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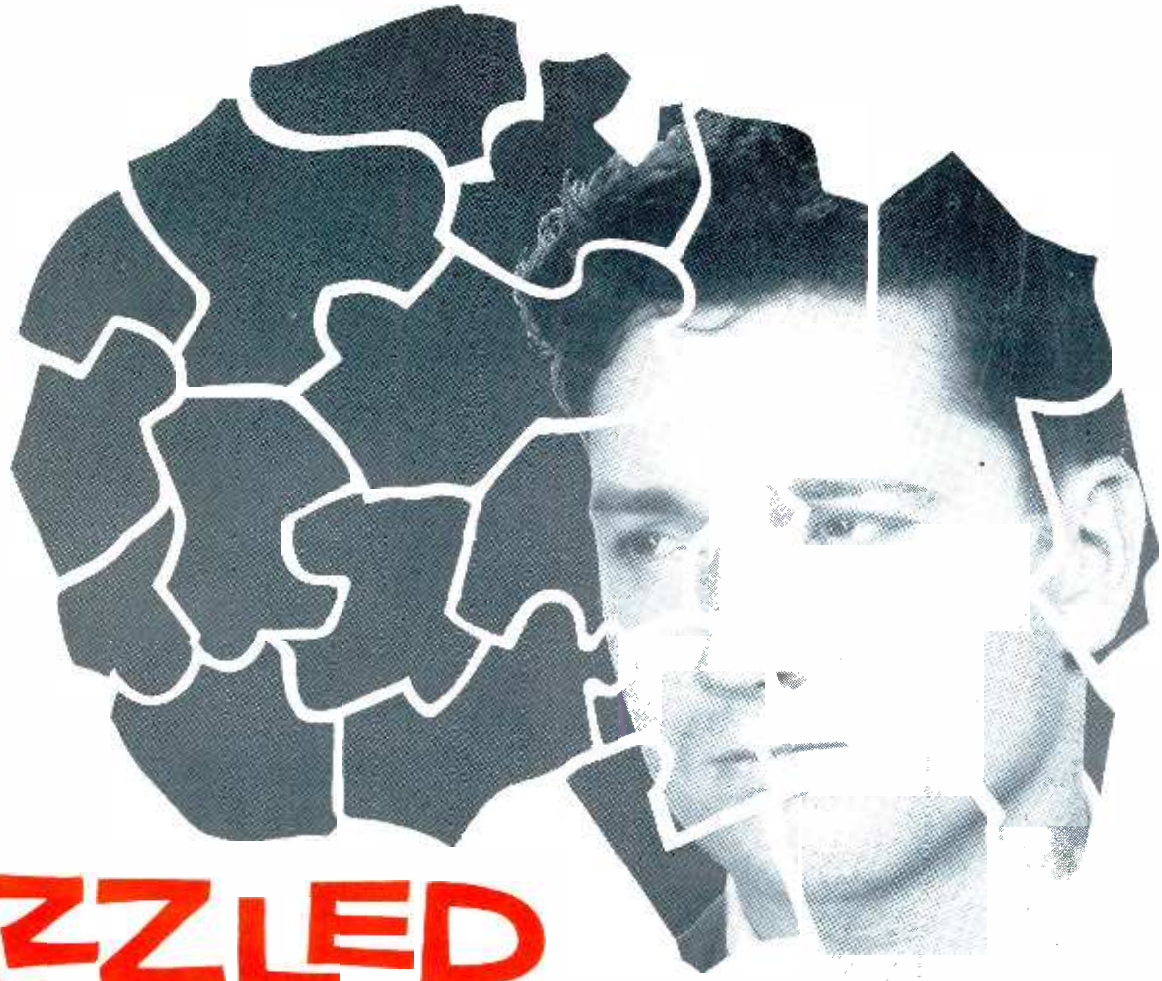

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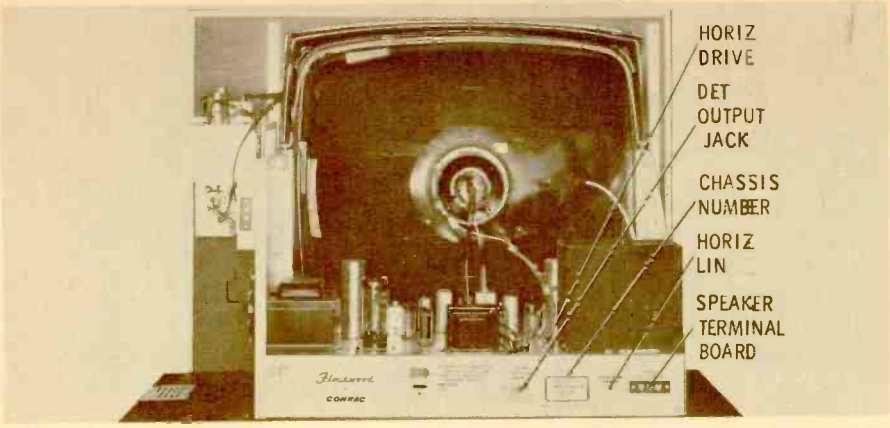
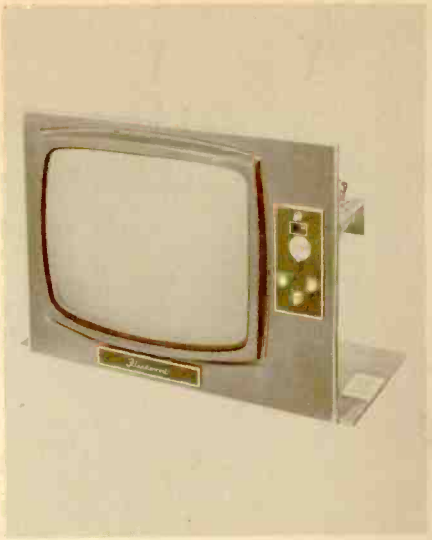
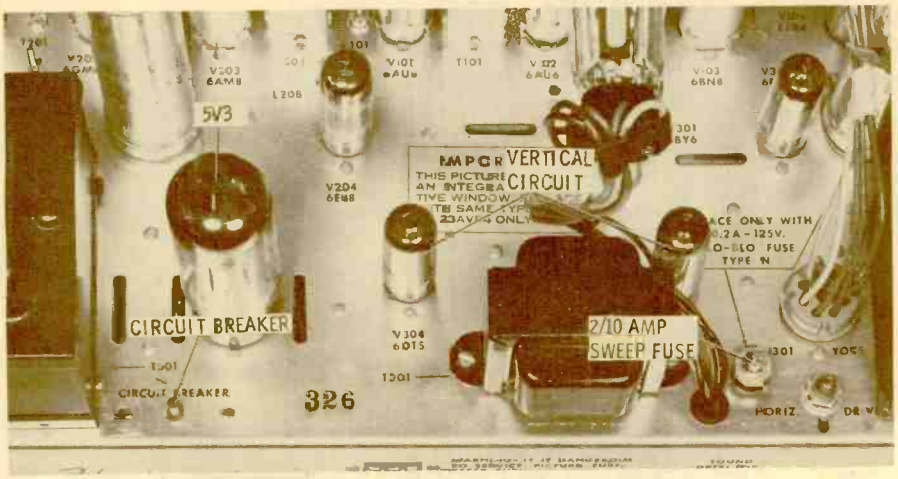
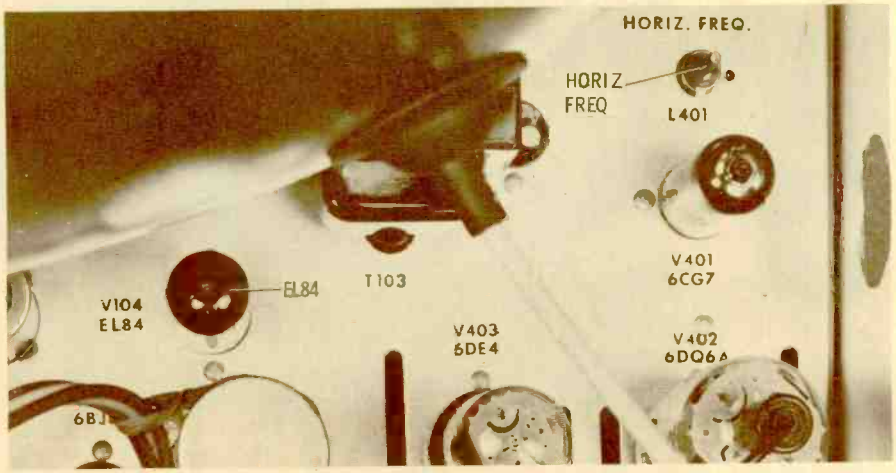
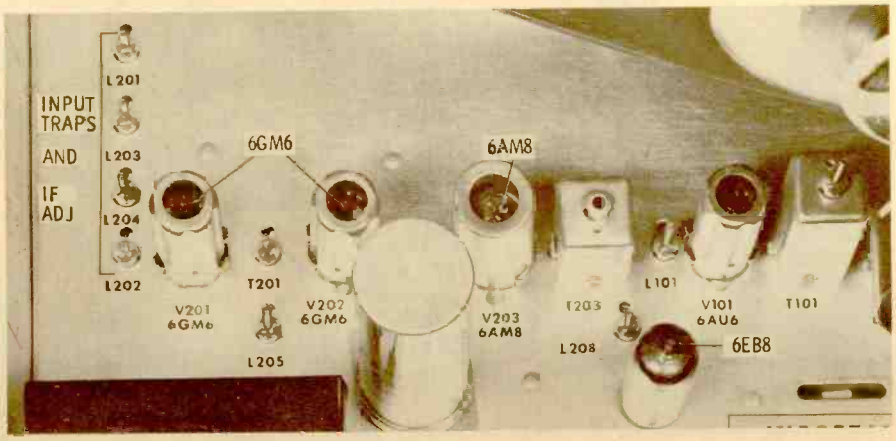
Fleetwood











Fleetwood Chassis 1010

Designed by Conrac for custom installations, this 23", 110° chassis uses either a 23AVP4 or 23CP4 picture tube with bonded safety shield. The front panel is mounted to the chassis, forming a one-piece unit. Well-marked on-off-volume, contrast, and brightness controls are mounted to the right of the CRT along with the channel selector and "do-it-yourself" fine tuning adjustment. Below the tube, the nameplate is a hinged door covering practically all the other adjustments. The nine controls mounted in this panel are well marked for easy identification. The only control that might make you wonder what function it serves is the three-position *definition* switch, which varies the response of the first video IF stage.

The extremely neat, 20-tube, hand-wired chassis has a very straightforward layout. The only adjustment located on the rear apron is for horizontal linearity. However, clearly-labeled horizontal drive and frequency adjustments protrude from the top of the chassis. The rear apron serves as the mounting for two unusual features of this chassis — a speaker terminal board for connecting either 3-4 ohm or 16-ohm speakers, and a detector-output jack to permit feeding the audio to a separate amplifier.

Vertical sweep and power-supply circuits occupy the back part of the chassis. B+ is supplied by a husky 5V3 which is protected by a circuit breaker. Sweep circuits are protected by a 2/10-amp, type-N fuse.

Immediately in front of the cage are the horizontal sweep and audio output circuits. (The latter uses an EL84 tube.) The horizontal-frequency adjustment is also located in this area.

The row of input traps and IF adjustments mark the beginning of the three-stage video IF strip. The final stage uses a 6AM8, which also serves as the video detector. A 6EB8 video output tube completes the video chain, which is located in the left front corner of the chassis. Two rather rare 6GM6's, which have high-transconductance and remote-cutoff characteristics, fill the first and second IF spots. If you get caught without one when you're out on a call, you can use a 6EW6 to "get by" until you obtain the correct type.

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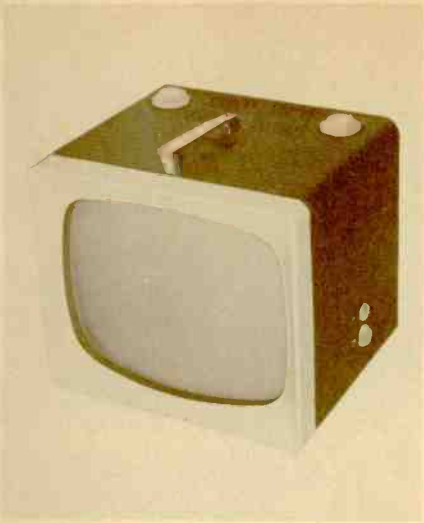


Olympic Model 17TU95 Chassis KU

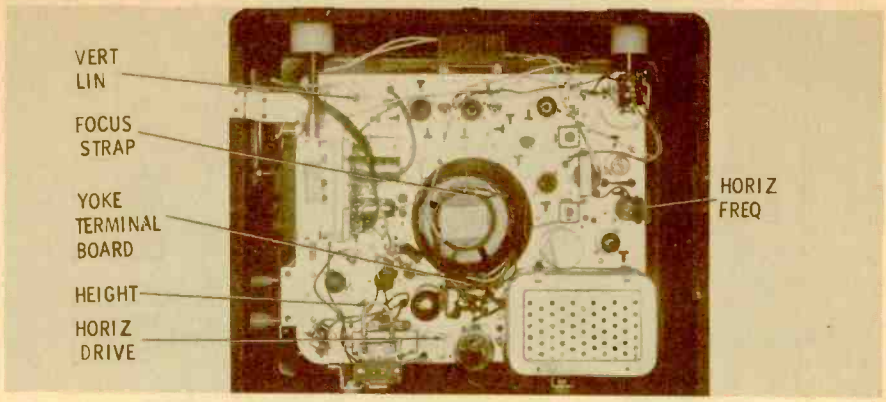
Price leader for the 1961 Olympic line is this 17", 90° portable table model equipped with a 17BJP4 picture tube. Operational controls for off-on-volume, contrast, and channel selection are top-mounted, while the brightness, horizontal hold, and vertical hold controls are along the right side. The front panel comes off after removing the retaining screws from the bottom, providing access to the CRT and safety glass for cleaning purposes.

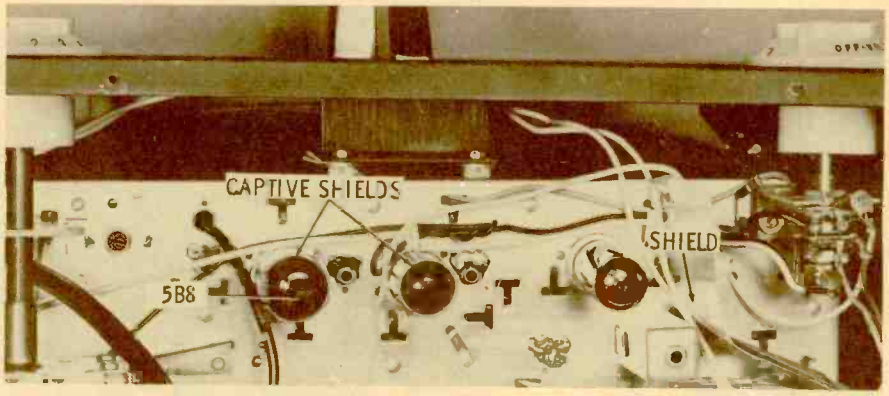
The 13-tube, series-filament chassis is conventionally wired and follows a familiar vertical chassis layout. Height, vertical linearity, horizontal frequency, and horizontal drive controls constitute the setup adjustments. Focus can be varied by means of a strap on the base of the picture tube; it should be connected between pins 6 and 1 or 6 and 10, whichever gives the best focus. Only three bolts need be removed to free the chassis — the rear handle bolt and two at the bottom. At first glance, it looks as though the yoke leads are soldered in place, but a special slip-together terminal board is used to provide a plug-in connection.

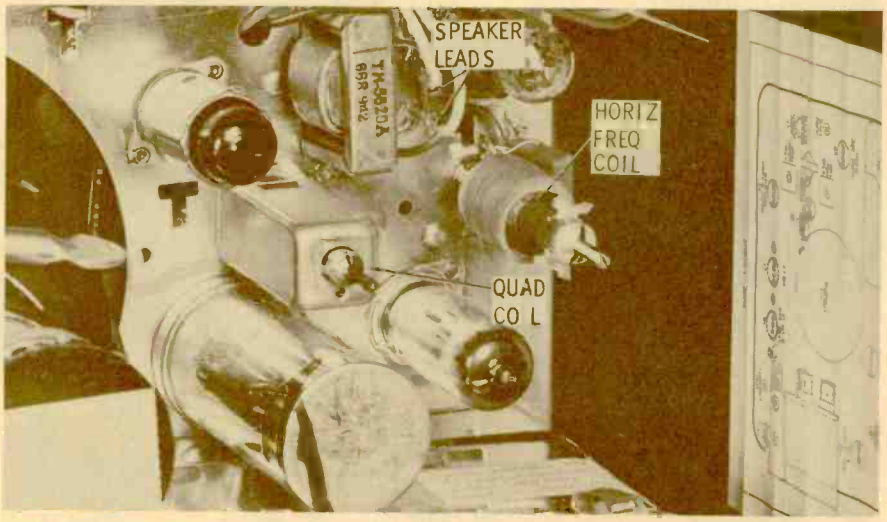
If you're called on to correct a sync problem, don't overlook the 5B8; it serves not only as the first video IF, but also as the sync separator. Also, after checking tubes, don't forget to put the tube shields back in place. The captive tube shields and the metal plate near the volume control stress the importance of this measure.

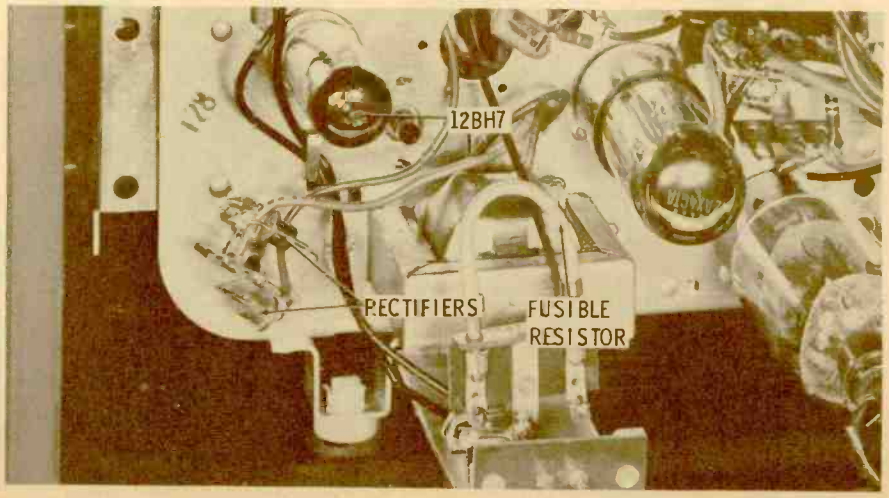
The area immediately above the high-voltage cage is occupied by the sound detector, audio output, and horizontal multivibrator circuits. The unshielded coil is in the horizontal frequency circuit, while the one with a shield is the audio-detector quadrature coil. Special terminal connections on the audio output transformer make it possible to slip the speaker leads off if disassembly is necessary.

The lower left-hand corner of the chassis is occupied by the deflection and power-supply circuits. A 12BH7 serves both sections of a combined vertical multivibrator and output circuit. A pair of silicon rectifiers are used in a conventional half-wave, voltage-doubler circuit. These are protected by a 10-ohm, 2.5-amp, plug-in fusible resistor.









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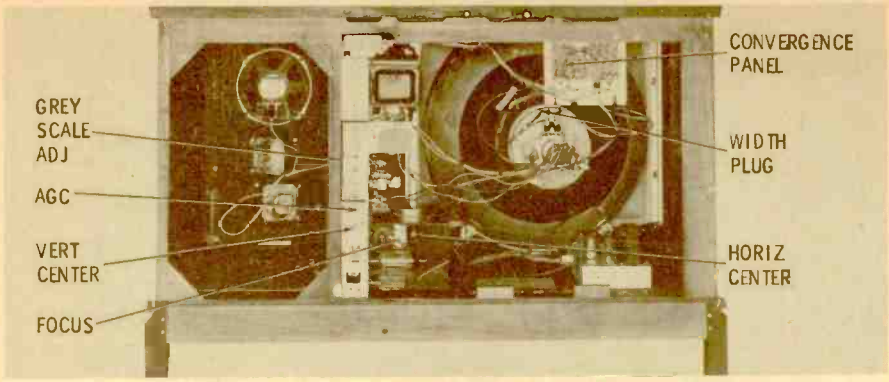

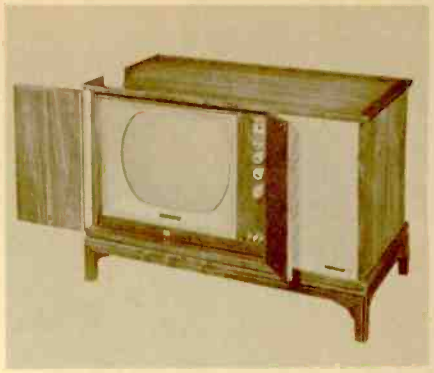

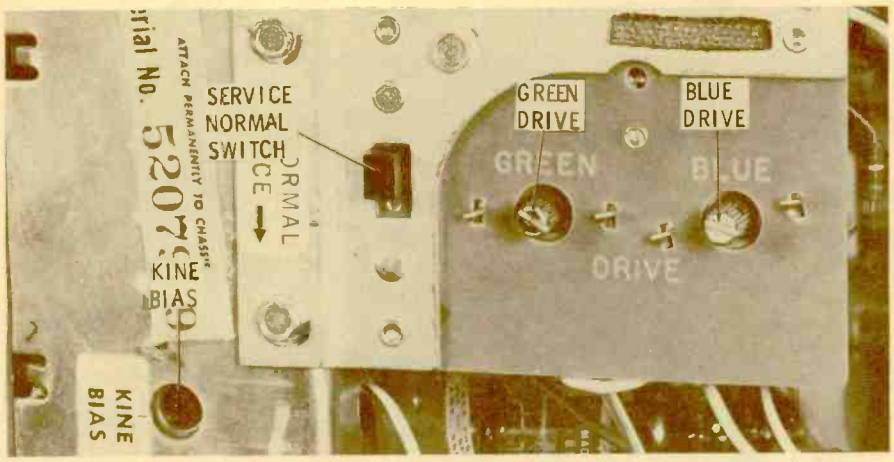

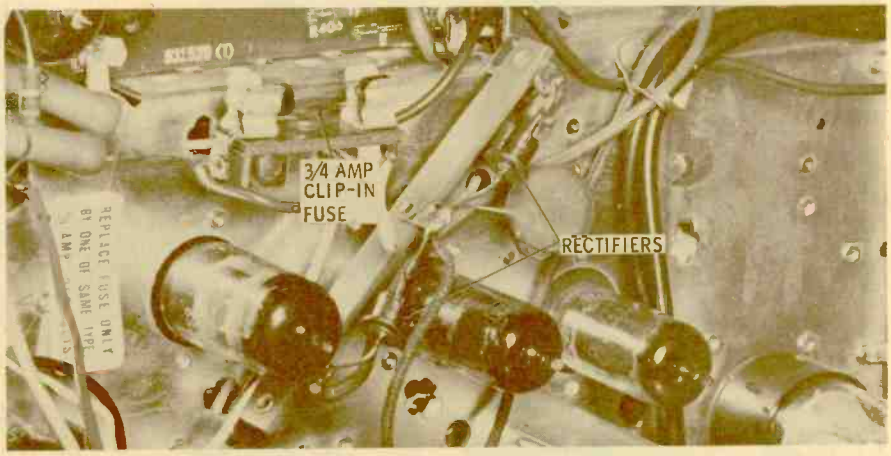

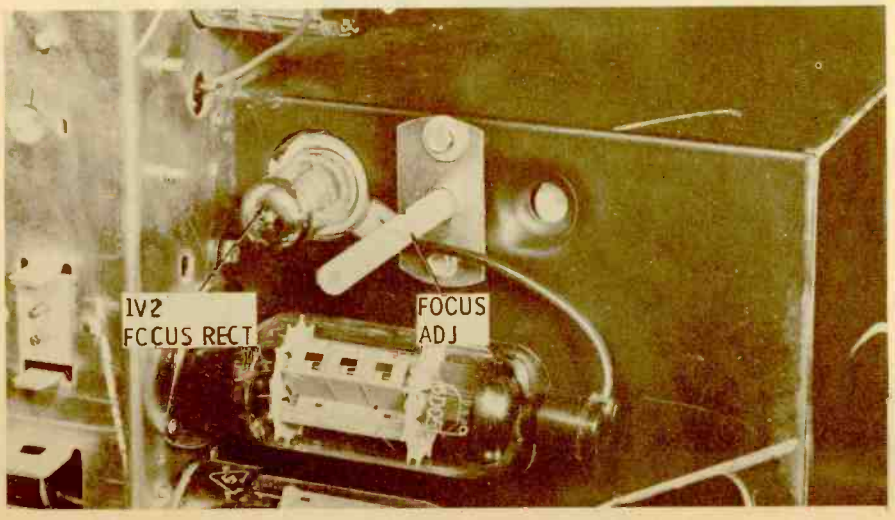

RCA Victor Model 211CDR936U Chassis CTC10

RCA's 1961 color TV line has been expanded to include 48 models using this basic chassis. Although there are eight chassis variations, the major differences are in the tuners used. All models are equipped with a removable safety glass to permit cleaning. Two different mountings hold the glass in place. In one a conventional trim strip is held in place by wood screws; the other uses a pry-out metal strip along the top edge which, when removed, exposes a sliding retainer. As in previous chassis, the height and vertical linearity adjustments are accessible through the hollow shafts of the tone and contrast controls.

The CTC10 is a refined version of earlier chassis. A combination of printed and hand wiring is used, although there is one less printed board than in previous models due to the vertical circuit becoming a part of the conventional wiring. One of the more noticeable differences is in the number of tube shields you'll find — only the third video IF and the video amplifier are equipped with shields in this chassis. Several circuits have been revised, some new ones have been developed, and there's been quite a shuffle in the tube lineup. However, the new high-transconductance 6GM6 pentode in the second IF stage is the only stranger. Two of the circuit revisions to bear in mind when called upon to service this chassis is the addition of a dual-diode AFC detector ahead of the *synchroguide* system, and the use of a 6DT6A in a noise-inverter and keyed-AGC circuit.

A new approach to grey-scale adjustments centers around the added *service-normal* switch and *kine bias* control. During the adjustments, the switch is set to the *service* position. Since this collapses the vertical sweep, an improperly-set switch could prove to be the source of an unwarranted service call. If the customer's description of the trouble indicates loss of vertical deflection, suggest that he check the position of this switch. You may save him the cost of a call.

Filament, B+, and sweep circuits are fused in the same way as earlier versions. However, the pigtail ¾-amp sweep fuse has been replaced by a clip-in type, making it easier to change.

A new circuit that replaces the focus-control potentiometer with a variable inductance has been developed. Opposing pulses are fed to the cathode circuit of the 1V2 focus rectifier; this varies its conduction and provides about 1 KV change in the focusing voltage.

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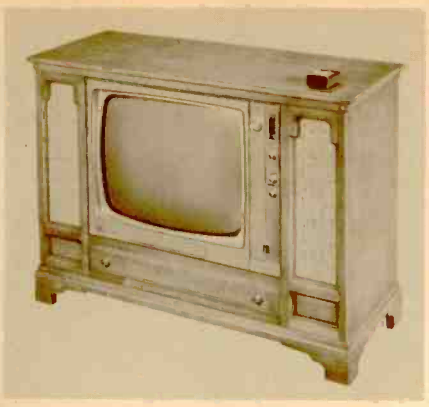
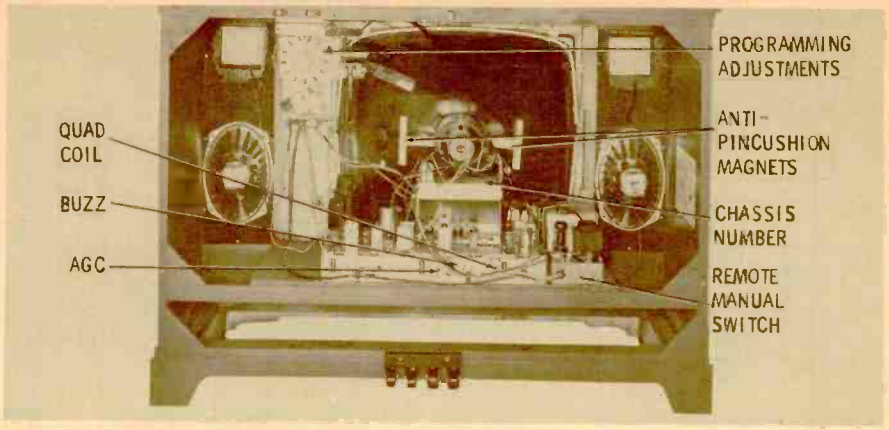




Zenith Model F3368M Chassis 16F28Q

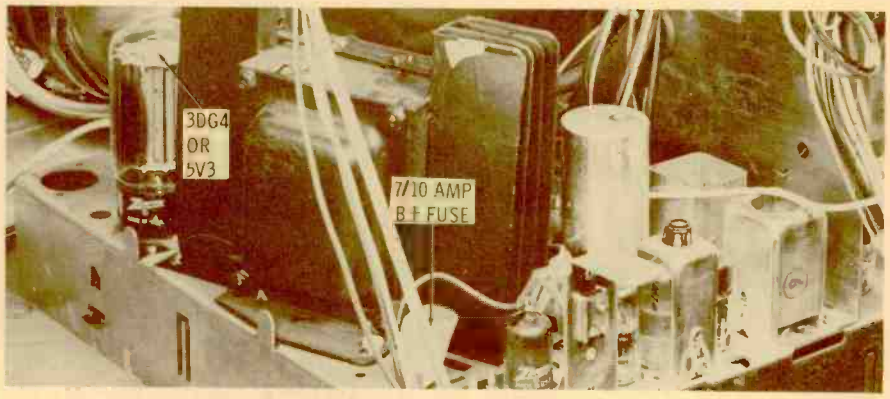
Twenty-one models of Zenith's "next to the top" series for '61 use the 16F28 chassis or one of its variations. All are equipped with a 23" picture tube featuring a bonded safety shield with a special anti-reflection treatment. This "Q" version employs the *Space Command 400* remote control and power tuning system that permits remote operation of off-on-volume, muting, and bidirectional channel selection. The operational controls are grouped to the right of the picture tube, while a control-panel door below the CRT provides access to the remaining customer controls and many of the setup adjustments.

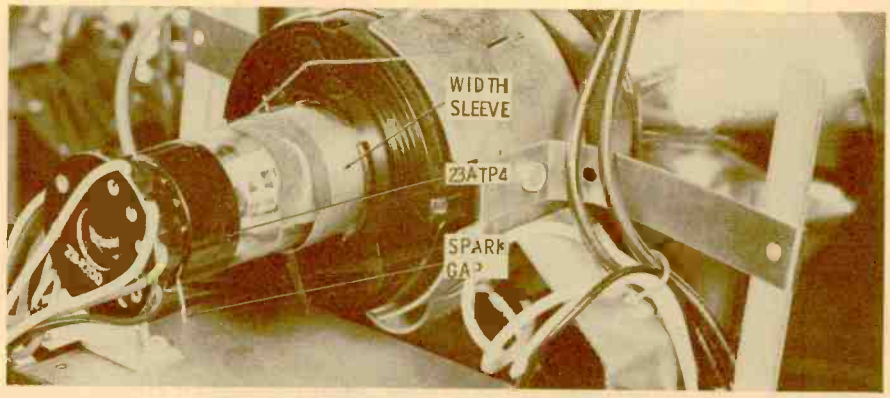
The 16-tube, conventionally-wired, 92° chassis has the AGC and buzz controls mounted on the rear apron. An access hole permits adjustment of the quadrature coil below the chassis. A pair of anti-pincushion magnets are used to assure good horizontal linearity. The programming cams of the power tuning unit should be rotated to the tangent position for channel skipping and to the perpendicular position for desired channels.

