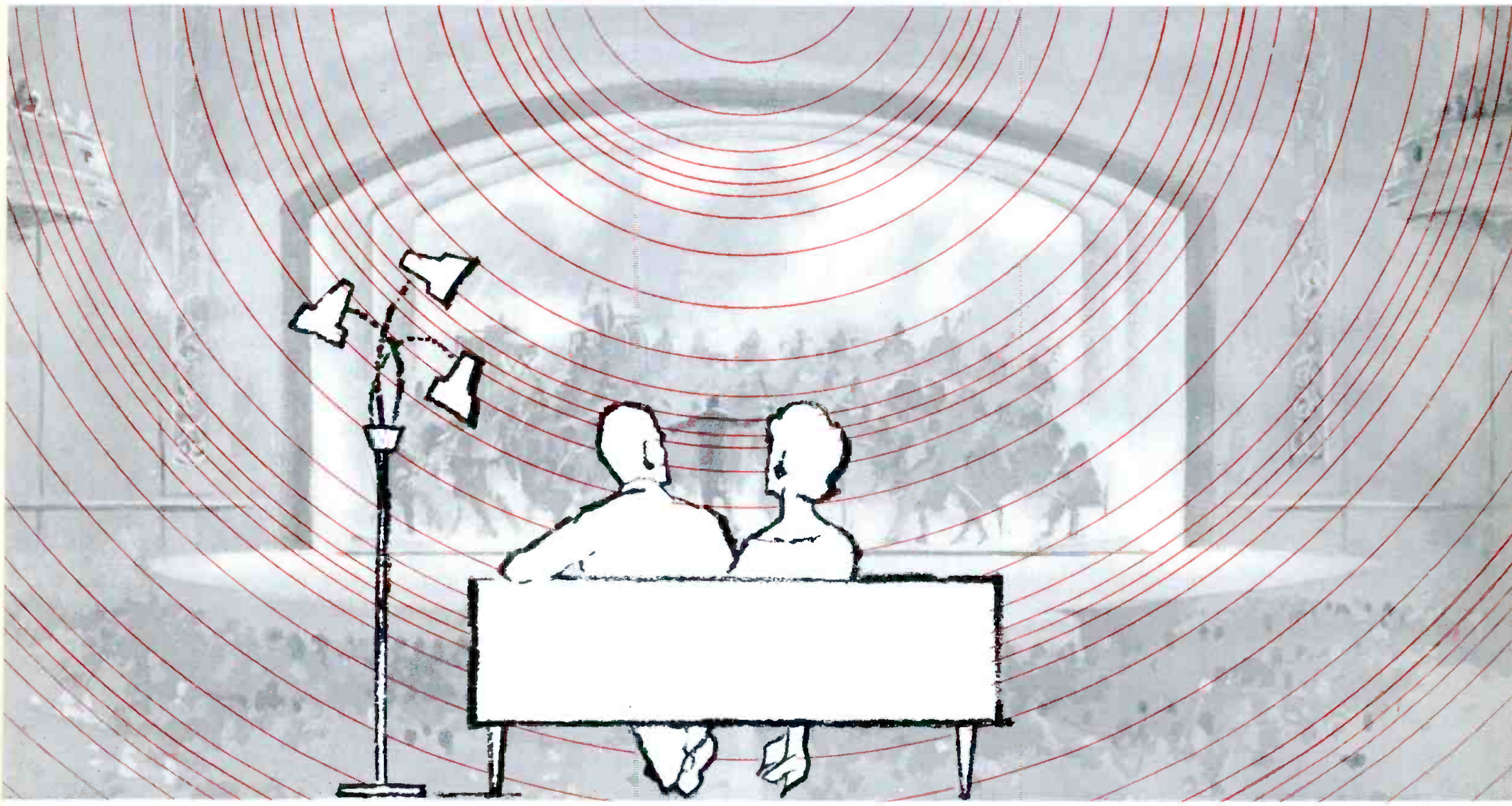
Plenty of snow in the raster, along with noisy sound (Fig. 1), directs your attention to the RF amplifier and antenna-input circuits. How you prove this is the most logical trouble spot will depend on the type of set you have, and on the test equipment you use. If the set is wired with parallel filaments, you can pull the mixer-oscillator tube. If this kills snow and noise, you'll know this "noise generator" is working, and you can go on to the RF amplifier. For a quick check of a series-filament set, you can set up a sweep generator for a 6-mc sweep on the video IF center frequency (43 mc for most sets). This signal should go sailing through the IF strip and the mixer, too, if all is well. No need to look for a connection — just touch the hot lead to the envelope of the mixer. If the signal path is complete, you'll have

Fig. 1. Snowy raster directs attention to RF and antenna input circuits.

Fig. 2. Bars show on CRT when a sweep-generator signal is getting through.

NEW FROM UTAH—ADD-ON REVERBERATION





MAKES YOUR LIVING ROOM SOUND AS LARGE AS A CONCERT HALL!

Change acoustic dimensions of a room to fit the music . . . switch from club lounge intimacy to concert hall grandeur at the touch of a dial. Controlled reverberation is the secret! Some of this year's consoles feature "built-in" reverberation. But Utah alone offers "Acousti-Control"—a self-contained reverberation speaker-and-amplifier that hooks into any radio, phonograph (mono or stereo), or component sound system.

Here's how it works: *Hook Utah's "Acousti-Control" unit into any speaker system. Part of the original signal feeds through a carefully tuned device which delays the sound for 1/30th of a second. This delayed sound blends with the original sound to add acoustic dimension to the room. (The further you turn the knob, the larger the room sounds.) Makes monaural FM sound like stereo—adds startling dimension to stereo itself. Ask for a demonstration at your dealer's—or write for free literature and prices.*

utah

UTAH RADIO & ELECTRONIC CORP.
Huntington, Indiana

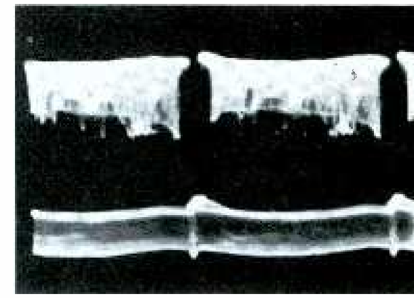


Fig. 3. Typical composite video signal waveform at output of detector.

the prettiest bars you ever saw on the CRT. (See Fig. 2.) The same test will work when applied to the RF amplifier.

A VTVM comes in mighty handy, as does a socket adaptor, in tracing trouble to its source. (The VTVM should include an ohmmeter function.) Don't wait too long before using the ohmmeter to check each side of the tuner's antenna terminals for continuity to ground, and don't overlook the possibility of an open antenna-isolation network in series with one of the input leads.

No Snow — No Noise

Which is it — IF, AGC, or video trouble? If you get snow and noise off channel, there's too much AGC. This can also be easily checked by disconnecting the antenna to see if you can obtain a snowy picture. Clamping both of the AGC lines with minus 1.5 volts for the RF, and minus 3 volts for the IF, will verify whether or not the trouble is improper AGC action. If it is, a scope and VTVM are your best tracing tools.

If this test indicates the trouble is not AGC-based, the mixer, IF, and video stages are the remaining possibilities. If you have a scope (and you should have), use it to check for a signal across the video-detector load resistor. Presence of a composite video signal (Fig. 3) at this point tells you to scope right on through the video stages to the CRT in your search for the trouble. If there's no signal at the detector output, you can switch to a detector probe and individually scope each IF stage until you find the one which is not doing its job.

A VTVM is effective in this area, too. If there's a negative DC voltage being developed across the detector load, ranging anywhere from 1 to 10 volts negative, there's a signal at this

In the years to come, this symbol will continue to identify tubes of the highest quality and most advanced design.

DISTRIBUTOR PRODUCTS DIVISION • 411 PROVIDENCE TURNPIKE • WESTWOOD, MASS.

RAYTHEON

RAYTHEON COMPANY

DISTRIBUTOR PRODUCTS DIVISION

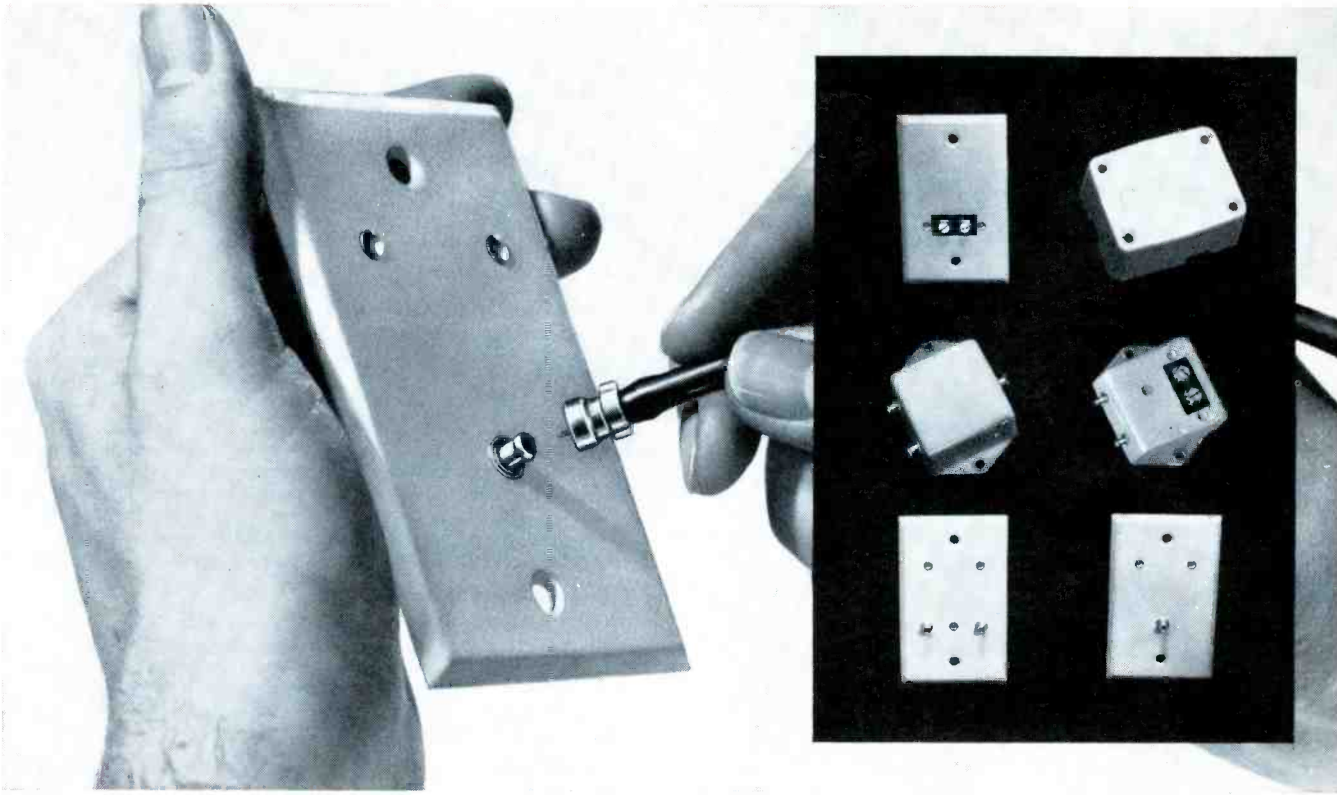
point. If it's over 10 volts, one of the IF stages is probably oscillating. On the other hand, if you have only a contact-potential indication (a fraction of a volt), switch to the lowest positive DC scale and check the cathode voltages on the IF stages. You'll find most cathodes going to ground through a low-value resistor, and the amount of voltage drop is a good "thermometer" for telling how well the stage is working. When you find a wrong voltage, you can check the grid, plate, and screen circuits for further clues. Of course, you could also use a sweep generator or other signal injector in these circuits, just as in tracing tuner troubles.

Have Sound

When sound is present, you can normally head for the video circuits — beginning at the output of the detector. Following either the scope or VTVM procedure just outlined is a good way to start. Continuing through the video circuits with a scope or VTVM should pinpoint the trouble. Don't overlook making tests at the base of the CRT, and checking the action of the brightness and contrast controls.

If you're equipped with a signal-substitution unit, you may prefer to use it to localize the trouble. Using this technique would have quickly solved a problem we recently heard of. The CRT had a perfect raster and no snow, but there was no control over brightness, even though the grid - cathode bias changed with the setting of the brightness control. Using signal injection would have proved that the CRT grid (the driven element in this case) was open — thus avoiding the doubt that faced the VTVM troubleshooter. By the same token, using a CRT tester would have removed *all* question, and speeded the repair.

To recap: There are several quick tests, requiring no equipment, that are helpful in solving a problem of raster and no picture. Once the general trouble area is surmised — prove it! A scope, VTVM, bias supply, sweep generator, signal-substitution unit, and CRT tester all have their place in tracing "raster — no picture" problems to their source. ▲



vital to superior tv signal distribution

NEW BLONDER-TONGUE TAPOFFS, SPLITTERS, BALUNS

featuring speedy, secure 75 and 300 ohm connections

FOR LARGE AND SMALL DISTRIBUTION SYSTEMS . . . IN ALL SIGNAL AREAS Select the units that best meet your requirements. Minimum insertion loss and maximum isolation are provided.

FOR NEW AND EXISTING CONSTRUCTION . . . INDOORS AND OUTDOORS Select a flush-mounted wall plate unit for new construction, or a surface-mounted unit for existing construction.

FOR 75, 300 OHM OR MIXED IMPEDANCE SYSTEMS—300/300, 75/75 or 75/300 ohm inputs and outputs cover every possible need. What's more, mixed impedance systems do not require additional matching accessories.

. . . all this plus speedy, secure 75 and 300 ohm connections

75 OHM CONNECTION—Coaxial cable may be plugged into an exclusive new solderless fitting on the tapoffs, baluns and splitters as simply as you would plug a tube into a socket. Simply strip the cable, insert it into the fitting and crimp the holding ring for a permanent connection. Where many connects and disconnects will be made, a special 'Quick-Disconnect' connector, which fits firmly over the coax cable, provides a secure, positive installation.

300 OHM CONNECTION—300 ohm line need not be stripped. It is inserted directly under pronged washers which bite through the insulation when tightened by the turn of a screw for a positive, secure connection.

THERE'S A BLONDER-TONGUE TAPOFF, SPLITTER OR BALUN FOR EVERY TV SIGNAL DISTRIBUTION NEED

MODEL	TYPE OF MOUNTING	IMPEDANCE INPUT	IMPEDANCE OUTPUT	ISOLATION	INSERTION LOSS	LIST PRICE
75 AND 300 OHM FEED THROUGHS						
TF-771	flush	75	75	none	negligible	$2.70
TF-331	flush	300	300	none	negligible	1.75
75 OHM SOLDERLESS TAPOFFS						
TF-771B	flush	75	75	17 db	less than 1 db	3.95
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						
TS-772	surface	75	(2) 75	14 db	3.5 db	5.20
TS-774	surface	75	(4) 75	11 db	6.5 db	7.50
75 TO 300 OHM MATCHING DEVICES						
TF-731	flush	75	300	—	negligible	4.30
TS-731	surface	75	300	—	negligible	3.40

Available through parts distributors. Write for free catalog Dept. PF-1

B-T LABS **BLONDER-TONGUE LABORATORIES, INC.**

9 Alling St., Newark 2, N. J.

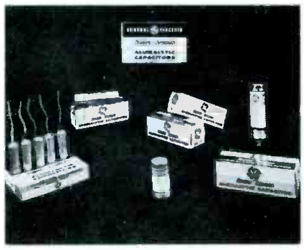
Canadian Div.: Benco Tlevision Assoc., Ltd., Toronto, Ont. Export: Morhan Export Corp., N. Y. 13, N. Y.

hi-fi components • UHF converters • master TV systems • industrial TV cameras • FM-AM radios

BLONDER TONGUE 10

The Electronic Scanner

New Brand of Replacement Capacitors



Don't be surprised when you walk into your distributor's store and find a line of replacement capacitors made by **General Electric.** The company, which has long been manufacturing capacitors of all types for use in original equipment, is now marketing 275 electrolytic and paper-Mylar units to fill all potential replacement applications.

A Million is a Lot of Anything

A late bulletin informs us that **Zenith Sales Corp.,** for the second consecutive year, sold over one million TV receivers in 1960. According to the best estimates, this means **Zenith** will have achieved the greatest percentage of total industry sales in the history of the company, further strengthening its position as number one in TV sales.