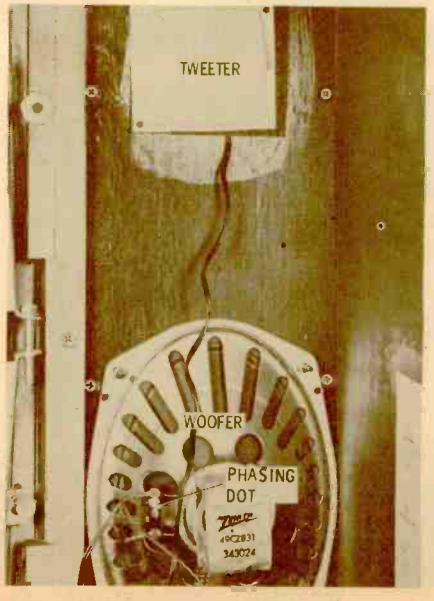
A new 3DG4 tube appears in the low-voltage rectifier circuit; however, the socket is also wired to accommodate a 5V3. Because the supply is designed to use either tube, the transformer has special taps for the plate and filament windings. B+ is protected by a 7/10-amp, type-N fuse, and the 6.3-volt filament supply is protected by a 1½" length of #24 wire.

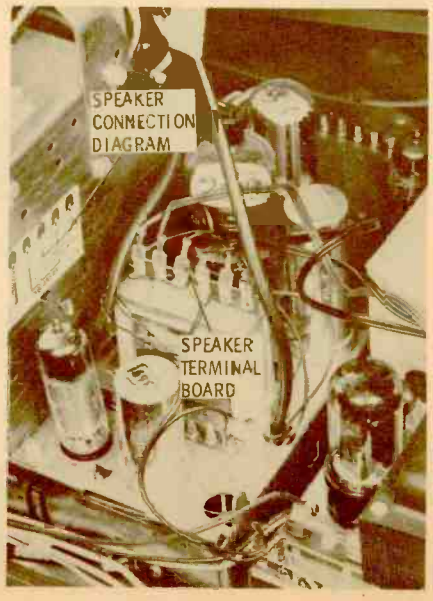
A metallic sleeve, used to control the width, is held in place on the CRT neck by tape. Due to the low Eg2 rating of the 23ATP4, two spark gaps are included in the picture tube circuitry. The one shown in the photo is connected between G1 and ground to prevent heater damage in the event of arcing within the tube. The G2 spark gap is a part of the chassis wiring and protects the accelerating anode in the event that excessive blanking signal is fed from the vertical multivibrator.

Although two matching pairs of woofers and electrostatic tweeter speakers are used for the output, they are in parallel and not used for stereo. Speaker phasing is therefore a necessity. In order to maintain the proper phasing connections, the speakers are coded with a paint dot and the connecting wires carry an identifying stripe. A speaker-connection diagram is glued to the side of the high-voltage cage to identify the many connections of the speaker terminal board.









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See PHOTOFACT Set 494, Folder 2

See PHOTOFACT Set 494, Folder 2

Mfr: Packard-Bell **Chassis No. 98D8**

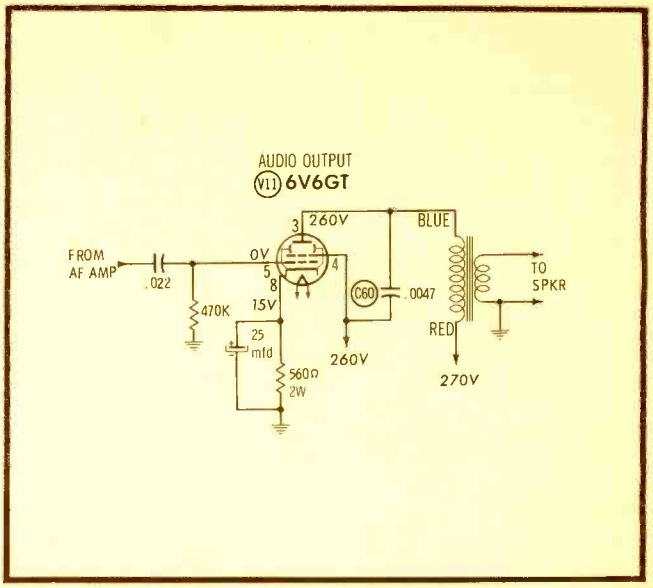
Card No: PB 98D8-1

Section Affected: Sound.

Symptoms: No sound. All voltages check OK.

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

What To Do: Replace C60 (.0047 mfd).



Mfr: Packard-Bell **Chassis No. 98D8**

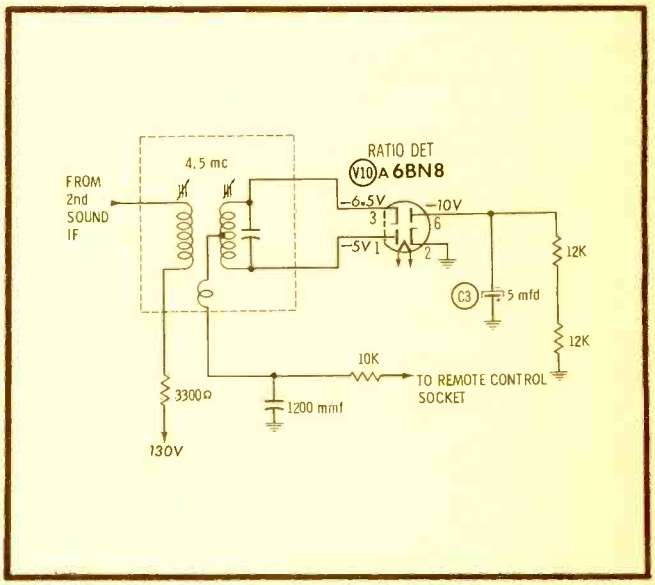
Card No: PB 98D8-2

Section Affected: Sound.

Symptoms: Buzz in sound. Incorrect voltage on pin 6 of V10A.

Cause: Defective ratio-detector stabilizing capacitor.

What To Do: Replace C3 (5 mfd—50V).



Mfr: Packard-Bell **Chassis No. 98D8**

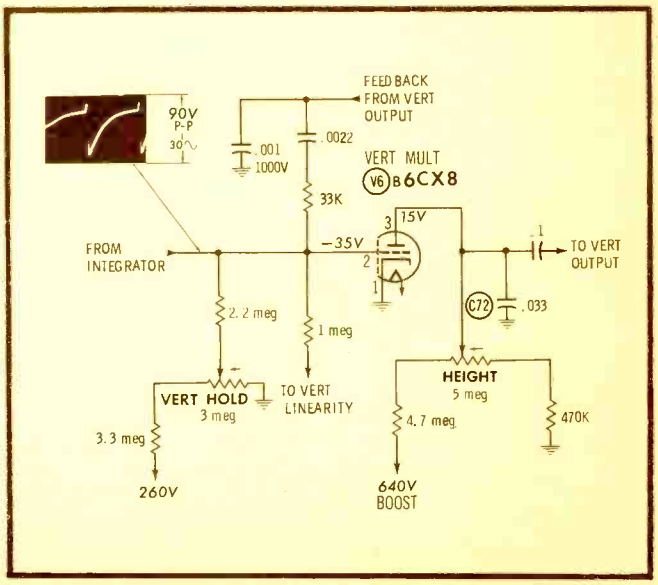
Card No: PB 98D8-3

Section Affected: Raster.

Symptoms: No vertical sweep. Low plate voltage in first section of vertical multivibrator.

Cause: Shorted vertical sawtooth-forming capacitor.

What To Do: Replace C72 (.033 mfd; .047 in early production).



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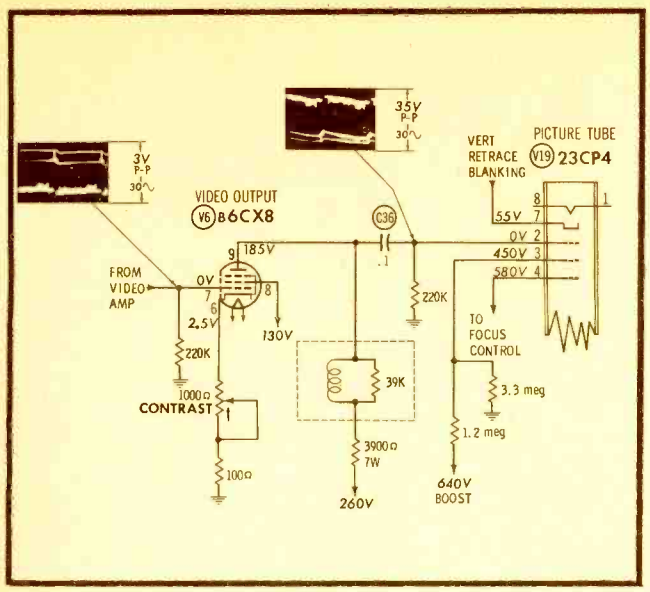
See PHOTOFACT Set 494, Folder 2



See PHOTOFACT Set 494, Folder 2

Mfr: Packard-Bell **Chassis No. 98D8**

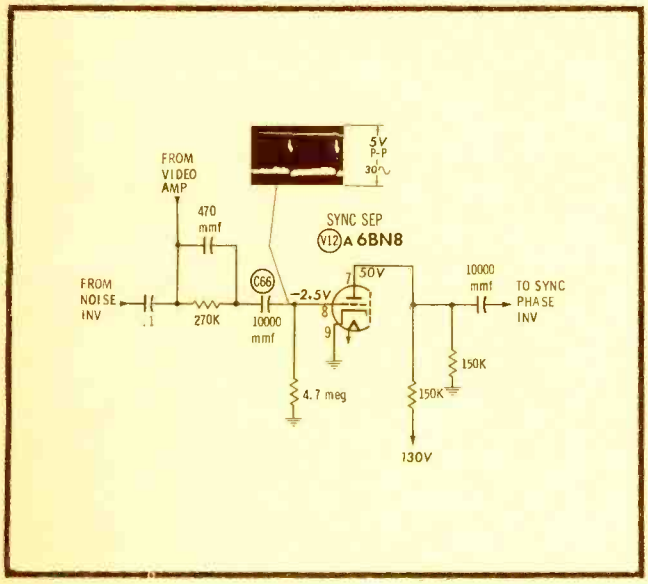
Card No: PB 98D8-4

Section Affected: Pix.

Symptoms: Brightness always at maximum. Positive voltage at grid of picture tube.

Cause: Shorted or leaky coupling capacitor between video output tube and picture tube.

What To Do: Replace C36 (.1 mfd).



Mfr: Packard-Bell **Chassis No. 98D8**

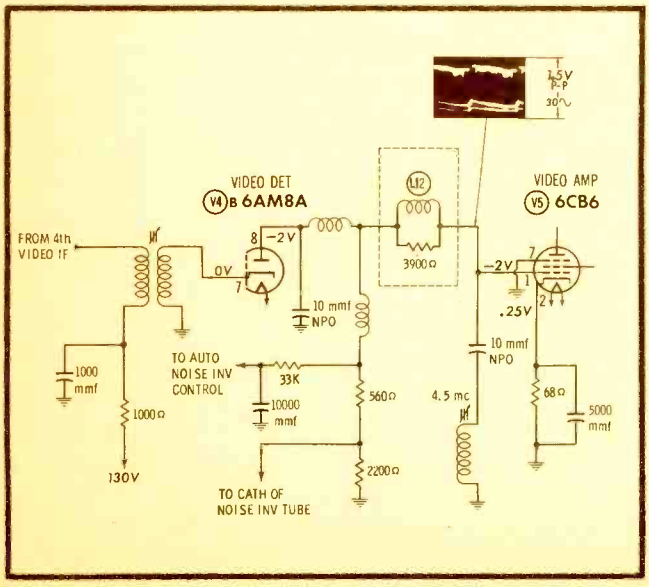
Card No: PB 98D8-5

Section Affected: Sync.

Symptoms: Loss of both horizontal and vertical sync.

Cause: Defective coupling capacitor at grid of sync separator.

What To Do: Replace C66 (10000 mmf).



Mfr: Packard-Bell **Chassis No. 98D8**

Card No: PB 98D8-6

Section Affected: Pix.

Symptoms: Intermittent smearing of picture.

Cause: Open series peaking coil in video detector circuit.

What To Do: Resolder pigtails of L12, or replace coil.

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See PHOTOFACT Set 487, Folder 2

See PHOTOFACT Set 487, Folder 2

Mfr: Westinghouse **Chassis No. V-2378**

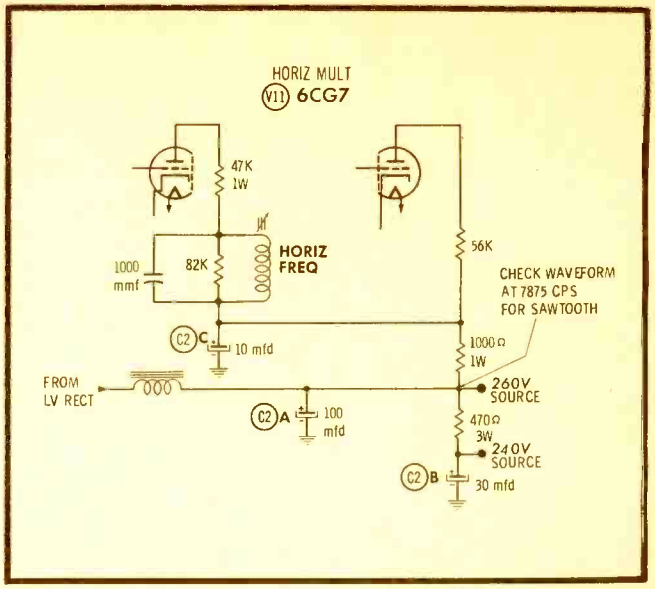
Card No: WE 2378-1

Section Affected: Raster.

Symptoms: Left side of screen dark and right side bright; picture and sound both present.

Cause: Defective electrolytic filter capacitor.

What To Do: Replace C2 (four-section unit: 100-30-10-40 mfd at 350-350-350-25V).



Mfr: Westinghouse **Chassis No. V-2378**

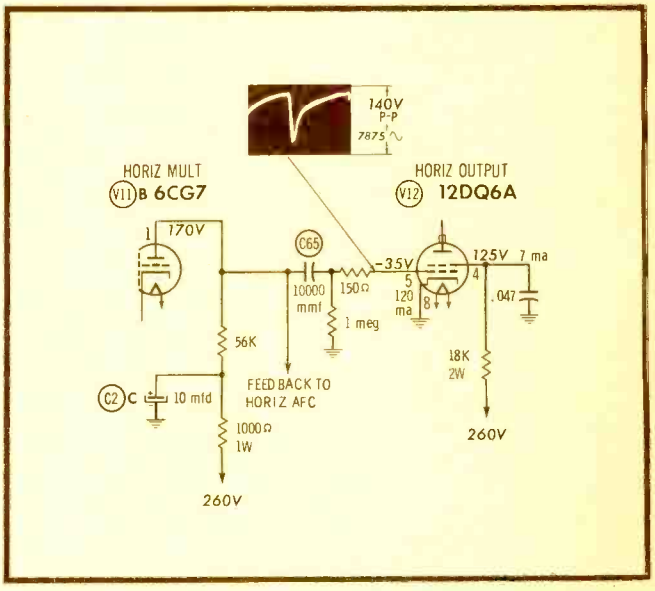
Card No: WE 2378-2

Section Affected: Raster.

Symptoms: No raster. Loss of bias voltage on pin 5 of V12.

Cause: Open coupling capacitor between horizontal multivibrator and output stages.

What To Do: Replace C65 (10000 mmf).



Mfr: Westinghouse **Chassis No. V-2378**

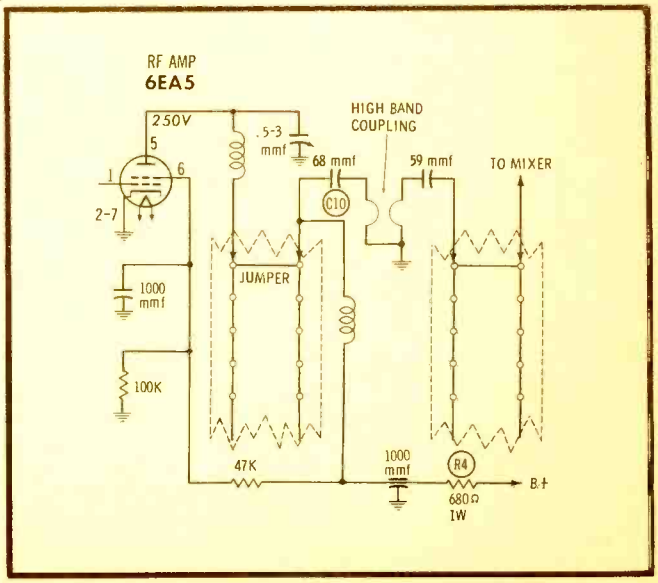
Card No: WE 2378-3

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

Symptoms: No sound; no picture; raster okay. Little or no plate voltage on pin 5 of 6EA5 RF amplifier.

Cause: Shorted capacitor in high-band coupling circuit, causing open B+ dropping resistor.

What To Do: Replace C10 (68 mmf) and R4 (680 ohms—1W).



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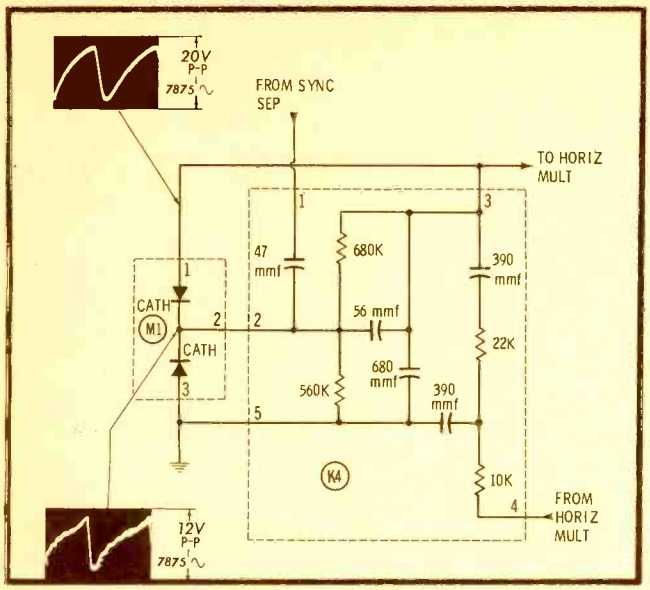


See PHOTOFACT Set 487, Folder 2

Mfr: Westinghouse **Chassis No. V-2378**

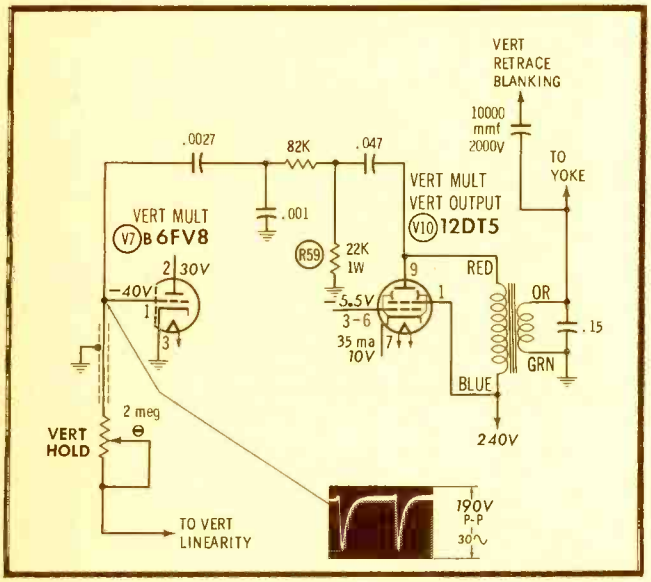
Card No: WE 2378-4

Section Affected: Raster.

Symptoms: Drive lines and "S" curve in raster.

Cause: Leakage in horizontal AFC component combination.

What To Do: Replace K4 (Westinghouse part number 219V028H03).



Mfr: Westinghouse **Chassis No. V-2378**

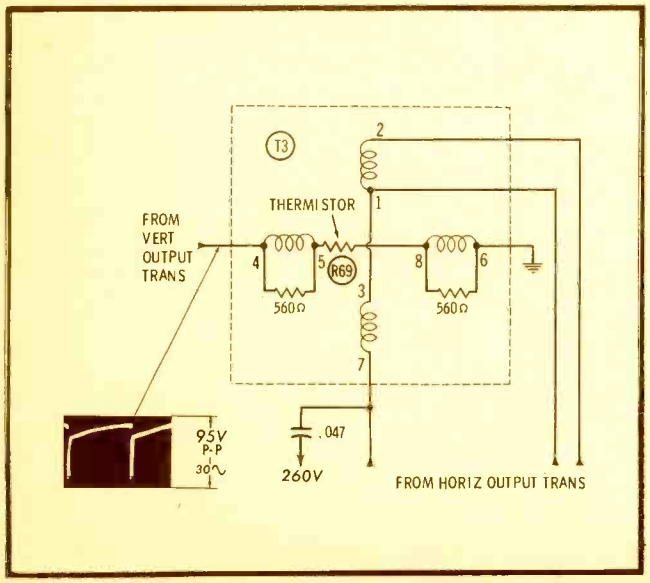
Card No: WE 2378-5

Section Affected: Raster.

Symptoms: Poor height and linearity, or unstable vertical hold.

Cause: Open resistor in feedback circuit of vertical multivibrator.

What To Do: Replace R59 (22K—1W).



Mfr: Westinghouse **Chassis No. V-2378**

Card No: WE 2378-6

Section Affected: Raster.

Symptoms: Vertical shrinkage.

Cause: Change in value of *thermistor* on yoke assembly.

What To Do: Replace R69 (8 ohms cold, 1 ohm hot).

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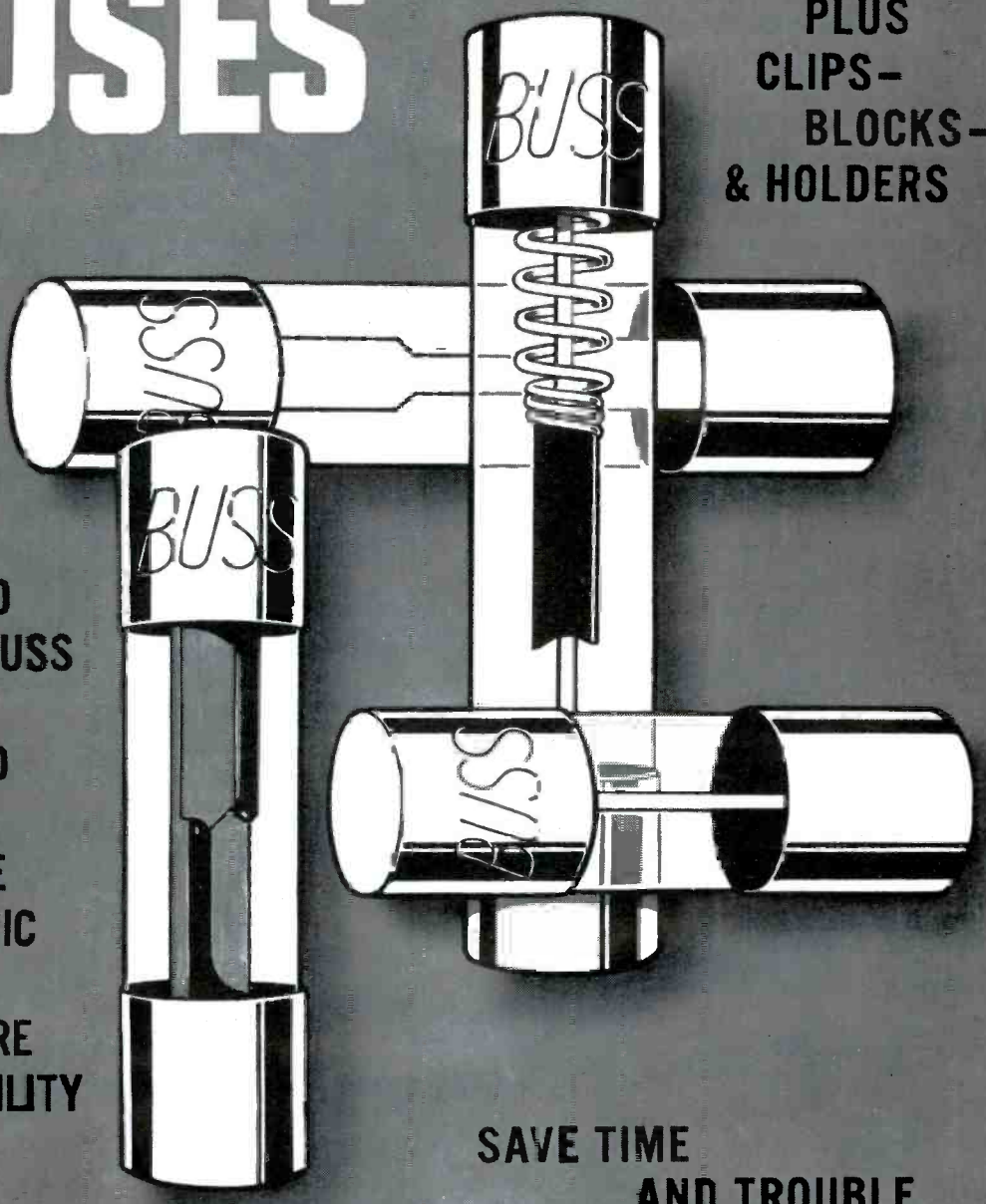

EACH AND EVERY BUSS FUSE IS TESTED IN A SENSITIVE ELECTRONIC DEVICE TO ASSURE DEPENDABILITY

SAVE TIME AND TROUBLE...

by standardizing on BUSS fuses. There's a right fuse for every need in the complete line. Write for the BUSS bulletin on small dimension fuses (Form SFB) to get full data for your files

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PF REPORTER

including Electronic Servicing

VOLUME 11, No. 2 *FEBRUARY, 1961*

CONTENTS

ABOUT THE COVER

The sky's the limit . . . that's what we found in our investigation of the business potential existing in the antenna installation field. You'll get an idea of how much potential from this month's "Antenna Installation News," which begins on page 37. Although names and places are fictitious, the material itself is based on fact.

www.americanradiohistory.com

Two outstanding products by the HIDDEN 500* who plan for your future:

DIFILM® BLACK BEAUTY® molded tubular CAPACITORS

DIFILM® ORANGE DROP® dipped tubular CAPACITORS

TWO GREAT TUBULARS . . . TAKE YOUR CHOICE!

(*± 10% Capacitance Tolerance is standard at no extra cost*)

Sprague Difilm Capacitors can't be beat! Dual-dielectric construction combines the best features of both Mylar® polyester film and special capacitor tissue. And for additional reliability, Difilm capacitors are impregnated with Sprague's HCX®, a solid impregnant which produces a rock-hard capacitor section—there's no wax to drip, no oil to leak!

BLACK BEAUTY Molded Tubulars are actually low-cost versions of the famous Sprague high-reliability capacitors used in modern military missiles. They're engineered to withstand 105°C (221°F) temperatures . . . even in the most humid climates! And their tough, molded phenolic cases can't be damaged in handling or soldering.

ORANGE DROP Dipped Tubulars are the perfect replacement for radial-lead capacitors now used by leading manufacturers of TV sets. Leads are crimped for neat mounting on printed wiring boards. Extremely small in size, they'll fit anywhere, work anywhere. And they're double-dipped in epoxy resin for extra protection against moisture.

***The "Hidden 500"** are Sprague's 500 experienced researchers who staff the **largest research organization in the electronic component industry** and who back up the efforts of some 7,000 Sprague employees working in 14 manufacturing operations—four at North Adams, Mass.; Bennington and Barre, Vt.; Concord and Nashua, N. H.; Lansing, N. C.; Grafton, Wis.; Visalia, Calif.; two at Ponce, Puerto Rico; and Milan, Italy.

SPRAGUE®
THE MARK OF RELIABILITY

WORLD'S LARGEST CAPACITOR MANUFACTURER

www.americanradiohistory.com

TVL TWIST-LOK® CAPACITORS

These 'lytics take on the toughest TV and radio duty, give maximum trouble-free service, *without HUMMM!* They are dependable at extremely high and low temperatures. Cathodes are etched to meet the needs of high ripple currents, high surge voltages.

TVA ATOM® CAPACITORS

Atom tubulars are service favorites because they fit anywhere, work anywhere. They're the *only* small size 85 C (185 F) capacitors in ratings up to 450 WVDC. They have low leakage current, long shelf life, and withstand high ripple currents, high surge voltages.

TE LITTL-LYTIC® CAPACITORS

The very best ultra-miniature replacements for transistor circuits, offering unusual reliability through all-welded construction. No pressure joints to cause "open" or intermittent circuits. Long shelf life—extremely important in sets used only part of the year.

VL VERTI-LYTIC* CAPACITORS

These single-ended molded tubulars are the ideal replacement for units of this type found on printed wiring boards.
Keyed terminals assure fast manual mounting and correct polarity. Resin end fill protects against drying of electrolyte or entrance of external moisture.

PCL PRINT-LOK® CAPACITORS

The printed circuit version of the Twist-Lok. Universal base replaces any of the printed circuit 'lytics in use today. No makeshift mounting adapters to damage capacitor or add extra height . . . no possibility of high resistance contacts.

EVERY 'LYTIC YOU NEED . . .

- every value
- every rating
- every style

Shown here are the more popular of Sprague's big family of Electrolytic Capacitors, the broadest in the industry. Other types include Metal-encased Screwbase; Plastic-encased High-MF; Metal-encased Octal-base; Ultra-low leakage Photoflash. All are listed and described in Sprague's NEW Catalog C-613A. Get your copy from any Sprague distributor, or write Sprague Products Company, 105 Marshall Street, North Adams, Massachusetts.

*TRADEMARK

SPRAGUE®
THE MARK OF RELIABILITY

WORLD'S LARGEST CAPACITOR MANUFACTURER

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Make your profit picture

"BRIGHT AND WIDE"

with Sylvania 6DQ6A and 6BQ6GTA

New improvements provide long life, high output, excellent high voltage cutoff.

Tube performance and life can mean the difference between a bright and dismal profit picture. Let's look at some of the proved-in-the-set Sylvania features:

Plate current capabilities have been increased. Plate to screen current ratio has been improved. A special screen-grid coating provides excellent heat dissipation eliminating interelement shorts without causing cathode "poisoning"—a major cause of short tube life. Tests for voltage breakdown, heater and tube life add up to extra quality assurance. The famous Sylvania "Automount" construction is used for the 6DQ6A.

Result: Sylvania 6BQ6GTA and 6DQ6A

- Deliver the horizontal output essential to full picture width.
- Increase picture tube light output.
- Offer extra-long life in TV set.

Here's a servicing plus: tapered pins provide easy insertion in hard-to-get-at sockets.

Make your servicing profits brighter . . . right now. Specify Sylvania 6BQ6GTA and 6DQ6A on your next tube order.

Electronic Tubes Division, Sylvania Electric Products Inc., Dept. 412, 1740 Broadway, New York 19, N. Y.

SYLVANIA

Subsidiary of GENERAL TELEPHONE & ELECTRONICS

www.americanradiohistory.com

Dear Editor:

Please send me a copy of the 1959 Subject Reference Index to PF REPORTER, and also one for 1960 up to the start of the monthly card index (September issue). I think putting the index on a card in each issue is the best idea you have had yet. Thanks for this service.

PORTER H. MANN

South Bend, Ind.

Dear Editor:

Congratulations on your Subject Reference Index card in the back of the magazine. At one time when this subject was being discussed, I was going to suggest a card-file index; but, like most thoughts, this one came and went without anything being done. I also thought a similar 3 x 5 card for the "Previews of New Sets" would make a handy quick reference when a new set comes into the shop.

DAVID A. LABER

Laber's Radio and TV Service
Port Huron, Mich.

Dear Editor:

I have all your PF REPORTERS except the first six since its inception, and would like to have the 1957, 1958, 1959, and 1960 Subject Reference Indexes. If I may offer a suggestion, could you list your *Troubleshooter* and other articles by model as well as make and trouble? This would save a considerable amount of time when looking up these subjects.

EDWARD R. DZEDA

Dzeda TV Service
Niles, Ohio

Dear Editor:

I am very much amused at the fellows who are trying to change the nature of your magazine. As for me, I like it fine as is. I read everything—including the ads.

I wonder if the fellows who like to change things could tell me how to change the polarity of a Ford radio Model OMF207906 so I can install it in a 1960 Ford.

Thanks for everything, and keep up the good work.

ORMAN COOK

Cook's Radio & TV Service
Bushton, Ill.

Your Ford radio needn't be changed any more than our magazine. Polarity doesn't matter, since a non-synchronous vibrator is used. Just add a voltage-dropping resistor to cut the DC supply down to the required 6.3 volts—Ed.

Dear Editor:

I have been a subscriber to your magazine from its inception many years ago and have received a great deal of benefit therefrom. I still remember being attracted to the tuner article in your January, 1951 issue, and have either purchased or subscribed to every issue since then. So the 10-year index in your January, 1961 issue was indeed a welcome addition.

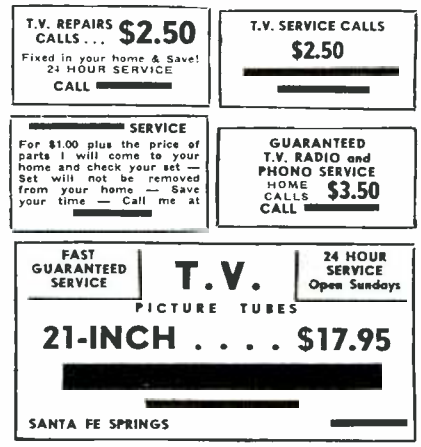
MAX L. LEVY

Braddock Electronics
Alexandria, Va.

Our index compiler, who hasn't yet recovered from the ordeal, thanks you one and all.—Ed.

Dear Editor:

Much has been said about unfair competition from part-timers, but how could they possibly compete with full-timers who use ads like these?



While they are not typical of the TV service advertisements around here, a single $1.00 service call ad does more to undermine the service industry than all the part-timers in the area.

The trouble with TV servicemen is that they are either good technicians or good businessmen—but rarely both.

W. G. EDWARDS

Norwalk, Calif.

At the prices shown, these guys must be using monkeys for servicemen . . . and paying them off in bananas!—Ed.

Dear Editor:

Attached is a letter I had made up to send to customers that fail to pick up their sets when they promised. I thought that some of my fellow technicians would like to know how I solved the problem.

WALTER A. KOEHLER

"SPACE" Economy Radio & TV Service
Houghton Lake 12, Mich.

Dear Customer:

Our policy here at "Space" has been to give the best, fastest, possible service always. That is why, at "Space," your set will be ready for delivery or pickup with a minimum

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FIRST CHOICE WITH SERVICE TECHNICIANS . . . EVERYWHERE!

THERE IS ONLY ONE

MINIATURIZED

ELMENCO

DIPPED MYLAR*-PAPER CAPACITOR

* Dupont Reg. Trademark

LOOK FOR THE "EM" ON ALL dp UNITS

ASK FOR ELMENCO

don't accept substitutes or imitations!

- OPERATES AT 125°C. WITHOUT DERATING
- STANDARD TOLERANCE ±10%
- MISSILE RELIABILITY
- COMPLETELY MOISTURE PROOF
- UP TO 50% SMALLER THAN OTHER TYPES

OVER 54,000,000 SOLD IN LESS THAN 2 YEARS

IS PROOF POSITIVE OF THE UNIVERSAL ACCEPTANCE OF ELMENCO dp DIPPED MYLAR-PAPER CAPACITORS

Available at every REPUTABLE distributor throughout the country!

Now being used in millions of television sets, radios, phonographs, electronic circuitry and military applications.

ARCO electronics inc.

Community Drive, Great Neck, New York • Branches: Dallas 7, Los Angeles 35

Write for Catalog dp 110.

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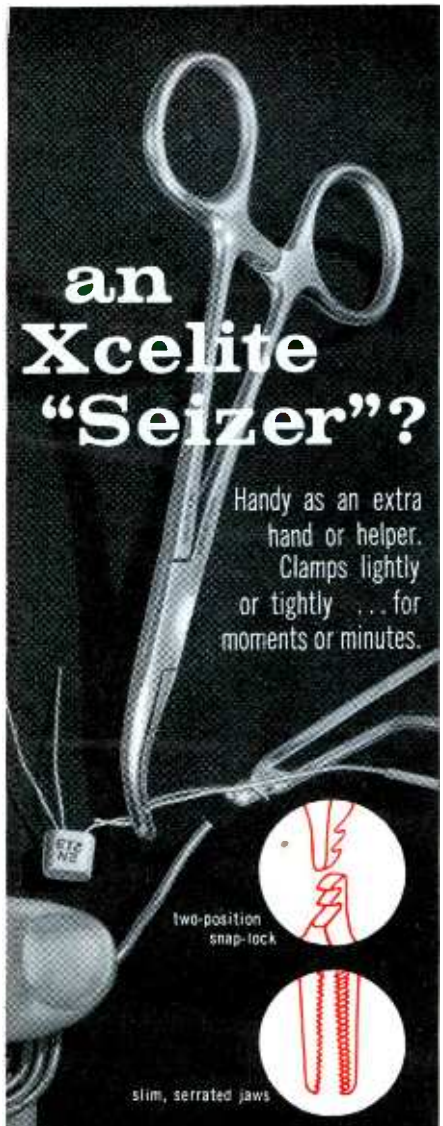
how often could you have used...



Outreaches, out-holds needle-nose pliers. Hardly a spot too small for it. Approx. 6" long. Dozens of uses: Holds and positions wires for soldering ... retrieves small parts from inaccessible places ... it's a heat sink. Two-position snap-lock won't slip, yet releases with a twist of the fingers. All stainless steel — precision machined and tempered for smooth action and years of service.

2 Models: No. 43H curved nose and No. 42H straight — Ask your distributor to show you Xcelite Seizers today.

XCELITE®

XCELITE, INC. • ORCHARD PARK, N. Y.
Canada: Charles W. Pointon, Ltd., Toronto, Ont.

Letters

(Continued from page 14)

amount of delay, so that you may continue to enjoy your favorite programs.

However, this kind of service requires that we stock heavily on all popular components and tubes. This also requires a larger than normal investment of ready cash for fast turnover. Now, if we were operating in a large city, close to the major distributors, this would not be necessary because of daily deliveries by these people. But, here at Houghton Lake, our distributors call only once a week, so you can see the need for a large cash outlay for parts and tubes.

Therefore, it has been our policy not to keep sets stored for more than thirty days after the set owner has been notified that his set has been repaired and serviced and ready for delivery or pickup.

We operate a rather small business with limited storage facilities which are always in need; also, we need to realize the cash investment we have in your set so we can continue this kind of service to our customers.

Please consider this letter a friendly reminder that your set is ready for delivery or pickup.

May we expect a call from you regarding your set?

Where did we get the impression that servicemen are usually hounded by customers wanting delivery of their sets? Thanks, Walter, on behalf of other readers whose shops have turned into storage warehouses.—Ed.

Dear Editor:

I have read letters from several of your readers concerning a method of filing the sheets for "Video Speed Servicing" and "Previews of New Sets."

I place the "Video Speed" sheets with the appropriate PHOTOFACT Folder. For the "Previews" data, I merely write the month and year in which the write-up can be found on the front of the folder. This way I have no trouble finding either coverage.

H. V. WILLIAMS

Radio-TV Lab
San Angelo, Tex.

Which leaves no doubt about the brand of cigarettes you smoke, H. V.—Ed.

Dear Editor:

You have done much for the service business in the past, so we are coming to you with this problem, hoping it will come to the attention of the right people.

The recent avalanche of new tube types is absurd. We don't wish to convey the impression that we are against progress, or anything of the sort, but we are against the recent trend of television manufacturers to confuse and complicate matters of inventory, service, etc. We cite a few reasons why:

1. The country is short of competent servicemen. But is it possible for a man to go into this business nowadays without a small fortune? If the present situation goes unchecked, it will be almost impossible.

2. Not discounting the possibility of a national crisis—how well could manufacturers continue to supply tubes to repair the sets they had sold?

3. Pity the poor distributors. They will soon need a warehouse to stock tubes alone!

Lately, it seems that a new tube is likely to be worse than the one it replaces. One example among the many: We all remember the 6J6 that RCA used for years. How often did it need replacing? Then look at the 6CQ8 of the last few years. Whew! That tube will do things a 6J6 never thought of doing.

We have two tube caddies now. When the day comes that we need three, we're quitting!

PAUL BEGIN
EVERETT TUTTEROW
Tutterow's TV and Radio Service
New Bedford, Mass.

"Why So Many Tube Types?" is a puzzling and complex question, and it has been so for at least five years—even though the service industry has made its feelings plain on the subject. You'll be interested in Bud Tomer's detailed discussion of this problem in his recent Howard W. Sams book, "Getting the Most Out of Vacuum Tubes."—Ed.

Dear Editor:

I'd appreciate it very much if you would be so kind as to give me any information you may have in regard to installing a new picture tube in an RCA Model 21T177 (Chassis KCS68C). The present tube is a metal 21AP4, and I wish to convert the set to use an aluminized glass tube.

WILLIAM FRISINO

Nanuet, N. Y.

The whole story of metal-to-glass CRT conversion is told on pages 18 and 19 of the May, 1958 issue.—Ed.

Dear Editor:

Maybe my eyes are going bad, but I think that the picture on your December cover is reversed. Am I right or wrong?

GEORGE N. DAKIS

Pittsburgh, Pa.

Your eyes are too good, George. Reflections in the plate-glass window made it necessary to take the picture at a specific angle, so we flopped the negative to get the effect we wanted.—Ed.

Dear Editor:

While rereading the October issue, I saw a letter asking for information on delay lines and their uses in industrial electronics. I will second the motion; any material on industrial electronics is helpful. I have your book, *Servicing Industrial Electronics*, which is also a help.

ROBERT VAN DUSEN

Rockford, Ill.

Okay, we'll not delay in making the delay-line assignment. Others who want a copy of the "Industrial" book may use the special subscription form on page 72 of this issue.—Ed.

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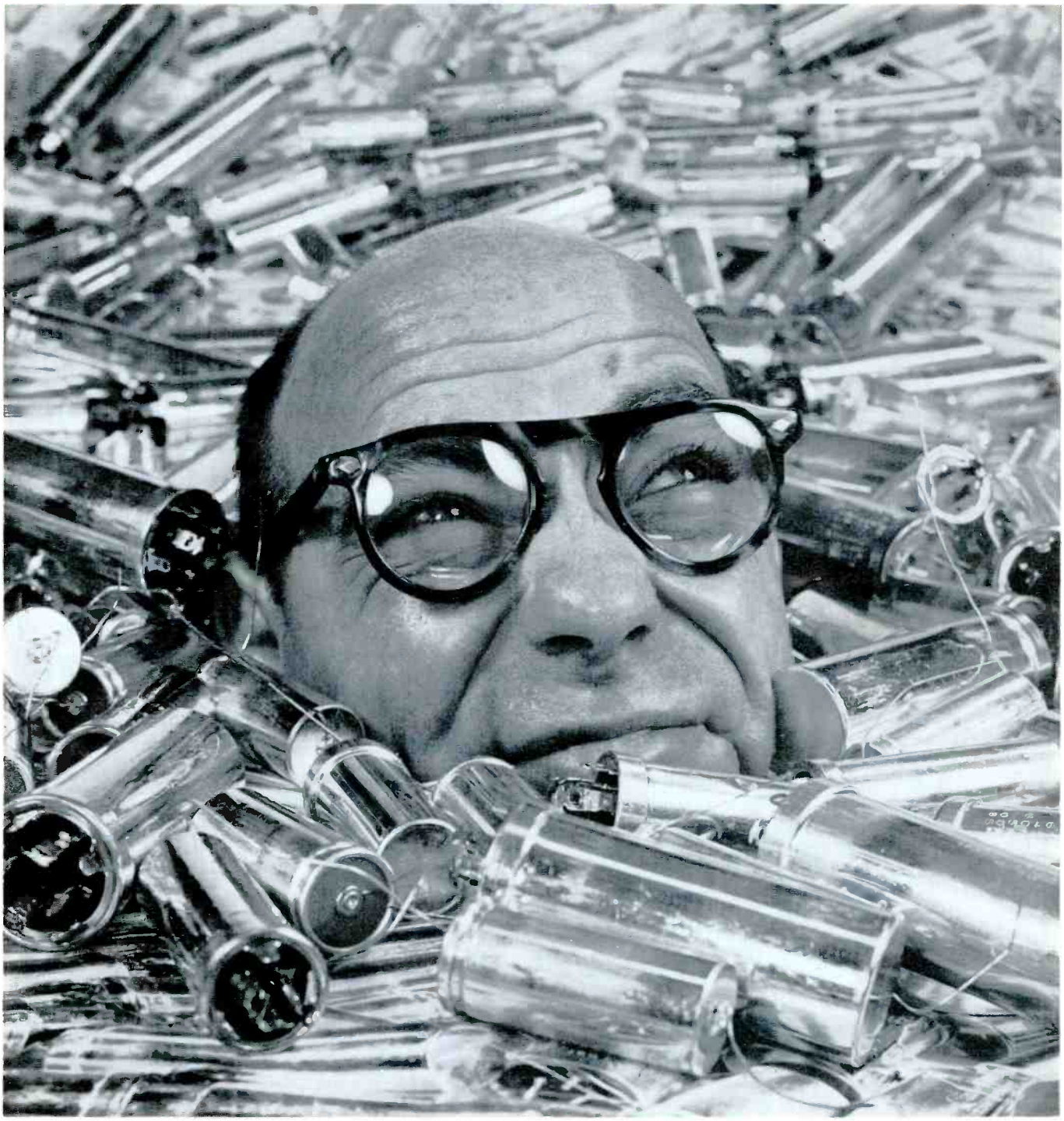

GENERAL ELECTRIC TAKES THE CONFUSION OUT OF THE CAPACITOR BUSINESS!

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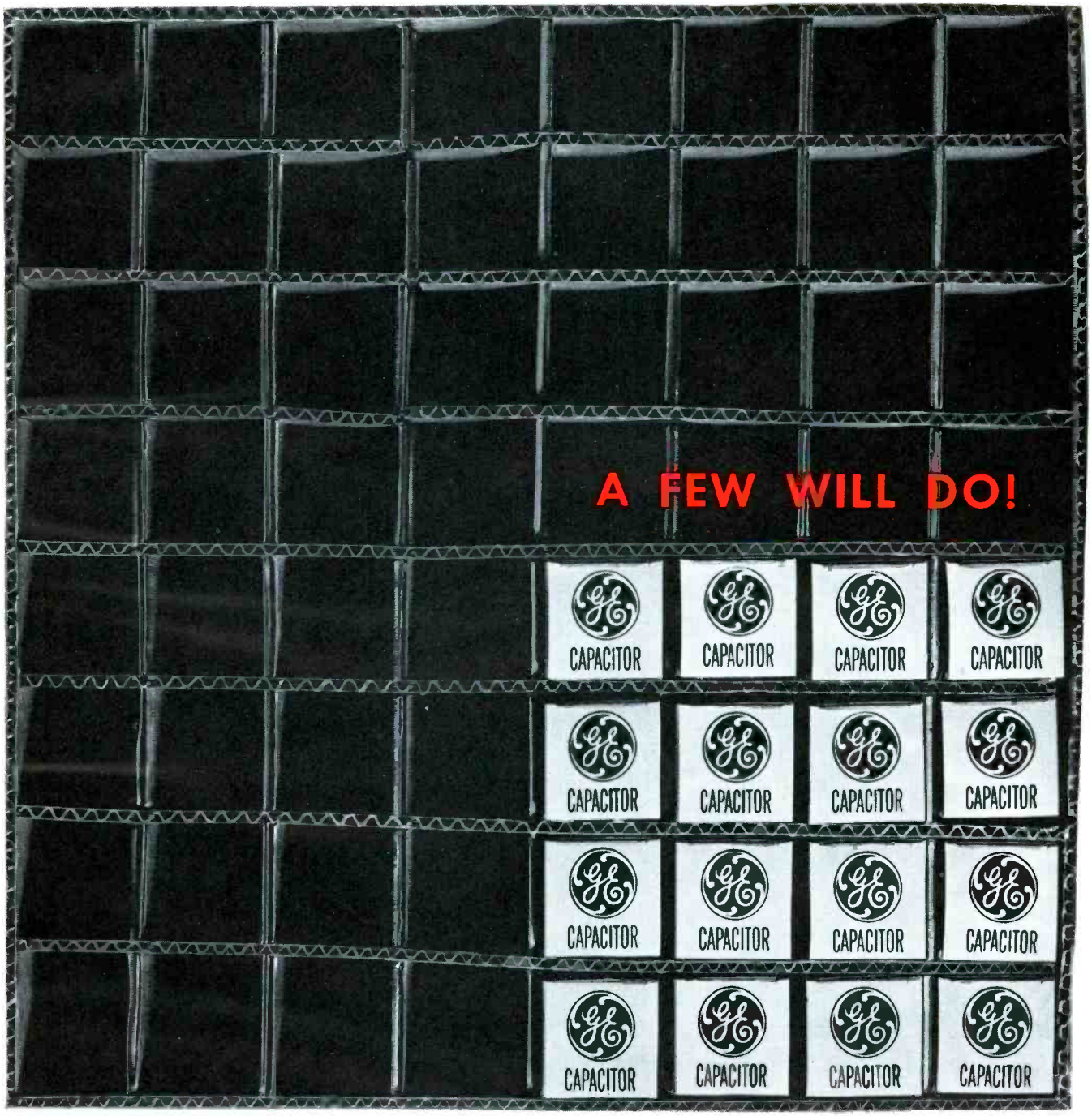

New G-E Capacitor line includes Tubulars, Twist-Prong and Miniature Electrolytic and Paper-Mylar® types

General Electric's new line of Service-Designed Capacitors slashes from 1,200 to just 295 the total number of types necessary to make all aluminum electrolytic capacitor replacements! In fact, you will be able to meet 70% of your replacement needs with just 20 types!

General Electric, long a leading manufacturer of original equipment capacitors, has cut the number of types needed for replacement by eliminating the needless duplication and overlapping of many present ratings. Through its new extended-range concept, similar to the one servicemen are already using in replacing rectifiers, G-E has taken the confusion out of making capacitor replacements!

Whether you stock capacitors yourself or order them as needed from your distributor, you will be able to simplify your purchasing and increase your profits on every capacitor replacement you make—because General Electric capacitors are Service-Designed with *you* in mind!

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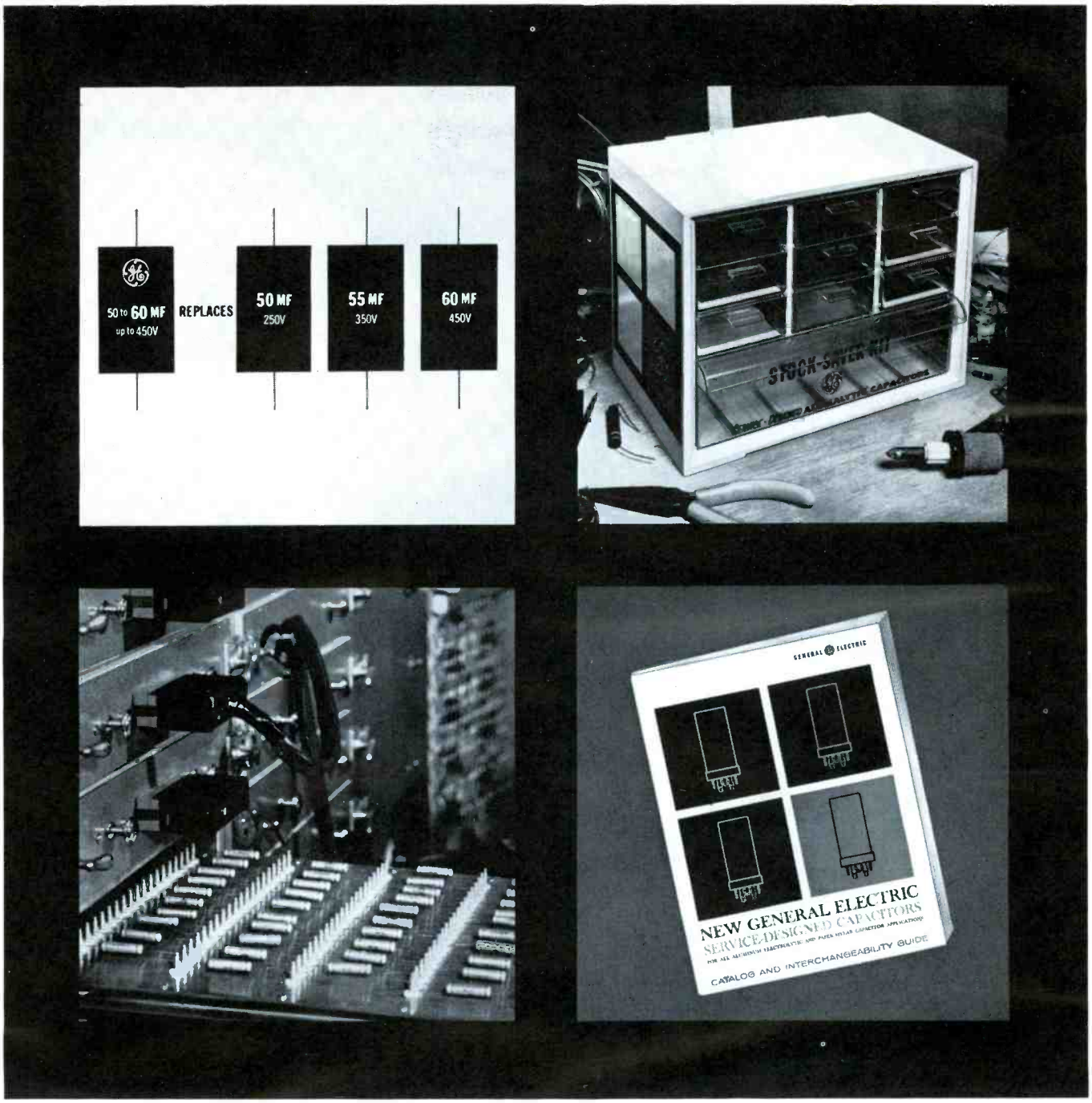

NEW G-E SERVICE-DESIGNED CAPACITORS

1. CUT NUMBER OF TYPES BY 75%! You can meet all your needs with fewer types because every G-E capacitor meets not just one, but a range of capacitance and voltage requirements. One G-E capacitor rated "50-60 mfd up to 450 V," for example, will replace any capacitor rated 50, 55 or 60 mfd at *any* voltage up to and including 450 V.

2. MEET MOST NEEDS WITH SMALL STOCK! For the first time it's possible to meet most replacement needs with a small number of units. The 14 tubular types in this Stock-Saver Kit, for example, will meet 9 out of 10 tubular electrolytic replacement needs! And you can buy this kit now from your G-E capacitor distributor at a greatly reduced introductory price!

3. LAST LONGER ON SHELF AND IN SERVICE! Because all G-E Alumalytic R capacitors are made with 99.99% pure aluminum foil, their lower-leakage currents reduce the chances that you'll ever get a "dud" from your distributor! G-E leadership in advanced-design capacitors for critical military applications brings you unmatched quality.

4. FREE 100%-COMPLETE REPLACEMENT GUIDE! The most complete catalog and replacement guide ever published shows you in a flash which G-E capacitor replaces *any* capacitor used in *any* radio or TV set in the past ten years! For your free copy, see your G-E capacitor distributor or write General Electric Company, Electronic Components Division, Owensboro, Kentucky.

Progress Is Our Most Important Product

GENERAL ELECTRIC

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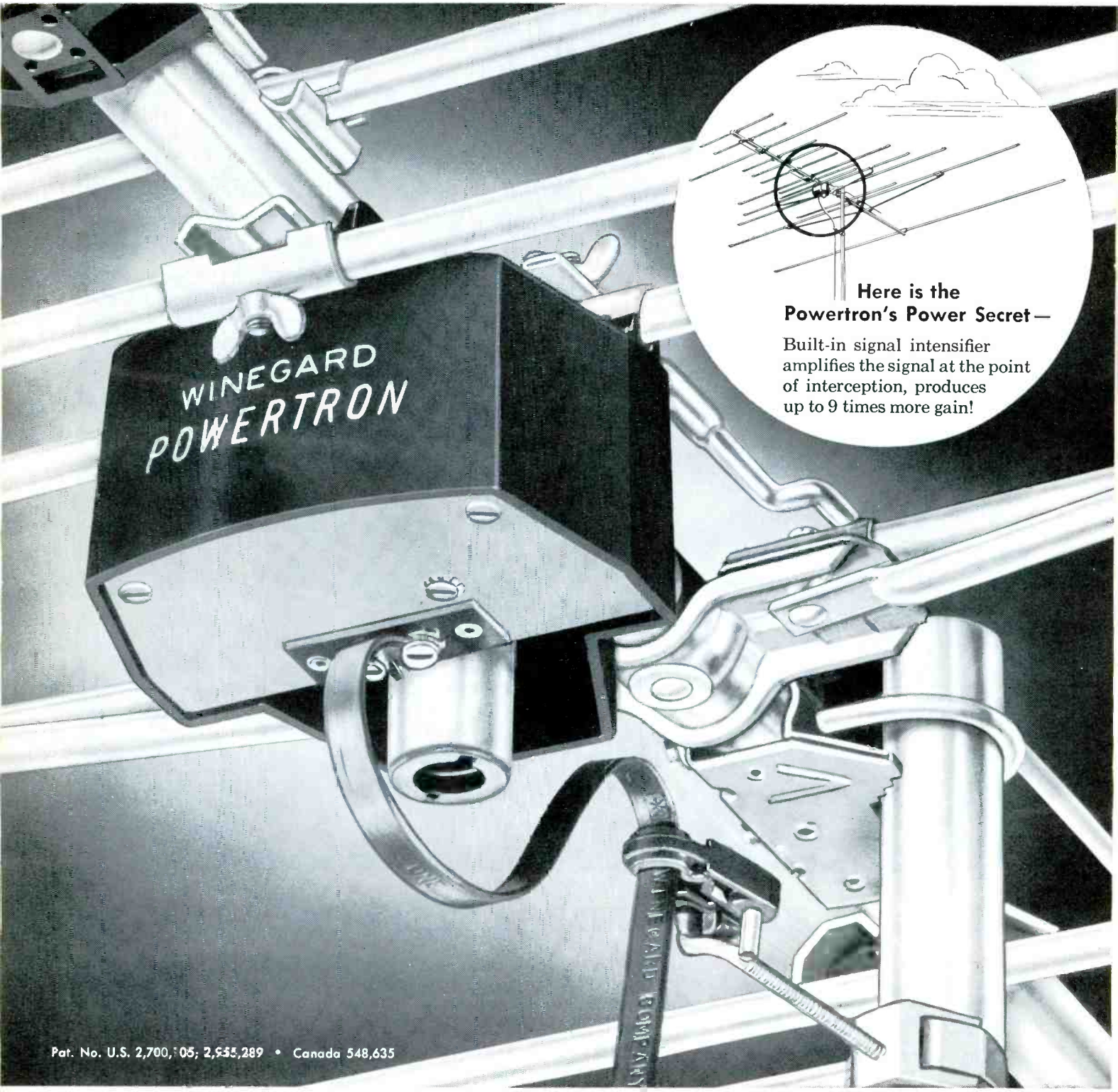
World's first Electronic TV Antenna..



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.

www.americanradiohistory.com

WINEGARD POWERTRON

POWERTRON AMPLIFIES TV SIGNALS AT THE POINT OF INTERCEPTION

Now Winegard engineers have designed a new high gain, all-channel yagi antenna incorporating a low noise, high gain RF amplifier in one integral unit! Because the input circuit of this amplifier *exactly matches* the characteristics of the *new "Tapered T" driven elements* to which it is *directly coupled*, every last particle of signal is amplified. The results are amazing.

We call this new electronic antenna the POWERTRON. The Powertron amplifier uses the frame grid 6DJ8 dual triode (12,500 MHOS) transconductance, in a radical new RF circuit, that allows this one tube to amplify all signals in the VHF TV band, 54 to 216 MC, with a gain of 5 times (14 DB). This gain is added to the gain of the antenna which is a high gain yagi design, quite superior to other all channel antennas.

The Powertron power supply lowers 117 VAC to a safe 24 volts which is fed up the lead-in to the Powertron antenna. Completely fused, the power supply is made shock-proof by an AC isolation transformer.

Imagine what this super-powerful electronic antenna can do! Weak signals become strong and clear—dim pictures bright and contrasty. Old-style tuners pull in snow-free pictures better than 1961 models on ordinary antennas.

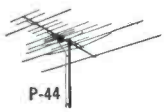
You can do many things with this new antenna that are impossible with any other. You can drive up to 6 TV sets in deep fringe, 10 TV sets in normal areas without an additional amplifier. You can put TV outlets in every room of the house and all sets will have better pictures than any single set with a regular antenna.

Because of its extreme sensitivity, Powertron can be installed lower than other antennas. For instance, where 40-ft. masts are normally used, a Powertron can usually be installed at 25 ft., yet give better results!

Where desirable, the Powertron can be remoted up to ¼ of a mile and still deliver a perfect signal.

In large distribution systems (motels, apartments, etc.), Powertron makes the perfect antenna to use in conjunction with Winegard's 4-tube A-400 or 7-tube A-700 distribution amplifiers.

For critical color, Powertron's extremely linear frequency response makes it the ideal antenna for your "color" installations.



To sum it up, Powertron makes weak TV pictures good, and good TV pictures even better. It *works equally well* for *color or black and white* reception. It is the world's first all channel (VHF) *electronic* TV antenna, and is a tremendous step forward in the search for improved TV reception.

3 Gold Anodized Powertron Models —

Powertron Model P-44, 14 elements **$74.95 list.**

Powertron with Power Pack Model P-44X, 21 elements, **$91.90 list.**

Super Powertron Model SP-44X, 30 elements. **$104.95 list.**

NEW TELETRONS, *TOO! NON-ELECTRONIC, BUT 26% TO 484% MORE POWER INCREASE THAN COLOR'CEPTOR*

Similar to the Powertron, but without the RF amplifier, Teletron embodies the same new WINEGARD "TAPERED T" DRIVEN ELEMENTS for proven performance superior to any other non-electronic TV antenna. Teletron is gold anodized, has the same fine quality construction and mechanical features as the Powertron.