Attention Dealers

If your location is suitable for walk-in trade, try this self-selling display from **Channel Master.** It features two of their brand-new transistorized table-portable models. Designed so customers can actually try them out and make their own listening tests, it includes a set of four "changeover" cards which you can rotate according to holiday, seasonal, and gift-giving occasions.

Learn Modern Servicing Techniques

In case you didn't know it, **B & K Mfg. Co.,** in cooperation with many of their distributors, has been sponsoring TV service seminars all around the country. 300 servicemen who attended a recent Chicago meeting were treated to a session on modern servicing techniques using *B & K* equipment. We heartily recommend that you take advantage of as many manufacturers' seminars as possible, whenever you have the opportunity.

Like Fishing?

Pyramid's "Sportsmen's Delight" capacitor kits each contain three colorful trout flies in addition to Gold Standard Mylar capacitor assortments. Both kits come in compartmented plastic boxes which are reusable as tackle boxes or for many other purposes.

And the Winner is . . .

Lucky man in the 1960 **Mallory** "Cool Deal" Contest is Vern W. Maxwell, radio and TV service dealer from Cantrall, Ill. He and his wife will receive an all-expense trip by jet to Jamaica for submitting the best statement on which **Mallory** component he liked best and why. Other winners were W. D. Ryan, salesman for Bruce Electronics in Springfield, who also won a trip for two for introducing Vern to "Cool Deal"; George Peroni of Best Television, Miami, who received the $150 second prize; and J. H. Hill of Waco, Texas, who won $50 third prize. Pictured are Mr. Ryan, **Mallory** Distributor Sales Manager O. E. Bishop, and Mr. Maxwell.

We Goofed!

Last month this column erroneously stated the price for the **Amperex** "Ice Bucket" deal as $49.46. The ice bucket, which normally sells for $11.95, is free; the right price for the tubes is $141.05.

You'll save time, trouble..

. . . *by turning FIRST to BUSS for fuses of unquestioned high quality*

By relying on BUSS as your source for fuses, you can quickly and easily find the type and size fuse you need. The complete BUSS line of fuses includes: dual-element "slow-blowing", single-element "quick-acting" and signal or visual indicating types . . . in sizes from 1/500 amp. up — plus a companion line of fuse clips, blocks and holders.

BUSS fuses are made to protect —not to blow needlessly

When you install BUSS fuses — you are sure your customers receive maximum protection against damage due to electrical faults. And just as important, your customers are safeguarded against irritating, useless shutdowns caused by faulty fuses blowing needlessly.

It pays to rely on dependable BUSS fuses because there are no 'kicks' or complaints from users about their operation . . . and you avoid costly, unnecessary call-backs.

Capitalize on the BUSS trademark

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 BUSS fuses — and other KNOWN items — helps safeguard your reputation for service and quality.

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

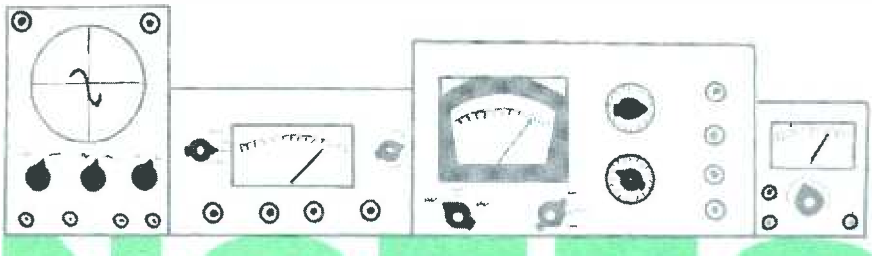
BUSSMANN MFG. DIVISION,
McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.

161

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 — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — BUSS — McGRAW EDISON



NOTES ON TEST EQUIPMENT

by Les Deane

Visual Troubleshooter

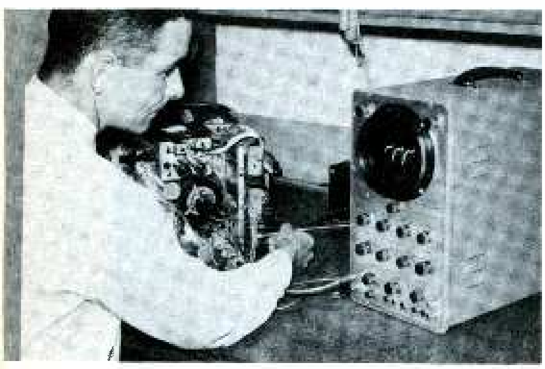


Fig. 1. Precision scope being used to align a horizontal sweep oscillator.

The Model ES-525 oscilloscope shown in Fig. 1 is manufactured by Precision Apparatus Company, Inc. of Glendale, Long Island. The instrument is housed in a blue-gray steel cabinet with brushed-aluminum panel, features a 5" CRT, and comes complete except for input cable.

Specifications are:

1. *Power Requirements — 110 / 120 volts, 50/60 cps; power consumption approximately 55 watts; isolated supply protected by line fuse, indicator on panel.*
2. *Vertical Input—frequency response from 10 cps to 500 kc within 3 db, and within 6 db to 700 kc; sensitivity 20 mv rms/inch; frequency - compensated attenuator provides steps of X 1, X 10, and X 100; input impedance 2.2 megohms shunted by 20 mmf; maximum input voltage 600 volts; direct CRT connections provided.*
3. *Horizontal Input — frequency response 10 cps to 150 kc within 3 db; sensitivity 60 mv rms/inch; input impedance 2.2 megohms shunted by 30 mmf; direct CRT connections provided.*
4. *Sweep System — internal sawtooth from 10 cps to 100 kc in 4 ranges; external capacitor jacks provided for sweep inputs as low as 2 cps; selector switch also provides 60-cycle line sweep with variable phase, and external sweep position.*
5. *Synchronization — 4-position selector provides plus or minus internal sync, line sync (60 cps), and external sync; sync amplitude control and external jack provided on front panel.*
6. *Other Features — built-in peak-to-peak voltage calibrator; intensity modulation (Z-axis) input on front panel; CRT bezel includes filter lens with illuminated graticule plus camera-mounting attachment; complete probe set available as accessory.*
7. *Size and Weight — 14½" x 8¼" x 18½", 29 lbs.*

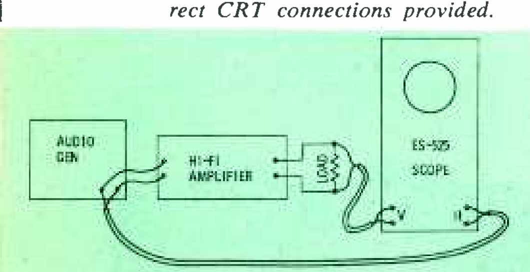


Fig. 2. Test setup for using Lissajous patterns to check amplifier distortion.

Looking over the instrument's circuit design, I noted that the vertical and horizontal amplifiers are both of push-pull design with compensated attenuators for the input signals. Two universal-type binding posts for each system are found on the front panel. Another feature I like is the small removable panel on the rear of the case, providing convenient access to the CRT deflection-plate connections. This permits the user to apply a signal directly, without the loading or phase shift characteristic of the internal amplifiers.

When performing a TV or FM sweep alignment, I noticed that it was not really necessary to apply a sweep signal from the generator to the horizontal input terminals of the Precision scope, because the instrument's sweep selector includes a LINE position that furnishes a 60-cycle sinusoidal sweep corresponding to the same signal modulating the generator's RF oscillator. The SYNC LOCK-LINE PHASE control is used to properly phase these two signals.

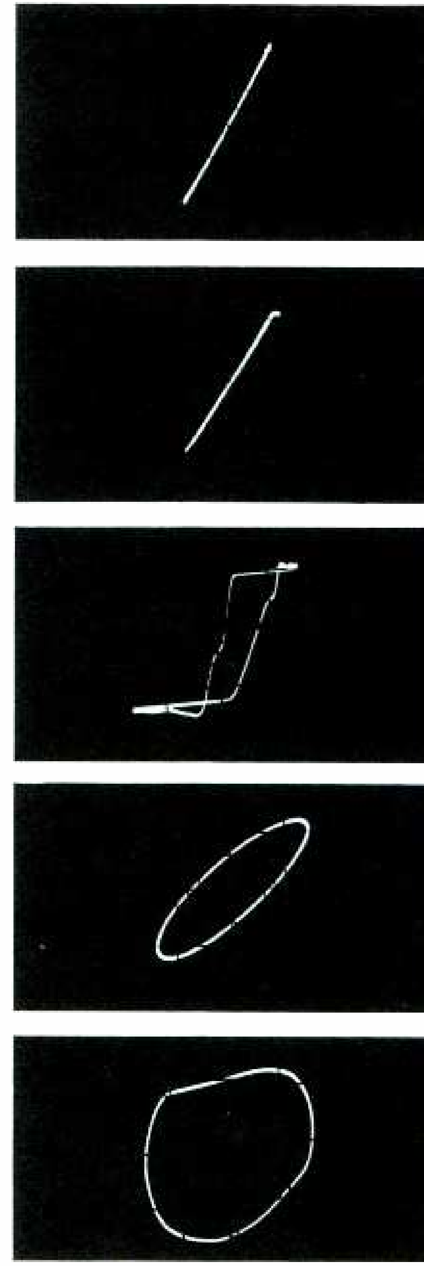
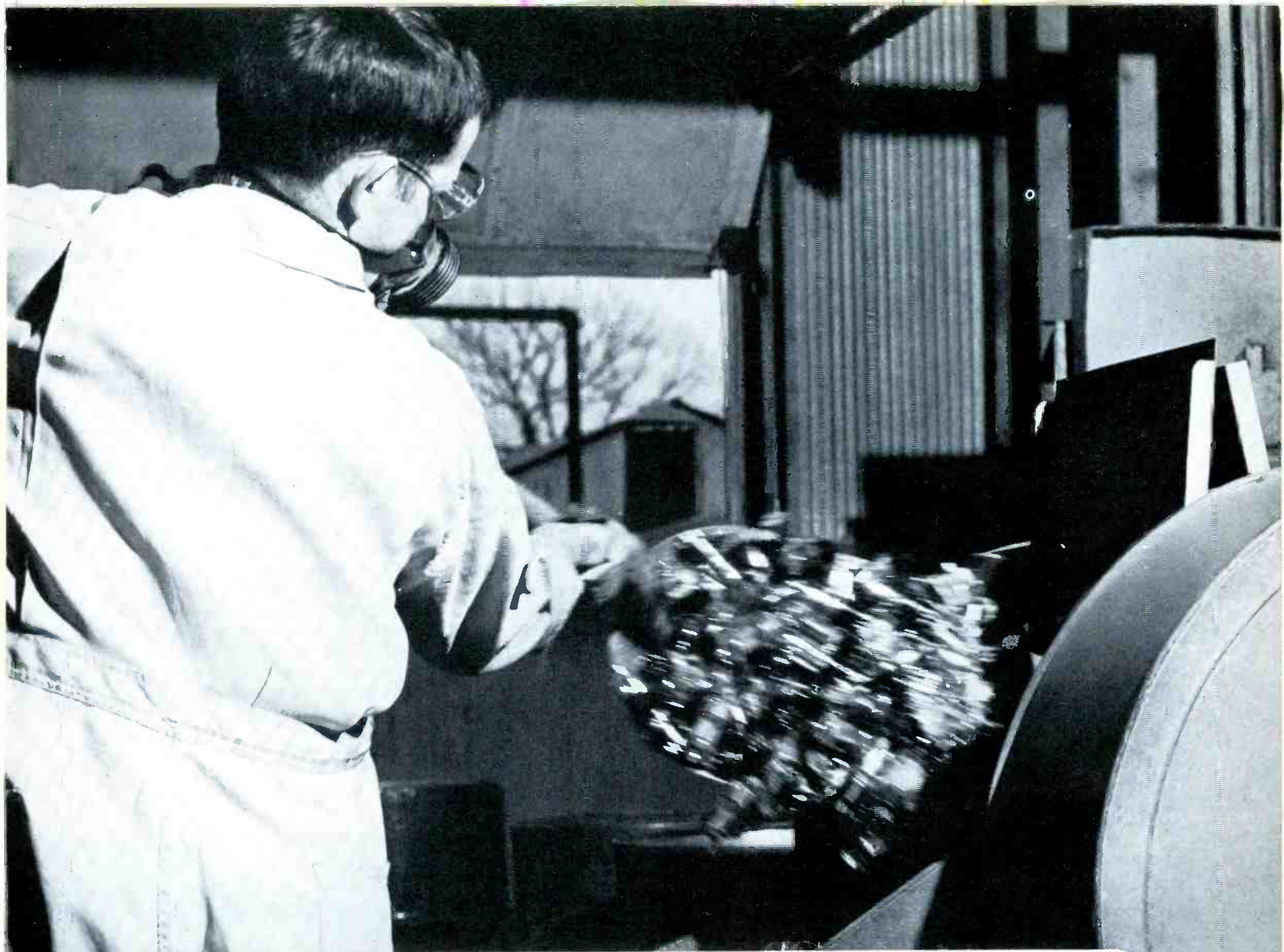


Fig. 3. Audio waveforms taken with a 35-mm camera attached to the ES-525.

Another feature which deserves special mention is the internal calibration system of the Model ES-525. The peak-to-peak amplitude of any pattern displayed on the screen can be immediately evaluated by three simple motions. The P-P RANGE switch is set to one of its three positions (.05, .5, or 5 volts); the P-P CAL VOLTAGE control is adjusted for any value between zero and the maximum voltage indicated by the position of the range switch; and the calibration voltage is applied to the vertical system by depressing the small push button in the lower-left corner of the front panel.

Of course, the calibration voltage can be applied to the scope, and then adjusted to occupy the same number of graticule markings as the unknown signal. The peak-to-peak value is then determined by the position of the CAL VOLTAGE control, which has linear di-



DESTROYED—NOT FIRST QUALITY!

...why General Electric cannot ship recovered or rebranded receiving tubes!

One area in every General Electric tube plant is given over to destruction. Here steel jaws chew to fragments all tubes that aren't (1) brand-new production, (2) proved first-quality by extensive tests.

No recovered receiving tubes, no "seconds" can leave a G-E factory. Be quality-safe! Buy only from your G-E tube distributor! *Distributor Sales, Electronic Components Div., General Electric Co., Owensboro, Ky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

3_1-302

visions from 0 to 5.

In one specific application, I used this scope for checking frequency response, signal distortion, and phase shift in a typical hi-fi amplifier. The test setup is shown in the block diagram of Fig. 2. Actually, this arrangement can be used to check any audio circuit.

I employed an audio generator with a pure sine-wave output variable in both frequency and amplitude. The output of the generator was applied to both the input of the hi-fi amplifier and the horizontal input terminals of the scope. The amplifier was terminated with a dummy resistive load, and its output was applied to the vertical input terminals of the scope.

To check frequency response, I reduced the horizontal sweep of the scope to zero and obtained a vertical line, which I adjusted to fill a precise number of calibrating divisions. Varying the frequency of the generator from 30 cps to 30 kc, I looked for any changes in amplitude of the line on the scope screen. As it turned out, the variations were hardly perceptible, indicating that response was virtually flat over the entire audio range.

With the amplifier operating normally and receiving a suitable input signal, I increased the scope's horizontal gain until I obtained the slanted-line pattern in Fig. 3A. This Lissajous pattern indicates that there is no distortion or phase shift in the amplifier under test. By increasing the amplitude of the input signal I reached a point where one or more of the stages started to overload (represented by the curve at the top of the line in Fig. 3B).

Increasing the signal still more resulted in considerably more distortion, as shown by the pattern in Fig. 3C. The separation of the trace and retrace lines also pointed to a slight phase-shift effect. By reducing the input signal and at the same time increasing frequency, the overload distortion disappeared, but a definite phase shift was indicated by the elliptical pattern seen in Fig. 3D. The waveform of Fig. 3E represents both overloading and severe phase shift. You'll find that these simple tests can tell you a lot when troubleshooting any audio system.

After verifying the instrument's specifications and using it to analyze numerous waveforms, I found that the Model ES-525 is well suited for radio and TV service applications, and especially so for alignment and audio work.

Transistors Your Problem?

The instrument in Fig. 4 is produced by Winston Electronics of Miami, Florida. Known as the *Win-Tronix* Model 620 Transistor Analyzer, it tests all signal- and power-type transistors for leakage and gain. In addition, its versatile front-panel connections and various internal battery potentials are ideal for use in building up breadboard circuits, making the instrument useful to engineers and experimenters. The unit is supplied with test cable, instruction manual, and test-data charts for almost every currently-manufactured transistor.

Specifications are:

1. *Power Requirements — two self-contained 7.5-volt batteries, providing potentials of 3, 6, 9, and 12 volts (not supplied with instrument), replaceable with standard tapped "C" batteries; panel connections available for external power source.*

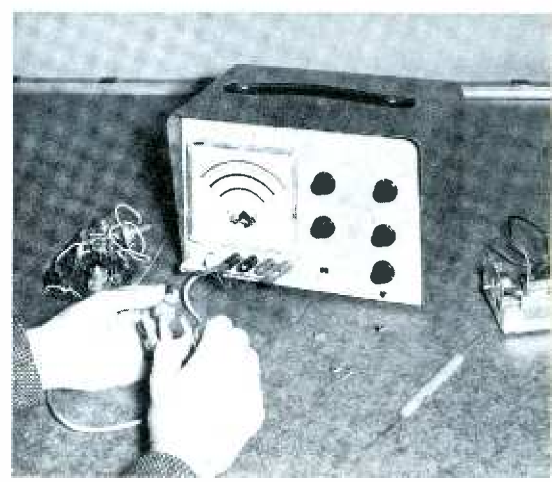


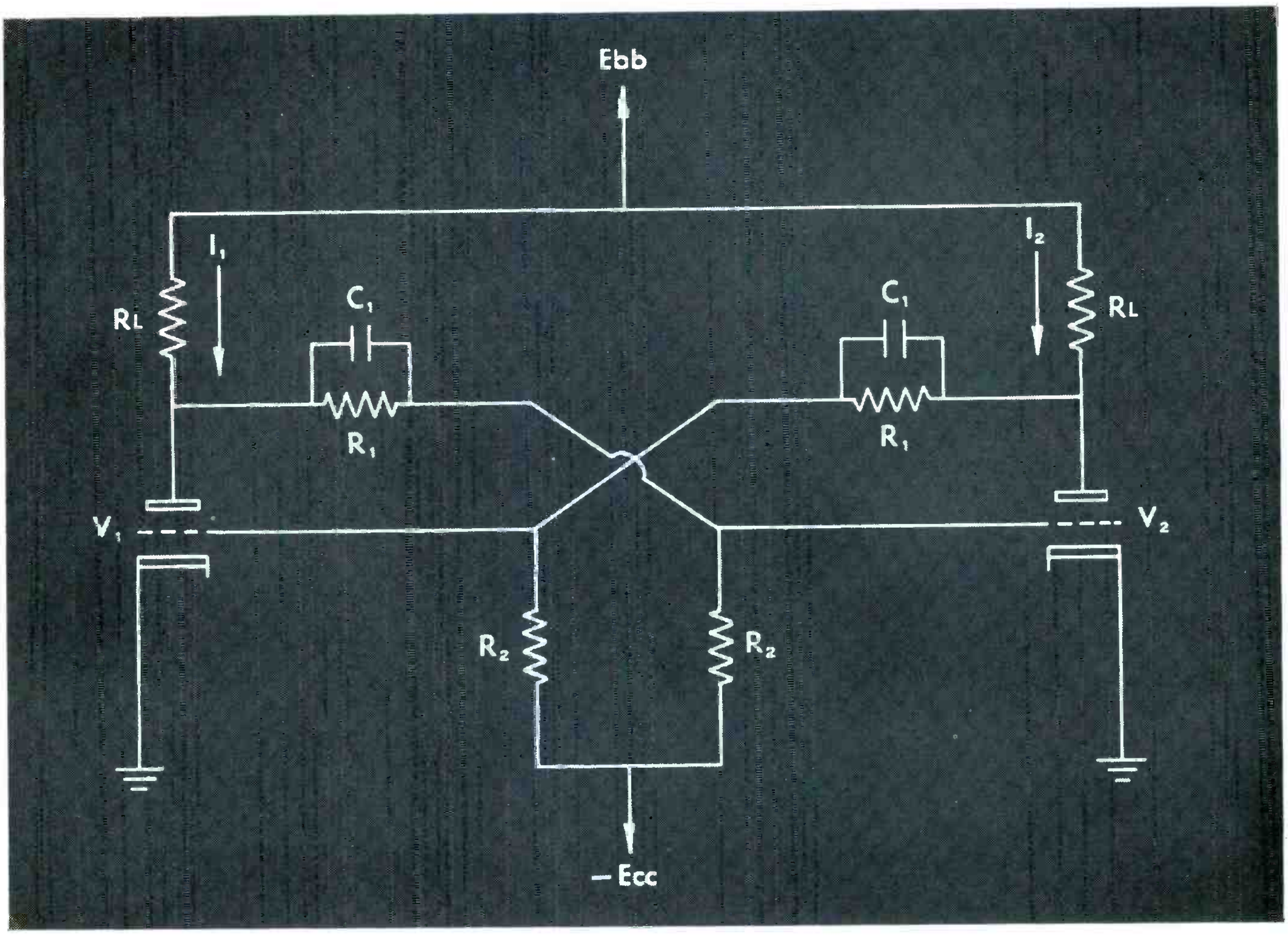
Fig. 4. Win-Tronix unit is designed for testing and analyzing transistors.

Latest Issue of

TUNG-SOL TIPS

tells you what you should know about

MULTIVIBRATOR CIRCUITS



HERE is a typical multivibrator circuit. It's just one of several which perform many basic functions in computers and electronic counters and which find wide use as waveform generators. For the serviceman planning to expand his business to industrial equipment servicing, a thorough knowledge of these devices is a "must".

To give you this fundamental grounding in multivibrators, Tung-Sol has devoted the latest issue of its monthly series, *Tung-Sol Tips*, to a vigorous, down-to-earth treatment of these important circuits.

In issue #13, you'll find a comprehensive, fast-reading analysis of all the multivibrator circuits which you can expect to find in your industrial work. These include: the bistable multi, the cathode coupled binary, monostable, astable and high speed multivibrators.

The operation and application of each is carefully defined. Many circuit diagrams are included to round out your understanding.

There's more! The author has also included a special section that gives you maintenance and servicing clues that you can put to practical use immediately. Or write directly Tung-Sol Electric Inc., Newark 4, New Jersey.

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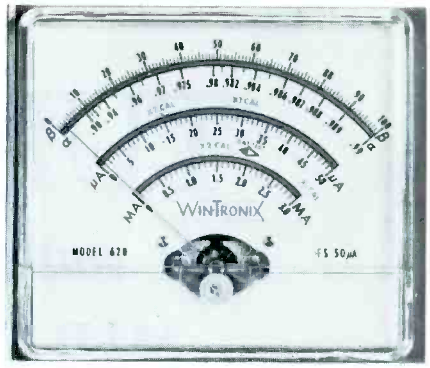


Fig. 5. 620 meter provides scales for beta, alpha, and four leakage ranges.

2. *Gain Tests—measures current gain factors beta and alpha; beta readings up to 200 obtainable in two ranges; accuracy ±8% of full-scale deflection; typical beta values given in setup data.*
3. *Leakage Tests—measures collector to emitter (*ICEO*) and collector to base (*ICBO*) leakage currents individually; readings indicated on four full-scale ranges of 50 ua, 3 ma, 10 ma, and 100 ma; accuracy ±2% of full-scale deflection; typical values given in setup data.*
4. *Diode Tests—forward and reverse current measurements up to 100 ma.*
5. *Breadboard Applications — panel binding posts provide universal connections for external circuit configurations for both* NPN *and* PNP *transistors.*
6. *Other Features—4½" panel meter with 50-ua full-scale movement; calibration control and battery test provided; panel test socket and external leads supplied; charts in manual include setup data for over 700 semiconductors.*
7. *Size and Weight—case 7" x 10½" x 6", approx 6 lbs. with batteries.*

As pictured in Fig. 5, the face of the instrument's meter has three arcs. The top arc is calibrated from 0 to 100 for beta readings, and from .9 to .99 for alpha measurements. The same scale also indicates leakage measurements in both 10- and 100-ma ranges.

The middle scale, calibrated from 0 to 50 microamps, is used for the most sensitive leakage measurements. Along this arc you'll also find two specific points labeled X2 CAL and X1 CAL. The lower scale is also marked in this manner. Before taking a gain measurement, the instrument is calibrated by adjusting a control on the front panel to align the meter needle with the CAL line determined by the beta range chosen. When calibrated at either of the X2 points, readings on the 0-to-100 beta scale must be multiplied by two.

The lower scale, labeled MA, is calibrated from 0 to 3 milliamps, plus the two CAL marks previously mentioned. This scale is employed for current-leakage measurements which fall within this particular range.

The six binding posts or test jacks on the front panel of the Analyzer are identified as J1 through J6 — two for each base, emitter, and collector element of the transistor under test. A jumper must be connected between each pair (J1 and J2, J3 and J4, J5 and J6) to complete the test circuit for all conventional leakage and gain measurements.

The test procedure is relatively simple when you become acquainted with the proper range settings and the calibration step. In my examination of the instrument, I tested a number of both good and bad transistors. Measurements of units having known gain characteristics were accurate within a very close tolerance; shorted units and those with excessive leakage caused the meter to read off scale in every case.

One of the extras of this particular transistor tester is its usefulness in constructing breadboard circuitry. By removing the shorting bars from between the test jacks on the panel, external supply voltages, resistors and capacitors, tuned circuits, etc., can be series-connected to the various elements of the transistor placed in the instrument's test circuit.

Using the breadboard feature, you can connect components to the test jacks as illustrated in Fig. 6A to derive the field strength meter shown in Fig. 6B. In this arrangement, the instrument's PNP-NPN switch is placed in its off position, and the transistor is inserted into the panel test socket.

Working with transistors in a breadboard arrangement will naturally help you to become more familiar with their theory of operation, and in many cases may help you determine interchangeability between various types. The Winston manual for the Model 620 also shows you how to construct an audio test oscillator circuit, a signal injector, and a crystal frequency standard. ▲

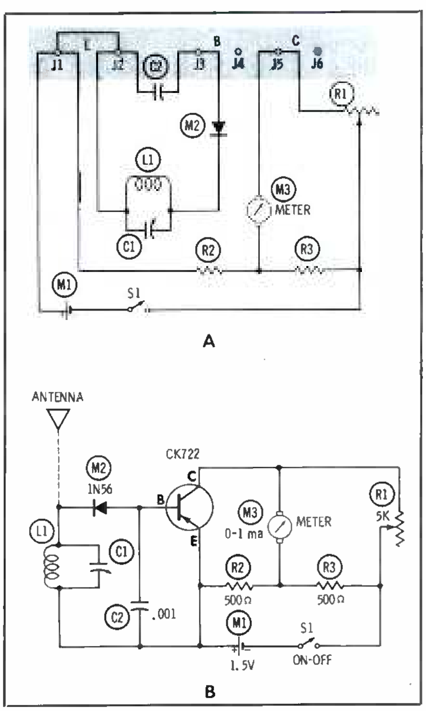


Fig. 6. Analyzer as a field-strength meter. (A) breadboard, (B) schematic.

THE TROUBLESHOOTER

answers your service problems

Tired Blood

I've got a Westinghouse Chassis V-2207 with a weak picture, poor sound, and too much B+ voltage being fed to the RF and IF sections. I've never been straightened out on this problem of high B+. I know that the current being drawn is less than normal, resulting in the increased voltage—but how do you track down the trouble when the normal stage-current measurements aren't given? I'd like to see an article on this subject in the old standby, PF REPORTER.

PAUL J. TATE

Wattsburg, Pa.

Glad to oblige. Your high B+ is probably the result of, rather than the cause for, the weak picture and sound. A general rule of thumb for determining the amount of current drawn by the tubes in the RF-IF sections is to assume 10 ma total for each stage with no signal applied. This can be verified in any particular circuit by applying Ohm's law to the voltage drop across one of the isolating resistors. For example, notice that the plate of V5 is 5 volts lower than the plate of V4; since only a 470-ohm resistor (R33) separates these two points, it shows the current drawn by V5 to be approximately 10 mils. This is further substantiated by the fact that you have 1.2 volts developed across the 150-ohm cathode resistor. Measuring cathode voltage is the easiest way to determine whether or not a tube is conducting normally.

In this particular case, I suspect excessive AGC bias. This would lower the gain of the RF and IF sections, thus reducing their current requirements and producing the higher B+ voltage. Critical voltage analysis of the AGC line, the IF control-grid circuits, and cathode voltages in the IF strip should lead you to the weak stage or the AGC malfunction.

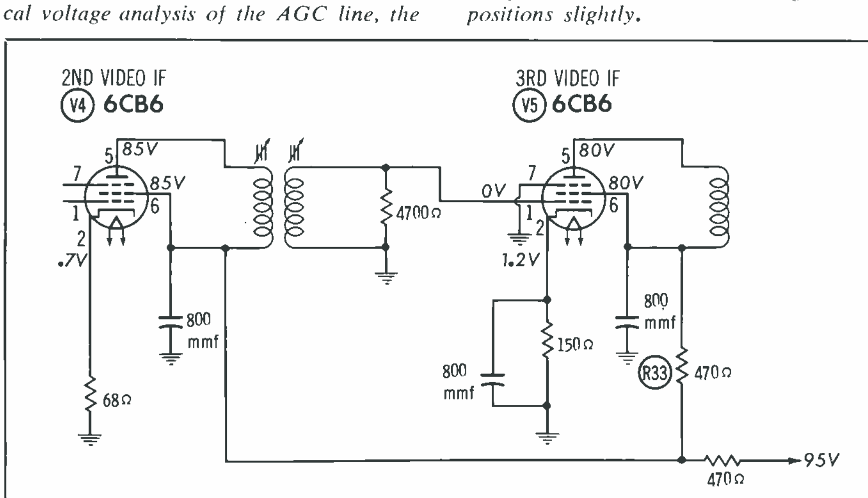
Hum Slow

A phono I had in the shop would develop a hum after about 10 minutes of playing. I substituted the filters to no avail. Tried a new 50C5—after 15 minutes, the hum returned. Tried another 50C5—ditto. Put in all new tubes—still it returned. Finally, in desperation, I converted the wiring so I could use a 50B5 and get the grid connection (pin 2 or 5) of the 50C5 away from the heater connections (pins 3 and 4). The 50B5 uses pin 7 for the grid, and this solved my problem. I was glad to be rid of this dog, but I like to know the causes for troubles! Was it the socket? The tube? Me?

HAROLD'S TV

Miami, Fla.

Since you didn't mention the name or model of the unit, I can't confirm my suspicions by looking at a photo. However, I feel you were very close to the solution of your problem when you became aware of the proximity of the control grid and heater connections to the 50C5. A trouble of this nature commonly occurs when components and leads associated with the grid circuit are placed close to the AC filament connection. Normally, the only work necessary to solve the problem is a little bit of lead rerouting to get the components out of the AC field produced by the filament wiring. Of course, when you converted the wiring to use a 50B5 tube, all of the components in the circuit changed their positions slightly.



The explanation of why the hum is not present from the beginning hinges on the warm-up characteristics of the amplifier tube, as well as on the fact that the radiated signal is very low in amplitude. The amplifier does not achieve full gain until it has thoroughly warmed up; thus, the feeble hum signal may not be amplified to an audible level during the first several minutes of operation. Warm-up characteristics will vary from chassis to chassis, so you may encounter time-interval variations that will range from only a minute or two to as high as 15 or 20 minutes.

Degeneration Control

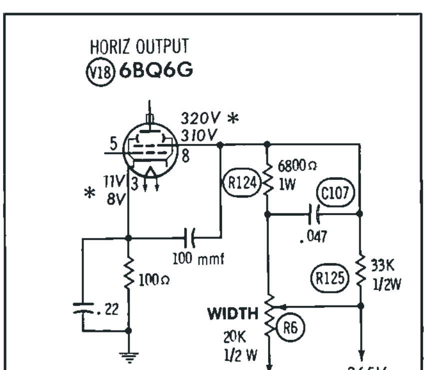
An RCA KCS47 chassis came in with a shot flyback, an open width control, and the screen resistor for the horizontal output tube jumpered. I've restored the circuit and solved the problems, but I'd like an explanation of how the width circuit functions and the logic of the wattage ratings of R6, R124, and R125.

CLAYTON G. LANDRY

Bodfish, Cal.