3 Gold Anodized Teletron Models —

Teletron Model T4, 14 elements, **$34.95 list.**

Teletron Model T-4X, 21 elements, **$51.90 list.**

Super Teletron Model ST-4X, 30 elements, **$64.95 list.**

COMPARISON OF POWERTRON AND TELETRON MODELS TO WINEGARD COLOR'CEPTOR

Chart shows Gain and Power Increase over Color'Ceptor (CL-4) Antenna

Model		DB Gain Over CL-4	Power Increase Over CL-4	Voltage Gain Over CL-4
P-44	Powertron	14 DB	25.1 Times (2500%)	5.01 Times
P-44X	Powertron with Pack	15.8 DB	38.4 Times (3800%)	6.20 Times
SP-44X	Super Powertron	19.1 DB	81 Times (8100%)	9.0 Times
T-4	Teletron	1.0 DB	1.26 Times (26%)	1.12 Times
T-4X	Teletron with Pack	2.8 DB	1.9 Times (90%)	1.38 Times
ST-4X	Super Teletron	6.1 DB	4.84 Times (484%)	2.2 Times

GET IN ON THE POWERTRON — TELETRON PROFIT BANDWAGON!

Be first in your area to offer the superb Powertron performance to your customers. Take advantage of many new sales aids now available through your Winegard distributor . . . and watch for sales-making consumer ads in LIFE

Winegard

Winegard Co. 3009-2 Scotten, Burlington, Iowa

www.americanradiohistory.com

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

PHILCO Industry Firsts

Just Plug in and Play!

Philco Built-In Aerials Revolutionized the Radio and TV Industry

In 1949, Philco introduced the first built-in aerial for television. Overnight, it took the aerial off the roof and the roof off of TV sales, and came just 10 years after Philco's famous built-in aerial for radio. These developments opened up vast new markets, with increased profit opportunities for you. 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

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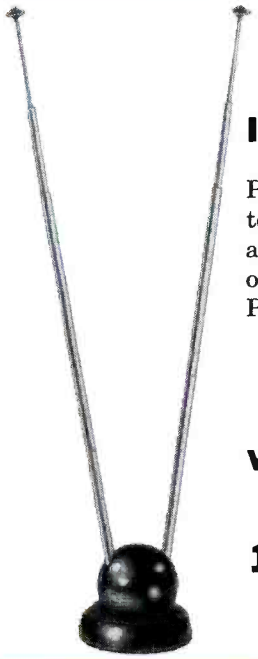
DON'T MISS THESE

FREE BONUS OFFERS

with your purchases of quality-first PHILCO® receiving tubes



DELUXE INDOOR ANTENNA

Philco 3-section telescoping antenna on non-tilting base. Every antenna you get on this bonus offer means extra profits for you. Part No. 426-0014.

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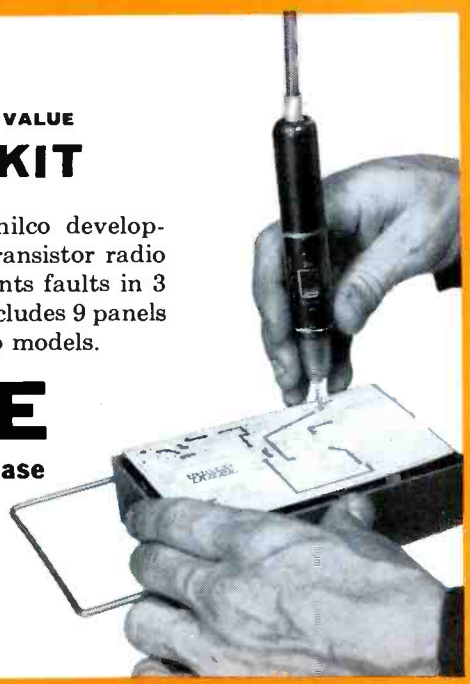

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PART 2

OPERATION

Broaden your knowledge of sync-coupling, in combined multivibrator-output systems.

Last month we outlined an effective method of servicing the combined vertical multivibrator-output circuit (CVC), based on a thorough understanding of circuit operation. In particular, we dealt with the version having sync pulses fed to the grid of the first stage, and the linearity control in the cathode circuit of the output stage. Now let's turn our attention to some variations in CVC design and see how these affect servicing.

Plate-Fed Sync

A more popular but less understood type of CVC which has been around for a long time is shown in Fig. 1. It is easily identified by the connection which feeds a negative-going sync pulse to the plate of the discharge stage. (Note C42 and W2 in Fig. 1.) This application of the sync signal makes the circuit seem more "different" than it really is, and many servicemen aren't sure about the exact effect of the pulses on circuit operation. Actually, the job of the sync pulse is the same as in last month's circuit—i.e., keying the discharge tube V8 into conduction. Once this is realized, the puzzle falls together with amazing ease.

To be sure, a negative pulse applied to the plate of V8 isn't going to key it into conduction, and even though the pulse is also coupled through C43 to the grid of V12, it isn't strong enough to drive V12 into cutoff. However, it can work indirectly. Since the output tube is conducting when the sync pulse arrives, this stage amplifies and inverts the pulse. The resulting positive sync signal is fed back to the grid of V8 to key it into conduction.

Note that the feedback circuit across the top of Fig. 1 is more complex than would be necessary for simple coupling of the pulses. The extra components are primarily for eliminating horizontal - sweep interference. Since the yoke is coupled directly to the autotransformer in the vertical output circuit, there's a definite possibility that yoke cross-talk will reach the multivibrator and interfere with its operation. Therefore, the pi-filter network consisting of C45, R73, and C46 is added to the feedback circuit to remove stray horizontal signals. A peaking circuit (C47 and R70) provides a more positive triggering action at the grid of V8.

The bias on V8 is regulated by adjusting the cathode voltage. An unusual feature is the use of two potentiometers in series — one an operating control, the other a service adjustment. Two factors determine the cathode bias: Voltage drop produced by cathode current through the controls, and voltage-divider action of the controls in series with R74 and R75 across the boost-voltage source. The grid circuit is returned to B+ through a high resistance (R72) to help V8 maintain correct bias.

One unusual feature of the output stage in Fig. 1 is the double-tapped autotransformer. In the winding below the B+ feed point (red lead), a signal inversion takes place, and a negative blanking pulse is obtained for the grid of the CRT.

Series Hold and Linearity

A more recent type of vertical circuit, rapidly growing in popularity, uses fixed bias (or a grounded cathode) in the output stage. The vertical hold and linearity controls are then connected in series as shown in Fig. 2. This Westinghouse circuit also happens to use an incoming sync signal of negative polarity; however, it is coupled to the grid of the output stage, rather than the plate of the discharge stage, to prevent attenuation by pulse division through C54 and C55. An amplified positive sync pulse appears at the plate of the output stage and is fed back as previously described.

The RC timing network controlling the frequency of the multivibrator consists of C52, the hold and linearity controls, and R62. A portion of the negative voltage de-

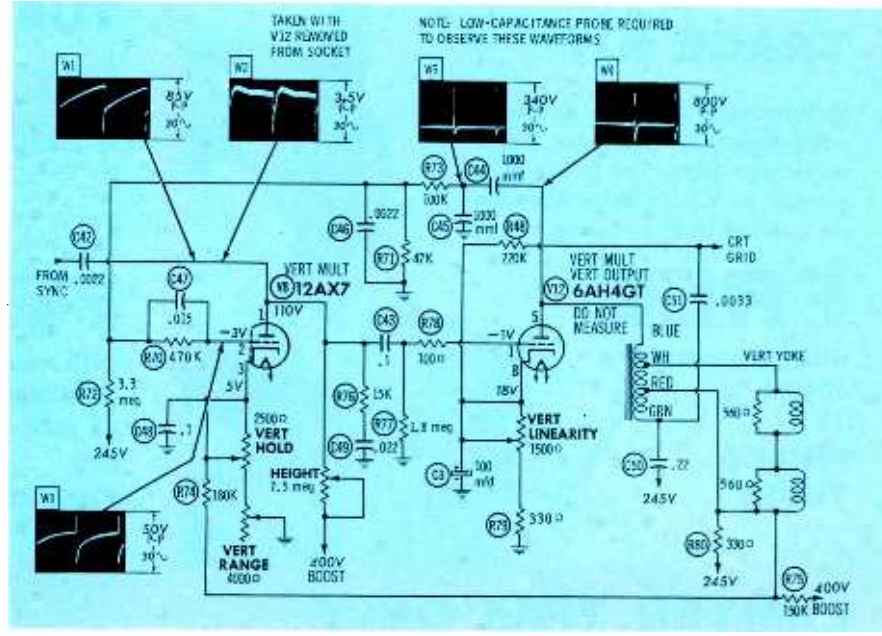

Fig. 1. Zenith Chassis 21K20 has a negative sync-pulse input to the CVC.

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VERTICAL

linearity, and feedback circuits

systems . . . by Joe A. Groves

veloped at the grid of the discharge stage is tapped off by the movable arm of the linearity control, providing a variable bias for the output-stage grid. In addition, the voltage drop across cathode resistor R66 provides fixed bias.

The discharge circuit between the two stages is a little unusual in that C54 has both discharge and coupling functions. (The "sawtooth-forming capacitor" in this set is actually a rather complex series-parallel network comprising C54, C55, C56, C57, and C1.) The resistors in this circuit are R60, the height control, and R61—the latter two forming a voltage divider across the boost supply. Although R66 is in series with the discharge network, it is bypassed by C1; thus, the drive signal does not have the usual trapezoidal shape, but is a nearly pure sawtooth signal (W1).

The output-transformer and yoke circuit is conventional, with an added modern feature—a *thermistor* connected between the yoke windings. This temperature-compensating component maintains proper height and linearity as the set warms up. It seldom causes trouble; however, if your picture is the wrong size and the output stage is functioning properly, don't overlook the possibility of a bad *thermistor*.

Remember the suggestions we made last month about twirling controls to localize the cause for collapsed vertical sweep? More specifically, if the output stage is working normally, a twist of the linearity control should make the raster line bounce slightly. Unfortunately, the circuit of Fig. 2 presents an exception to this rule. The line won't bounce unless the multivibrator, coupling and output circuits are all working. However, this circuit *will* respond to the height-control twist test; the raster line will bounce if the discharge network, coupling circuit, and output stage are in normal condition.

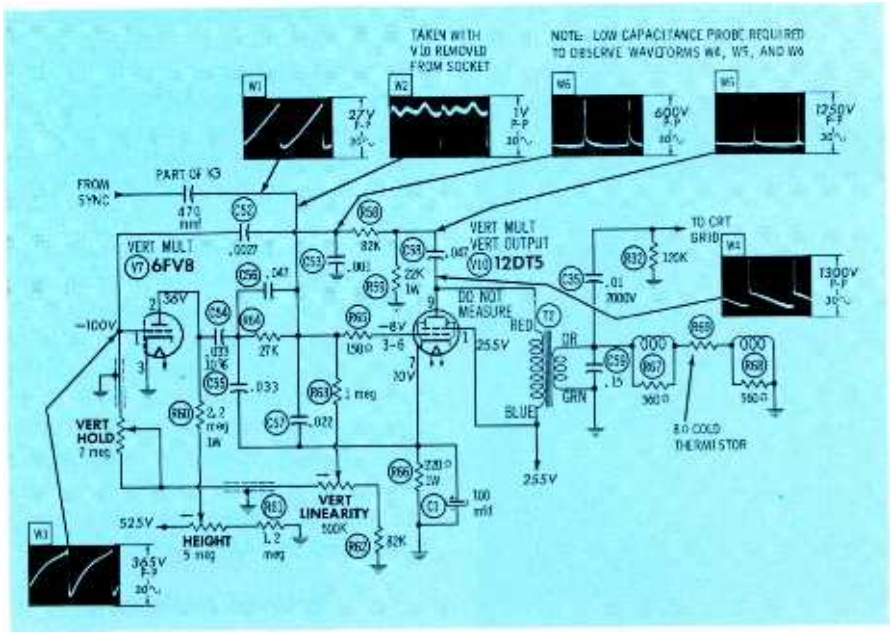

Fig. 2. Hold and linearity controls are in series in Westinghouse V-2389.

Some servicemen prefer injecting an AC signal from the filament circuit to trace the inoperative section. This is easily accomplished by connecting one end of a .05-mfd capacitor to a 6.3-volt AC source, and probing the circuit with the loose end of the capacitor.

Sync-Signal Check

In tracing the cause of off-frequency operation in a CVC, negative-going sync-input signals can be checked by the same methods as positive-going signals, as described in Part 1 of this article. However, in the type of circuit shown in Figs. 1 and 2, the incoming sync pulse isn't the *working* pulse, and it's preferable to see what shape it's in by the time it reaches the grid of the discharge tube. If you can pull this tube without disabling the output stage, interrupting the input-signal path, or breaking a series heater string, you can view the sync-pulse waveform by itself. Otherwise, you'd be better advised to throw the receiver out of vertical sync and view the pulses superimposed on the multivibrator-feedback waveform.

Fig. 3 is an intentional double exposure showing this combined waveform as it appears at two different settings of the scope's vertical gain control. (The observation point is the grid of V7 in Fig. 2.) The hold control was adjusted to roll the blanking bar about three-fourths of the way down the screen. The sync pulse appears as only a tiny pip on the 365-volt grid signal, although vertical expansion of the scope trace (and recalibration) discloses that the sync pulse has an amplitude of 22 volts.

Assuming that you find no defect in the sync-pulse signal, let's see what else you can do to determine the reason for off-frequency operation. (For sync-affected vertical troubles, refer to "Quicker Servicing" in this issue.) Since the conduction of the discharge tube is of prime importance in determining operating frequency, this is the stage you should consider first.

Grid-Cathode Circuit

In any triode stage supplied with adequate plate voltage, the grid-cathode bias relationship controls

• *Please turn to page 74*

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SNOWED UNDER
BY AN RCA KCS68C

A recent TV repair — which started out as a routine call for a new customer — turned out to be quite a "snow job." The initial trouble, no raster, was cured by replacement of the 1B3GT high-voltage rectifier. When I looked at the picture, however, it seemed to be more snowy than it should have been for the area. When I asked the customer about this, she said, "Yes, I've noticed those little flecks, but didn't think much about it. Lately, though, they seemed to be getting worse."

Judging from the nine-year age of the receiver, I knew the trouble could range from a defect in the keyed AGC circuit to moderate changes in tuner-component values. I immediately checked the action of the AGC control and tried new tubes in the AGC keyer, AGC clamper, RF amplifier, and IF amplifier stages. Noting a slight improvement, I checked the old tubes in the emission-type tube checker I use on home calls. Emission on one side of the 6BQ7 RF amplifier was definitely low, and some inter-element leakage showed up in the 6CB6 AGC tube. Still, I felt the basic trouble hadn't been cured, since the pictures for the two weaker stations in the area were a bit flecky — a condition that would prove most annoying once the customer had seated herself for an evening's entertainment. I carefully explained the situation to her and asked that I be permitted to take the receiver out for complete repairs. When she was assured the fault would not clear of its own accord, she consented.

The Thinker

Knowing that a couple of pretty good men had already worked on this set, I decided to give it the full treatment — beginning with a little study and thought. In looking over the circuit diagram for this particular RCA, I found that the cascode tuner fed into a four-stage IF system—plenty of stages to provide a snow-free picture.

The AGC circuitry caught my eye. This receiver used one of the early keyed AGC systems that differs greatly from those found in modern sets. (See Fig. 1.) Instead of the usual video signal being at the control grid of V8, a .1-mfd capacitor (C60) assured that the only voltage at this point would be pure DC. How, then, was the conduction of V8 going to vary in accordance with the strength of the incoming signal? The AGC control provided adjustment of the "fixed bias" of the stage, but wait—it's in the cathode circuit of the two sync separators! That's where the variable bias comes from. The video signal regulates the bias of the separators, and any change in signal level is reflected in a corresponding change in current through V14. Since the left-hand triode of this stage serves as a cathode follower, any change in the current through R92 and R100 would change the DC voltage at the grid of the AGC keyer stage.

With this knowledge, I began to realize that all the waveforms and DC voltages of these stages had to be correct for proper AGC action. Then the real complexity of the problem came to light. All these signals, and some of the DC voltages, develop from the video signal which, in turn, is supplied by the RF and IF stages, the latter being controlled by AGC action!

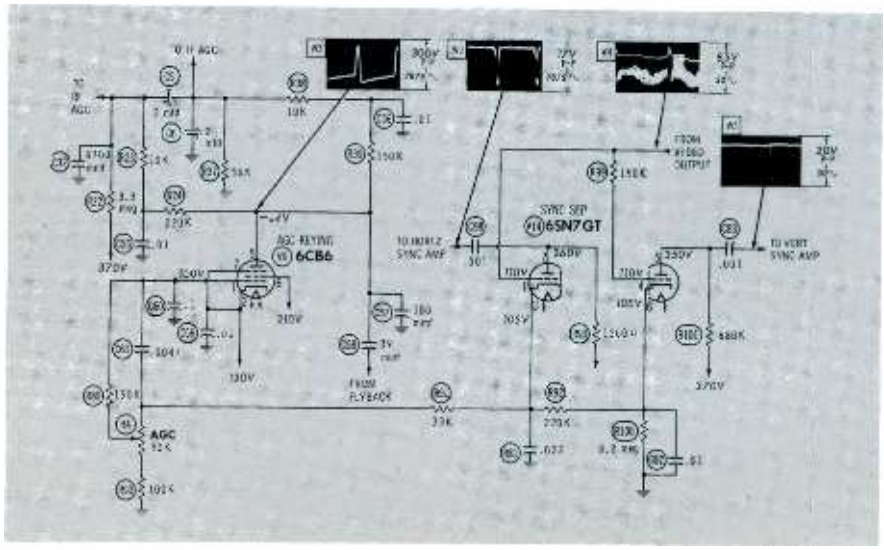

Fig. 1. A defective resistor in KCS68C AGC circuit "helped" make the snow.

Rescued with Bias

I decided to verify the wave-

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forms first. With a low-capacitance probe connected to my DC oscilloscope, I looked at the waveforms associated with the circuits of Fig. 1. The composite video signal was a little shy of the amplitude indicated on the schematic, but this didn't seem to affect the sync waveforms. AGC potentiometer R4 had fair range and good control over the input voltage to the AGC keyer, and the spikes at the plate of V8 were slightly higher than the 300 volts indicated. Another glance at the picture convinced me that the snowy condition still persisted.

Firing up a transistorized variable bias supply I'd purchased recently, I connected the positive lead to chassis and the negative lead first to the plate of the AGC amplifier, and then to the junction of R37 and R38. In both instances, an increase in negative voltage caused both picture and sound to cut out. Remembering that the problem seemed to be lack of signal, I reversed the bias supply leads and connected them to the same points. This sent the IF and RF amplifiers into saturation, compressing the sync pulses and distorting and blanking out the picture. Now, even with my well-thought-out approach, this puzzle began to assume slightly larger proportions. "One more try with bias voltage," I thought, "and then we'll go for the tuner." Connecting the positive lead to the AGC line—but this time at the junction of R23 and R24—I was happy to see that with just a little positive voltage, the snowy symptom disappeared.

My problem, it seemed, was solved. But where was the (s)thinker? I hauled out my VOM and measured the resistance across C32. There was nothing unusual. Next, I disconnected R22 from the 370-volt line and measured across it. The reading on the ohms scale was well over five megohms. "Now we're getting somewhere," I thought, as I soldered in a new resistor. When I turned on the set and looked at the picture, however, I wasn't so sure. The flecks didn't seem to be as prominent, but I still wasn't convinced that this set couldn't do better. A quick check of the voltage on the RF AGC line showed it to be okay—now what?

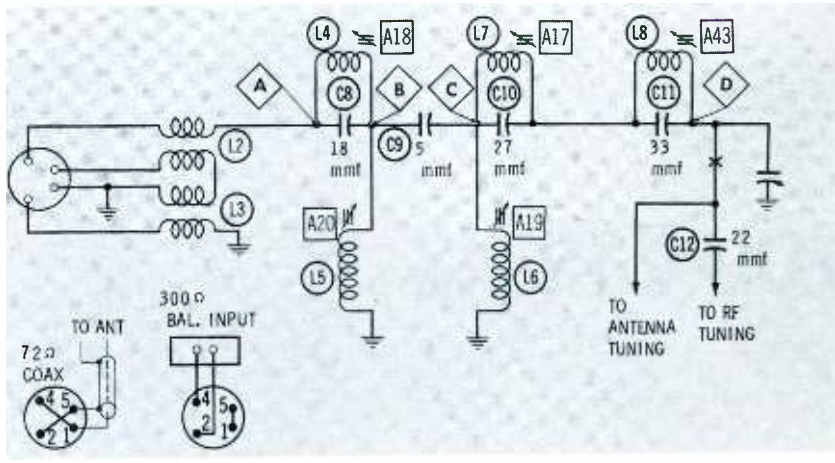

Fig. 2. A complete check of the antenna input circuit solved the problem.

The Tuner?

If any further improvement could be gained, I felt the tuner held the answer. My VOM was handy, so I chucked a couple of socket adapters in the tuner and measured voltages around the RF stages. These checked out almost precisely as shown on the schematic, indicating that perhaps the tuner didn't hold the key to the solution after all. But I still had one more ace up my sleeve.

Voltage measurements couldn't provide a true picture of dynamic operation, so I sought out the tuner-alignment information from the service data, hooked up my sweep-marker generator, and checked the over-all response curve of the tuner on several channels. While the waveshapes looked okay, and the carrier-signal markers were positioned correctly, I had to use almost all the generator output to push a signal through. And although the sensitivity of this older tuner couldn't compare with those used today, it seemed as though it should do somewhat better. As long as the equipment was all fired up, it wouldn't take long to make a stage-by-stage response check.

With the sweep generator already connected across the antenna input terminals, and the scope connected to point D (Fig. 2), I checked the response of the input circuit. As you'll note from the schematic, the antenna input can be hooked up for a 300-ohm balanced or a 72-ohm unbalanced input. Having already used up most of my thinking power by this time, I didn't pay much attention to this point until a little later—but just in case you encounter a receiver with this type of input circuit, you may avoid a "snow job" by checking the matching-network connections. It was my good fortune to discover — before giving up and returning this particular set — that it was hooked up for a 72-ohm input! Once this was changed to 300 ohms, the last of the snow melted away.

Before reaching this point, however, my explorations took me through a thorough analysis of the tuner. This included a complete signal-tracing procedure and a component-by-component comparison of part values with those shown in my service literature, as well as a check for circuit modifications. Try as I might, I just couldn't find the

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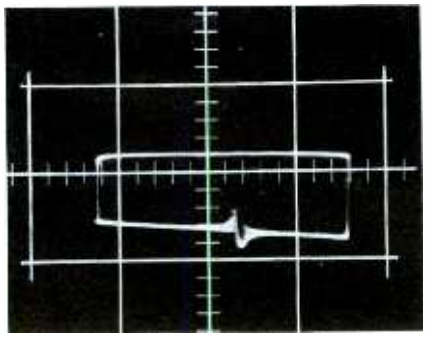

Fig. 3. Normal indication when 70-mc signal is fed to antenna input socket.

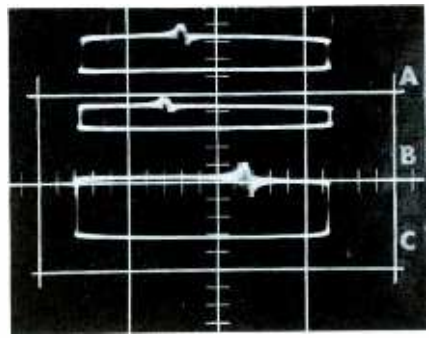

Fig. 4. Tracing through the antenna input circuit provided these waveforms.

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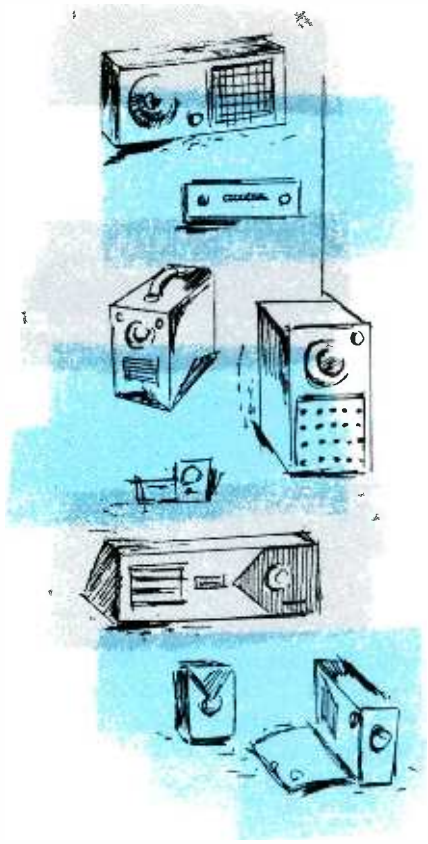
YOU CAN FIX SMALL RADIOS



by Harold Davis

Walking into a friend's shop the other day, I found him engaged in what is becoming one of his favorite pastimes—cussing a small radio. I watched him blunder around until I could stand it no longer, and dragged him away for a cup of coffee and some helpful conversation.

"You know something," he griped, "I'd rather fix half a dozen TV sets than one radio. Why do those things give me so much trouble?

"Do you want information or conversation?" I asked.

"Go ahead. I can take it."

"You haven't any technique," I replied—and that applies to most of us. The youngsters arriving on the scene during the last few years have taken radio for granted and have devoted all their attention to TV. Many old-timers have likewise been so engrossed with the intricacies of the "look" business that they have neglected the "listen" field. And yet, the difference between finding troubles quickly and blundering around blindly is primarily technique.

A radio will almost tell you what's wrong with it, if you will listen. Let's assume you're working on a standard 4- or 5-tube superhet. We'll take it for granted that you have eliminated tubes, which even a housewife can replace. As in any troubleshooting technique, the first step is to analyze the symptoms. Radio troubles usually fall into one of three categories.

1. Dead. No sound of any kind, not even hum.
2. Alive, but no voice or music.
3. Weak and distorted sound.

There are two kinds of "dead." One is caused by lack of signal at the speaker voice coil; the other is a result of no B+.

When absolutely no signal reaches the voice coil, it's usually the result of one of two things—either the voice coil or the output transformer is open. To find out which, you can scratch the voice-coil terminals with a probe from an ohmmeter set on a low scale. Or, you can use a flashlight battery. If the speaker sounds when the flashlight terminals are connected across the coils, it is okay. If not, it is open.

To find out about the transformer, measure the voltage at the plate lead (invariably a blue lead). Then measure the voltage at the red lead, which goes to B+. Voltage on the red lead but not on the blue means the transformer is open.

Lack of B+ is almost always caused by a defective rectifier tube; if the set uses a dry rectifier, there will usually be some voltage. The TV man has not only neglected keeping up to date on radios, but also has neglected his radio tube stock—so half the time he doesn't have the ones he needs. If a tube is not available, connect a small rectifier in parallel with the tube, from plate to cathode, but be sure the + terminal goes to the cathode. If the trouble is being caused by a bad tube, you'll know it in a matter of seconds. The filaments must be intact, of course, so if a 35Z5 is being used, and its filament is open, you can put a 25L6 in the socket temporarily to complete the circuit. Incidentally, if you ever run across a set with two 25L6s and no 35Z5, look under the chassis to see if someone has heard about this trick ahead of you.

Although helpful, it's not really necessary to have a schematic diagram when checking voltages on a standard tube-type radio. Once you find a place to check from, you're on easy street. And the best place to check from is B-minus—easily identified as the black wire on the filter capacitor, or as the can of metal electrolytics. Connect the negative lead of the voltmeter to this point, and touch the positive lead to the points shown in Fig. 1. First, check the red and blue wires coming from

• *Please turn to page 72*

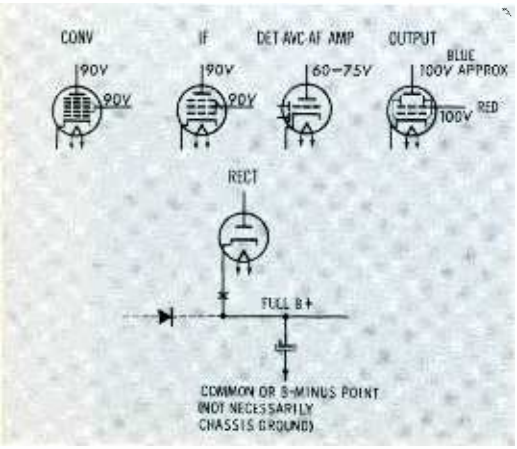


Fig. 1. Check points in the B+ system of a typical small superhet radio.

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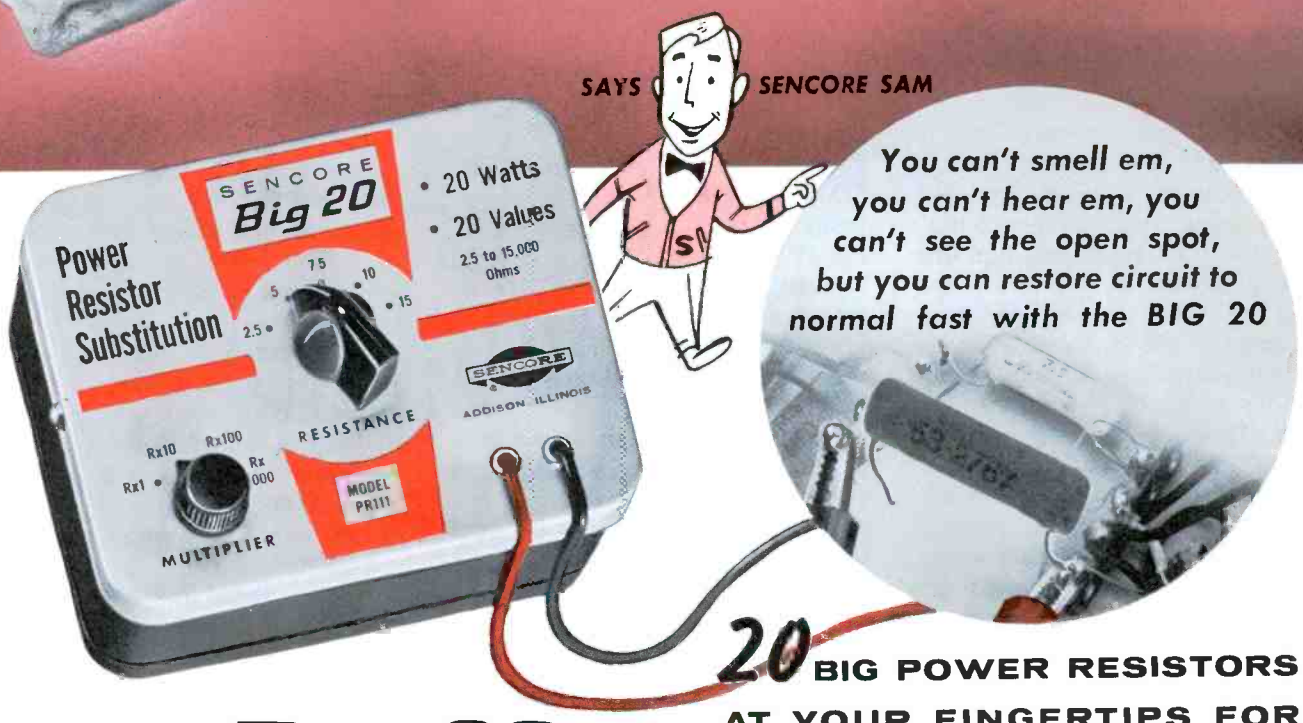

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Most of us are unwilling to admit that as human beings we're basically a selfish lot. We start learning "peaceful coexistence" from the time we throw our first temper tantrum as an infant and wind up with a warm posterior. We learn of the rights of others—often the hard way—and are taught that it's better to give than to receive. However, our own personal desires, gains, and well-being continue to influence many of our decisions and actions. While most of us reach a point of maturity where we respect the opinions, rights, and privileges of others, we retain an inborn desire to look out for ourselves and those who are very close to us. How successful we are in attaining our objectives depends as much on how we get along with people as it does on our technical proficiencies. So, because we want to be liked and admired, we develop an ability to get along with and show an interest in others.