Width is controlled by two interactions in the screen circuit of the output stage. The first of these is the control of screen voltage as B+ is fed to the screen via two parallel paths—R125 in one leg, and the series resistance of R124 and the upper part of the width control in the other leg. As the value of R6 is adjusted, the resistance of the parallel circuit is varied, thus regulating screen voltage. The other means of control is achieved by regulating the degeneration introduced into the screen circuit as a result of the connection of screen bypass capacitor C107. Normally the screen is bypassed directly to ground. However, C107 is isolated from AC ground (B+) by the amount of series resistance determined by the setting of the width control. Therefore, when the width control is adjusted to introduce more resistance between B+ and the junction of C107 and R124, width is reduced by lowering screen voltage as well as by introducing more degeneration into the circuit.

Since the width control is normally adjusted to introduce only a small amount of resistance into the circuit, the major portion of the voltage drop across the parallel circuit will develop across R124—providing the logic for its being a 1-watt resistor.



*AT EXTREMES OF WIDTH-CONTROL SETTING

Operation Vertical

(Continued from page 35)

where it is most likely to be produced. Try monitoring waveforms in the suspected area (hooking the scope to a point, and leaving the probe in place for an extended period). Any change in the shape or amplitude of the waveform will help you pinpoint the trouble source.

Isolating Roll Troubles

A rolling picture is one of the most common vertical-circuit problems. The first step in localizing the cause is to determine whether the rolling is due to a defect in the sync section or to a fault within the multivibrator itself. Normally, this is readily determined by turning the hold control. If the picture can be stopped, even momentarily, look for sync trouble (except in certain cases of intermittent rolling). If you can't stop the picture, don't give the sync signal a clean bill of health until you've made waveform checks or tried disconnecting the incoming sync signal. It is possible for the sync to upset multivibrator action to the point where the normal lock-in range of the hold control can't compensate for the sync defect.

The fastest and best way to inspect the sync signal is to view it as it enters the vertical circuit. Of course, if the multivibrator were locked into sync, the pulses would be hidden by the much stronger feedback signal of the multivibrator; but this fact is of no practical importance when the picture is rolling. Your trouble symptom will automatically bring the sync pulses into view as small pips which travel through the waveform at a rate proportional to the speed of the rolling (Fig. 3A). To get the best possible view of the sync pulses, use the hold control to slow down the rolling as much as possible. Then, by increasing the gain of the scope, you can increase the apparent height of the pulses so that their amplitude can be measured. (See Fig. 3B.) Even if the multivibrator is far off frequency, don't despair; Fig. 3C demonstrates that you can still make out the sync pulses at normal scope gain, when the vertical circuit is operating at nearly three times the correct frequency. If the sync pulse is this strong, you can be assured that the trouble is in the multivibrator.

If you wish to view the sync pulse alone, disable the multivibrator in order to remove the feedback signal. The simplest method (pulling a vertical sweep tube) is often impractical, due to the prevalence of multisection tubes and series heater strings. An alternate method—grounding the plate of the vertical discharge tube—results in a sync-pulse waveform like W2 in Fig. 2. But did you know that this test gives you a somewhat distorted waveform, as a result of grid detection in the tube? The simpler test outlined above will give you a truer picture of the sync signal's amplitude; for example, the pulses in Fig. 3B have an amplitude of 13 volts peak to peak, as opposed to the distorted 5.5-volt signal in W2 of Fig. 2.

When a vertical-frequency trouble has been isolated to the multivibrator, the grid circuit of the discharge stage is an excellent place to begin troubleshooting. In the CVC, this circuit includes the components in the feedback line from the output stage. To most servicemen, this is the least-understood portion of the multivibrator—so here is one place where extra study is bound to pay off in easier and faster vertical-sweep servicing.

The feedback circuit in Fig. 2 is a little unusual in that the final filter capacitor of the integrator (shown as a 10000-mmf unit to the left of C37) must be considered for its effect on the feedback signal. There are also two series resistors, R54 and R50, which affect the signal's waveshape and amplitude.

The original retrace pulse at the plate of V8 has a peak-to-peak amplitude of 740 volts. (The "inductive kick" produced by the sudden interruption of current through the output transformer accounts for this high peak of voltage.) About one-third of this pulse voltage is dropped across R54, leaving only a 460-volt signal at the junction of R54 and C38. At this point, the signal also encounters a series-capacitor network to ground, consisting of C38, C37, and the output section of the integrator. Since C38 has more capacitive reactance than the other units, it drops the signal level down to only 85 volts at the grid. Very little of the signal is developed across the 10000-mmf integrator capacitor, but this component is important because it provides a low-reactance path to ground and makes proper pulse division possible.

It should be apparent from the above discussion that any marked change in the value of any component in the feedback network will affect the amplitude of the discharge-tube grid signal. In so doing, it will also affect the running frequency of the multivibrator. Defects such as leakage in a capacitor will have an even more pronounced effect. By the way, even though you won't find a whole series of feedback waveforms in most service data, you can generally evaluate the output-tube plate pulse indirectly by checking the amplitude of the yoke-drive signal (W4 in Fig. 2). If it's correct, you can be reasonably sure that the plate signal is normal, too.

Other Roll Factors

We've already talked about V7's grid-cathode bias relationship and its place in determining the running speed of the multivibrator. However, we didn't pursue the subject of cathode bias. If cathode resistors change value, or if the associated capacitors become leaky or off-value, the bias level may change enough to throw the multivibrator off frequency.

It is possible for a change in plate voltage to affect the running speed of the circuit, but it's far more likely to produce size problems that would outweigh any frequency problems.

No Sweep

Lack of sweep can stem from one of three causes: Either the multivibrator isn't working, the sawtooth-forming or coupling circuit is at fault, or the output stage is defective. Instead of being unduly concerned about interaction between the discharge and output stages, you're usually better off if you treat the multivibrator as two separate stages.

The easiest way I've found to locate the general trouble area is to twirl the controls. Rapidly turning the vertical linearity control will cause the line across the picture tube to jump if the output section is operating. Similarly, rapidly turning the height control will cause the line to bounce if the discharge, coupling, and output circuits are OK. Therefore, in a matter of seconds, the general trouble area can be spotted and precious time saved by avoiding unnecessary tests.

Once the general trouble spot has been found, simple voltage, resistance, and waveform tests within the affected circuit should lead you to the defective component without too much effort.

One problem you'll sometimes encounter in this circuit is a pulsating sweep. This appears when the multivibrator attempts to run, but is unable to do so because of improper bias. The most frequent cause of this is a leaky coupling capacitor in the feedback circuit.

Sometimes a CVC multivibrator will produce a fine picture when on channel, but will not operate on inactive channels. This invariably indicates an open feedback circuit. What happens is that the incoming positive sync pulses key the discharge stage into conduction to produce a normal scan.

Size and Linearity Problems

If you're faced with a lack of height or vertical distortion, your best bet is to concentrate on the circuits beginning at the plate of the discharge tube and continuing through the yoke circuit. There are remote possibilities of trouble arising from the interaction between halves of the multivibrator, but the problem will normally be in those circuits which actually generate and amplify the scanning signal.

Don't overlook the blanking circuit when you encounter a size problem. Leakage in the capacitors that feed a vertical retrace pulse to the picture tube can easily produce height problems.

When some lines in the raster are squeezed together or spread apart, or when over-all height is insufficient, the trouble often centers in the discharge circuit with its sawtooth-forming network. Since some part of this network is often connected to the cathode of the output stage (note R57 in Fig. 2), it is possible for an output-stage defect to produce exaggerated size and linearity problems. For example, an open C3 in Fig. 2 would cause compression at the bottom of the raster and a stretched picture at the top.

The grid waveform of the output tube (W3 in Fig. 2) is the best indicator available for spotting such troubles. For example, Fig. 4A shows how W3 changes shape if C3 opens. Notice that the peaking (negative pulse) is practically absent and the waveform has an arched appearance. Fig. 4B shows the effect produced in W3 by a different trouble in the same culprit; here, C3 was so leaky it measured only 1000 ohms, and the raster was suffering from foldover at the bottom. In both of the above cases, the peak-to-peak amplitude of the drive signal soared to over 200 volts.

A more common cause of foldover is a positive voltage on the grid of the output tube as a result of a leaky coupling capacitor C42 or grid emission in the tube. Fig. 4C shows the abnormally flattened positive peaks of the drive signal that characterize this trouble. Here, the peak-to-peak signal amplitude was reduced to 95 volts as a consequence of the grid drawing current.

Logically, if the input signal is correct and the yoke signal is not, the trouble is in the output stage—possibly including the transformer and yoke. If you'll follow the clues you see on a scope, those size and linearity problems — like many others—can be easily traced to their source. ▲

Synchros and Servos

(Continued from page 37)

shaft and that synchro torque is not sufficient to turn it. If this were not so, both units could move, and both would probably stop at about 15° when the command was set at 30°.

Synchros are extremely accurate, have fast response, and are relatively easy to install and adjust. Their main disadvantage is that only a light load can be connected to the motor shaft if satisfactory operation is to be obtained. Synchros can also be used for heavier loads, but as part of a complete system called a servomechanism (or "servo" for short).

Control Transformers

The synchro control transformer, developed for servo use, is similar to the synchro generator or motor except that its rotor is cylindrical and therefore does not exert any torque or turning characteristics. Its primary purpose is to produce an electrical output rather than a mechanical turning force. The usual arrangement includes a synchro generator and a control transformer connected as shown in Fig. 6.

The stators are connected in the same manner as in previous circuits, but the CT rotor does not have voltage applied to it. Control transformers are rated as to maximum applied stator-terminal voltage and maximum output voltage from the rotor—for example, 90/90. Rotor output depends upon the respective angular positions of the two rotors and is determined by:

$Er = Et \cos \theta$, where

Er = CT rotor output voltage,

Et = maximum stator terminal voltage, and

θ = the angular separation between the two rotors.

In the arrangement of Fig. 5, the two rotors are 90° out of phase, so the rotor output is

$$Er = 90 \cos 90° = 0 \text{ volts.}$$

Control transformers also use the R1 end of the rotor as the reference, but the rotation is measured with respect to the rotor position shown in Fig. 6. Thus, the CT rotor in this schematic is considered to be at zero degrees, as is the generator—even though their reference angles are physically separated by 90°. The reason for using a different zero point in the CT is simple: When the rotor is at right angles to the stator field, it produces minimum electrical output.

Another method of CT rotor-voltage calculation takes into account the differences in references and is stated as follows:

$$Er = Et \sin (CT - G),$$

where Er and Et are the same as given previously, and (CT —G) is the CT-rotor angle minus the generator-rotor angle. Remember that, for this use, the two units have different zero reference angles.

In Fig. 7, the synchro generator has been turned 30° counterclockwise, while the CT has been rotated 15° clockwise. In this case, the flux of the CT stator field is concentrated in the same direction as the generator rotor; this results in an angular displacement of 135° between the stator field and the R1 end of the CT rotor. The induced rotor voltage is then

$$Er = 90 \cos 135° = 90 (-.707) = -64\text{v.}$$

Calculation by the sine method produces the same result.

$$Er = 90 \sin (-15° - 30°) = 90 \sin (-45°) = -64 \text{ volts.}$$

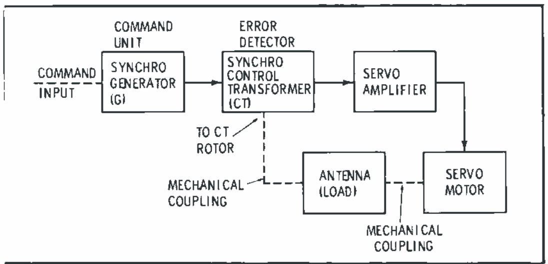


Fig. 8. Block diagram of servomechanism controlled by pair of synchros.

Whenever there is 90° of separation between the stator field and rotor of the control transformer, there is zero induced voltage in the CT rotor. When the angular difference is less than 90°, the induced voltage is positive, meaning that it is in phase with the potential at the R1 end of the generator rotor. When the angular difference is greater than 90°, the induced voltage is negative, or of opposite phase from the generator reference. In this way the control-transformer output voltage has a magnitude proportional to the angle of difference between the two rotor positions. The phase of the output voltage depends upon the direction in which the change occurs. This will become more evident when we see how synchros are used in a servomechanism.

Servomechanisms

The basic idea of a servomechanism using synchros is illustrated by the block diagram in Fig. 8, which represents a system used to control the rotation of a large antenna. The same principles are used in many other applications in industry, business, and defense. In this illustration, the desired antenna position is set by turning the rotor of the command unit, a synchro generator. The stator voltages are transferred to the CT stator coils, setting up a magnetic flux in the direction determined by the command.

The rotor-output voltage of the control transformer depends upon the relative angles of the generator and control-transformer rotors. The CT rotor does not turn in response to synchro torque, but can be rotated only by mechanical means. In the case of Fig. 8, the CT rotor is mechanically coupled to the load, most likely through an arrangement of shafts and gears. Whenever the load turns, the rotor follows. The control transformer is thus used as an error detector, producing an output proportional to the difference between two inputs. The command generator applies an electrical input to the CT, while the load applies a mechanical input.

With the load and command units both set at the same angle, the CT rotor plane is at right angles to the total stator flux. The induced rotor voltage is then zero; hence, there is no input to the servo amplifier. With no input there is no output, so the servo motor and the load remain stationary.

As an example of servo operation, let's assume that the synchro generator is turned 45° clockwise. The resulting changes in stator voltages move the total stator flux of the CT 45° closer to the R1 end of the rotor, and a voltage is then induced in the rotor. This *error voltage* output, equivalent to the difference between the command and load settings, is applied to the servo amplifier. The amplified version of this signal appears at the output of the amplifier and drives the servo motor, which in turn drives the load. As the load begins to turn in the direction dictated by the command signal, the CT rotor is turned in the same direction through mechanical coupling from the load.

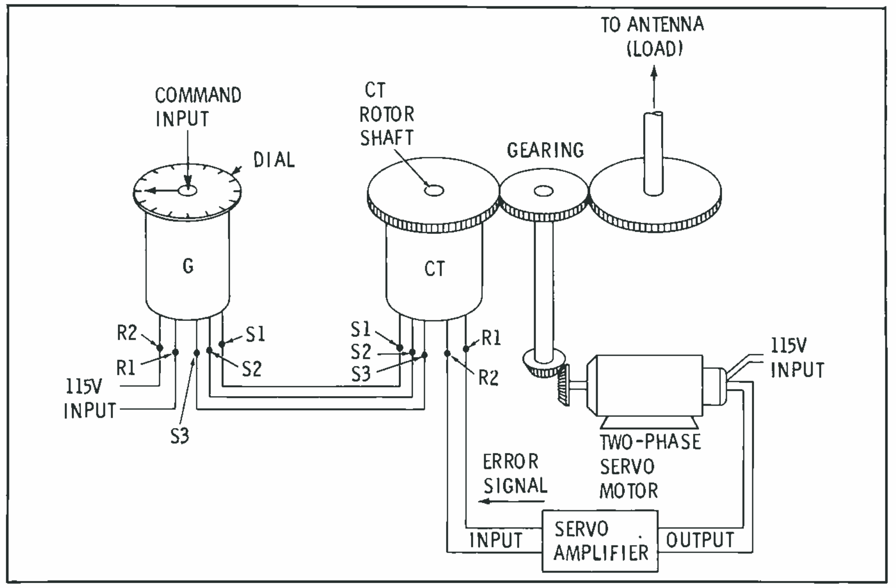


Fig. 9. Pictorial diagram showing application of servo system in Fig. 8.

This rotation of the CT rotor causes the amplitude of the error signal to decrease, which in turn decreases the speed of the motor. When the load reaches the command position, the CT rotor has been moved to a point at which the induced voltage is zero. This means that there is no longer any error signal, so the motion of the servo system stops.

For the servomechanism to be completely effective, the load must be able to move in either direction; so the entire system must be set up with that in mind. Many AC servomechanisms use a two-phase motor to drive the load. This type has two separate windings, fed from separate sources 90° out of phase with respect to each other. One phase, the reference phase, is shifted by 90° and applied to the motor at all times. The other phase is supplied in varying amplitude by the servo amplifier.

With no error signal, the motor does not turn because both phases are required for rotation. Whenever an error signal is produced, the motor rotates in a direction dictated by the phase of the signal originating in the control transformer. If the control phase leads the reference phase by 90°, the rotation will be in a certain direction. On the other hand, if the control phase *lags* the reference by 90°, rotation will be in the opposite direction. The control phase is determined by the direction in which the command unit is turned, thus determining the direction in which the load must turn to reduce the error signal to zero.

Fig. 9 is a pictorial representation of one servo system which could be represented by the block diagram of Fig. 8. In this system the motor drives both the load and the control-transformer rotor through a system of gears and shafts. The load for this system could be an antenna, as previously mentioned—or perhaps a valve, a switch, a gun-positioning system, another dial, or any number of similar devices involving rotary motion.

Other types of synchros are available—for example, the differential type, which is used in systems where the load must follow a combination of two different command settings. However, differentials are used on a much smaller scale than the two types described here. We have concentrated on the units most often found in practical control systems.

Servos have many different variations as to their equipment complement and the ways in which they are interconnected. The example shown is representative of an AC electrical system. DC servos are also used, as are combination AC-DC systems. Other types of position transducers are sometimes used for the command and error-detecting units, and the control elements may be hydraulic or pneumatic devices; however, synchros are used in such a large number of systems that they can be considered as an integral part of the field of servomechanisms and automatic control. ▲

Solid State Diodes

(Continued from page 26)

tionally-wired chassis.

In addition to a complete loss of video, some of the common trouble symptoms caused by faulty crystal detectors are pictured in Fig. 3. Fig. 3A shows a weak, washed-out picture which lacks contrast. A negative picture symptom is shown in Fig. 3B; the image is reversed and is out of synchronization. Fig. 3C shows a smeared picture where the darker portions of the image are followed by trailing blacks, while 3D shows overloading and the resultant loss of fine detail.

Since there are no voltages of any magnitude in this circuit, the semiconductors are not prone to breakdown. Nevertheless, these components do become defective from time to time, and a logical troubleshooting approach must be followed to determine if they are at fault. As with vacuum tubes, the most positive test is direct substitution. Commercial substitution instruments, provided with test leads that easily clip into the circuit, are now available. Detector diodes can also be tested by the signal injection method. In this procedure, a test signal is applied to the input side of the detector, and an oscilloscope is used to monitor the output signal across the detector load.

You can also make a pretty fair check of the diode by taking resistance measurements with the unit disconnected from the circuit. These ohmmeter measurements can get you into trouble, however, if you don't know what you're doing. For example, if you measure the diode's forward resistance on one range of the meter and then measure its reverse resistance on another range, the ratio of the two readings is likely to be erroneous. Many VOM's use a 1.5-volt battery on the lower resistance ranges and a 30-volt battery on the higher ranges. If you employ the R x 100K or R x 1 meg range, the forward resistance indications will be zero. On the other hand, when you use a low range such as R x 10 or R x 100, the reverse resistance reading will be infinity. The ohmmeter range best suited for measuring crystal diodes is in the neighborhood of R x 1K or R x 10K. A good crystal will have a forward-to-reverse ratio of approximately 1 to 100. For example, the forward resistance may measure 6K and the reverse resistance 600K. Whenever this ratio falls below 1 to 30, the diode should be suspected of being defective.

Sound Detectors

Another TV circuit that makes use of semiconductor diodes is the FM sound detector stage. Here, germanium diodes are often used in lieu of the conventional vacuum tube. The most common circuit is the discriminator shown in Fig. 4A, in which the diodes are connected in the same polarity as any set of vacuum-tube diodes. However, since the semiconductors have a small amount of reverse conduction, it's necessary to establish a definite reverse resistance for both units. The diodes may not be perfectly matched; therefore, compensating resistors are placed in parallel with each unit to help offset minor differences in the reverse resistances of the diodes.

In the circuit of Fig. 4B, a typical ratio detector stage utilizes two crystal diodes. Again, like the familiar vacuum-tube circuit, the input signal is applied to the anode of one diode and to the cathode of the other. In this particular circuit, compensating resistors are not used; in such cases, the two diodes must be closely matched. In variations of this circuit, however, you'll find resistors shunting each diode.

The diodes employed as FM detectors are of the same types employed in video detector stages. In addition to those units mentioned previously, you'll find 1N35's, 1N48's, and 1N51's used extensively. The crystals are usually of the pigtail type and are soldered either to the top of printed boards or underneath the chassis.

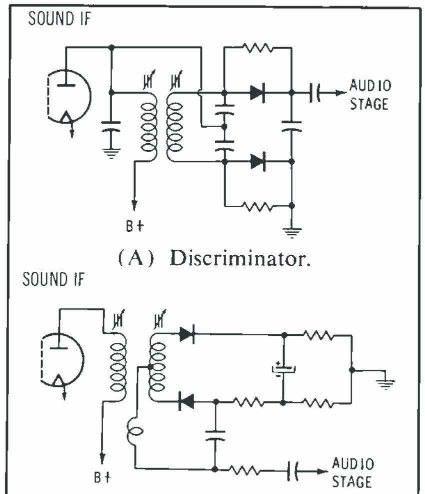
Since operating potentials in FM detector circuits are relatively low, little trouble is encountered with these diodes. If they do become defective, or badly mismatched, trouble symptoms will show up in the sound. Faulty crystals in this application have been known to result in complete loss of sound, weak or distorted output, interfering buzz, or fluctuations in volume.

Horizontal AFC Circuits

Both germanium and selenium semiconductors are found in horizontal phase-detector circuits. The most common circuit configurations are shown in Fig. 5. The accompanying circuit components are similar to those used with vacuum-tube detectors; however, the finite reverse resistance of the diode must be compensated for by appropriate circuit modifications. As with the sound detectors, this compensation takes the form of shunt resistors across each diode as seen in A and B of Fig. 5. Looking at all three circuits of Fig. 5, you'll find the diodes connected in three different ways — plate-to-plate, cathode-to-cathode, and plate-to-cathode combinations.

Some older TV receivers employ a matched pair of crystals (1N60's), while a few even employ miniature stacked seleniums. The recent trend is to use selenium or germanium dual diode units. These have only three leads as pictured at left in Fig. 6. The center lead is the common connection and, depending on individual component design, may conform to any one of the three hookups shown in Fig. 5. Miniature selenium diodes have also been used in this application.

Troubles originating from diode failures in AFC stages may range from a slight horizontal wiggle to a complete loss of raster (see Fig. 7). Fig. 7A illustrates improper horizontal sync phasing where the picture tends to shift back and forth across the screen; Fig. 7B shows a horizontal phasing ghost that looks like a white cloud drifting in on one side of the picture, often accompanied by a slight shift in picture centering; Fig. 7C depicts the well known "Christmas - tree" effect, which is due to an erratic triggering of the oscillator.



(A) Discriminator.

(B) Ratio detector.

Fig. 4. FM sound detector circuits.

The diodes employed in AFC circuits are more prone to breakdown because of the pulse voltages involved, and the rather high ambient temperatures associated with horizontal sweep circuits. The best way to troubleshoot this stage is to use a scope to check the sync and sawtooth signals for both proper shape and peak-to-peak amplitude. Any discrepancies should be followed up with voltage and resistance measurements. When the trouble symptom is horizontal frequency shift, it's possible that one of the diodes is being affected by temperature change. In this case, the culprit may be discovered with application of heat from a soldering iron or gun, or upon using a cooling chemical to reduce its temperature.

When taking resistance measurements with the dual diode out of the circuit, you'll generally have to use a higher ohmmeter range than commonly required for video or FM detector crystals. The forward-to-reverse resistance ratio will most likely be in the neighborhood of 1 to 200. The most important factor is whether or not the resistance measurements of the two diodes (or diode sections) are fairly equal.

Power Supplies

A good percentage of the late-model receivers, particularly the portable and less expensive models, employ solid-state rectifiers. A few of the different types are shown in Fig. 8. The largest unit consists of two germanium diodes mounted sep-

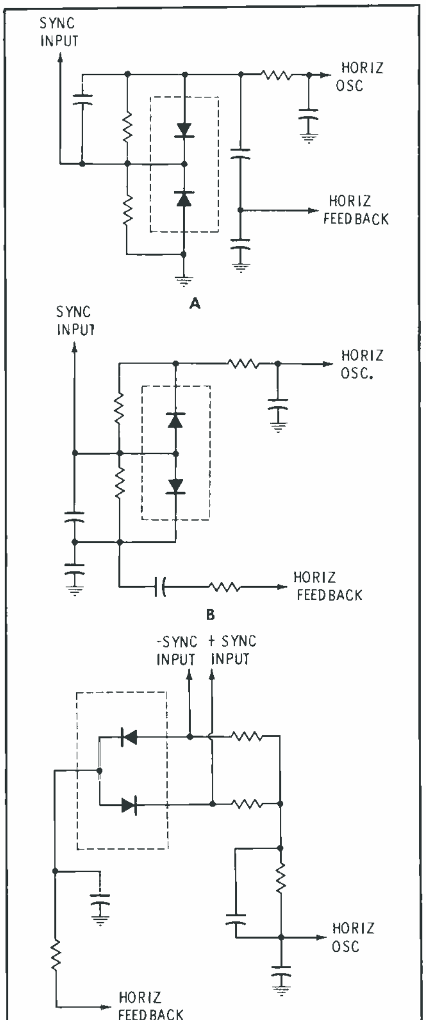


Fig. 5. Typical horizontal AFC circuits with semiconductor diode detectors.

arately on heat-sink plates. The contact terminals resemble those of the conventional selenium rectifier type, and are often used in a plug-in arrangement. The silicon unit at the bottom of Fig. 8 is a snap-in type that fits into a standard fuse holder; these same units are also available in the pigtail style. The pigtail type shown at the right in Fig. 8 is usually soldered to a terminal board in the power supply section.

The most common circuits for these semiconductors are illustrated in Fig. 9 Fig. 9A represents a half-wave supply utilizing a single rectifier with a simple pi-type filter output. The B+ potential developed by a circuit of this type is in the neighborhood of 120 to 140 volts DC. Fig. 9B shows a half-wave voltage-doubler configuration. The voltage it develops is on the order of 240 to 260 volts DC. A full-wave doubler supply is illustrated in Fig. 9C. This circuit also develops B+ in the 250-volt range, but the ripple frequency is 120 cps as opposed to 60 cps for the output in 9B. Silicon and germanium units employed in these typical circuits have a forward voltage rating of at

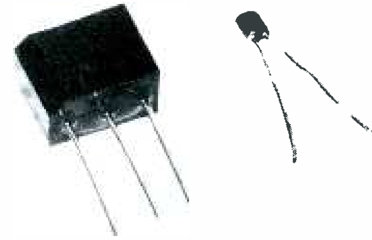


Fig. 6. Two types of AFC diodes.

least 130 volts rms and will safely handle currents of 400 to 500 ma.

Most of the new semiconductors in this application have a relatively low forward resistance; consequently, the voltage drop across each unit is very low. Because of this low resistance, coupled with the fact that electrolytics in the circuit offer an extremely low impedance when power is first applied, initial surge current is quite high. This is the reason most power rectifier circuits incorporate some form of surge limiter. A small series input resistor is often used as shown in Figs. 9A and 9B. The value and wattage of these resistors are somewhat critical, and the original ratings should be observed whenever replacements are made.

An open or shorted rectifier will

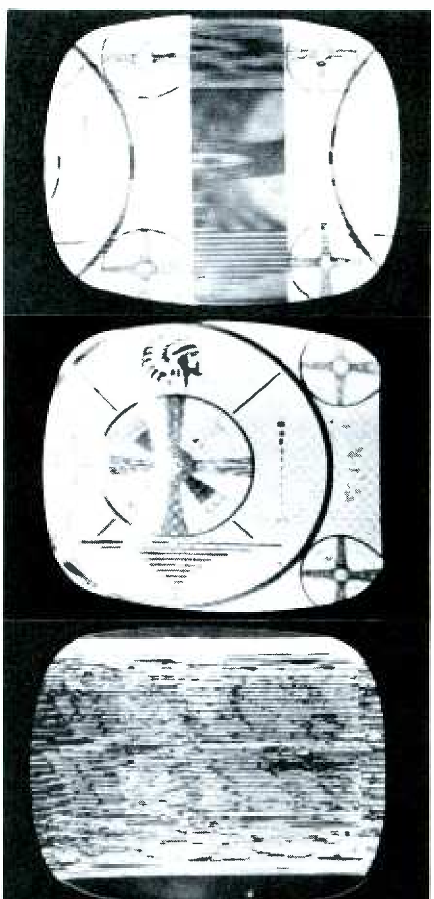


Fig. 7. Symptoms indicating trouble in dual-diode horizontal AFC stage.

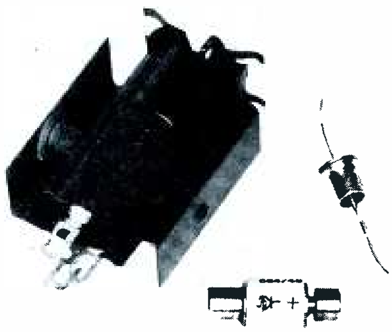


Fig. 8. Three types of solid state rectifiers employed in TV power supplies.

naturally render the receiver inoperative. If rectifier operation is only partially impaired, however, B+ will drop considerably. The simplest way to troubleshoot this circuit is to check voltage and resistance measurements under load and no load conditions.

When attempting to measure the forward and reverse resistances of power rectifiers, the type of diode as well as the meter resistance range selected must be considered. For silicon types, a range of R x 10K will give a reverse reading up in the "infinity" area of the scale. Employing a higher meter scale, say R x 1 meg, will usually result in a forward-to-reverse resistance ratio of about 1 to 50. When the reverse resistance is less than about 30 times the forward value, the unit can be suspected of causing trouble. Stacked selenium rectifiers, on the other hand, should be measured on the 1K or 10K range. A good rectifier on the 1K range will have a forward-to-reverse ratio of about 1 to 20. On the 10K-range, however, the same rectifier may have a ratio of only 1 to 5. Thus, resistance measurements of power rectifiers are not always conclusive.

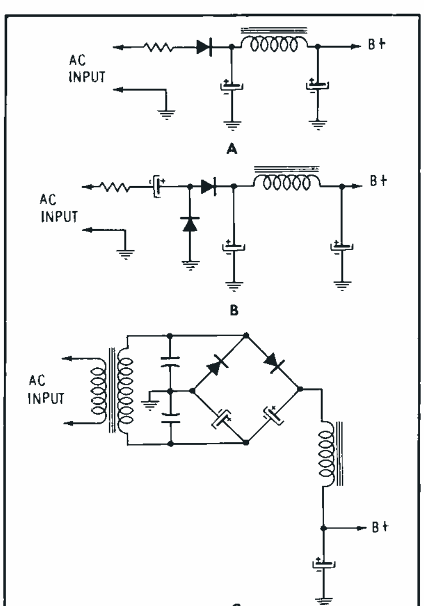


Fig. 9. Typical TV power supply circuits using semiconductor rectifiers.

When choosing a power rectifier replacement, consider the current requirements, observe connection polarities, and make sure all associated components (surge-limiting resistors and filter capacitors) are within proper tolerance. If the units are conventional selenium rectifiers, avoid scratching the plates or permitting any foreign material to lodge between them.

Other Applications

High frequency crystal diodes are currently employed in television tuners as UHF mixers and automatic fine tuning detectors. Techniques for testing these diodes are much like those discussed for the video and sound detector crystals. In some of the older receivers, you'll also find a few germanium and selenium diodes used as DC restorers, sync separators, noise clippers, clampers, and bias rectifiers. These, too, have functions as simple as those discussed, and they can be analyzed and serviced in the same manner. ▲

Transistor Testers

(*Continued from page 24*)

will be calibrated with beta values increasing to the left.

Breadboard Measurements

Some test circuits not only permit transistors to be conventionally tested for gain and leakage, but also provide for checking transistor performance in actual amplifier configurations. As illustrated in Fig. 3, one test circuit can serve in any one of the three amplifier hookups used — the common emitter, common base, and common collector arrangements — by merely changing connections to the transistor. While a PNP arrangement is shown, reversal of the battery connections is all that's necessary for conversion to NPN. Essentially this is a breadboard setup, with separate meters and batteries for the input and output circuits. Selector switches are used to alter battery voltages and resistance values in the base, emitter, and collector circuits. Thus, it not only provides the means for determining gain and leakage values, but also for checking the operation of a transistor in an actual amplifying circuit. This might be a duplicate of the circuit in which the transistor is actually used, or a prototype which can be altered to determine transistor operation in a variety of situations.

Separate 100-ua meters are used in the input and the output circuits. Therefore, to measure either I_{CBO} or I_{CEO}, the various switches are set for the desired conditions. For example, in an I_{CEO} test, the base circuit is opened and the reverse emitter-collector current is measured. To check I_{CBO}, the emitter element is left open and the current flowing through the reverse-biased base-collector circuit is measured.