For those of us in the electronics servicing business, it's imperative that we realize our own motivations in relations with the consuming public — whether we're "the hired help" or the "boss man."

But what about a customer's motivation? For example, think of some of the questions in a consumer's mind when faced with the necessity of their selecting a service company. "Are they honest? Competent? Can I depend on them?" "Do they really know what they're doing? Are they making a sucker out of me? Have I been selected as their special meal ticket? Is my set a lemon? Should I have bought brand Y instead of brand Z?" You see—the customer is thinking of his well-being, too.

Most of us realize the importance of developing and maintaining good customer relations in reaching our own goals. Understanding the customer's desires thus provides the groundwork for determining our own actions whenever one of these knotty customer situations arise.

Keeping in mind that "your way" means retaining your customer as a contributor to your financial well-being, it becomes obvious that sometimes it's going to take some delicate handling to "let the customer have your way." Take for example, the case of Suspicious Sam.

The first time you encounter Sam Snyder is during a call at his home to fix a "no light" complaint. He lets you in, points out the TV, and breathes down your neck to observe your every move. Removing the back takes only a minute; you plug in the cheater cord and wait. Meanwhile, you ask Mr. Snyder what happened when the set failed. For a response you get, "Young man, if I knew that, you wouldn't be here." Earlier suspicions prove correct—you're walking on eggs.

As the audio comes on, you don't hear the horizontal - frequency "sing" and you can't draw an arc from the 1B3 plate cap. Pulling the plug, you reach for the fuse; it's a slow-blow type, and you immediately see that it's shot. Slipping in a replacement, you try again. Same deal—audio, but no sing and no arc. A quick check tells you the fuse is gone again.

As the troubleshooting continues, you refer to a schematic. Sam erupts, "Why don't you do your studying at home? Don't you know how to fix it, or are you just running up my bill?" Inside, you do a slow burn. Those words dig deep.

Forcing a smile, and remembering you're there to "let the customer have your way," you take special care in controlling your voice as you answer. "I'm sorry to hear you say that, Mr. Snyder, because it means you must have had a bitter experience with someone else. However, we pride ourselves on our honesty and competency. This schematic gives me specific information about your set so I can do the job faster and save you money. If you like, I'll give you the names of some of our customers who live in this area, and you can call them to see what kind of a recommendation they give before I continue my work. Then, if you'd rather, I'll reassemble your set and there'll be no charge."

It takes a lot of self-control not to tell such a customer what he can do with his set. But if you remember your "selfishness," and think of the lost business such action will mean, you'll retain your pride *and gain business* by using truth and reason to "let the customer have *your* way." ▲

EDITOR'S NOTE: The customer situation in this article is adapted from a section of the new Howard W. Sams publication, "Satisfying Customers for Profit," an Electronic Industries Association project.

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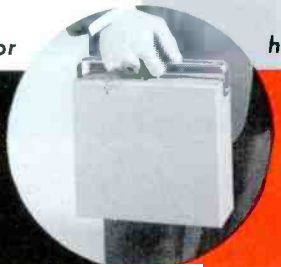

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PF Reporter, Nov., 1960, page 65 . . .
"When putting the Model TC109 to work in the lab, I tried to 'trip up' the tester by throwing a few curves at it. Using my prized collection of rejected tubes that have mostly 'tough dog' defects, I proceeded 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."

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.

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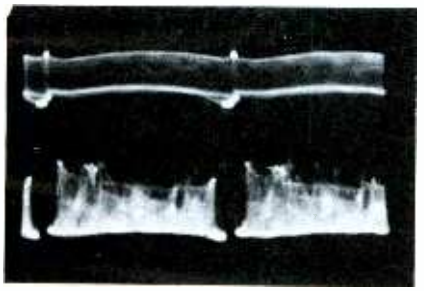


Fig. 1. Normal composite video signal at control grid of sync separator.

To be technically correct, sync problems must be defined as those troubles originating from a malfunction in a stage specifically designed either to separate sync information from the composite video signal, or to amplify sync information before or after separation.

Stability problems are often identified as sync trouble when the fault is in some stage completely foreign to the sync circuits. As a result, much time is wasted in checking circuits that are functioning properly. This pitfall can be avoided by making three simple tests.

The first test is to check the waveform at the control grid of the sync separator. It should appear as shown in Fig. 1. You may find a slight amount of compression if you use a direct scope probe — that's normal. If there's excessive compression, however, or if hum modulation is present, look ahead of this point for trouble and forget the sync stages.

If the sync-input signal is OK, the next test is to determine whether the trouble is in the sync or the sweep stages. Disable the horizontal AFC, as well as the vertical oscillator circuit, so the sync output signals can be viewed in their "raw" state. Fig. 2 shows the normal waveforms you should obtain. If these are OK, forget the sync circuits completely and look for trouble in the sweep circuits. If the waveforms are distorted, you can be sure you have sync-circuit trouble, and can begin tracing it to the source.

The sync separator is normally the first, and often the only, stage in a sync circuit. Occasionally, you may find a stage of preamplification similar to a video amplifier without peaking coils; if so, you'll probably find the sync portions of the signal accentuated by a peaking circuit consisting of a capacitor and resistor connected in parallel in the take-off path.

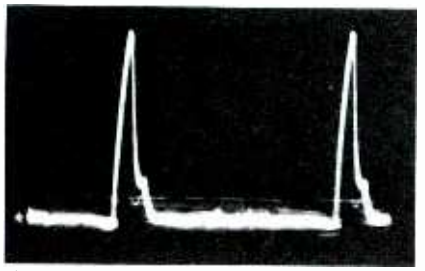
Normally, you can spot the sync-separator circuit rather easily. Most of the newer sets use a 'BU8 tube as an AGC keyer and sync separator. It's easy to tell which half is which by looking at pins 6 and 9—the two signal-grid connections. The grid of the separator will have a high-value resistor connected to it; 2.2 meg is the most popular size, but it may range from 1 meg to 6.8 meg.

This high-value resistor and the input coupling capacitor form the grid-leak circuit; bias on the tube is thus determined by the level of the incoming signal. With no signal applied, tube conduction is maximum. This normally drops the plate voltage to some very low value. With a signal at the grid, the bias builds up to a negative DC value approximately equal to 75% of the peak-to-peak level of the incoming signal. A check of the input waveform and an interpretation of the DC bias completes the third test. If these aren't up to par, you're on the track of the sync problem.

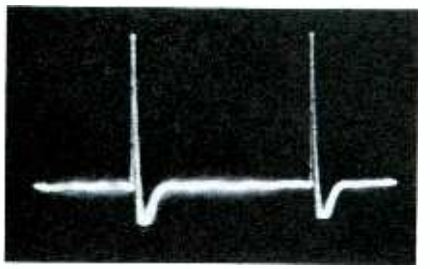
In tracking down a specific component defect, it's often best to check sync-circuit voltages with no signal applied. Under this condition, the tubes are at maximum conduction and voltage discrepancies are more meaningful. With a signal applied, it's difficult to tell just what the various voltages should be, or whether discrepancies are due to signal distortions or circuit defects.

Voltage checks will lead you to leaky or shorted capacitors, and to resistors that have changed value. In the popular 'BU8 circuit, you'll want to check the bias voltages between the noise-control grid (pin 7) and cathode (pin 1), as well as the bias between the signal-control grid and cathode. Incorrect voltages in either bias network indicate that the stage is not capable of properly separating the sync and video portions of the signal.

It's important to remember that screen voltage affects the output signal as much as plate voltage.



(A) Horizontal—scope set at 7875 cps.



(B) Vertical—scope set at 30 cps.

Fig. 2. Normal sync output signals to horizontal and vertical circuits.

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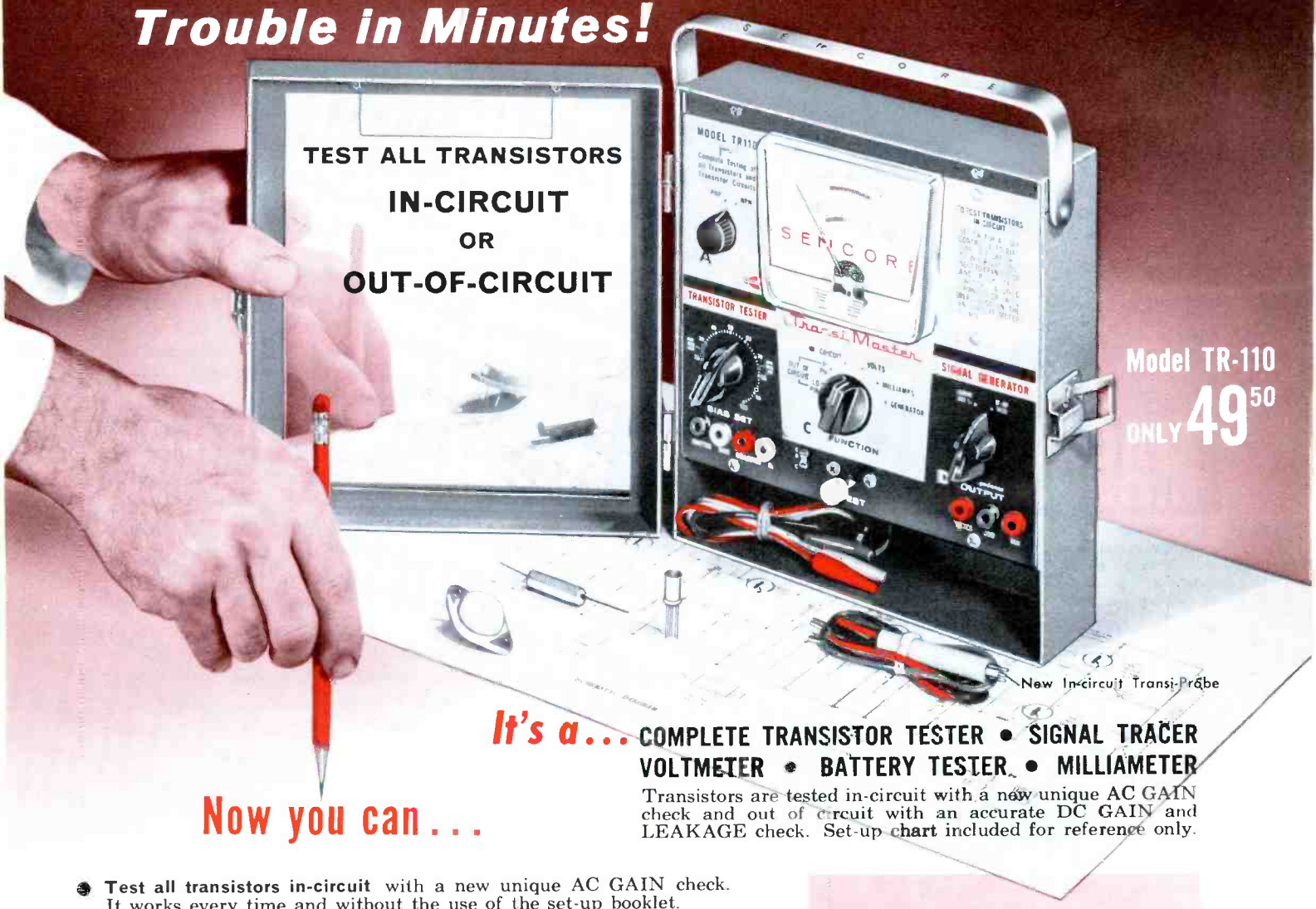

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Transistors are tested in-circuit with a new unique AC GAIN check and out of circuit with an accurate DC GAIN and LEAKAGE check. Set-up chart included for reference only.

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- **Signal trace** from speaker to antenna with a special low impedance generator. No tuning, adjustments, or indicating device needed for transistor radio trouble shooting. Just touch output leads to transistor inputs and outputs until 2000 cycle note is no longer heard from speaker. (Generator output monitored by meter.) It's a harmonic generator for RF-IF trouble shooting and a sine wave generator for audio amplifier trouble shooting.
- **Check batteries** under operating conditions as well as the voltage dividers with a special 12 volt scale.
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Benefit from these Sencore extras

- Lists Japanese equivalents.
- Automatically determines NPN or PNP.
- Mirror in detachable cover to reflect opposite side of printed board.
- Special clip to fit between batteries for current check.
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Color	modern two tone gray
Size	8" x 7⅝" x 3"
Weight	only 5 lbs.
Meter	0 to 3 Ma, 3½", 5% tolerance, modern plastic
Batteries	two size "C" cells

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Therefore, the plate and screen voltages should both be checked very carefully.

Simple clipper-amplifier stages are sometimes used after a triode separator to provide cleaner sync. However, the most common second stage in sync circuits is a phase inverter, providing positive sync signals from its plate and negative signals from its cathode. Equal portions of the horizontal signal, with opposite polarities, are taken from the plate and cathode circuits. These signals are applied to the horizontal AFC circuit through coupling capacitors and AFC load resistors which have a short RC time constant; thus, the signal voltages developed at the AFC detector are unaffected by vertical sync pulses.

Vertical sync pulses are normally taken directly from the plate of the phase inverter and fed to the vertical oscillator through an integrator circuit. The RC time constant of the series resistors and shunting capacitors is sufficiently long to filter out horizontal-frequency fluctuations.

Again, as in the sync separator circuits, the voltmeter can help pin down leaky and shorted capacitors, as well as drastic changes in resistor values. However, the more difficult problems, causing only minor variations in a sync circuit's performance, are more easily pinned down through the use of a scope, or by signal substitution. Invariably such troubles can be traced to capacitors which have changed value or become open, or to slightly off-value resistors.

Signal Injection

The growing popularity of signal-injection testing is understandable when you consider its usefulness in providing a quick and easy check on the ability of one or more circuits to process a signal. Of course, the trend toward the use of printed circuitry, and the influx of transistor radios, has also stimulated the use of this troubleshooting technique. However, development of compact, self-contained, versatile signal-injection units has probably been the greatest contributing factor in popularizing this method of servicing.

One such unit, the Eby Model 59-01 *Signal-Jet,* uses two transistors in a free-running multivibrator circuit powered with a self-contained 3-volt battery. It generates a signal having a fundamental frequency of slightly over 1000 cycles, and rich in harmonics. This basic frequency, being in the audible range, is useful in tracing any audio circuit. The harmonics will pass through AM and FM tuned circuits; therefore, it is possible to inject test signals at any point in the signal path of a standard AM or FM broadcast receiver.

The output level of the *Signal-Jet* is continuously variable from 0 to 3 volts peak to peak, thus providing control of the input-signal amplitude during troubleshooting, and for calibration purposes.

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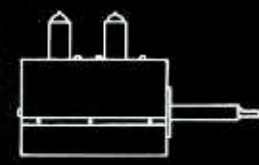

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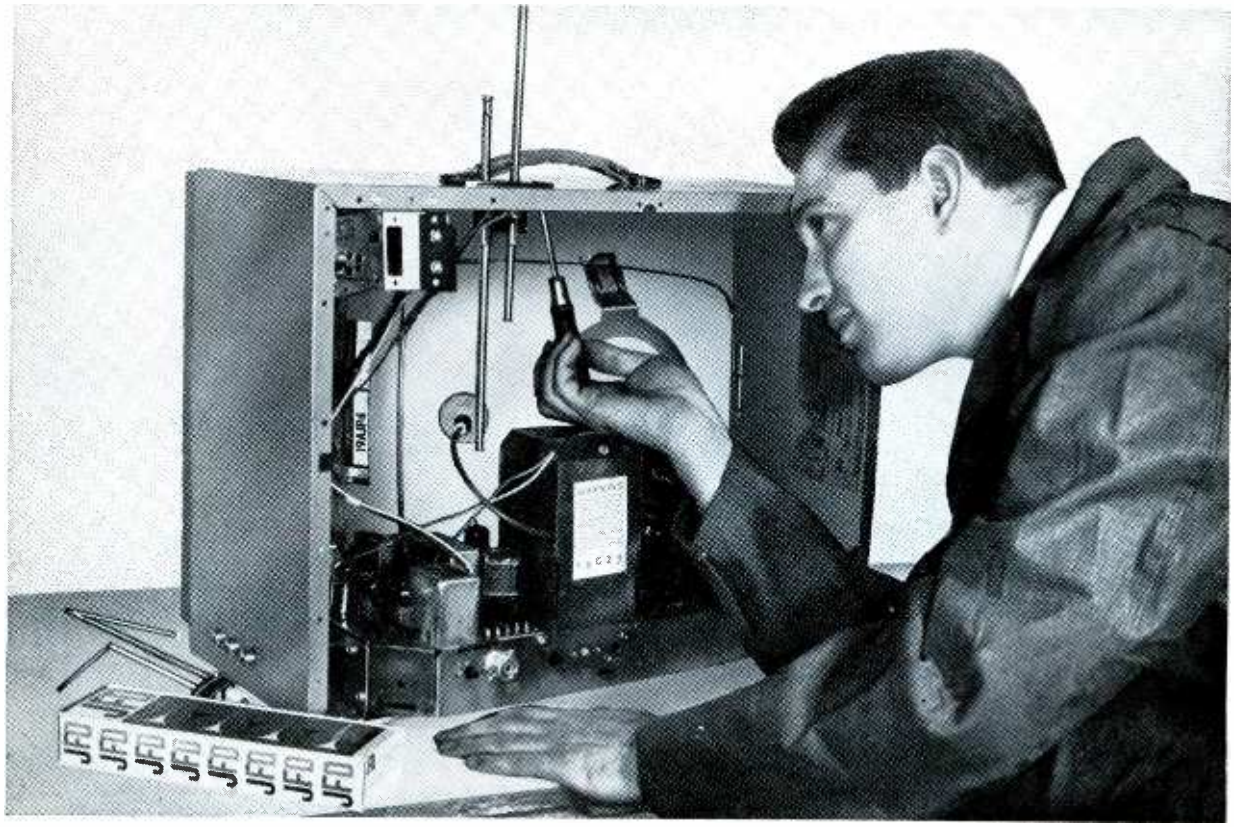

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THE PLACE: Thousands of service shops all over the U. S. A.

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ANTENNA INSTALLATION NEWS

VOL. 1, NO. 1 PUBLISHED FOR THE BENEFIT OF SERVICE DEALERS EVERYWHERE FEBRUARY, 1961

1961 Predicted As Banner Year

Local Hotel to Install TV Sets in Each Room

BANEVILLE, OHIO — The Bel-Grove Hotel, currently undergoing redecoration and modernization, has awarded ABC Electronics, a local electronics servicing firm, the contract for installing a master TV antenna system. Mr. Jacob Bell, manager of the hotel, said 110 rooms will be equipped with 19" sets, while each of the 10 suites will have a 23" set.

When asked for comment about the contract, Mr. W. A. Watts, who manages ABC Electronics, said the system offered some problems peculiar to this area. The local firm was awarded the contract since they are more familiar with handling these problems. Mr. Watts pointed out that the system will tune in three UHF channels, at unused VHF positions, by means of master UHF converters installed at the distribution point. Channels 3 and 7 will be received by high-gain antennas mounted on top of the 10-story hotel. Although these channels are not available to most homes, the height

(See Page 2, Col. 1)

Do-It-Yourselfer Saves $20, Loses Life

Wilmont, N. J. — Tragedy struck this afternoon when Mr. I. R. Wise was electrocuted while installing a television antenna on his home. Mr. O. L. Gates, a neighbor helping Mr. Wise, witnessed the accident. He said there was a blinding flash and Mr. Wise fell from the roof dead. The antenna apparently touched a nearby 7,200-volt power line.

Mr. G. A. Mann, president of the local Radio and Television Servicemen's group, said the labor charge for the installation would have been approximately $20. "Accidents like this happen throughout the country. I wish people would become aware of the dangers involved and trust such jobs to reputable firms skilled in the techniques of making such installations," he said.

Consumer Antenna System Sales to Top $200 Million

HILLSIDE, N. Y.—"1961 should be one of the biggest years for sales of TV antenna system materials." So predicted Mr. Arthur Allen, Chairman of the Northeastern Conference of Parts Distributors, last night's dinner speaker for the NCPD convention being held in this city.

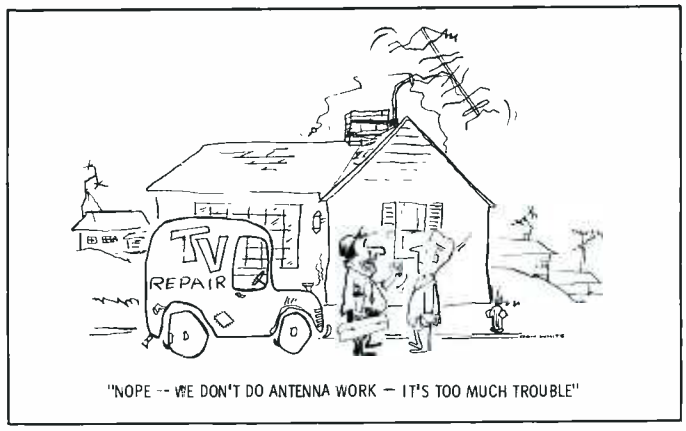
In his address Mr. Allen pointed out that sales to consumers of TV antenna-system products should top the $200 million mark. He further stated, however, ". . . although this figure may sound impressive, there is definite indication that dealers are overlooking the possibilities of even greater sales potential in this field.

"Our sales volume of rotators, towers, masts, lead-in wire and cable, distribution systems, stand-offs, guy wire, and all the components associated with TV antenna installations is not in line with new set sales and new home construction . . . to say nothing of the tremendous potential represented by the replacement market," he declared.

Mr. Allen hastened to point out, "We have ourselves to blame for being negligent in the promotion of antennas and accessories. The consumer market is there — a tour around any residential area will prove that," he said. At this point, Mr. Allen showed a series of slides which graphically illustrated the need for antenna repairs and replacements.

"I've seen antennas with two leads connected to them, installations needing towers, lead-in running through metal windows instead of regular entrance insulators, and many broken and missing antenna elements. At my friends' homes, I've watched TV pictures that blink and flash because of broken leads, pictures that have "ghost" images from

(See Page 3, Col. 1)



"NOPE -- WE DON'T DO ANTENNA WORK — IT'S TOO MUCH TROUBLE"

Lightning Guilty, Hearing Date Set

LAMENT, ORE. — Prosecutor Joe Jewel reported today that his case against the notorious Mr. Lightning is nearly complete. Subpoenas have been issued to all witnesses, and the hearing is scheduled for next Monday is Judge T. V. Viewer's quarters.

Confident of conviction, the prosecutor has based his case upon facts revealed during a recent TV investigation. Mr. Jewel first suspected foul play when he received a call concerning a snowy TV picture. Investigation showed the receiver's balun coils had been burned to a crisp.

As he pieced together clues gathered through painstaking research, the complete story began to unfold. The first breakthrough came when it was discovered that a line filter capacitor had shorted. Theorizing that the "hot" side of the AC line may have been connected to the shorted capacitor, the possibility of a gounded antenna offered the next avenue of search. When investigators reached the scene of the crime, they performed a preliminary check of the antenna by connecting a neon lamp between the power-line and antenna-lead conductors. When this resulted in a faint glow, an AC voltmeter was used to confirm the existence of a 117-volt potential between the "hot" AC line and one antenna lead. Further tracing revealed the lightning arrester was the culprit completing the circuit. Mr. Jewel feels confident he can prove his case, stating, "Smoke smudge along the arrester ground lead proves, beyond a shadow of a doubt, it had to be Mr. Lightning."

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The Roving Reporter

Frank Fields

This week's jaunt took yours truly over our beautiful rolling countryside to see how signals from our four local TV stations are received in various areas. The question popped at TV service dealers was, "What does it take to get a good picture on Channel 4, 6, 8, and 13?"

Our first stop was at Bill's TV in the center of the city. Bill Weaver owns and operates his own shop and had this to say: "Most of our customers get all of the channels OK with an indoor antenna. A few, who live behind large buildings, or out in the hilly area north of here, need outdoor antennas and a rotator to overcome a severe ghost problem."

The next area we surveyed was about 20 miles out. Here we talked to Pete Johnson, owner of Johnson's Electronics. Pete is in the antenna installation business in a big way, and covers an "outbound" radius of about 40 miles. He had some real good dope for us. "We cover the entire zone-2 area over this way, and run into some pretty rough fringe-area spots.

"Around here a normal installation consists of an outdoor antenna in a fixed position. Some spots require a double-stacked array, others a single. There's a valley east of here where we have to install towers or guyed telescoping masts, although we find ourselves selling more towers these days in good signal areas than out in the fringe, primarily because of homeowners' desires to avoid the mounting of antennas directly on the roof or chimney.

"Just a few miles farther out marks the true beginning of the fringe area. To get good signals requires a tower on most installations — some of them 100′ jobs. Generally, a rotator is used, and some installations require stacked high-band and low-band antennas. We've installed amplified systems, mostly where multiple outlets are required, but a few even on single-set installations out in the shallow fringe area."

We thanked Pete and headed "way out." We ended up in front of Gary Brown's place — ACE TV. We were about 80 air miles from the stations—a little over 100 miles from Channel 4. Gary said we'd penetrated the wilds of VHF fringe. It was also a fringe area for five UHF channels. A look at his antenna setup and we were believers.

Gary had a beautiful 150′ self-supporting tower, stacked high-gain, highly-directional VHF antennas, an impressive UHF array, and a mast-mounted mixer-amplifier feeding the signals down a single RG-11U coax cable to a distribution amplifier. The results were certainly pleasing. We watched three different Channel 6's, all of **our** stations, and some real fine UHF.

Gary serves customers in all directions from his "in-between" spot, and really promotes antenna installations. "After all," he said, "We get more profit out of an installation than we could from a set sale!" You've got something there, Gary.

Hotel to Install Sets

(Continued from Page 1, Col 1) of the receiving antenna, and the increased amplification of the hotel's system, will provide good pictures. When asked about the local station. Mr. Watts said special steps would have to be taken to reduce the signal to a usable level; however, the type of distribution amplifiers used would take care of this.

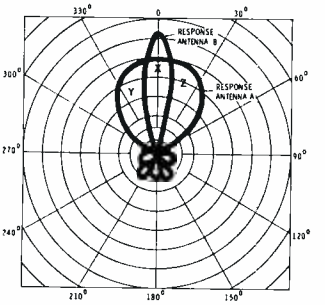
Polar Expedition Finds Way to Eliminate Snow

Survey Proves Rotator Required

Daleville, Tenn — A spokesman for a group of local TV service dealers reported yesterday that a recent survey on TV signal reception problems in Daleville indicates an antenna rotator is needed in most surrounding city and surburban areas. "Multiple antennas can be used," he said, "but generally we've found a highly directional antenna and rotor does a better job of providing the best signals." Asked why this was so, he pointed out that the transmitting towers for the three stations serving the area were located in different parts of the city. Consequently, their signals arrive at most homes from different directions. Furthermore, the hilly terrain to the north results in "ghost" signals which cause the double-image effect noticed mostly on Channel 9.

"Most firms doing installation work in this area plan to include a rotator in a standard installation, particularly in the more troublesome areas. The units won't cost the customer even a penny a day in the long run, and the improvement in reception will far outweigh the cost," he said.

The polar graphs used to show an antenna's response characteristics tell a vivid story, and should be considered carefully when selecting an antenna.



Directional characteristics and gain factors can be quickly determined from a polar graph. The circular scales are graduations of gain, while the straight line portions represent direction. Therefore, studying the graph patterns of various antennas will permit you to select the right antenna for any given job.

The illustration shows the typical response lobes of two antennas; locations X, Y, and Z represent three TV stations. If three different channels are represented by the transmitting stations, antenna A is the proper choice for the receiver. However, if some of the transmitters are on the same channel, the more directional pattern of antenna B shows it to be the best antenna for the job.

"Marion will soon have TV," announced Mr. J. R. Crandall, Chairman of the new local firm, Community TV, Inc. "The FCC has approved our application for a translator station, and by fall we should be on the air.

"We'll pick up Channel 8 from Koceba — which is 100 miles away — and rebroadcast programs for this community on Channel 74. Many of the local citizens seem to be delighted at the prospect of having good TV." Mr. Crandall is shown with the type of translator unit to be installed.

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Home Show Features TV in Every Room

Big Horn, Tex.—The model home at this year's home show is particularly designed for easy living. According to Mr. L. T. George, chairman of the home show planning committee, a master distribution system will provide TV antenna outlets in every room, and on the patio as well. Recognizing that the ladies like to rearrange furniture, some rooms will have several outlets.

Local firms providing antenna installation services will sponsor a booth showing several methods that can be used in existing homes to modernize their TV systems. Flush and surface outlets will be connected to various types of distribution systems to show how multiple sets can provide "living-room quality" pictures throughout the home. A wide range of antennas, rotating devices, UHF converters, and UHF antennas will also be shown. Mr. George said, "Major emphasis will be on overhauling existing antenna installations to have them ready to receive the new UHF station scheduled to begin operation."

1961 Banner Year

(From Page 1, Col. 3)

poorly-directed antennas, and pictures so snowy you'd never guess there was a double-stacked antenna on the roof.

"Display merchandising alone will not overcome the lax attitude of most servicemen. In our store we display blowups of these slides, and we try to impress each and every service dealer with the highly profitable aspects of antenna sales and service.

"If we can get the professional TV boys to realize the potential they're overlooking, and convince them of the need for more professional installers who will make an effort to sell the viewing public the antenna systems they need, my prediction of $200 million will be conservative," he concluded.

Fire Chief Speaks To Service Group

GREEN BRIAR, PA.—A stern warning was issued last night to service dealers by Fire Chief S. M. Anderson, speaking before the monthly meeting of The Roof Toppers Association of Himmel County. "You may not know it," Chief Anderson said, "but certain basic requirements have been established for television antenna installations. Also, the code changes from time to time. Therefore, he advised, "if you're installing antenna systems it will pay you to keep posted on current requirements."

In summarizing the code, Chief Anderson stated that outdoor antennas and lead-in wires must be securely supported, and that they cannot be attached to a pole or other structure supporting power lines of over 250 volts. "Furthermore," he pointed out, "antennas and wires must be located away from light and power circuits of over 150 volts to avoid the possibility of accidental contact. Support lead wires so they cannot swing closer than within two feet of 250-volt wiring, or within ten feet of higher voltage conductors. In the case of 150-volt conductors whose permanent placement is assured, clearance can be reduced to not less than four inches. Lead-ins must be run at least six feet away from any conductor forming part of a lightning rod system.

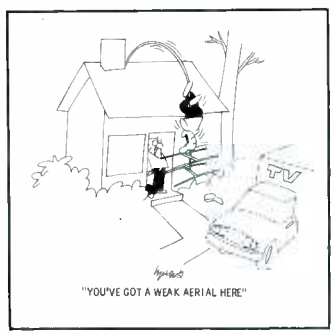
"Aluminum-alloy and hard-drawn copper lead-in must be at least #19AWG for open span lengths of up to 35 feet, #14 up to 150 feet, and #12 over 150 feet," Mr. Anderson pointed out. "You can use copper-clad steel, bronze, and other high-strength material of #20 wire for spans up to 35 feet, #17 up to 150 feet, and #14 over 150 feet. Longer spans will require larger conductors.