To measure beta, the transistor is connected in the common-emitter configuration, and the resistance in the base circuit is adjusted until 50 ua is indicated on the associated meter. Dividing the collector-circuit reading by this value (Ic/Ib) gives the DC beta gain figure for the transistor.

Other Tests and Measurements

The flexible circuit arrangement in Fig. 3 also permits evaluation of the AC or dynamic beta value, which is the ratio of a small change in base current to the corresponding

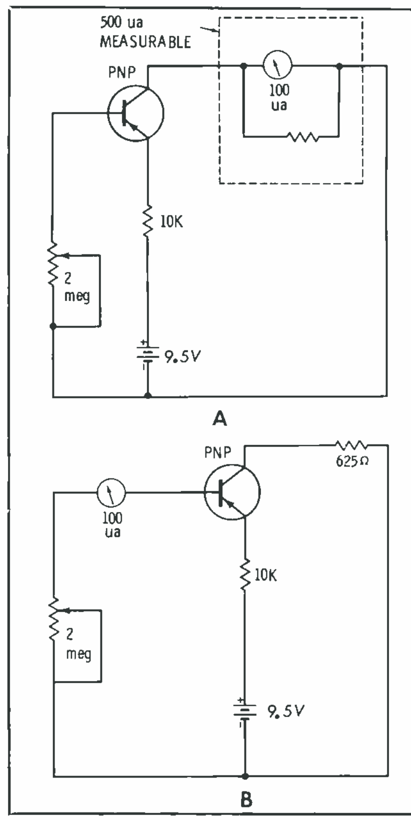


Fig. 2. DC beta is determined by measuring collector and base currents.

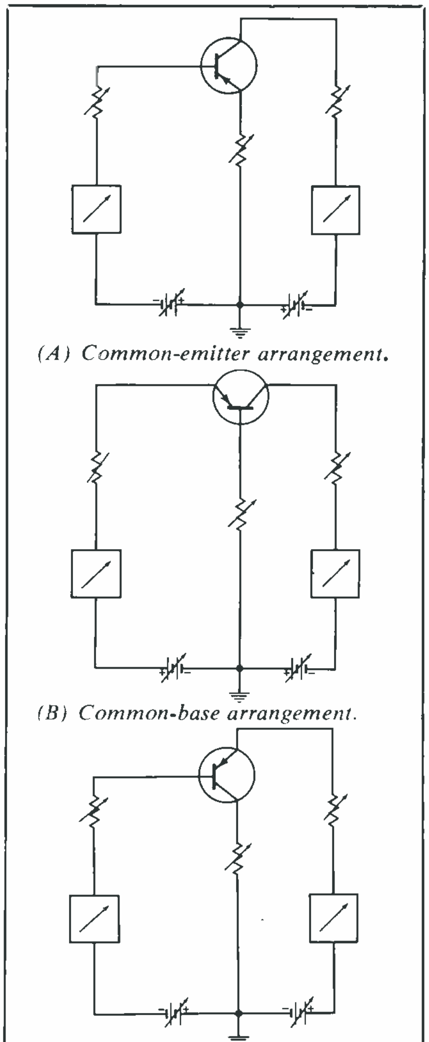
change in collector current.

AC beta may be very simply measured while the circuit is set up for the DC beta check by introducing a small change in base current —for example, from 50 to 60 ua— and noting the corresponding change in collector current. If the 10-ua change in base current produces a 400-ua change in collector current, AC beta equals 400 divided by 10, or 40.

The same circuit can be used to determine resistance of a transistor. Using the common-emitter configuration, the battery voltage between base and emitter is measured while the input current it provides to the base is noted from the meter in this circuit. The battery voltage control is then adjusted to cause a small increase in the voltmeter reading, which will also result in a corresponding change in input current. The input resistance is then determined by dividing the small change of input current into the small change of input voltage.

As an example, if the input current changed 50 ua with an input voltage change of .05 volts, the input resistance would be 1000 ohms. The same test can be performed for the common-base and common-collector arrangements, in each case noting the differences in input resistance. The highest input resistance will be obtained with the common-collector arrangement, and the lowest value with the common-base circuit.

If desired, the output resistance of a transistor can also be measured in essentially the same way as the input resistance. The input circuit is set up for a normal operating current in the input and output circuits, as specified by the transistor manufacturer's literature. The collector current flowing in the output circuit is then noted and recorded. Next, the battery voltage between collector and base is decreased, and the corresponding change in collector current is observed. Output resistance is found by dividing the change in collector voltage by the change in collector current.



(A) Common-emitter arrangement.

(B) Common-base arrangement.

(C) Common-collector arrangement.

Fig. 3. Basic test circuit for determining various transistor parameters.

Let's assume that collector current is .5 ma with a collector voltage of 12 volts, and .4 ma with a collector voltage of 6 volts. This represents a change of .1 ma in collector current with a 6-volt change in collector voltage; therefore, the output resistance of the transistor is 60,000 ohms. The same check can be made for common-base and common-collector configurations. It will be found that the lowest output impedance is obtained with a common-collector circuit, whereas the highest output impedance is obtained with a common-base circuit.

Power Gain

Another measurement which can be performed with the circuit in Fig. 3 has to do with power gain. To correctly measure the power gain of a transistor, the following conditions must be met: (1) The source resistance must equal the input resistance of the transistor, and (2) the load resistance must equal the output resistance of the transistor. Thus, the input and output resistance of the transistor under test must be determined first. This can be done as previously described. The circuit is then set up so that the proper resistance appears between emitter and base, and between base and collector. No resistance is inserted in the base circuit. The battery voltages in both the input and output circuits are then adjusted for typical operating conditions.

Power gain of a transistor is equal to its output power divided by its input power. Input power is equal to I^2R, where I is the input current and R is the input resistance. Output power is found in the same manner.

Special Test Circuits

For troubleshooting purposes, "go—no go" tests are often most expedient in isolating troubles. There are many occasions, for example, where it is only necessary to determine whether or not a transistor *could be* the cause of the trouble. The test circuit need not be capable of measuring actual transistor parameters, when all you need is some basis for quickly detecting inoperative (or nearly so) transistors.

Most of the leakage and gain tests described in November fall into this category. However, after isolating a trouble to a specific stage, a sus-

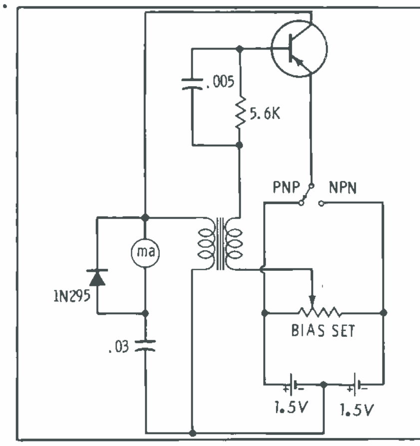


Fig. 4. Configuration for making "in-circuit" test operates as an oscillator.

pected transistor must be removed from the circuit before it can be tested. The test circuit in Fig. 4 permits "in-circuit" checks to be made. In principle, the transistor under test is connected as an oscillator. By utilizing a fairly high-Q transformer, in-circuit shunt impedances as low as 150 ohms will not impair oscillator action.

In making an actual in-circuit test, power is removed from the equipment being serviced, the transistor-polarity switch is placed in the proper position, and connecting leads are used to complete the test circuit. If the transistor is usable, an oscillating condition will be set up between the base-emitter, base-collector circuits. Oscillating current in the collector section of the transformer is rectified and applied to the meter. Rotation of the bias control may be necessary before the meter will provide a satisfactory reading.

A low reading, or none at all, does not necssarily mean the transistor is defective. It only indicates that it *could* be. Other factors, such as a shunt impedance below 150 ohms, or a defective component in the transistor circuit, may also cause the oscillator test circuit to be inoperative.

With the inroads transistors are making in all types of home-entertainment equipment, service technicians would do well to become acquainted with appropriate troubleshooting and testing techniques. Since this will, in most cases, require that some type of test instrument be obtained, the special chart at the beginning of this article has been prepared for your guidance in selecting the equipment most suited to your needs. ▲

Reverberation

(Continued from page 39)

represent a large number of diffused sound waves reaching the listener from indefinite sources.

Two Inputs—Two Outputs

The first system is typified by the General Electric *Resonant Stereo* circuit in Fig. 3. Both outputs of the stereo cartridge are routed through the reverberation subchassis on their way to the main amplifier, and the delay-line unit shunts a portion of the signal path. The signals at the plates of preamp tube V1 are mixed and fed to 6BQ5 power amplifier V2, whose output is strong enough to drive the field coil of the Hammond unit. The signal generated at the opposite field coil, only about as strong as that from a tape head or magnetic cartridge, is brought up to a usable level by a two-stage amplifier employing a 7025 tube, V3. The output, adjusted in amplitude by the RESONANCE control, is applied to the right and left output jacks; here, it is mixed with undelayed signals coupled through RC networks from the plates of V1. A switch on the RESONANCE control provides a means of disabling the reverberation feature by shunting the delayed signal to ground.

A different type of matrixing circuit for splitting and recombining the signals is found in some other sets, including the Curtis Mathes Chassis 20 (Fig. 4). Both sections of a 12AX7 are used for each channel. The signal to be delayed is taken from the plate of the input section, amplified, reverberated, and delivered to the grid of the output section. Meanwhile, the undelayed signal is coupled from one cathode to the other. The combined signals are taken from the plates of the output sections and fed to the main amplifier.

Philco's SPR-1 reverberation unit uses a matrix circuit quite similar to Fig. 4. The outputs of the stereo cartridge are passed through wafer switches on the main chassis and directed to the grids of the reverberation preamp. The output of the Hammond unit is controlled by a switch that provides four different levels of reverberation, plus an off position.

RCA also favors the common-cathode matrixing circuit; however, the right- and left-channel signals go through one or two stages of preamplification (depending on model) *before* being tapped off for application to the reverberation unit. A 6CW4 *Nuvistor* triode furnishes low-level amplification for the delayed signal emerging from the mechanical reverberator; its plate signal, adjusted in amplitude by a control potentiometer, is fed to a dual mixer circuit similar to the one in Fig. 4.

Motorola's System

The inputs to the *Vibrasonic* amplifier are taken from across the voice coils of the right- and left-channel speakers, so they are strong enough to be applied directly to the mechanical reverberator with no need for preamplification. (See Fig. 5.) To prevent overloading of the transducer on signal peaks, a pilot lamp is series-connected in each input lead to act as a limiter. At high output levels, the lamps burn more brightly, and their resistance increases; this serves to prevent excessive voltage from being developed across the transducer field coil.

As we have already noted, the reverberated signal is fed to a self-contained amplifier, rather than being recombined with the main stereo signals. This additional section includes a push-pull output stage which drives a 6″ speaker. In the Motorola system, the original and reverberated signals are acoustically mixed. This yields practically the same effect as electronic mixing but with an added advantage: If of the signals within the amplifiers, any partial cancellation takes place between the undelayed and delayed signal elements, the resulting faults in the sound can often be remedied by changing the location of the console or the position of the listener.

One Channel In— Other Channel Out

Probably the simplest reverberation circuit in current use is the Westinghouse design presented in Fig. 6. The section preceding the Hammond unit (not shown) is very similar to the corresponding part of Fig. 5 except that the input is taken only from the left-channel output transformer. Here again, a pilot lamp is used to limit signal peaks. After being reverberated, the signal is amplified by a one-stage transistorized circuit and then fed to the reverberation control.

Another transistorized amplifier, the Silvertone Model 9612, is sold as a kit to be field-installed in several 1961-model stereo phonographs which also have a transistorized main amplifier. These models contain a four-terminal jack which provides connections for either the reverberation unit or a remote-control device, but not both.

Although the left- and right-channel circuits of the amplifier are identical, the right or "main" channel includes a larger bass-frequency speaker than the left or "stereo" channel. A signal is fed from the output transformer of the stereo channel to the reverberator unit, and the delayed output proceeds through a "full - music - voice - off" selector switch to a two-stage transistorized amplifier. The resulting output signal joins the main (right) channel at a point between the preamp and power amplifier sections, where the tone controls are located.

Zenith's unusual *Extended Stereo* system, in which the left- and right-channel signals are converted to sum and difference signals, lends itself well to the cross-channel type of reverberation system. Before seeing how the reverberation unit fits into the circuit, it would be well to review the principles of *Extended Stereo* operation, referring to Fig. 7.

In the more elaborate consoles, the left and right signals from the stereo cartridge are fed to twin preamps whose outputs are mixed to create signals equivalent to the *similarities* and *differences* between the channels—i.e., R + L and R — L. The signals are amplified in this form (meanwhile being inverted to L + R and L — R), and are then applied to matrix-type output transformers. The driving circuit for each set of speakers includes the sum-channel transformer secondary in series with half of the center-tapped difference-channel secondary (Fig. 7B). Momentary signal polarities for one-half cycle of operation are marked on this diagram to illustrate how the signals combine. Note that the left-channel information is in phase, but the right-channel information is out of phase, as applied to the left-channel speakers. If the sum and difference signals had equal amplitudes, the right-channel signal components would cancel each other and would not appear in the left-hand speakers. However, the difference signal is stronger than the sum signal by some controlled amount, and some out-of-phase or "minus R" signal is fed to the left side of the system. Similarly, negative L-channel information is fed to the right speakers. The result is a heightening of the stereo effect. (For fuller details, refer to *Servicing New Designs* in the January, 1960 issue.)

The *sum* output of the matrixing preamp is fed to an additional amplifier on the reverberation subchassis, which drives the input coil of the Hammond unit. The reverberated signal goes through a 12AX7 cascade amplifier that includes a control. Finally comes a mixer-amplifier, which receives the delayed signal at its grid and the *difference*-signal output of the matrixing preamp at its cathode. The blend of these two signals appears at the plate and is fed to the difference channel of the main amplifier.

Equal amounts of delayed signal information appear across the two halves of the difference-output transformer. Since there is no corresponding signal in the sum channel

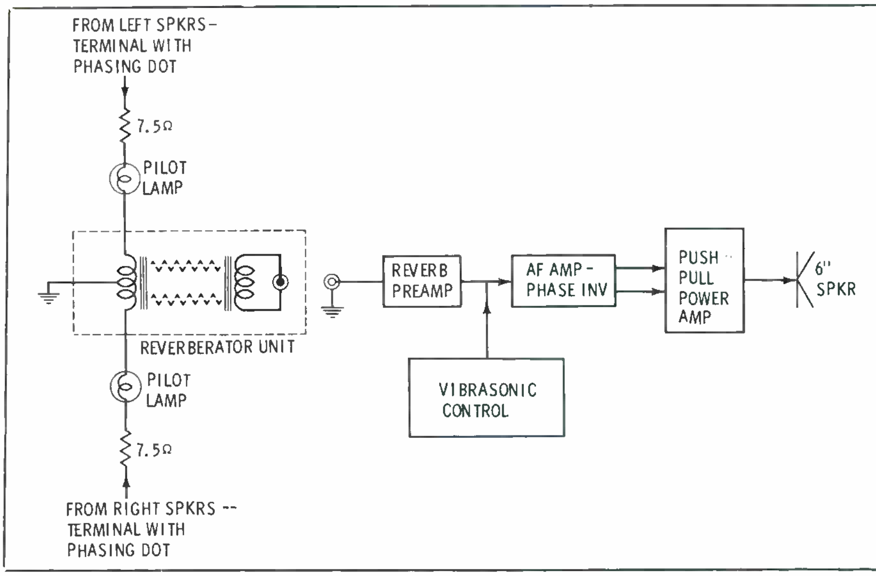


Fig. 5. Motorola *Vibrasonic* system feeds output to a separate speaker.

to cause reinforcement or cancellation of signal elements, the reverberations are fed equally to both sets of speakers.

A simplified version of the Zenith *Extended Stereo* system, used in many of the lower-priced consoles, includes a vertical-horizontal type of phono cartridge which directly furnishes sum (lateral) and difference (vertical) information—thereby dispensing with the matrix-preamp stage. A reverberation kit, available for use with these models, takes its input directly from the sum-channel side of the cartridge. Circuitry is very similar to that used in built-in reverberation units, except that extra gain is provided ahead of the reverberator unit to make up for the omission of the matrixing preamp.

Questions & Answers on Service

How can you tell when the reverberator is working? This is simple to detect, even for an untrained ear. Most systems have enough reserve gain so that turning the control to its maximum position will result in an unnatural "echo chamber" effect or metallic ring. In operation, the control should normally be kept turned down to almost its minimum setting for the most natural results. (This point may be hard to get across to the type of customer who wants to turn a color TV set's tint control up to "comic-book" level.)

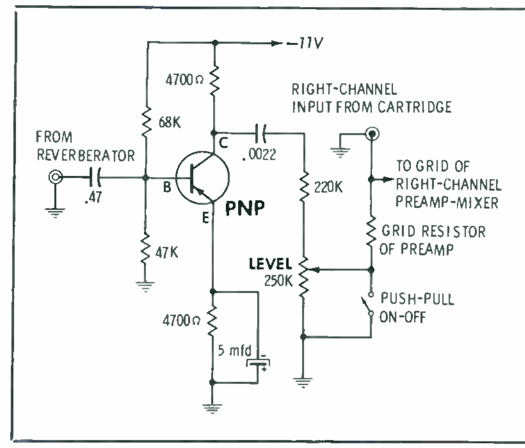


Fig. 6. Westinghouse uses transistor circuit to amplify reverberations.

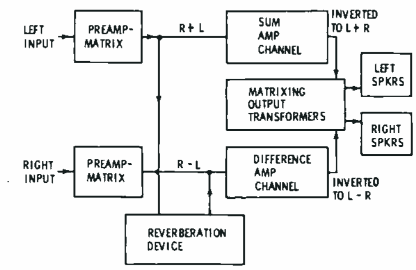
If you can't clearly recognize the reverberatory effect by listening to music, try touching a probe tip to a preamp lead. Instead of a single sharp click, you should hear something more on the order of a bouncing ping-pong ball. If you kick or jar the reverberator unit while in operation, it'll "sound off" like a tipped-over grand piano — so be especially gentle with the set when the customer is around!

What is the most likely cause of failure? Some reports have already been received of broken input or output leads at the phono jacks inside the Hammond unit. This damage is more likely to have occurred during shipment or initial setup than during day-to-day operation. Many of these units are shipped with special retaining clips or plastic-foam pads to hold the reverberator unit securely in place, and damage can frequently be traced to these devices working loose. Conversely, a failure of the unit to operate may simply mean that someone has forgotten to remove the clips or pads during installation.

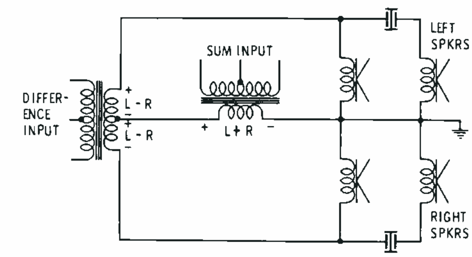
If a defect in a mechanical reverberator unit cannot be remedied by obvious measures, manufacturers generally recommend that the device be either replaced or sent to an authorized service station for specialized work.

Wouldn't microphonism and hum cause weird effects? Yes—and that's why the stage following the Hammond unit uses low-noise, low-hum circuits incorporating transistors, *Nuvistors,* or tubes such as the 12AX7 and 7025. In addition, DC heater supplies are used in several reverberation units.

As an added safeguard against hum and interference, be sure to maintain correct lead dress away from hum-producing circuits, as well as proper suspension of the reverberator springs.



(A) Block diagram of amplifiers.



(B) Matrix-type output circuit.

Fig. 7. Zenith *Extended Stereo*.

Can the reverberation amplifier be operated when removed from the phonograph, and vice versa? Quite often the answer is yes. Many reverberation subchassis have their own power supplies, making it possible to operate them independently on the shop bench. To operate the rest of the phonograph without the reverberation feature, all you usually need to do is install jumpers across certain connections in the interchassis plugs as instructed in service data. The reverberation amplifier is not essential, since it usually contributes little or no gain to the undelayed signals. Thus, the temporary removal of this section will not deprive the hi-fi owner of the use of his set. ▲

Wild Goose Chase

(Continued from page 28)

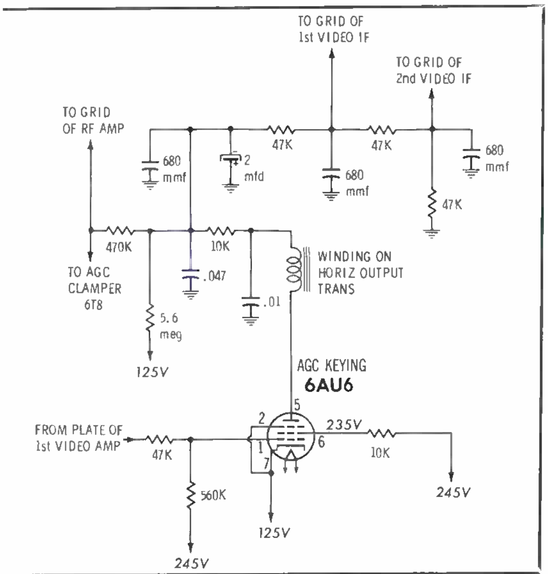


Fig. 1. Keyed AGC circuit used in Philco's Chassis 91 television sets.

tern of the pulse proved to be considerably higher than that obtained off the AC line, so I accepted it as being okay.

Next, I directed my friend to take a look at the pulse on the grid of the AGC tube. Even with the vertical-gain control wide open, there was no indication; but rather than taking this evidence at face value, I advised him, "Remove that low-capacitance probe and use a 10,000-ohm series resistor instead. There's too much loss in a low-capacitance probe, especially with a low-gain scope."

He made this change; then, with the control well open, there were traces of horizontal pulses.

"How much should we get on the grid?" he asked.

"The diagram calls for 22 volts, and I'd say we're getting it," I mused, but I wasn't satisfied. The pulse on the grid should come from the plate circuit of the first video amplifier. With no sound or picture, how could we be getting a pulse on the AGC grid?

I went into a Perry Mason while he answered the phone. When he returned, I said, "Let me take another look at that pulse on the grid." On closer examination I could see it was exactly like the pulse on the plate, only much weaker.

I glanced at the scope and noticed the sweep frequency was about 3000 cps. "Change the sweep to 60 cycles," I directed. He did, and the pulses disappeared.

"Now, what goes?" he asked. I didn't have an answer. "Well, what were we looking at?" he asked.

"My guess is that it's part of the flyback pulse on the plate, being passed by the interelement capacitance of the tube. Notice it doesn't show up at a low sweep frequency."

"Put your probe on the plate of the 6U8—pin 6." He did, and there was no signal there.

"Pull the AGC tube and see." He complied, but there was still no signal.

"Try the grid, pin 2." With that, a beautiful video waveform spread across the scope screen. However, the amplitude seemed excessive, more like what you would expect on the plate.

"The tube is not passing the signal. Have you changed it?" He had.

On measuring the voltages, we found the plate low—about half of the required 95 volts—and the grid 8 volts negative.

"It boils down to this. With the AGC tube in the socket, the video IF's are blocked by too much AGC. With it out, the first video amplifier is blocking because of excessive signal being applied, and also because of the abnormally low plate voltage. With either condition, there is no signal on the plate of the video amplifier, and accordingly no signal delivered to the grid of the AGC tube.

I had to leave the problem with him, but promised to return the next day. When I did, he avowed with vehemence that he had checked every resistor and capacitor in the set.

"All but one," I prophesied, hoping he hadn't manufactured an additional trouble by connecting a lead to a wrong terminal. "Now look, when I came in yesterday I told you a good voltage-resistance check should turn up a clue. It did, but we ignored it. Now let's go back to that low-voltage condition at the video amplifier plate. Let's find the source of supply."

"The power supply provides a 125-volt source." he ventured.

"Yes, but not for the voltage we're checking. From what I see, these low voltages are being supplied from the cathode of the 6BA6, the first sound IF," I explained.

"Sound IF!" he shouted.

"Yep! Some sets use the audio output stage for the same purpose. See, it has a highly positive grid and cathode — a pretty good way of identifying a stage being used as a voltage divider."

"I've never seen anyone use a sound IF."

"Well, this one does. Check the voltage on the grid." I watched the meter register about 65 volts. The diagram called for 125. "Now check the cathode," I advised. It, too, was low by the same amount.

"Now we're getting somewhere," I said hopefully. "Let's find out why these voltages are low, and we'll have the answer."

The voltage on the grid came

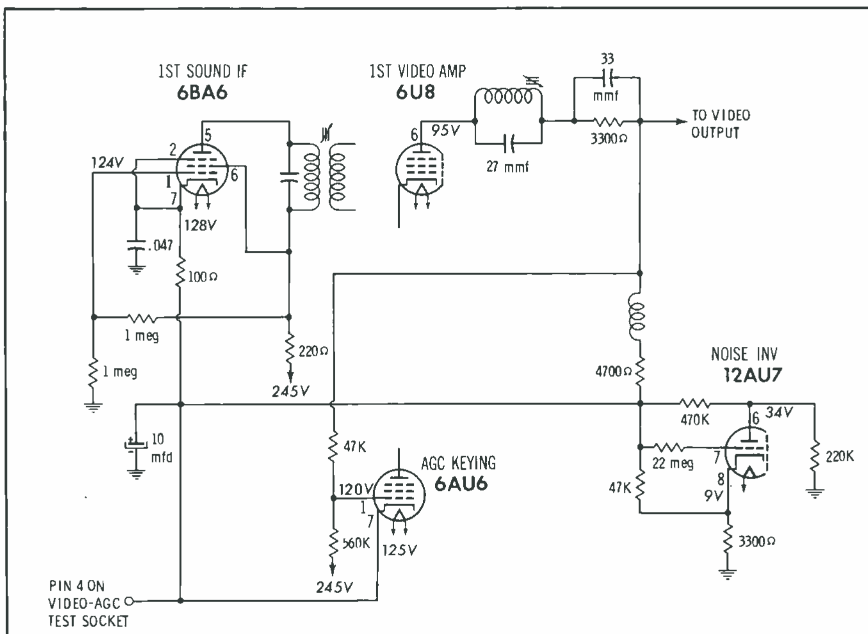


Fig. 2. Circuit diagram showing how sound IF stage develops 125V supply.

from the screen through a 1-megohm resistor (Fig. 2). There was another 1 meg from grid to ground. The two formed a voltage divider, and inasmuch as the grid pulled little or no current, the voltage at the resistor junction should have been about half the 250 volts on the screen.

"Do you find a 1-meg resistor connected from pin 6 to pin 1?" I asked. He said he did, and I instructed him to check it. In the circuit it looked good, but I was not to be taken in by that.

"Clip it," I told him. I saw him shift the probes to the other 1-meg unit. "It would hardly be that one," I advised. "These high ohmage resistors almost always increase in value. That one would have to decrease to lower the grid voltage."

"What about the cathode? It's low, too."

"I know, but that particular resistor wouldn't have anything to do with the cathode. Get the grid voltage back to normal and the cathode will take care of itself."

He clipped the resistor and connected it across an ohmmeter. It read about 3.5 megohms.

"That's the culprit I was talking about when I said you had checked all but one," I ribbed him. He soldered in a replacement, and when he fired up the set, both sound and picture came on perfectly.

"I still don't understand why the cathode was low," he remarked.

"Well, it's simple when you get the whole picture. Where do you think that voltage on the cathode is coming from? It is not connected to any part of the B+ supply." He shrugged his shoulders.

"If you trace the lead running from the cathode, which is a job within itself, you'll find it returns to ground through some resistors in the cathode of the 12AU7 noise inverter. These resistors are quite high for cathode circuits. If they weren't, the sound IF tube, with 125 volts on the grid, would burn up. The resistors provide a cathode bias, and develop 125 volts in the process.

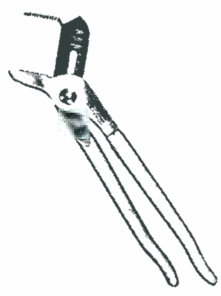
"Sounds interesting," he mumbled, "but I'd never have thought about looking in a sound IF stage for AGC trouble."

"Which is a pretty good reason why you didn't find it," I surmised. ▲

PRODUCT report

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

Large-Capacity Pliers (43X)



The new "Channellock" No. 440 "Gripmaster" tongue-and-groove pliers, manufactured by **Champion DeArment,** have a maximum capacity of 2¼" with jaws parallel. The unusually thin jaws (only 5/16" thick) make it possible to use this tool on work inaccessible to other large-capacity pliers. Handles dip-coated with plastic, and smooth-surfaced jaws for working on plated fittings, are two optional features.

Tuner Parts Kit (44X)

A new kit, **Standard Kollsman** Model 31T 3890, contains an assortment of 90% of the replacement parts most commonly used in field servicing of Standard Coil tuners built from 1947 to 1957. Special springs, detent spring and roller assemblies, detent ball assemblies, and a special IF alignment tool for late-model tuners are also included. Dealer net price is $27.99.

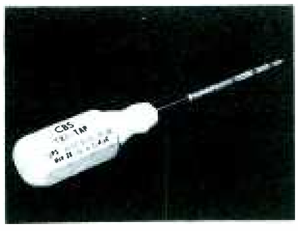
Oval Auto Speaker (45X)

Auto-radio speakers 4" x 10" in size, used in many Buick, Cadillac, Pontiac, and other late-model automobiles, can be replaced with the **Quam-Nichols** Model 410A2. The weight of this speaker's Alnico V magnet is 1.4 oz., and power-handling capacity is 6 watts.

Miniature Electrolytics (46X)

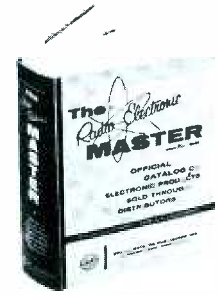
Plastic-cased miniature tubular electrolytic capacitors for use in transistorized circuits, **Illinois** Type BMT, maintain low leakage throughout their operating temperature range of —30° to +65° C. Obtainable capacitance values range from 1 to 2000 mfd at voltage ratings from 3 to 50 volts; diameters vary from 3/16" to 5/8".

Thread-Tapping Tool (47X)



Screw threads can be tapped in newly-drilled holes in metal or plastic with the **CBS** Tri-Tap; another use for this tool is in renewing damaged threads. The shaft is made of heat-treated, high-carbon steel with hard-chrome plating, and is tapered to provide three different tap sizes—6-32, 8-32, and 10-32.

Electronic Product Catalog (48X)



United Catalog Publishers has announced the 25th edition of "The Radio-Electronic Master," a 1600-page catalog giving specifications and prices for more than 175,000 products from over 300 manufacturers in the electronics field. There are many new listings of items such as subminiature components, semiconductors, CB and SSB gear, test equipment, and telemetering components. Price is $3.95.

Four-In-One Tool (49X)

The ¼" hex socket at one end of the **Vaco** "Piggy-Back" tool serves two purposes. Besides acting as a nut driver, it slips over the handle of a midget screwdriver (furnished as an accessory) so that the large main handle can be used with the latter. At the opposite end of the large handle is a reversible shaft with a 3/16" flat blade at one end and a No. 1 Phillips bit at the other. Price is $1.60.

Replacement Electrolytic (50X)

Cornell-Dubilier offers the ESS-7515—a compact, cardboard-sleeved electrolytic capacitor with two sections—as an exact electrical and mechanical replacement for a number of 150-WVDC capacitors commonly used in printed-circuit radios and TV sets. The first section is said to replace any value from 40 to 80 mfd, and the second section any value from 30 to 60 mfd. List price is $2.00.

Antenna System Kit (51X)

Designed for "do-it-yourself" installation by the set owner, the **Blonder - Tongue** "Home TV/FM System Kit" contains all materials needed for assembling a "hideaway" indoor antenna and connecting it to as many as four receivers. The buyer needs only a screwdriver and diagonal cutters to wire the antenna together, following the instructions printed on the 72" x 18" cardboard frame in the kit. A Model A-104 four-set coupler is furnished, plus sufficient twin-lead for hooking the antenna to receivers in several different rooms. Suggested list price is $9.95.

Variable Transformer (52X)

A portable variable transformer for service-bench use, the **Ohmite** Model VT8G, has two output ranges; a switch provides for either limiting the output voltage to 120 volts or applying "overvoltage" (as high as 140 volts) to the load. The dial is calibrated in two scales, marked in different colors. The handle swings back to support the unit in a tilted position, with slippage prevented by a detent. Output rating is 7.5 amp; a circuit breaker gives overload protection. Net price is $28.50.