"If you splice the lead-in, your splices should be made with approved splicing devices, or by such other means that won't appreciably weaken the conductors.

"Indoor antennas and leads must be at least two inches from other wiring — unless the other conductors are in metal raceways or cable armor, or unless permanently separated by a continuous and firmly fixed nonconductor such as porcelain tubes or flexible tubing.

"Each conductor of the lead-in from an outdoor antenna must be protected by a lightning arrester approved for the purpose. An exception can be made when both conductors are inside a metal shield — then the shield can be protected by an arrester or grounded. Locate the arrester outside the building, or if necessary inside the building between the entrance and any tap-off, and as near the entrance as possible. Don't locate the arrester near combustible material or in a hazardous location." Chief Anderson warned.

"Lightning arresters, masts, and metal supporting structures must be effectively and permanently grounded — and you can't splice the wire. The ground wire must be securely fastened in place, and may be attached to the surface wired over. Minimum requirements for the ground wire say it must be #10 copper, #8 aluminum, of #17 copper-clad steel or bronze. Protect the wire from physical damage and run it in as straight a line as possible to the grounding electrode. The grounding electrode can be an underground water piping system; the grounded metal frame of a building; or ground rods of 5/8" iron or steel, or 1/2" non-ferrous metal or approved equivalent."



DEFEND YOURSELF

George LaMar, LL.D.

Dear Mr. LaMar:

Can I be held responsible for lightning damage to an antenna, home, or TV, or for personal injuries if I've failed to install the proper protective devices when making an antenna installation? D.H.

ANSWER:

You can. Remember a few years back, when insurance companies were paying off for lightning and wind damage to TV installations without question? If so, you're probably aware of the changes that have taken place—if not, you need to be informed of your responsibilities.

To begin with, when TV first made its appearance, the insurance companies were among the first to take notice. The reason is obvious—they were called upon to replace millions of dollars worth of storm-damaged antenna installations, and pay the service charges for receivers damaged by lightning. Something had to be done. It was. Claim payments showed the necessity of adding restrictive clauses to policies, or increasing the rates to cover such losses.

What does this have to do with you, the installer? Plenty. John Q. Public doesn't like to pay for anything if there's a way around it. Therefore, if an antenna system is damaged by wind, snow, sleet, or lightning, and the insurance company won't stand the loss — John Q's going to try to see to it that you, the installer, come through.

You'll be OK if you've made certain all of your installation jobs meet certain basic requirements. Your customers will have the best protection possible as the result of a job well done, and if anything goes wrong, you can prove you did all within your power to assure protection.

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THE ANSWER MAN

Ben Smith

PROBLEM:

I know that selection of the proper antenna lead-in plays an important role in the satisfactory operation of an antenna system. However, I'm just getting started in antenna work and would like an explanation of the different types of lead-ins. J.L.

ANSWER:

For all practical purposes, lead-in can be classified into four general categories: Coaxial cable, open wire, twin lead, and

tubular. Naturally, no one type is satisfactory for all purposes.

Coaxial cable (A) has the highest attenuation factor of the four types. However, unlike some types, it's not affected by weather, and it's particularly useful in minimizing noise pick-up. Two different types are normally used—RG-59U and RG-11U. Both have a characteristic impedance of 72 ohms; the main difference between them is the amount of signal loss from attenuation. RG-59U has an attenuation factor of 3.5 db per 100′ at 100 mc; RG-11U has only 2.0 db per 100′.

Coax, as it's commonly called, is ideal for noisy areas, or for runs near metal, stray electrical fields, etc. Matching transformers, or baluns, are necessary for minimizing signal losses when

coupling between antenna and cable, or cable and receiver or other type lead. Special strippers and connectors make coax easy to work with, and a wide range of amplifiers, splitters, and tap-offs are available to meet the demands of almost any installation.

Open wire (B) contrasts quite sharply from coax. It's designed for just the opposite situation. Open wire is used for long runs where there is little noise (see photo). The lead is light in weight, is unaffected by rain and snow, has little wind-loading, and has the least attenuation of any type — .45 db per 100′. The characteristic impedance of open line is 470 ahms. When installing open lead, be sure to maintain the spacing between the wires and make sweeping curves rather than sharp bends.

Twin lead (C) is the most common lead-in. Its 300-ohm impedance matches most antennas and receivers, eliminating the need for coupling transformers. While twin lead is rated at 1.1 db attenuation per 100′, the losses may jump to six times this level when the lead is wet. Twin lead can be twisted to minimize stray pickup of noise. It should be supported at fairly close intervals by standoff insulators, and kept away from metal surfaces. Metal absorbs signal and causes line losses to be increased.

Tubular lead (D) is very similar to regular twin lead. The tube may be hollow or filled with cellulose, and the leads may be along the outside or completely surrounded. While rated losses of tubular lead are slightly higher than twin lead (1.4 db per 100′), losses due to moisture are much less because of the dry inner path for the magnetic fields that surround the conductors.

Both tubular and flat twin lead have shorter life expectancies than coax or open wire because of the deterioration of the polyethylene dielectric separating the conductors. Therefore, these types should be protected from the elements as much as possible.

All splices and connections exposed to weather should be protected by a film of clear acrylic lacquer (after the connection has been made) to reduce oxidation. Stranded wire is used in twin lead; therefore, it's advisable to use crimp-on lugs at connecting points to eliminate frayed wires and possible shorts. The use of lugs also makes a sturdier connection.

Business and Industry

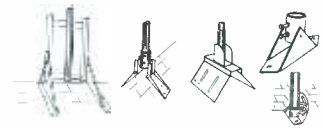
by Bill Greene

A tour through this year's TV Antenna Exhibit really proved eye-opening. I was particularly impressed by the wide selection of mounting hardware that's available. Here's a brief rundown of what we saw.

For attaching lightweight antennas to chimneys, you'll find a wide selection of mounts to choose from. Materials include both aluminum and stainless steel types, in addition to the standard galvanized types.

A wide variety of roof mounts are available for medium-size installations. You can choose from either self-supporting or guyed types, including styles suitable for installation on the slope of the roof or over the comb. Even modern flat-roofed homes can be outfitted with one of the adjustable mounts.

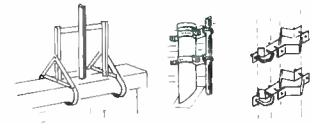
For the ranch-type home, there are special mounts for overjutting eaves. Cape Cods,



with their peaked gables, call for use of the adjustable eave and wall mount, while short wall mounts are most suitable for the straight-walled Colonial home. For heavy installations, wide-spread braces span be-

tween studdings for additional support.

If you install antennas for apartments or commercial establishments, you'll find parapet, vent, and pipe mountings suitable for your needs.

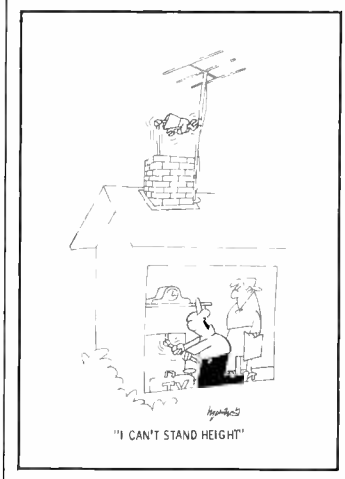


You'll even find special mounts for securing telescoping masts and towers, as well as tilt-over and crank-up towers for almost any purpose. What-

ever your needs, you'll find that this year's tower selections, ranging from 2′ dwarfs to 200′ giants, have many outstanding features.

Average Installer Invests $400

Waldon, Pa. — A survey of television service dealers serving eastern Pensylvania showed the average dealer's investment in antenna installation equipment to be roughly $400. Typical items included in this equipment are: Field-strength meters, extension ladders, electric drills, masonry drills, fish-tapes, two-way communications equipment, safety belts, and special hand tools such as crimpers, strippers, assorted wrenches, etc.



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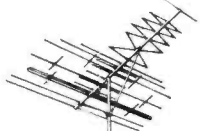
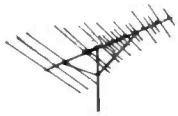
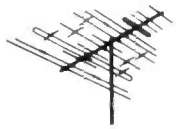


HI-FI HELIX



HI-FI BANSHEE



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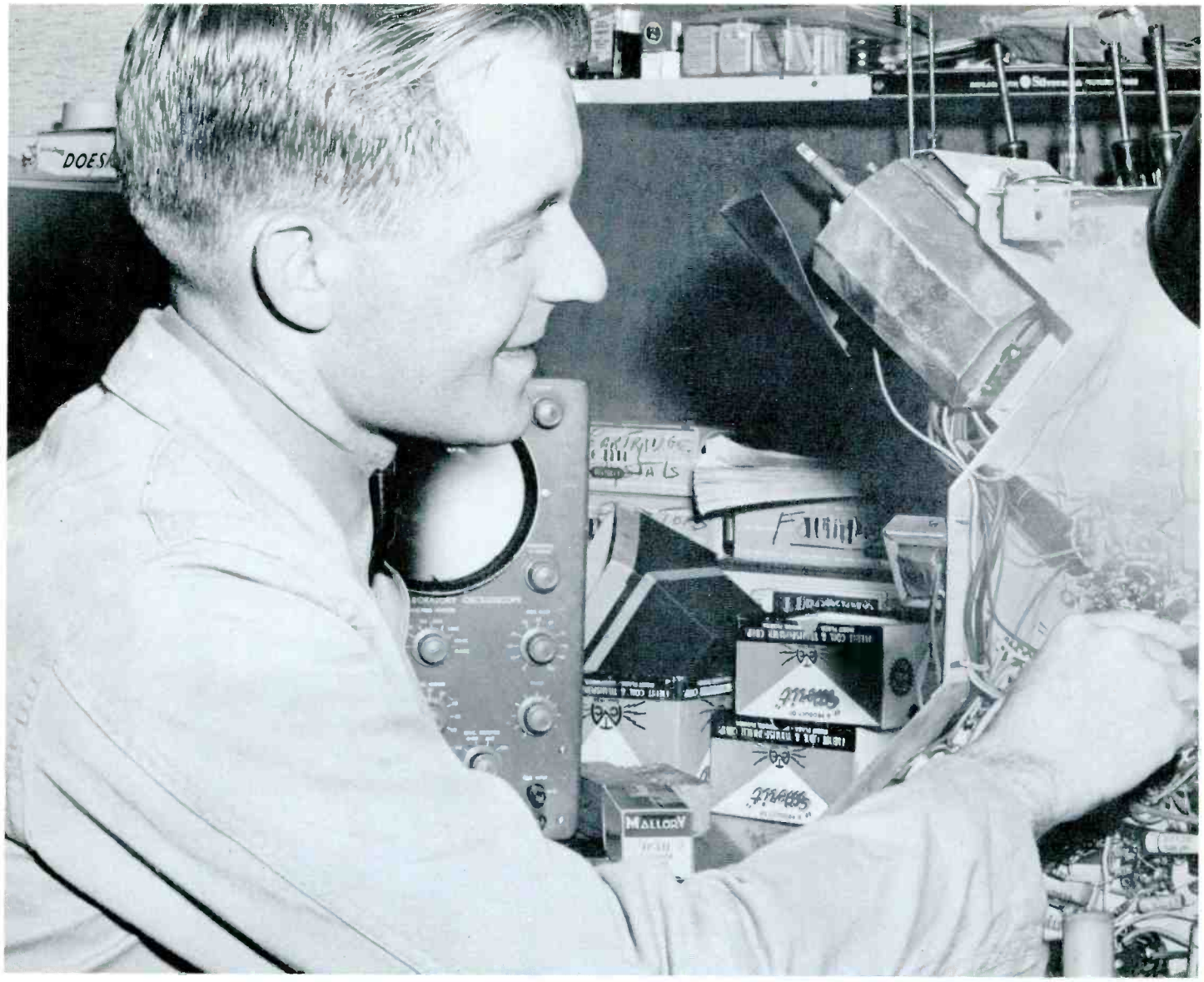

Roger Hefner owns and operates Hefner Television & Radio Service in Lima, Ohio. He attended DeVry School in Chicago, worked with a major radio-TV manufacturer, then went into business for himself. Roger now has two technicians helping him with sales and service on home and auto radio, TV and hi-fi.

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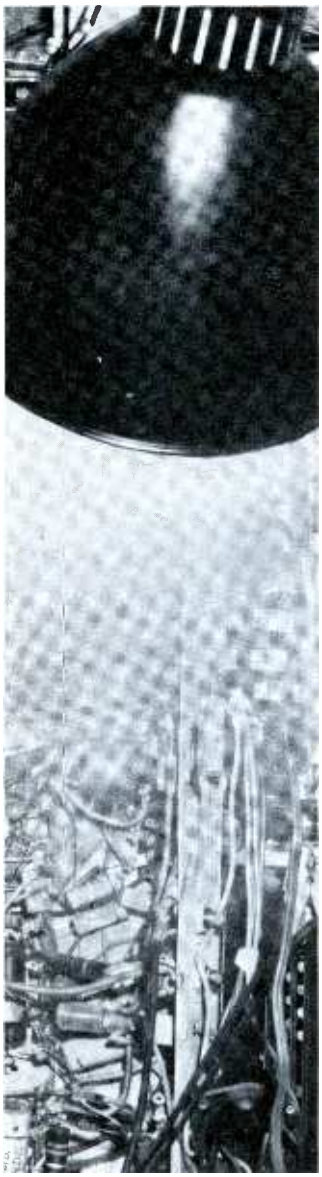

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servicing

ELECTRONIC PHOTOFLASH

equipment

by Jack Darr

Safety precautions and hints for finding the cause of misfiring.

Electronic photoflash equipment has become quite popular with photographers, especially professionals, because it ends, once and for all, the nuisance of having to change flashbulbs. Servicing should not be too difficult for TV technicians. The circuits are extremely simple, although the high voltage presents somewhat of a problem. Aside from this, there is no reason why these units cannot be easily repaired.

Construction

Earlier electronic photoflash units required as high as 2,000 volts. Today, the common types used in professional equipment require only 900 volts; and there are special flashtubes using only 450 volts. The heart of the unit is the flashtube itself—usually a small spiral of tubing filled with xenon, (see Fig. 1). A high voltage (varying with tube size and type) from a charged capacitor is applied to each end of the tube, as shown. The applied voltage is *not* high enough to fire the tube. Firing is accomplished instead by a momentary pulse of high voltage applied to the triggering electrode shown near the center of the tube. This pulse breaks down the gas, and the high voltage discharges through it. The electrical energy of the arc heats the gas to incandescence, resulting in a burst of intense white light. The discharge usually takes less than a thousandth of a second. The intensity of the light depends upon the amount of energy available from the high-voltage supply, which is almost always a charged electrolytic capacitor or a pair of capacitors. The duration of the flash depends upon the size of the charging capacitor and the resistance in the discharge circuit.

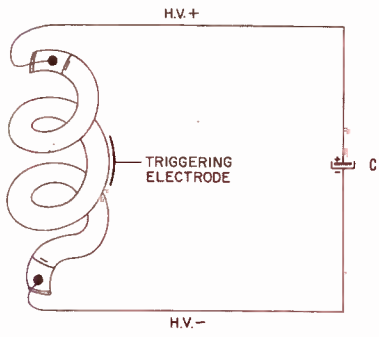

Fig. 1. Basic circuit of typical spiral-shaped, xenon gas-filled phototube.

The actinic quality of the light from a xenon flashtube is so close to that of daylight that no special color-correcting filters are needed. The life of the tube, when operated within its limits, is very long—many of them are guaranteed for at least 10,000 flashes. The extraordinarily high speed of the light makes it popular for shooting stop-motion shots of rapidly moving objects. Special equipment (called "strobe lights" for *stroboscope*) gives a light of very high intensity and extremely short duration.

Typical Equipment

The smaller, 450-volt flashtubes are ideal for portable cameras. The power supply is made up of portable radio *B* batteries. Five of these, at 90 volts each, provide the necessary voltage. Recent developments in the small, high-capacity, low-leakage electrolytic capacitors permit the entire unit to be built into a compact case. Fig. 2 shows the schematic of a typical unit. Two 525-mfd, 450-volt capacitors (C1 and C2) are charged by the batteries when the switch is turned on. The neon lamp indicates when the capacitors are fully charged.

The batteries will give over 3,000 flashes when a single capacitor is used, and over 1,500 flashes with dual capacitors. The cutoff level for the batteries is considered to be the point where light from the flash is reduced by one-half aperture stop from the initial setting. Charging time for the capacitors is less than two seconds—quite an improvement over the earlier models, which often took 30 seconds or more to build up a sufficient charge!

The flashtube in this unit, a special type called the *Kemlite* DX, incorporates its own high-voltage triggering coil, T1. A similar unit with a different flashtube, the *Kemlite* U-5W shown in Fig. 3, uses an external triggering coil. An AC-operated version of this 450-volt circuit, using the *Kemlite* U-5W flashtube, is shown in Fig. 4. Power is supplied by transformer T1, and two selenium rectifiers, M1 and M2, connected in series; otherwise, this circuit is identical to that in Fig. 3.

Commercial Equipment

Commercial units, used mainly by professional photographers, employ a few circuit refinements not found in the amateur or home-built units. They are mainly AC-powered for studio use, although portable units are also available.

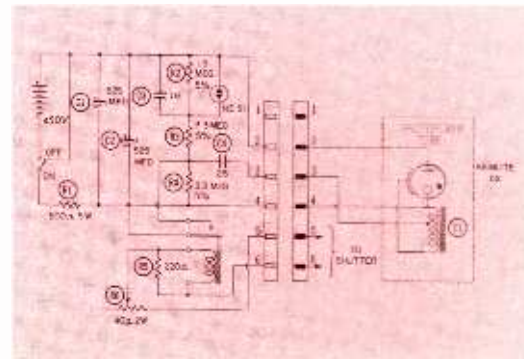

Fig. 2. Typical electronic photoflash unit is portable — uses 5 batteries.

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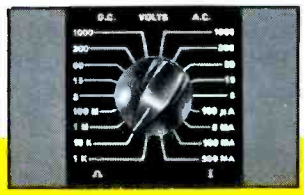

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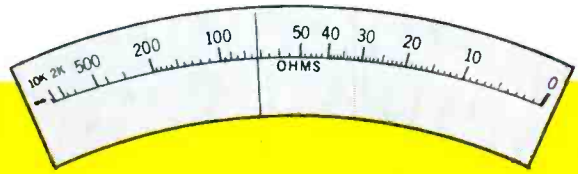

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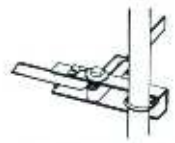

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Fig. 5 shows a portable unit. The triggering cable from the camera is connected to the input, just below the base of the lamp. The photoflash tube, under the frosted glass shell in the center, also contains a small incandescent lamp used for focusing. The cylindrical shell on which the photoflash tube is mounted is actually the triggering transformer housing. The unit is built into a medium-sized case, and has a large reflector and a pair of hinged covers or lids to allow the photographer to direct the light as desired. One interesting feature is the "slave" photocell (on top of the case) which is connected into the grid circuit of the thyratron triggering tube. Only one unit need be connected to the camera shutter. The light of the flash, as it strikes the photocell, triggers all additional units simultaneously.

A schematic diagram of this model is shown in Fig. 6. A step-up transformer supplies the operating power, and two selenium rectifiers charge the capacitors. This is a form of voltage-doubler circuit, each capacitor assuming a charge of about 450 volts; both capacitors then discharge in series, making 900 volts available for the flashtube. The midpoint of the two capacitors is grounded.

A miniature 2D21 thyratron is used to trigger the flashtube. Its operating potentials are supplied through resistors connected into the power-supply circuit. Grid bias, supplied by a voltage-divider arrangement (R2, R3, and R4), is such that the tube is held just below its firing point. The camera switch is connected so that, when depressed, it shorts out the 68K-ohm resistor R3. This raises the grid voltage just enough to allow the tube to fire. Note the connection of the photocell in the grid circuit.

The actual triggering is done by step-up autotransformer T2 in the plate circuit of the 2D21. When the thyratron fires, a pulse of current is drawn through the upper part of the winding, resulting in a large pulse being developed in the lower half. This pulse is applied to the trigger element of the flashtube, causing it to fire.

Servicing

The actual servicing of these units

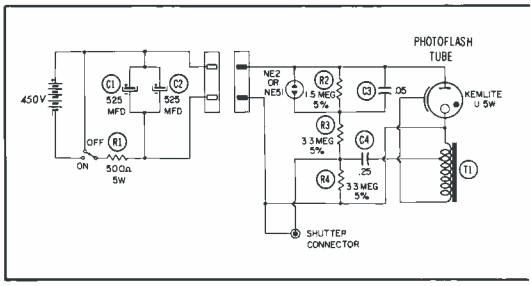

Fig. 3. T1 serves as triggering coil in this electronic photoflash unit.

is quite simple. The first step, of course, is to check the unit to see exactly *what* it is doing—not firing at all, firing incorrectly, taking too long to recharge between flashes, etc. As a first test, the power-supply voltages should be checked. The 900-volt peak is well within the range of most VOM's or VTVM's. There is one great difference between this high-voltage supply and the one in a TV receiver. Although the voltage in the TV set is much higher, the amperage is too small to do more than inflict a painful burn. On the other hand, the discharge current of the large capacitors in photoflash units contains enough energy to give you a fatal shock!

Therefore, always use extreme caution when making any voltage measurements around this equipment. All units include a safety-discharge switch (not shown on the diagram) which grounds the discharge capacitors when the case is opened. The safety-discharge switch will close with a rifle-like pop if there is any residual charge in the capacitors, so watch out. Just like a TV interlock, this switch will have to be disabled before the equipment can be operated with the case open. The best way is to slip a long piece of cardboard between the contacts, cutting it long enough to pull back out if necessary.

The safest way to take voltage readings is to turn the equipment off and discharge the capacitors with the safety switch; then connect the voltmeter across the circuit to be checked, using test clips. (A 10K, 10-watt resistor with a clip lead on one end and a long test prod on the other makes a good discharging tool.) If a series resistance is used, the capacitors can be discharged without the deafening report and burning of test clips. Another way is to simply close the camera switch or short the switch terminals, caus-

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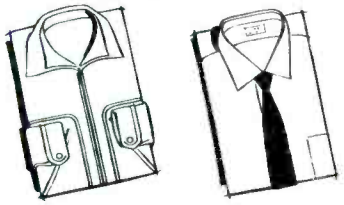

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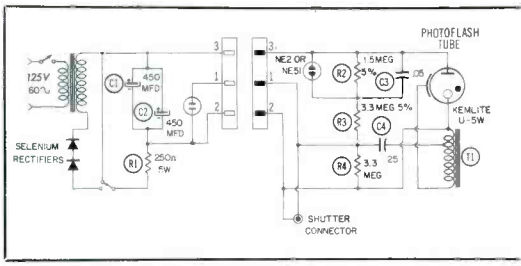

Fig. 4. Typical circuit of AC-operated photoflash using *Kemlite* U-5W tube.

ing the unit to flash. In the circuit in Fig. 6, each capacitor should charge to about 450 volts, depending upon the applied line voltage. The charge on the two capacitors should be nearly equal, and they should charge from minimum to maximum within about five seconds.

Operating voltages are indicated on the schematic. The 450 volts on the 2D21 plate is obtained from the upper capacitor, through the 1-meg plate load resistor. The –15 to –18 volts on the grid of the 2D21 comes from voltage divider R2, R3, and R4, connected to the negative half of the power supply. The readings shown were taken with the unit in standby condition and the capacitors fully charged.

If the unit won't fire at all, check the voltages across the power supply and capacitors C1 and C2. The voltage should be equal for each capacitor, and should add up to approximately 900 or 1,000 volts. If there is no voltage across the capacitors, or it is lower than normal, pull the thyratron tube and recheck. If voltage is still low or missing, check the rectifiers (by substitution) and the capacitors (for leakage and capacitance). These high-voltage types should have a very small leakage and be within about twenty per cent of their rated capacitance. If they are slightly above normal, that's all right; but if they are be-

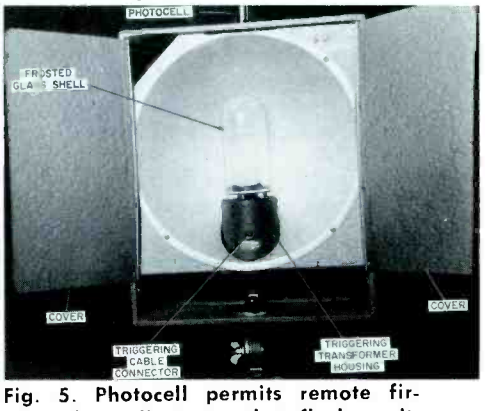

Fig. 5. Photocell permits remote firing of studio-type photoflash unit.

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Handbook of Electronic Circuits. A practical reference book on important circuits: 32 circuits used in TV stages; 4 power supply circuits; 14 circuits used in radio stages; 8 circuits used in transmitter stages; 7 additional circuits having special applications. 72 pages; 8½ x 11". No. HEC-1. *Only*..... **$1.00**

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low, look out. (A temporary substitute for the high-voltage rectifiers can be made by clipping about four standard silicon TV rectifiers in series—that is, four for each side—to see whether this will return the capacitor voltage to normal.)

Now replace the thyratron tube, and then short the camera switch to see if the unit will fire. If it refuses to flash, check the plate and grid voltages on the 2D21. If the grid voltage is slightly positive and the tube glows at all times, there is trouble in the grid circuit—the thyratron is conducting and thereby not allowing the charge to build up to normal. Check the grid resistors in the bias divider, and replace the .001-mfd coupling capacitor C3. There must be no perceptible leakage in this unit. Because of the very high-value resistors used, and the critical nature of the circuit, even a small amount of leakage here will upset the whole circuit.

If the flashtube fires erratically or all by itself at irregular intervals, check capacitors C3 and C5, voltage divider resistors R2, R3, and R4, and the thyratron tube itself, by substitution. Also, a leaky 0.47-mfd capacitor C4 in the plate return circuit of the thyratron will affect the plate voltage, and erratic firing will result.

If the thyratron is firing normally but the flashtube will not fire, check C4 and T2. Measure the resistance in each section of T2. The DC resistance of the lower half should read several thousand ohms, much higher than that of the upper section. Connect a scope or high-range voltmeter across the lower section of T2, and touch a battery (3 or 4.5 volts, for example) across the plate winding. As an alternate method,

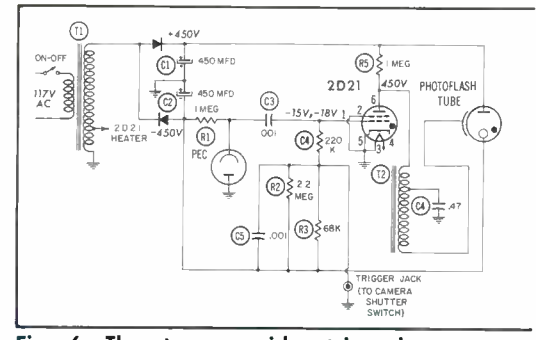

Fig. 6. Thyratron provides triggering pulse in studio-type photoflash unit.

open the triggering tap to the flashtube, and fire the thyratron (by shorting the trigger jack or R3) while holding the lead close to the chassis. A fairly good spark should result.

Always check the plugs and jacks in the camera wiring. Since they are dragged around the floor, stepped on, and otherwise abused, wiring troubles may have developed. The plugs and jacks should be cleaned and tightened. Many units use commercial microphone plugs and jacks for connections, and POSJ cord for the wiring. Don't forget to measure the contact resistance of the camera shutter switch, too!

The "slave" circuit can be easily checked by shining a flashlight into the photocell to see if the unit fires. If it doesn't, fire another flash unit. The "slave" unit should go off. If not, check the photocell by substitution, and the values of resistors R1, R2, R3, and R4. A small change in the value of one might make it possible for the unit to be set off with the switch but not with the photocell.

Finally, let us repeat the precaution about handling charged capacitors: They can easily give you a lethal shock, *so be extremely careful at all times!* ▲

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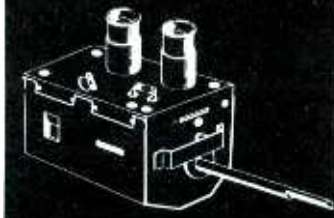

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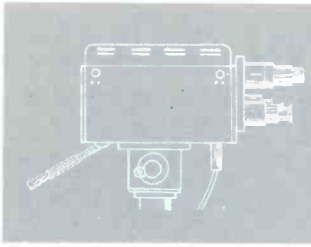

The Electronic Scanner

Lytics by the Hundreds

On the heels of several expansions in their manufacturing facilities, **Arco Electronics, Inc.** recently announced that they now have the largest selection of exact replacement twist-mount and tubular electrolytics in the industry. The new "Arcolytic" line, consisting of single, double, triple, and quadruple units, is now on display at all **Arco** distributors in special self-service racks which provide access to 1401 values.

News for Philatelists

Walco Electronics has just introduced a new incentive program for dealers in the phono needle and record accessory field. By agreement with National Red Stamps of Denver, Colo., dealers will receive a merchandise catalog in addition to certificates entitling them to red stamps on the **Walco** products they sell.

Replacement Parts Catalog

A new 151-page catalog, including mechanical and electrical specifications for universal-type components, as well as cross-reference charts and complete price lists of major parts used in **Motorola** TV receivers, home and auto radios, and record changers produced since 1949, is now available through **Motorola** distributors.

They Do Get Around

Over 50 servicemen in Roanoke, Va. were recently treated to a **Sencore** service clinic sponsored by Peoples Radio and TV Supply Co., the local **Sencore** distributor. Manufacturers' Representative Joe Rodimack presented the "Old Tubes Seldom Die" slide film, and Peoples' sales manager Bob Jones gave a live demonstration of the "Mighty Mite" tube checker.

Help for Master TV System Installers

To help master antenna system installers do a more effective job, **Blonder-Tongue Labs** has set up a consultant service through its affiliate, Blonder-Tongue Systems, Inc. Assistance in leasing and financing arrangements, factory guarantees where required, and supervision by factory personnel, are available on a fee basis. Free confidential layout service and technical training is also offered where special field engineering is not required.

"Door" Prize Parks at Curb

One of the snazziest "door" prizes ever given away is this **Volkswagen** "Transporter" truck won by Earl Ehling and Forrest Wyckoff, partners in Ehling Radio & TV Service Co. of Winfield, Kansas. They were among the service dealers participating in a recent state-wide promotion sponsored by **Finney Antenna Co.** and **Tung-Sol Electric,** along with their mutual distributor, **Radio Supply Co.** Quoting Earl Ehling, "Winning this Volkswagen has been one of the greatest thrills since our business was started in 1925."

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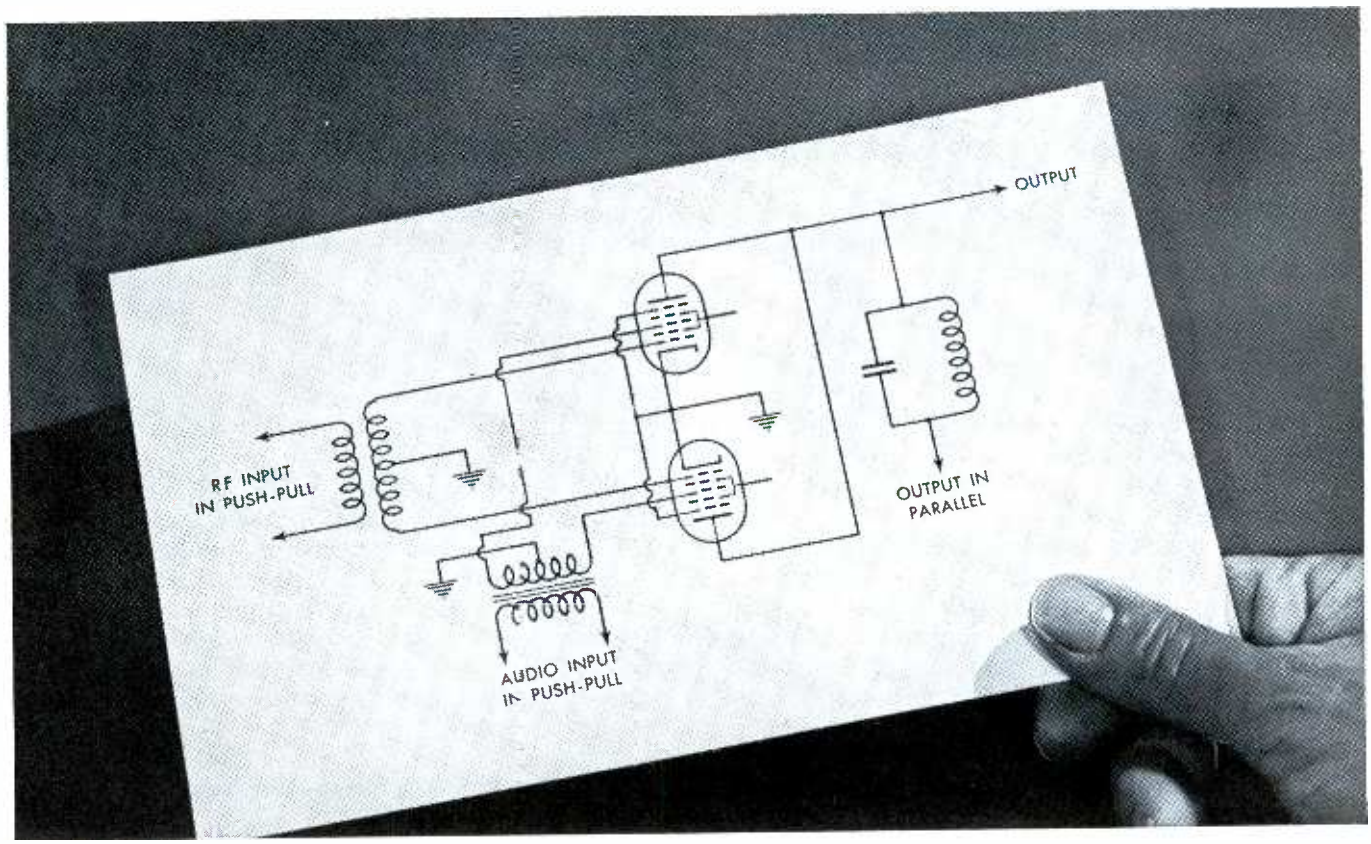
Latest issue of
TUNG-SOL TIPS
tells you what you should know about
SINGLE SIDE BAND



The two-tube balance modulator circuit is an important element in single side band transmission. It's discussed in the latest issue of Tung-Sol Tips.

MONTH after month Tung-Sol has been delivering to the industrial serviceman one important issue of *Tung-Sol Tips* after another. Specially written for the service dealer who wants to devote his talents to servicing industrial equipment, every issue of *Tips* is crammed full of vital information to help him in his work. This latest issue is no exception.

Issue #14 offers in down-to-earth, on-the-job terms a full-scale treatment of single side band transmission. It discusses its advantages over conventional AM signals — and these advantages are considerable. You'll discover how the elimination of the carrier signal and one-side band are accomplished without any reduction of signal quality and intelligence. You'll be introduced to a whole series of typical modulator circuits which are used to suppress the carrier. In addition, there's a thorough explanation of the filtering and phasing methods for eliminating sidebands.

So, if you're a serviceman who still hasn't signed up to get his issues of *Tung-Sol Tips* free every month, now is the time to do it. You won't want to miss this issue and the important issues planned for the future. All you have to do is drop in to see your local Tung-Sol distributor and ask him to put you on the *Tung-Sol Tips* mailing list. Or write directly. Tung-Sol Electric Inc., Newark 4, N. J.

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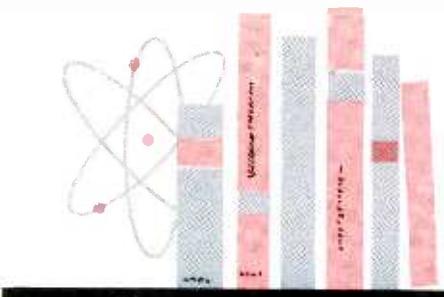

a survey of UPGRADING COURSES

Correspondence and resident schools offer many programs to help servicemen advance in electronics.

The trend in business today is toward diversification. This is as true of small- and medium-size businesses as it is of corporate giants. Electronics servicing offers many areas for diversification, and radio-TV technicians are increasingly broadening their activities to take advantage of the opportunity to increase their business and minimize seasonal fluctuations in their work load.

For example, the hi-fi boom has prompted many to include home audio equipment in their activities, or even to specialize in the fields of custom high fidelity and commercial sound work. Other shops are participating in the burgeoning fields of communications and industrial electronics.

Actual statistics are swiftly outmoded in these fast-moving fields, but some idea of their growth potential can be grasped by learning that the FCC has authorized nearly 2 million two-way communications radios —and this figure has been increasing at the rate of 10% per year. If you count in the exploding Citizens band, it is easy to foresee an even faster expansion.

Although these latest "growth fields" can keep a shop busy full time, they can also be used to strengthen an all-around service operation. Many reports indicate that the contacts made in new fields have resulted in increased radio-TV business.

The opportunities in various branches of electronics servicing are almost limitless, but taking advantage of them requires more than a willingness to "try anything once." The real reason for the opportunity is the desperate shortage of men with specific technical skills. Even an experienced radio-TV man needs further qualifications before branching into other fields. In communications work, for example, a second-class FCC radiotelephone license is a minimum requirement.

Where can a serviceman get the additional "know-how" to tackle more advanced work? Books and magazines are helpful for getting acquainted with different fields, finding out what additional shop equipment will be required, and locating potential sources of business. They also can give a serviceman a good groundwork in fundamentals, and can introduce him to typical installations. However, a complete and organized training program provides a more solid background, and helps to convince prospective customers that a man has the proper qualifications for a job.

Both general and specialized training courses on many aspects of electronics are available from numerous schools, as well as from several electronics manufacturers. Detailed at the end of this article is a large selection from which a serviceman can choose; in addition to these, it will pay to check on courses offered locally by institutions such as state universities and their extension centers.

The courses described can be grouped into two broad classifications, indicating that there are two possible directions in which the serviceman can grow professionally. On the one hand, he can continue to concentrate on installation and maintenance, but expand his abilities by taking technician-level courses of an advanced trade-school type in the fields of industrial, communications, or home electronics. On the other hand, he can embark on a program at the junior-college level which concentrates more heavily on theory; this leads to more highly specialized work in communications, or to laboratory work as an engineering assistant.

Training for Specific Goals

Opportunities in electronics (except in the military field) fall into the three general categories of industrial, communications, and "home-entertainment" electronics. The prospective student can choose courses entirely within one of these fields, or training that gives a more general background. Taking the three basic categories, let's see what training is desirable for specific types of work.

Industrial Electronics

Maintenance: Several schools give relatively short courses in specialized fields such as servomechanisms, for experienced technicians who need greater familiarity with specific types of equipment. More widely available are complete courses which begin with basic electronics and introduce the student to all phases of the industrial field, so he can benefit more by later training through books, manuals, and on-the-job experience. These are similar to radio-TV servicing courses in their general approach. It is not usually necessary to have completed high school before enrolling for a course of this type—although, of course, it helps. Some schools make provisions for accepting

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What Does F.C.C. Mean To You?

What is the F. C. C.?

F. C. C. stands for Federal Communications Commission. This is an agency of the Federal Government, created by Congress to regulate all wire and radio communication and radio and television broadcasting in the United States.

What is an F. C. C. Operator License?

The F. C. C. requires that only qualified persons be allowed to install, maintain, and operate electronic communications equipment, including radio and television broadcast transmitters. To determine who is qualified to take on such responsibility, the F. C. C. gives technical examinations. Operator licenses are awarded to those who pass these examinations. There are different types and classes of operator licenses, based on the type and difficulty of the examination passed.

What are the Different Types of Operator Licenses?

The F. C. C. grants three different types (or groups) of operator licenses—commercial radiotelePHONE, commercial radioteleGRAPH, and amateur.

COMMERCIAL RADIOTELE*PHONE* operator licenses are those required of technicians and engineers responsible for the proper operation of electronic equipment involved in the transmission of voice, music, or pictures. For example, a person who installs or maintains two-way mobile radio systems or radio and television broadcast equipment must hold a radiotelePHONE license. (A knowledge of Morse code is NOT required to obtain such a license.)

COMMERCIAL RADIOTELE*GRAPH* operator licenses are those required of the operators and maintenance men working with communications equipment which involves the use of Morse code. For example, a radio operator on board a merchant ship must hold a radioteleGRAPH license. (The ability to send and receive Morse is required to obtain such a license.)

AMATEUR operator licenses are those required of radio "hams"—people who are radio hobbyists and experimenters. (A knowledge of Morse code is necessary to be a "ham".)

What are the Different Classes of RadiotelePHONE licenses?

Each type (or group) of license is divided into different *classes*. There are *three* classes of radiotelephone licenses, as follows:

(1) Third Class Radiotelephone License. No previous license or on-the-job experience is required to qualify for the examination for this license. The examination consists of F. C. C. Elements I and II covering radio laws, F. C. C. regulations, and basic operating practices.

(2) Second Class Radiotelephone License. No on-the-job experience is required for this examination. However, the applicant must have already passed examination Elements I and II. The *second class* radiotelephone examination consists of F. C. C. Element III. It is mostly technical and covers basic radiotelephone theory (including electrical calculations), vacuum tubes, transistors, amplifiers, oscillators, power supplies, amplitude modulation, frequency modulation, measuring instruments, transmitters, receivers, antennas and transmission lines, etc.

(3) First Class Radiotelephone License. No on-the-job experience is required to qualify for this examination. However, the applicant must have already passed examination Elements I, II, and III. (If the applicant wishes, he may take all four elements at the same sitting, but this is not the general practice.) The *first class* radiotelephone examination consists of F. C. C. Element IV. It is mostly technical covering advanced radiotelephone theory and basic television theory. This examination covers generally the same subject matter as the second class examination, but the questions are more difficult and involve more mathematics.

Which License Qualifies for Which Jobs?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain, and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain, and operate every type of radiotelephone equipment (except amateur, of course) including all radio and television stations in the United States, and in its Territories and Possessions. This is the highest class of radiotelephone license available.

How Long Does it Take to Prepare for F. C. C. Exams?

The time required to prepare for FCC examinations naturally varies with the individual, depending on his background and aptitude. Grantham training prepares the student to pass FCC exams in a minimum of time.

In the Grantham *correspondence course*, the average beginner should prepare for his *second class* radiotelephone license after from 200 to 250 hours of study. This same student should then prepare for his *first class* license in approximately 75 additional hours of study.

In the Grantham *resident course*, the time normally required to complete the course and get your license is as follows:

In the DAY course (5 days a week) you should get your *second class* license at the end of the first 9 weeks of classes, and your *first class* license at the end of 3 additional weeks of classes. This makes a total of 12 weeks (just a little less than 3 months) required to cover the whole course, from "scratch" through *first class*.

In the EVENING course (3 nights a week) you should get your *second class* license at the end of the 15th week of classes and your *first class* license at the end of 5 additional weeks of classes. This makes a total of less than 5 months required to cover the whole course, from "scratch" through *first class*, in the evening course.

The Grantham course is designed specifically to prepare you to pass FCC examinations. All the instruction is presented with the FCC examinations in mind. In every lesson test and pre-examination you are given constant practice in answering FCC-type questions, presented in the same manner as the questions you will have to answer on your FCC examinations.

Why Choose Grantham Training?

The Grantham Communications Electronics Course is planned primarily to lead to an F.C.C. license, but it does this by TEACHING electronics. This course can prepare you *quickly* to pass F. C. C. examinations because it presents the necessary principles of electronics in a simple "easy to grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time, because we make the subject easy and interesting.

Is the Grantham Course a "Memory Course"?

No doubt you've heard rumors about "memory courses" or "cram courses" offering "all the exact FCC questions". Ask anyone who has an FCC license if the necessary material can be memorized. Even if you had the exact exam questions and answers, it would be much more difficult to memorize this "meaningless" material than to learn to understand the subject. Choose the school that teaches you to thoroughly understand—choose Grantham School of Electronics.

Is the Grantham Course Merely a "Coaching Service"?

Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service" method is that it presumes the student already has a knowledge of technical radio and approaches the subject on a "question and answer" basis. On the other hand, the Grantham course "begins at the beginning" and progresses in logical order from one point to another. Every subject is covered simply and in detail. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test so you can discover daily just which points you do not understand and clear them up as you go along.

HERE'S PROOF that Grantham Students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Hugh J. Stock, Box 446, Lander, Wyo.	1st	11
Orlie W. McCool, 414 W. South St., Neosho, Mo.	1st	12
Eugene R. Kraus, Moore Drive, Peru, N. Y.	1st	12
Robert E. Sullivan, 2475 E. Douglas, Des Moines, Iowa	1st	12
Jack Hughes, 101 4th Street, Sebring, Fla.	1st	22
Dennis K. Bingaman, R.D. #1, Dalmatia, Penna.	1st	14
Earl Howard Tolley, RR #3, Eaton, Ohio	1st	11
Victor B. Arroyo, 3633 Gangel Ave., Pico Rivera, Calif.	1st	20
Henry N. Wright, 160 Cedar Street, Springfield, Mass.	1st	12

Resident Classes Offered at Four Locations

To better serve our many students throughout the nation, Grantham School of Electronics maintains four separate schools—located in Hollywood, Seattle, Kansas City, and Washington, D.C.—all offering the same resident courses in F.C.C. license preparation. (Correspondence courses are conducted from Hollywood.)

For further details concerning F.C.C. licenses and our training, send for our FREE booklet, "Careers in Electronics". Clip the coupon below and mail it to the School nearest you.

Get your First Class Commercial F.C.C. License Quickly by training at

GRANTHAM SCHOOL OF ELECTRONICS

1505 N. Western Ave. Hollywood 27, Calif.	408 Marion Street Seattle 4, Wash.	3123 Gillham Road Kansas City 9, Mo.	821 - 19th Street, N.W. Washington 6, D.C.
(Phone: HO 7-7727)	(Phone: MA 2-7227)	(Phone: JE 1-6320)	(Phone: ST 3-3614)

MAIL COUPON NOW—NO SALESMAN WILL CALL →

MAIL COUPON TO SCHOOL NEAREST YOU

(Mail in envelope or paste on postal card)

TO: **GRANTHAM SCHOOL OF ELECTRONICS**

1505 N. Western **Hollywood** • 408 Marion **Seattle** • 3123 Gillham Rd. **Kansas City** • 821-19th, NW **Washington**

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

Name_____ Age_____

Address_____

City_____ State_____

I am interested in: ☐ Home Study, ☐ Seattle classes ☐ Hollywood classes, ☐ Kansas City classes, ☐ Washington classes

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students with experience; for instance, they may bypass the first, or "Basic Electronics" phase if they have previously taken a similar course. However, schools generally urge students to "begin at the beginning" and avoid leaving gaps in their basic understanding of electronics. The first several lessons of a general course can serve as an excellent review for a practical man who may have become somewhat rusty on theory. One advantage of correspondence courses for general training is that the experienced man can go through the early lessons at a pace that suits him.

Design: Technicians employed in engineering laboratories do work of a practical nature, but the applications are more experimental and thus require a more theoretical background. A general understanding of industrial electronics is also more important, and engineering-technician courses are seldom very highly specialized in any one branch of the field. A number of schools give two-year resident programs in engineering technology, such as the technical-institute courses accredited by the Engineers' Council for Professional Development (ECPD). Certain correspondence courses are also available to cover similar subject matter, although not quite as extensively as for a full-time course. These programs almost always require prior completion of high school with a good background and aptitude in mathematics.

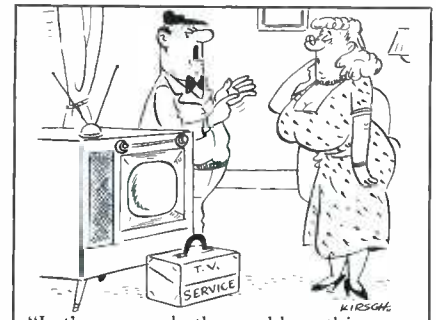
Communications:

Installation and maintenance of mobile radio: Several courses provide specific instruction at the service-technician level in maintenance of two-way radio systems, along with preparation for obtaining the necessary FCC second-class radiotelephone operator's license. It is also possible to take further training specifically aimed at obtaining a first-class license, but this material is more often given as part of a broader training program in communications technology, designed to train the student more adequately for the work in which he will need the more advanced license. The general training courses in industrial electronics also frequently include material on communications.

Broadcast Engineering, or maintenance, installation, and operation of radio and TV transmitting stations, is one of the major fields open to the holder of a first-class FCC license. Training almost as thorough as for general electronics technology, but somewhat shorter and more specialized, is recommended for broadcast work. The entrance requirements are the same as for a prospective engineering technician.

Home-Entertainment Electronics

TV-Radio Service Technician: Several specific courses are available to the experienced serviceman to help him upgrade his TV-servicing ability, or bring him up to date



"Let's approach the problem this way, madam: If it goes fht't, fht't, fht't, it'll be $7.50. But if it goes fht't, fht't, fht't, fht't, fht't, fht't, we charge $12.50."

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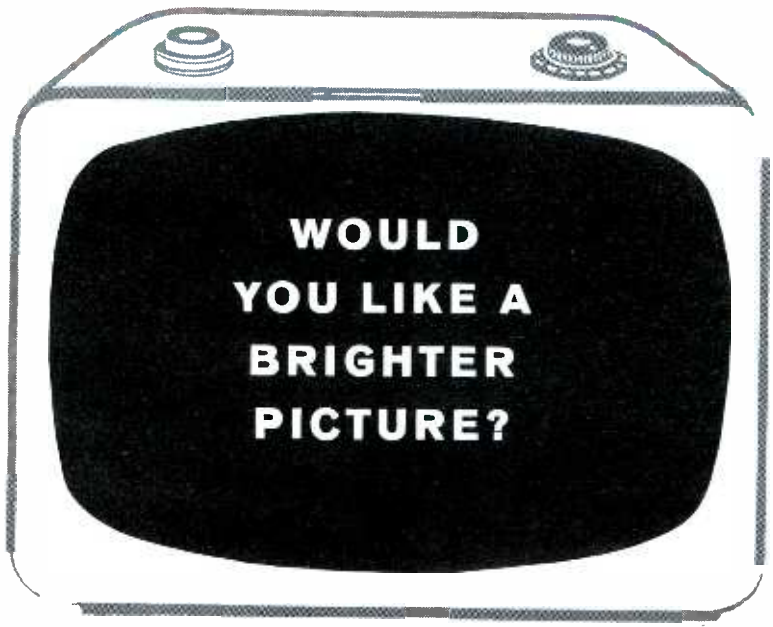

That's a question with only one possible answer—YES. Every customer wants a better, brighter picture . . . but doesn't realize how easy it is to get one.

When you say you'll brighten the picture—When you quote the low cost—you've sold the customer.

Don't sell Briteners—sell Brighter Pictures!

On every service call, remember to use Perma-Power's 6 Magic Words—Would You Like A Brighter Picture? You'll sell a 12-pack of Briteners almost as fast as you can say Perma-Power!

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on specific subjects (such as color TV and transistors).

For relative newcomers to servicing, or for those technicians who feel they need a better understanding of theory in order to cope with new developments, a good selection of complete radio-TV courses is offered. Like the general courses in industrial electronics, these begin with elementary principles; but many men find they profit from reviewing the fundamentals in the light of practical experience.

Audio and Hi-Fi: This subject is generally included in up-to-date radio-TV servicing courses, and upgrading courses specializing in audio are also offered to experienced technicians. Commercial sound and entertainment-type equipment are most likely to be treated as separate specialties, since the markets are somewhat different for these two branches of audio.

Within the general categories outlined above are many specialized areas suitable for diversification and growth, such as computer technology, radar, marine electronics, amateur radio, ultrasonics, etc. Training courses for these and others are described below.

Considering that electronics is finding its way into virtually every phase of modern-day life, today's "electronician" is faced with the necessity for keeping pace. Thus, the prime question facing anyone in electronics today is not, "Shall I study?" but "*What* shall I study?" To make it easier for you to obtain information which will help you decide, use the Catalog & Literature card facing page 80, which contains key numbers corresponding to the schools in the following list.

Key To Abbreviations In List of Courses

50Y: CBS — CBS Electronics, Danvers, Mass.
51Y: CREI—Capitol Radio Engineering Institute, Washington, D.C.
52Y: CTI — Central Technical Institute, Kansas City, Mo.
53Y: CIE—Cleveland Institute of Electronics, Cleveland, Ohio
54Y: CES—Coyle Electrical School, Chicago, Ill.
55Y: DR—Delco Radio Division (GMC), Kokomo, Ind.
56Y: DTI — DeVry Technical Institute, Chicago, Ill.-Toronto, Canada
57Y: GSE — Grantham School of Electronics, Hollywood, Calif.
58Y: IHSI—Indiana Home Study Institute, Fort Wayne, Ind.

BIG family—and getting bigger all the time!

The new **MERIT** family of

110° YOKES

Merit's superior 110° cosine wound deflection yokes — exact replacements for most American TV chassis' — are coming off the assembly line **fast.** Your Merit Distributor has them **now.** For example:

MDF-117 RCA REPLACEMENT
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MDF-106 GE REPLACEMENT
AND MANY OTHERS

THEY ELIMINATE CALLBACKS BECAUSE:

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Remember — your Merit Distributor "gits thar fustest with the mostest" of what you need when you need it!

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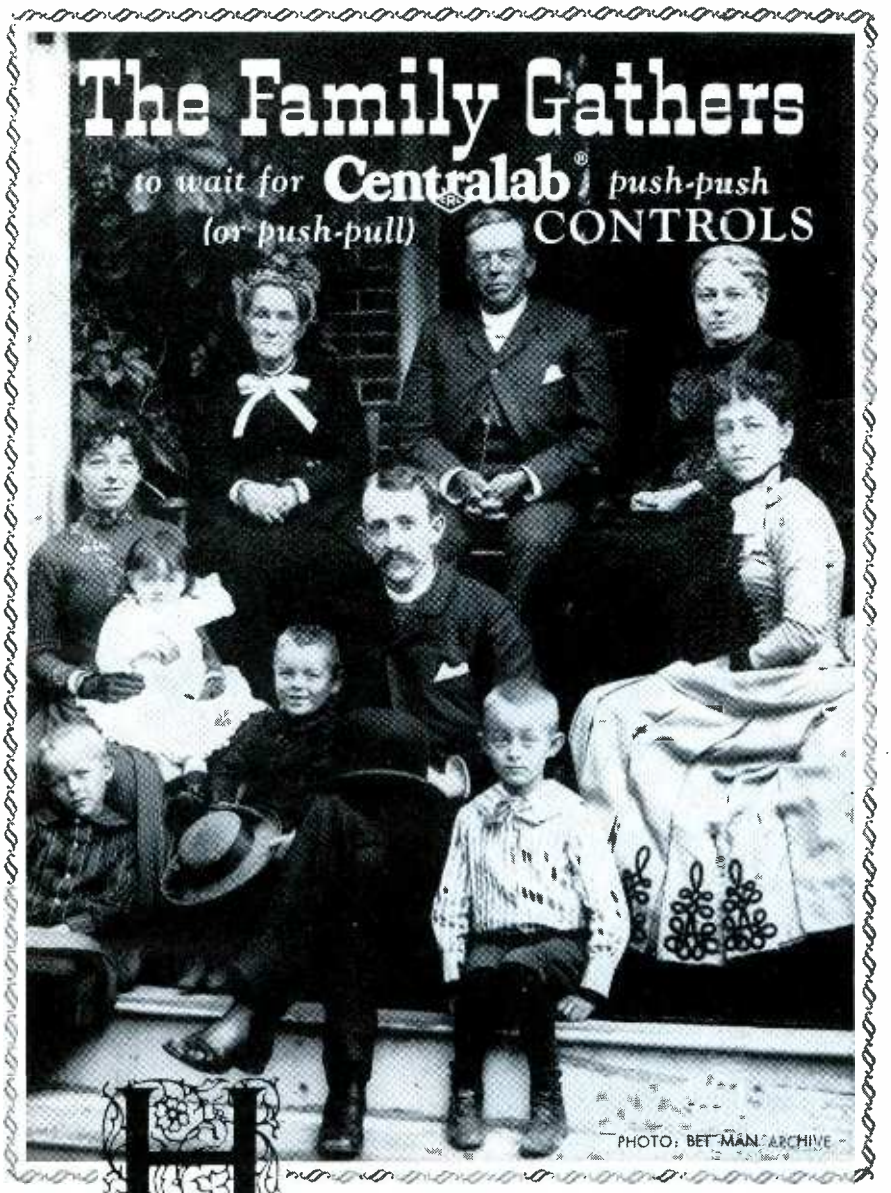

Hail, hail, the gang's all here

They'd be inside if the TV set were working . . . but a push-push control went bloo-ey.

Luckily for them, though, CENTRALAB has replacement units . . . the only push-push units on the market, plus a complete line of 35 push-pulls. Four different types—Adashaft, Universal Shaft, Fastatch or dual concentrics, and Twin types for stereo.

Push-push and push-pull controls are now being used in over 78% of the TV, radio and hi-fi sets coming out of the factories. Find the CENTRALAB replacement you need at your distributors, so the folks can get back inside to see what Wyatt Earp is up to.

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ELECTRONIC SWITCHES • VARIABLE RESISTORS • CERAMIC CAPACITORS
PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS

59Y: ITI—Industrial Training Institute, Chicago, Ill.
60Y: ICS — International Correspondence Schools, Scranton, Pa.
61Y: MSOE—Milwaukee School of Engineering, Milwaukee, Wis.
62Y: MTI — Motorola Technical Institute, Chicago, Ill.
63Y: NRI — National Radio Institute, Washington, D.C.
64Y: NBS—Niles Bryant School, Sacramento, Calif.
65Y: PIC—Pacific International College of Arts and Sciences, Hollywood, Calif.
66Y: PTC — Philco Technological Center, Philadelphia, Pa.
67Y: RAY — Raytheon Mfg. Co., Distributor Products Div., Westwood, Mass.
68Y: RCA — RCA Institutes, Inc., New York, N.Y.
69Y: RTTA—Radio-Television Training of America, New York, N.Y.
70Y: RTS — Radio-Television Training School, Inc., Los Angeles, Calif.
71Y: UEI—United Electronics Institute (Div. U.E. Labs), Louisville, Ky.
72Y: USET—United School of Electronic Trades, Chicago, Ill.

Abbreviations preceding the names are keyed to the courses described below. Both correspondence and resident courses are offered, coded by the letters (C) and (R). For correspondence courses, the period of time marked with an asterisk indicates the approximate period of spare-time study required by the average student. Tuition fees quoted for the various courses are generally cash in advance, but most schools also offer time-payment plans at a slight additional cost. Where course length is stated in terms of a number of lessons, remember that lesson size will vary.

Courses Offered by Schools and Manufacturers

Industrial (Technician-Level)

DTI—(C) Courses in specific areas ($3.50 per lesson text): Industrial Circuits 17 texts), Industrial Electronics (14 texts), Digital Circuits (12 texts), Electronic Instrumentation (17 texts), Servomechanisms (15 texts), Applied Mathematics I and II (10 and 20 texts), Industrial Instruments (7 texts), Automatic Control Instrumentation (8 texts). (R) also available.

ITI—(C) Practical Electronics (24 mo*—$395). (C) Practical and Industrial Electricity (16 mo*—$195).

ICS—(C) General and specific courses ($160 to $340): Electronics Technician (800 hr*), Principles of Semiconductor-Transistor Circuits (465 hr*), Ultrasonics (570 hr*), Industrial Electronics (750 hr*), Electronics Drafting (420 hr*), Fundament-

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als of Electronic Computers (252 hr*), Sound Systems Specialist (735 hr), Principles of Radio-Electronic Telemetry (360 hr.*).

NRI—(C) Electronics: Principles, Practices, Maintenance (24 mo*—$288).

PTC—(C) Courses in specific areas: Principles of Radar Circuits and Equipment (40 wks*—$115), Radar Systems Principles and Practice (52 wks*—$129), Transistor Principles and Practices (40 wks*—$159), Introduction to Analog Computers (25 wks*—$60), Analog Computer Systems (15 wks*—$40), Automatic Digital Computers (30 wks*—$125); Programming for Digital Computers (18 wks*—$72).

RCA—(C) Electronics for Automation (30 wks*—$59.50), Transistors (30 wks*—$59.50). (R) also available.

RTS—(C) Industrial Electronics (125 lessons—$249.50 plus materials).

USET—(R) Drafting and Blueprint Reading (26 wks—$342).

Communications (Technician-Level)

CTI—(C) Radio and Electronics (10 mo* —$325)

DTI—(C) Communication Electronics (17 lesson texts—$3.50 per text); can be followed by 2nd Class Radiotelephone Operator (16 texts), Microwaves (13 texts), and 1st Class Radiotelephone Operator (12 texts). (R) also available.

GSE—(C) Communications Electronics—preparation for 1st Class FCC license (300 hr*—$195). (R) Same course available in Hollywood, Seattle, Kansas City, and Washington (12 wks daytime or 20 or 30 wks eves—$285).

ICS—(C) 2nd Class Radiotelephone License (705 hr*), 1st Class Radiotelephone License (795 hr*), Communications Technology (765 hr*). (Costs range from $160—$340).

MTI—(C) Two-Way Mobile Radio Servicing 9 mo*—$90).

NRI—(C) Radio and Television Communications (24 mo*—$225).

RAY—(C) Communications Technician's Course.

RTTA—(C) TV Studio Technician (6 mo*—$135).

Home Electronics (Technician-Level)

CBS—(C) Transistor Course—Revised Edition ($25).

CES—(C) Television-Electronics (12-14 mo*—$107). (R) Radio-Television Technicians' Course (30 wks); also available including Refrigeration and Electrical Appliances (6 wks extra).

DR—(R) Free 1-wk courses at regional training centers: Transistor fundamentals and troubleshooting; signal-seeking, portable, and hybrid auto radios; electronic headlight controls; Delco-Matic garage-door opener.

DTI—(C) Courses following Basic Electronics ($3.50 per lesson text): Television Principles (20 texts), Radio

• *Please turn to page 71*

It's the new

Sonotone Ceramic "Velocitone"

No stereo cartridge—not even the finest magnetic in the world—outperforms it!

Listen!.. with any magnetic you sell today—at *any* price. Then replace it *directly* in any component system with Sonotone's new "VELOCITONE" STEREO CERAMIC CARTRIDGE ASSEMBLY. Listen again! We challenge you to tell the difference. Experts have tried...in dozens of A-B listening tests. And, in every single one, Sonotone's "VELOCITONE" performed as well as or better than the world's best magnetic.