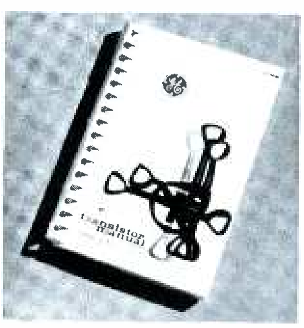
Push-Pull Switches (53X)

Clarostat is now supplying push-pull switches that can be combined with Series 47 controls to provide replacements for the push-pull on-off-volume controls now popular in radio, TV, and communications equipment. Besides the control and rear-mounted switch, the completed C47S push-pull assembly includes an appropriate shaft chosen from the regular "Pick-A-Shaft" assortment.

Kit of Fuses (54X)

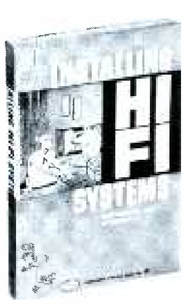
Sightmaster Corp. has introduced a kit of 60 fuses packed in a reusable, compartmented box. Contents include one box of each of the following 11 types often needed by TV men: Type 3AG in 7 ratings from ¼ to 5 amp; 8AG, ¼ amp; Type N, ¼ and 1 amp; and Type C, 3/10 amp. A box of 5 assorted automotive fuses is also provided, as well as a cross-reference chart of different fuse designations.

Revised Transistor Manual (55X)



The fifth edition of the **General Electric** "Transistor Manual" has just been published. Expanded from 224 to 339 pages, it contains four new chapters on tunnel-diode theory and switching circuits, tunnel-diode amplifiers, feedback and servo amplifiers, and test circuits. Other chapters have been expanded and revised. The "Transistor Specifications" chapter contains an up-to-date listing of JEDEC-registered types.

Book on Custom Hi-Fi (56X)



"Installing Hi-Fi Systems" by Jeff Markell and Jay Stanton, recently published by **Gernsback Library,** tells how to design and assemble component-type hi-fi systems for maximum customer satisfaction. Written in a breezy style, the book follows a strictly practical approach. Subjects covered include learning the customer's tastes and preferences, avoiding legal tangles, wiring the interconnections between components, solving acoustic problems, understanding cabinet styling, and constructing cabinets.

Premium Offer (57X)

With each 8-oz. aerosol can of **Chemtronics** "Tun O Lube" tuner cleaner or "Trol Aid" control and contact cleaner (each $1.98), the serviceman is given a flexible "Spray Aid" tube for pinpoint application of the spray, in addition to a choice between two premiums —a screwdriver with pocket clip, or a roll of printed-circuit solder in a dispenser tube. Also, the "Spray Aid" is now furnished with each 98c, 3-oz. can of either chemical

INDEX TO ADVERTISERS

January, 1961

Latest Jackson Tube Test Data

Tube Type	MODEL 648 Fil.	D.	E.	Plate Test	MODEL 598 A.	B.	C.	Fil. Cont.	D.	E.	F.	G.
6EQ7	6.3	1234	B589	39 V	6.3	4		5	7	2	6	41
	"	123	7	95 X	"	4	Z		8			56
6FG7	6.3	A123	AC689	23 XZ	6.3	4		5	6	9Z	7	85
	"	"	AC45	43 V	"	4Z			2	1		34
6HJ8	6.3	A1256	AB348*	18 WY	6.3	4Y		5	6	2	3	43
	"	129	7	35 Y	"	4			8	Z		50
8ET7	8.4	A128	679	43 Z	8.4	4Y		5	9	7	8	22
	"	124	5	94 X	"	4			2			59
	"	"	3	"	"	4			3			59
12DY8	12.6	A129	AC67	70 X	12.6	4Y	Z	5	8	9		49
	"	A125	AB348	53 X	"	4Y	Z		6	1	3	33

SUPPLEMENTS LATEST ROLL CHART 648 23C

SUPPLEMENTS LATEST ROLL CHART 598 2

MODEL 658

Tube Type	Sec.	Heater	Circuit H-K	Circuit P-G	Plate	Grid Test	Heater Current
6EQ7	P	6.4J	1234	b589	34S	15XY•	
	D	"	123	7	95S	X	
6FG7	P	5.4J	123	ac689	44R	15WY•	
	T	"	"	ac45	22R	15WY•	A13.6E Z450
6HJ8	P	6.4K	1246	ab358	37R	10WY•	
	D	"	129	7	50R	X	A13.6H Z450
8ET7	P	8.5H	128	679	28R	25VY•	
	D	"	124	5	89R	X	
	D	"	"	3	"	X	A18.6J Z600
12DY8	T	13.6G	129	ac67	83U	5XY•	
	T	"	125	ab348	22U	15WY•	

SUPPLEMENTS LATEST ROLL CHART 658-3

CATALOG AND LITERATURE SERVICE

ANTENNAS AND ACCESSORIES

1X. *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 940 dealer catalog illustrating and describing the 1960 line of natural silver and gold anodized *Hi-Fi* TV antennas, mounts, masts, and accessories. *See ads pages 40, 57.*

2X. *ROHN*—New folder describing complete line of antenna towers and allied accessories; also descriptive literature on heavy-duty communications towers. *See ad page 92.*

3X. *WINEGARD*—Catalog sheet describing Model A-100, 1- to 3-set distribution amplifier with 26-db gain, plus deluxe accessories including line tapoffs, splitters, and transformers. *See ad pages 18, 19.*

AUDIO AND HI-FI

4X. *ASTATIC* — 33-4 cartridge catalog; CRC cartridge cross-reference guide; M-10 microphone catalog; N-61 needle catalog.

5X. *EICO*—New 28-page 1960 catalog of kits and wired equipment for stereo and monophonic hi-fi, test instruments, "ham" gear, Citizens band transceivers, and transistor radios. Also "Stereo Hi-Fi Guide" and "Short Course for Novice License." *See ad page 68.*

6X. *MARANTZ* — Literature (including specifications) on line of component-type stereo and monophonic high-fidelity amplifier—featuring new Model 9 deluxe unit with 70-watt rms output.

7X. *PRECISION ELECTRONICS*—Grommes hi-fi catalog; *Premiere* hi-fi sound catalog; Precision Electronics public-address catalog; Grommes amplifier-kit and instrument-kit catalog. *See ad page 100.*

8X. *SONOTONE*—Literature on the new "Velocitone" ceramic-cartridge assembly for replacement use in any phonograph. *See ad page 75.*

9X. *SWITCHCRAFT* — New-product bulletin No. 105, describing new *Twin Plug* (Part No. 413) designed to meet the high standards of reliability of the telephone and broadcast industries. *See ad page 89.*

10X. *UTAH*—Information about RVB-1 self-contained reverberation unit, incorporating amplifier and speaker, for easy addition to any speaker system. *See ad page 63.*

BUSINESS AIDS

11X. *SYLVANIA* — New 112-page *Dealer Aids* catalog tells how to make pennies into dollars; describes everything from home-study technician courses and sales-promotion aids to store signs and tube cases. *See ads pages 12-13.*

COMPONENTS

12X. *BUSSMANN*—24-page booklet giving detailed information on complete line of *BUSS* and *FUSETRON Small Dimension* fuses and fuse holders — the ones most used in protecting electronic equipment. *See ad page 69.*

13X. *CHICAGO STANDARD*—Form P-60-P, pocket-size, part-to-part TV-transformer replacement guide.

14X. *SAMPSON — Transistor Battery Data and Reference Guide*, with size, price, and cross-reference data on batteries used in all transistor radios; also information on "point-of-Purchase Profit Pak," a counter display for *Samco* dry batteries. *See ads pages 94, 95.*

15X. *SPRAGUE* — Catalog C-613a, 48-page listing of popular TV and radio replacement parts for 1961. *See ad page 10.*

16X. *WORKMAN* — Specification sheet on non-inductive dummy loads for ham and industrial use, available in four popular resistance values with wattage ranges from 10 to 500 watts.

RADIOS

17X. *ATR* — Descriptive literature on table-model home radios, with or without clock. *See ad page 14.*

SERVICE AIDS

18X. *ABBOTT-LANE* — Brochure on *Visionkleen* pellets which can be dissolved in water to make an antistatic cleaning solution for glass, plastic, etc.; available for service use as well as for resale to customers.

19X. *ACME LITE* — Literature describing four models of new "MAGNIFLEX" fluorescent lamp for use in precision work requiring both illumination and magnification.

20X. *CHEMTRONICS* — Pamphlet describing *No-Arc High-Voltage Insulator*, a nonflammable, clear fluid for repairing damaged insulation on yokes and horizontal-output transformers, or for use as corona dope.

21X. *I. H. MFG.* — Informative booklet on new 110° version of *Tele-Check* substitution unit for picture tube and yoke. *See ad page 86.*

22X. *PRECISION TUNER* — Information on repair and alignment service available for any type of TV tuner. *See ad page 96.*

23X. *YEATS*—Information about dolly for delivering TV and hi-fi sets or appliances, and about padded TV, radio, and appliance covers. *See ad page 80.*

SPECIAL EQUIPMENT

24X. *COMMUNICATIONS CO.* — Literature on *680 Basecom*, a base station for 25-50 and 144-174 mc FM two-way communications; also data on *680 Fleet-com* mobile unit. *See ad page 93.*

25X. *VIDAIRE* — Flyer on Model LR-10 *Line Voltage Regulator* for increasing or decreasing AC line voltage fed to TV sets and other equipment rated at up to 350 watts; also data on Model UC-234 *Universal TV* and *FM Coupler* for connecting several sets to one antenna. *See ad page 100.*

TECHNICAL PUBLICATIONS

26X. *CBS* — *Tech Tips* bulletin PA-503, "The Care and Control of Thyratrons," by Bud Tomer. *See ad page 21.*

27X. *GERNSBACK*—Descriptions of Gernsback Library books.

28X. *RCA INSTITUTES* — 64-page illustrated booklet describing comprehensive training program for home study, ranging from electronics fundamentals to transistors and automation.

29X. *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics servicing. *See ads page 76,77,82,96.*

30X. *SYLVANIA* (Home Electronics) — Information on availability of service literature on television, radio, and high fidelity, and monthly *Service Digest.*

TEST EQUIPMENT

31X. *B & K* — Bulletin AP16-R gives information on new Model 1076 *Television Analyst*, Models 1070 and A107 *Dyna-Sweep Circuit Analyzers*, Models 550, 650, 675, and new 685 *Dyna-Quik* mutual conductance tube testers, new Model 610 Test Panel, New Model 160 Transistor Tester, and Model 440 CRT rejuvenator-tester. *See ad page 15.*

32X. *DOSS* — Instruction books for D150 Flyback-Yoke Bridge, D200T Video Master, D400R Capacitor Analyzer, D600R Electrolytic Sub, D700 Sync Master, D800 Noy-Z-Ject, and *Pioneer 250* Horizontal Sweep Quantalyst. *See ad page 88.*

33X. *ELECTRO PRODUCTS* — Information on Model EFB and NFB DC power supplies for use in design and servicing of all types of electronic equipment. *See ad page 86.*

34X. *MERCURY* — Bulletin 500, giving complete specifications on new Model 500 *Component Substitutor* and full information on other test equipment in line. *See ads pages 80, 82, 98.*

35X. *RCA* (Electron Tube Div.) — Folder 1Q1015 on new sine/square wave audio generator; also Folder 1Q1016 on new *Senior VoltOhmyst* WV-98B and *Senior VoltOhmyst* kit WV-98B (K). *See ad 3rd cover.*

36X. *SECO* — New 16-page booklet illustrating tube testers, dynamic transistor checker, two-way radio test set, and several time-saving service aids.

37X. *SENCORE* — New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter*, plus brochure on complete line of *time-saver* instruments. *See ads pages 25, 27, 29.*

TOOLS

38X. *ARROW* — Catalog 6/60 on full line of automatic tackers, as well as representative selection of desk- and plier-type staplers (including several new models). *See ad page 84.*

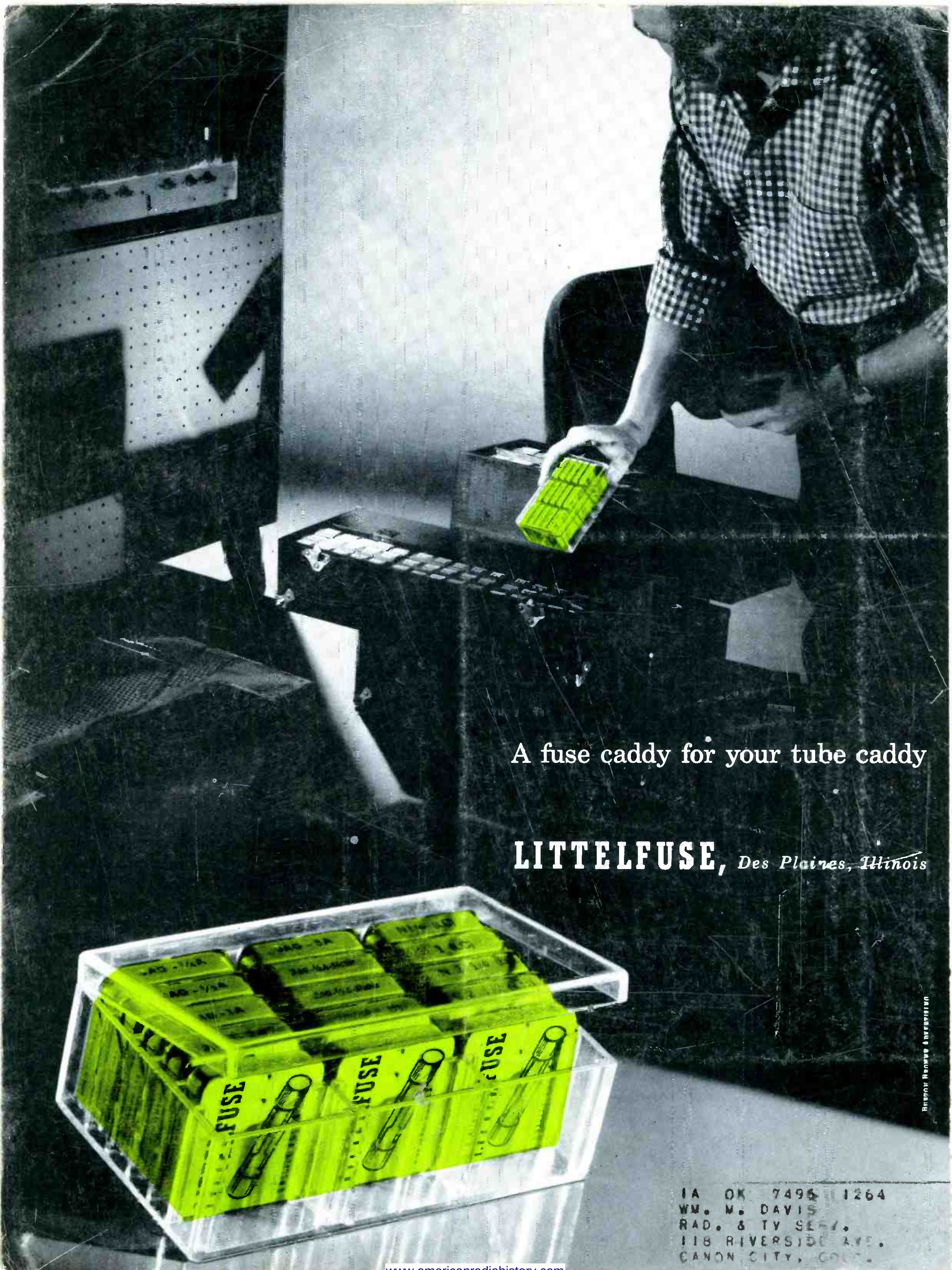
39X. *BERNS* — Data on 3-in-1 picture-tube repair tool, on *Audio Pin-Plug Crimper* that lets you make pin-plug and ground connections for shielded cable without soldering, and on *ION* adjustable beam bender. *See ad page 98.*

40X. *HANDICRAFT TOOLS* — Catalog, "Precision Hand Tools for Industry," describing and illustating the *X-acto* line of knives, blades, and tools for industrial use. Product applications are listed. *See ad page 97.*

41X. *VACO* — New 8-page catalog on specialty tools, entitled "Choose Your Cards," illustrating 34 different carded displays of tools.

TUBES

42X. *SAMPSON* — Hitachi receiving-tube manual, giving extensive specifications, basing diagrams, and outlines for complete tube line; also catalog sheet with color photos and descriptions of *Hitachi* broadcast-band and two-band transistor radios. *See ads pages 94, 95.*


A fuse caddy for your tube caddy
LITTELFUSE, Des Plaines, Illinois
FUSE
FUSE
FUSE