Listen!.. perfectly flat response in the extreme highs and lows (better than many of the largest-selling magnetics).

Listen!.. excellent channel separation—sharp, crisp definition.

Listen!.. highest compliance—considerably superior tracking ability.

Listen!.. absolutely no magnetic hum—quick, easy, *direct* attachment to any magnetic inputs.

Listen!.. remarkable performance characteristics unexcelled anywhere. (Write Sonotone Corporation for specifications.)

Now listen to the price. Only $23.50...about one-half the price of a good stereo magnetic cartridge. Stock and sell Sonotone's "VELOCITONE"...the stereo ceramic cartridge system that cannot be outperformed by any magnetic—regardless of price.

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IN CANADA, CONTACT ATLAS RADIO CORP., LTD., TORONTO

LEADING MAKERS OF CARTRIDGES · SPEAKERS · TAPE HEADS · MIKES · ELECTRONIC TUBES · BATTERIES

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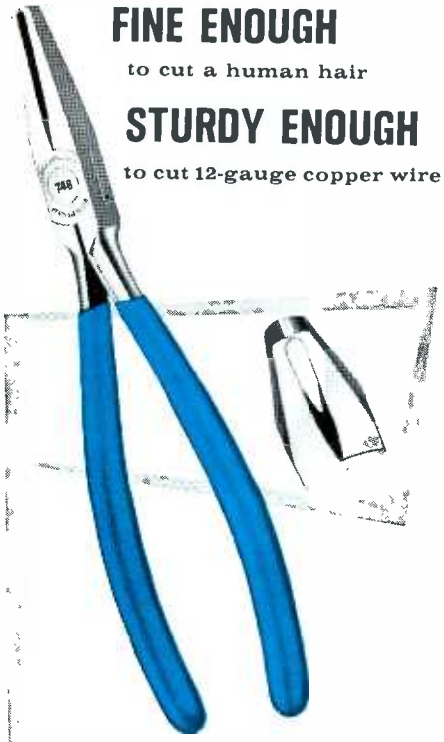


FINE ENOUGH
to cut a human hair

STURDY ENOUGH
to cut 12-gauge copper wire

Specially Designed
CHANNELLOCK®

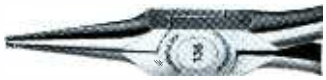
No. 748 Long-reach
End Cutter

Here's the answer to your hard-to-get-at wire cutting jobs . . . the CHANNELLOCK Long-Reach End Cutter. Gets into tight places you can't reach with any other cutter. Especially handy for electrical, radio, TV, Hi-Fi and electronics work. Precision-honed, specially hardened cutting edges. Long, blue-plastic coated handles. Top quality polished forged steel. Ask your tool supplier for a CHANNELLOCK No. 748 End Cutter. If he doesn't have one, ask him to order it for you.

Write for Catalog of Complete Line of Pliers

#718 LONG-REACH FLAT-NOSE PLIER

#728 LONG-REACH DIAGONAL CUTTER



#738 LONG-REACH ROUND-NOSE PLIER

Channellock Pliers are made only by

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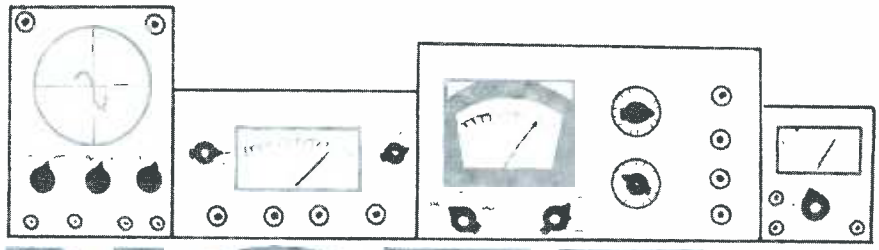
Meadville, Pennsylvania



NOTES ON TEST EQUIPMENT

by Les Deane

EIR + C = "400"

The "400" is a new meter recently introduced by Mercury Electronics Corp. of Mineola, New York. It's a VOM that not only reads voltage, current, and resistance, but when operated from the AC line, measures capacitance as well. Featuring a special high DC-voltage range and capacitance scales up to 80 mfd, the VOM-Capacity Tester comes complete with test leads, manual, and interlock cord as pictured in Fig. 1.

Specifications are:

1. *Power Requirements—self-contained 1.5- and 6-volt batteries (supplied); 105/125-volt, 60-cps isolated supply for capacitance measurements.*
2. *DC Voltmeter—full-scale ranges of 15, 75, 150, 300, 750 and 1500 volts, plus special jack for 7500-volt range; sensitivity 20,000 ohms/volt; accuracy within 2%.*
3. *AC Voltmeter—six full-scale ranges of 15, 75, 150, 300, 750 and 1500 volts; sensitivity 5,000 ohms/volt; accuracy within 5%.*
4. *DC Ammeter—five full-scale ranges of 75 ua, 7.5 ma, 75 ma, 750 ma, and 15 amps; leads and terminals color-coded for polarity identification.*
5. *Ohmmeter—0 to 10 megohms in three ranges of R x 1, R x 100, and R x 10K; center-scale indication 12; zero-ohms adjust on front panel; "+" test jack connected to negative terminal of internal battery.*
6. *Capacitance Meter — measures capacitor values in two ranges of from .001 to .5 mfd and .1 to 80 mfd (including electrolytics); calibration adjustment and* HI-LO *range selector provided on panel.*
7. *Panel Meter—4½" 50-ua DC movement with five scales serving all 23 different ranges.*
8. *Size and Weight — case 7¾" x 5⅞" x 3½", 3¾ lbs. complete with batteries.*

I had the chance to check out one of the Mercury units in our service lab the other day. The entire case and front panel are metal; the panel, containing meter, three knobs, and three test jacks, is recessed for protection. An AC interlock receptacle is located on the left side of the case.

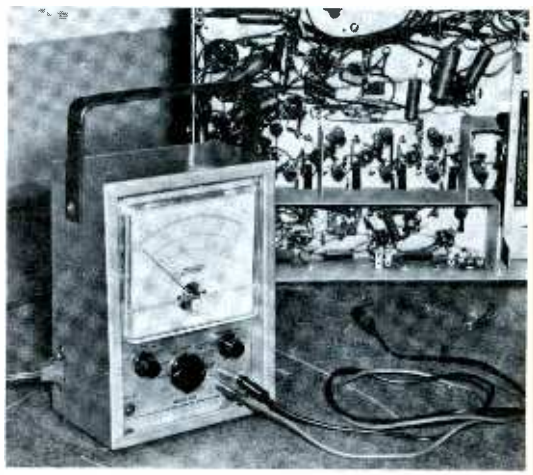


Fig. 1. Mercury's "400" speeds servicing by including a capacitor checker.

At first, no mounting screws are seen for the panel or chassis. When disassembling the unit, I found that a panel on the bottom of the case slips off after removal of four Phillips-head screws. With this panel off and two wires leading to the AC interlock unplugged, the

Fig. 2. Chassis of the VOM-Capacity Tester slides out from bottom of case.

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SUBJECTS OFFERED AT NO COST TO YOU:

❶ TRANSISTOR FUNDAMENTALS—complete coverage of transistor theory without the use of mathematics. ❷ GUIDE-MATIC POWER HEADLIGHT CONTROL (Autronic Eye)—lecture and lab. ❸ TWILIGHT SENTINEL ELECTRIC HEADLIGHT SWITCH—lecture and lab. ❹ TROUBLE-SHOOTING PROCEDURES for dead or weak low voltage auto radio tuners and trigger circuits. ❺ LECTURE AND LAB. PRACTICE ON "SIGNAL SEEKER" AND "WONDER BAR" auto radio tuners and trigger circuits. ❻ TRANSISTOR CIRCUIT TROUBLE-SHOOTING—lecture and lab. work analyzing defects in transistor circuits. ❼ HYBRID-TYPE AUTOMOBILE RADIOS—low voltage tube and output transistor circuits. Lecture and lab. ❽ DELCO-MATIC ALL-TRANSISTOR GARAGE DOOR OPERATORS—lecture and lab. ❾ AUTO PORTABLE RADIOS—lectures and lab. practice on all-transistor portable radios. Get prepared for the all-transistor auto radio that will appear in the next few years.

LEARN THE LATEST ON TRANSISTORS AND AUTOMOTIVE ELECTRONICS 9 SUBJECTS

AVAILABLE TO YOU AT THE FREE DELCO RADIO - GUIDE LAMP ADVANCED TRAINING SCHOOL. One week of instruction. No lab. fees. No tuition charge. Textbooks supplied.

In 1960 over 900 electronics technicians completed our one-week course. You, too, can receive this same valuable training in 1961. Bring yourself up to date on transistors and automotive electronics with personalized instruction at the General Motors Training Center near you. (See schedule below.)

Classes will be conducted by graduate engineers with special training in your field. Diplomas, awarded only to those who successfully complete the courses, will mean a great deal to you—and to your customers.

Register now through your local Delco Electronics Parts Distributor or write directly to Delco Radio Division, General Motors Corporation, Kokomo, Indiana, Attention: Service Manager.

GUIDE LAMP DIVISION GENERAL MOTORS CORP. ANDERSON, INDIANA

DELCO RADIO DEPENDABILITY RELIABILITY

DELCO ELECTRONICS TRAINING SCHOOL SCHEDULE

DATE	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6
1-16	Philadelphia		Detroit			
1-23		Charlotte	Detroit		Dallas	
2-6	Washington			St. Louis		
2-13	Washington	Atlanta			Houston	
2-20			Cincinnati		Houston	Los Angeles
2-27						Los Angeles
3-6	Tarrytown	Memphis		Omaha		
3-13	Tarrytown					
3-20		Jacksonville	Cleveland			San Francisco
4-10	Boston		Cincinnati	Kansas City	El Paso	Portland
4-17	Boston	Atlanta		Kansas City	El Paso	
5-1		New Orleans	Pittsburgh	Minneapolis		Los Angeles
5-8	Union		Pittsburgh		Oklahoma City	
5-15				Milwaukee		
5-22		Memphis	Buffalo			San Francisco
6-5	Philadelphia			Chicago	Denver	
6-12		Charlotte		Chicago		Portland
6-19			Cleveland			
6-26	Union	Atlanta		Minneapolis	Dallas	Salt Lake City

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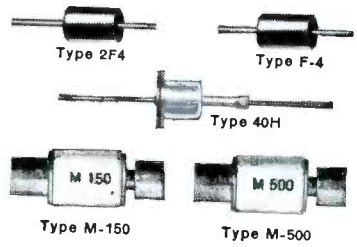
TARZIAN TUBE REPLACEMENT SILICON RECTIFIERS

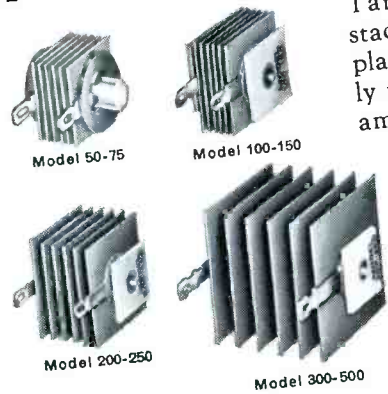
Tarzian's 9 standard models of tube replacement rectifiers are directly interchangeable with over 95% of all popular vacuum tube rectifiers. An added plus is the new Sarkes Tarzian Full Wave Silicon Rectifier (S5347), replacing 6BW4 or 12BW4 in Citizen's Band radios where maximum performance in reception quality and range is desired.

TARZIAN SILICON RECTIFIERS (PLUS CONVERSION KITS)

Sarkes Tarzian silicon rectifiers are made in production quantities by a special Tarzian process that provides optimum forward to reverse ratios, extremely low voltage drop, high reliability and long useful life. Compact conversion kits are available for both the M-150 and M-500 units.



TARZIAN "CONDENSED-STACK" SELENIUM RECTIFIERS



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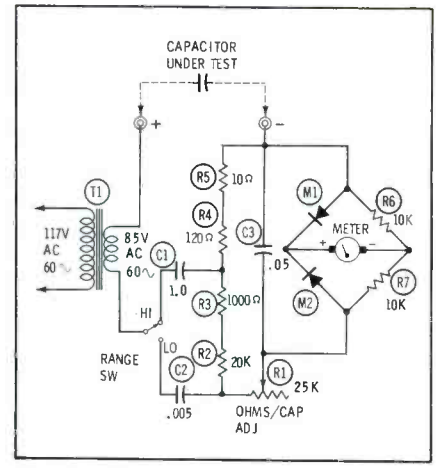

Fig. 3. Wiring of capacitance-measuring circuit in the Mercury instrument.

front panel and printed-board chassis can be removed by sliding the whole assembly downward as pictured in Fig. 2.

Since it is a VOM, the Model 400 is useful in analyzing voltages and resistances, and after isolating a fault to a certain stage or section, it can further help pinpoint trouble by checking suspected capacitors.

Direct-reading capacitance scales are unusual on a VOM, so I thought you'd like to learn something about the capacitance-measuring circuitry used in this instrument. Since the reactance of a capacitor depends upon its capacitance, the amount of AC voltage developed across it is directly proportional to its value. With a few modifying components for accurate conversion from AC voltage to capacitance values, this basic law is put to work in the test circuit of Fig. 3.

The AC test voltage for all measurements is supplied from the secondary of transformer T1. Resistors R2 through R5, and capacitors C1, C2, C3, form fixed voltage-dividing networks for the two available capacitance ranges. Control R1 is also a voltage-dividing component, but is made variable for calibrating the test circuit.

When measuring a capacitor, the two test leads (+ and −) are first shorted together, and R1 is adjusted for a full-scale meter reading. This calibrates the circuit so that the AC voltage appearing across C3 causes precisely the correct DC potential at the meter terminals to produce full-scale deflection.

When the test leads are connected across an unknown capacitor, the 60-cycle AC voltage then hivides across the precalibrated circuit and the unit under test. Consequently, the voltage dropped across C3 decreases in direct proportion to the capacitance value of the unknown unit. The resulting meter deflection is then simply calibrated in capacitance values. Due to scale-length limitations, the markings are rather closely spaced, and accuracy of a reading will therefore depend considerably on the operator's ability to interpolate.

After testing other functions of the Model 400 on some typical bench jobs, I found the instrument very handy and accurate for use as a VOM. When troubleshooting a TV chassis, for example,

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the extra-high DC voltage range is convenient for measuring "hot spots" such as boost supply lines and sweep-output circuits.

Signals for the Ear

The RCA Electron Tube Div., Harrison, N. J., is currently producing the Model WA-44C audio generator pictured in Fig. 4. This factory-wired instrument is especially designed for audio, radio, and TV servicemen, and it features either sine- or square-wave output signals which are useful for checking and troubleshooting both audio and video circuits.

Specifications:

1. *Power Requirements — 105 / 125 volts, 50/60 cps; power consumption approximately 40 watts; power transformer provides line isolation.*
2. *Output Signals—sine or symmetrical square wave; maximum output approximately 10 to 12 volts p-p across 100K ohms (shunted by 75 mmf); output constant within 1.5 db from 30 cps to 100 kc; four-position step attenuator and output control provided; separate panel jacks provide line-frequency output variable up to 6 volts rms.*
3. *Frequency Range — sine or square waves from 20 cps to 200 kc in four continuous bands; direct-reading 4¼" panel dial provided.*
4. *Source Impedance — approximately 3,000 ohms on maximum output range at 200 cps, and approximately 300 ohms for all other attenuator ranges.*
5. *Accuracy—frequency stability ±2%; dial calibrations within ±5% from 20 cps to 20 kc; harmonic distortion less than .25% from 30 cps to 15 kc; maximum hum less than .1%.*
6. *Size and Weight—7" x 10 11/16" x 6⅛", 10½ lbs.*

Examining one of the RCA generators first hand, I found that it has all-metal exterior construction, a printed-board chassis with four tubes, and two wing-type brackets on top of the case for storage of line cord and/or test leads.

Halves of a 6U8A and a 6AQ5 form a "bridged-T" oscillator circuit in the sine-

Fig. 4. RCA's WA-44C supplies signals for radio, TV, and hi-fi servicing.

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The Model 890 also measures these other in-circuit parameters: R_{in} (transistor input resistance), Z Ohms (base-emitter circuit impedance), and I_c. Out-of-circuit measurements include AC Beta, I_c and I_{cbo}.

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Crosshatch Pattern .. A crosshatch of thin sharp lines for adjusting vertical and horizontal linearity, raster size, and overscan. **Dot Pattern** (not illustrated) permits accurate color convergence.

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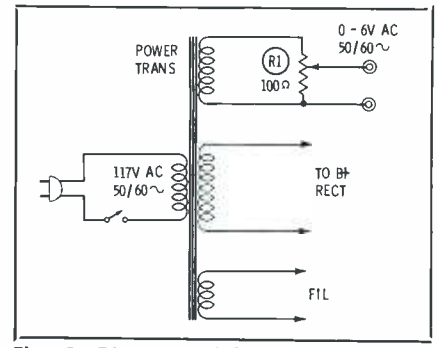

Fig. 5. Diagram of line-frequency signal source provided in RCA generator.

wave section of the instrument. The output is taken from the cathode circuit of the 6AQ5, is passed through the SINE/-SQUARE selector switch and a resistive step attenuator, and terminates at the two output jacks on the right side of the front panel. In the square-wave section, a sine-wave signal from the plate circuit of the 6AQ5 is clipped by two 6U8A triode stages, and is finally shaped by another cathode-follower output stage employing the pentode section of a 6U8A. This signal is also passed through the selector and attenuator, and on to the same two panel jacks.

The full-wave power supply makes use of a 6X4 rectifier and line-isolating transformer. A hum-balance control is provided in the tube's AC filament circuit—one reason why the hum output level is less than .1% of the rated signal voltage.

A feature of the Model WA-44C not always found on audio generators is the set of output terminals on the left side of the panel labeled LINE FREQ. The AC output at these jacks is isolated from chassis ground, and is derived from the instrument's power supply. As illustrated in Fig. 5, an individual secondary winding on the power transformer furnishes approximately 6 volts rms to the wire-wound potentiometer R1. Hence, the output at the power-line frequency is variable from zero to 6 volts rms.

To check for intermodulation distortion in an audio system, two separate signals of different frequencies are required. Since the generator itself is not "stereo," the line-frequency output can be used as this additional signal. Aside from this application, I also found the AC source useful for calibrating a scope to measure peak-to-peak values of waveforms. The peak-to-peak output is variable from zero to approximately 17 volts, and I'm sure it would be a simple matter to calibrate the output control right on the instrument's panel. By rectifying and filtering this AC voltage, it can be used as a handy DC bias supply with either a positive or negative output variable from zero to 6.5 volts.

About 15 to 20 other specific uses for the generator are described in the instrument's manual. Among these are: Signal tracing, db measurements, hi-fi response checks, intermodulation - distortion tests, and determining the resonant frequency of LC circuits.

One of the lab experiments I tried with this generator was finding the resonant frequency of several loudspeakers, which

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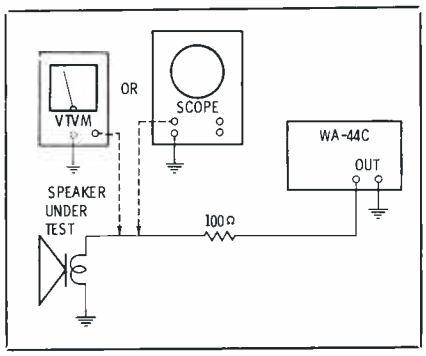

Fig. 6. Checking resonant frequency of speaker using the WA-44C generator.

is of particular interest to those involved in audio and hi-fi work. The test setup I used is shown in Fig. 6. For the most accurate results, the speaker should be unmounted and positioned away from any objects that might act as a load to change its resonant frequency.

The 100-ohm series resistor need be only a 2- to 5-watt unit, preferably a carbon type. Using either a VTVM or an oscilloscope as an AC peak indicator, the generator is slowly adjusted through an output range of about 20 to 300 cycles. At resonance you'll notice a fairly sharp rise in voltage across the speaker's voice coil. The exact frequency can then be read directly from the instrument's dial. Most speakers will resonate somewhere between 50 and 250 cps. In some cases, the voltage across the speaker may be too small for a VTVM to detect, even at maximum generator output; therefore, I found a scope much more sensitive for this application.

Portable Lab for T-Radios

Superior Instruments Co. of New York has developed a new combination instrument that not only tests transistors, but is also useful in troubleshooting transistorized circuitry. The Model 88 Transistor Radio Tester (Fig. 7) measures transistor leakage and gain, in addition to serving as both signal generator and signal tracer.

Fig. 7. The Model 88 comes with three cables plus transistor-element leads.

to take advantage of the best signal-to-noise ratio... mast mount this amplifier

to use ac power source up to 1 mile from the antenna... plug in this remote power supply

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Specifications are:

1. *Power Requirements—self-contained 4.5-volt battery pack (supplied), replaceable with three standard size "AA" Penlite cells; power* ON-OFF *switch provided on panel.*
2. *Transistor Tests—measures collector-to-emitter leakage resistance plus relative gain for both small-signal and power types; direct readings obtained on panel meter;* NPN-PNP *and* REGULAR-POWER *selectors provided; three plug in test leads supplied.*
3. *Signal Generator — self-modulated oscillator with harmonic output to over 30 mc for use in RF, IF, or audio stages; attenuator and jack provided on panel; separate output cable supplied.*
4. *Signal Tracer — sensitive amplifier section picks up signals and reproduces them through built-in speaker; input jack, external meter jacks, and volume control provided on panel; RF-IF detector and AF input cables supplied.*
5. *Other Features — portable case has detachable lid, carrying handle, and storage compartment for test leads and cables; built-in 3½" panel speaker; 2¾" panel meter with two scales —leakage 500 ohms to 100K ohms (red), and relative gain 0 to 100 (black).*
6. *Size and Weight — 6¾" x 11" x 3⅞", 3½ lbs. complete.*

In my lab tryout of the Model 88, I performed all of the troubleshooting procedures outlined in the unit's manual, plus some techniques of my own, on a number of portable transistor radios. In addition, I tested a cross section of the most popular types of transistors—each previously classified as to quality.

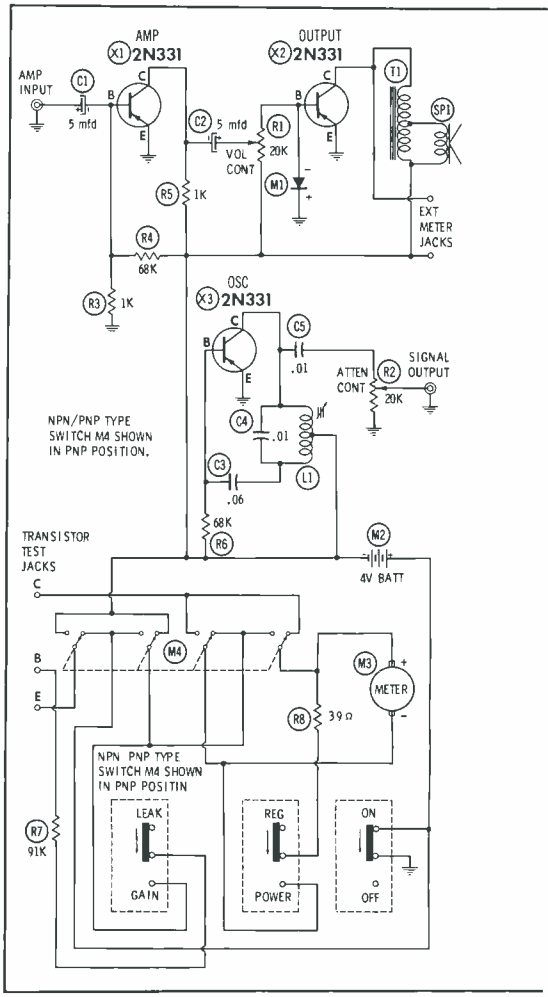

Fig. 8. Complete schematic of Superior Model 88 Transistor Radio Tester.

All you have to know to check a transistor is whether it's an NPN or a PNP type. After placing the type switch in the proper position, the transistor is connected to the test leads (C for collector and E for emitter). This will automatically give you a leakage reading on the panel meter. Instead of measuring ICEO, the instrument rates leakage in resistance—or we might say RCEO. Incidentally, the REG-POWER switch is set to its regular position unless the meter deflection goes off scale, in which case the power position is used to reduce the ohms scale by a factor of 10.

Resistive leakage readings will naturally be proportional to leakage-current characteristics. From actual experiments, I found that the average *good* RF or IF transistor will generally have a leakage resistance above 10K ohms; power types, on the other hand, measure only several hundred ohms.

To make the gain measurement, test lead B (for base) is connected to the base element of the transistor, and the spring-loaded slide switch labeled LEAK-GAIN is held in the gain position. The meter then registers relative gain on a separate 0 to 100 scale. As in the leakage test, if the

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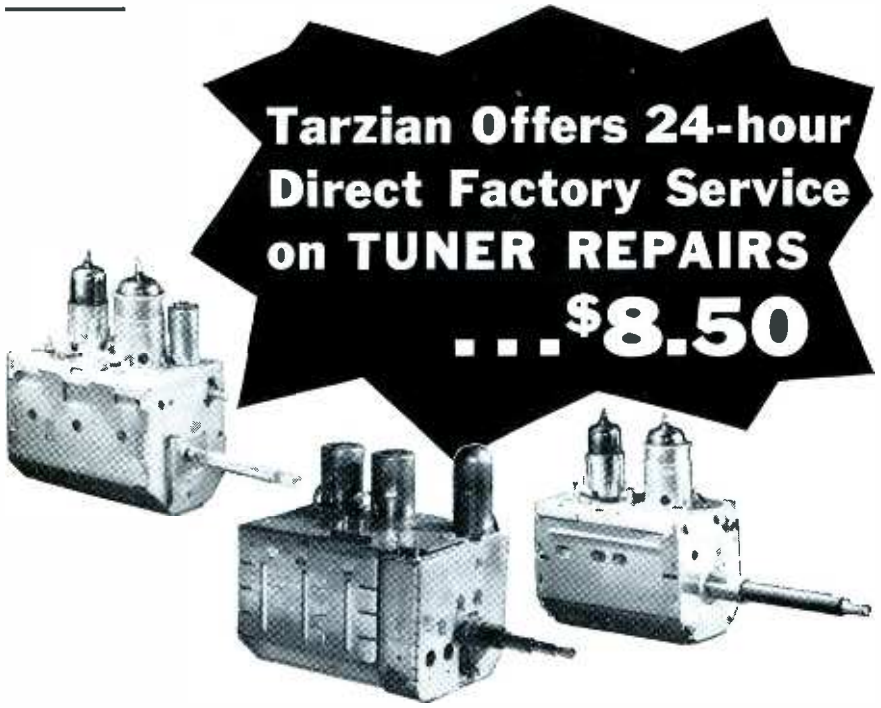

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Tarzian-made tuners easily identified by this stamping. When inquiring about service on other than Tarzian-made tuners, always give tube complement . . . shaft length . . . filament voltage . . . series or shunt heater . . . IF frequency . . . chassis identification. And, allow a little more time for service on these tuners. See your distributor, or use this address for fast, factory repair service:

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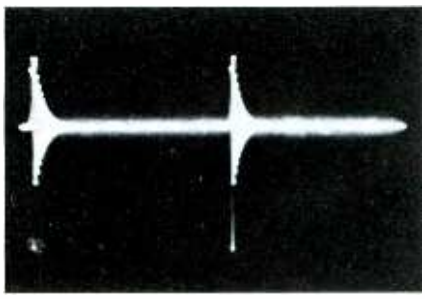
needle goes off scale, the REG-POWER switch is thrown to the power position, which increases the gain reading by a factor of 10. Most of the good transistors I checked had indicated gain values between 20 and 80.

Using the tester as a signal source, I found that you can inject the test signal at just about any point along a receiver's signal path and, provided all stages following that point are functioning, you will hear a test note in the set's speaker. I used the instrument only once in this application before my curiosity was aroused regarding the nature of the test signal which would pass through RF, IF, and audio stages alike.

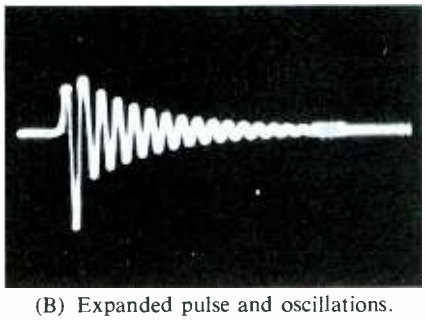
After removing the unit from its case and examining its printed-board chassis, I was able to prepare the wiring diagram shown in Fig. 8. Notice that the signal source takes the form of a transistorized blocking oscillator, employing transistor X3 and a tank circuit composed of L1 and C4. The circuit acts as a harmonic generator with a basic output frequency of 400 cps. Waveforms of this signal are illustrated in Fig. 9. Maximum output level is about 10 volts peak to peak.

The signal-tracer section of the tester employs transistors X1 and X2, plus an audio output transformer and speaker. Using the direct probe for audio circuits and the detector probe for RF and IF stages, either a station signal or the instrument's own test tone can be traced and monitored by the built-in speaker.

Station signals obtained from the RF and IF sections of a small portable may be somewhat weak at times, but the fidelity of reproduction is satisfactory. I also found it best to use a series capacitor of about .01 mfd when attempting to pick up signals at low-impedance points. I might mention, too, that the Model 88 is useful in servicing not only transistorized equipment, but also tube-type sets and hybrid auto radios. ▲



(A) Pulses viewed at 200-cps sweep.



(B) Expanded pulse and oscillations.

Fig. 9. Waveforms of the test signal generated by the Model 88 Tester.

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Wrong Way Electrons

Only four or five days after I wrote you asking for an explanation of the negative-picture effect (other than the usual statement that it is due to "overloading"), my copy of the October issue arrived with your article, "Causes and Cures for Negative Picture." Some service: I didn't know that even electrons could move that fast!

However, on page 83, the article states, "Plate current thus starts to flow in the opposite (from normal) direction through the (plate) load circuit. . ." How can that occur with a plate-supply voltage of 255 volts and a screen voltage of only 115 volts?

WILLIAM NEILSON

San Jose, Calif.

The flow of current from plate to screen in the video amplifier, resulting in a weak negative picture, can be explained as follows: When the plate current is very heavy, and the plate-resistor value has increased to a much greater than normal value, the plate voltage may drop to as low as 10 or 20 volts. Then, as the plate is bombarded by electrons being accelerated by the screen grid, secondary emission takes place at the plate. That is, electrons are attracted from plate to screen, since the latter element has the higher potential. This secondary-emission current accounts for the plate-to-screen flow.

Stubborn Osc!

An RCA Chassis KCS126 operates OK most of the time, but occasionally it loses horizontal sweep. We've checked the oscillator circuit very carefully without making any progress. The voltage on pin 2 of the 6CG7 goes to +10; pin 7 remains negative, but only slightly.

WALTER DINSMORE

Machias, Maine

The trouble seems almost certain to be a leaky C43. This would couple the positive voltage to pin 2 of V10. In addition to causing increased conduction of the AFC section, such leakage would provide a path for positive voltage through R57 and R60 to the grid of the oscillator. This would stop the oscillations, and the second section of the tube would conduct continuously. A small amount of grid current would be drawn; thus, the grid of this stage would remain slightly negative instead of going to some positive value.

Should C43 not be the source of your trouble, disable the AFC section by disconnecting R57 and R58 from Circuit-Trace *point 45. If the oscillator still fails to operate, you can check the oscillator without concern for the AFC circuit.*

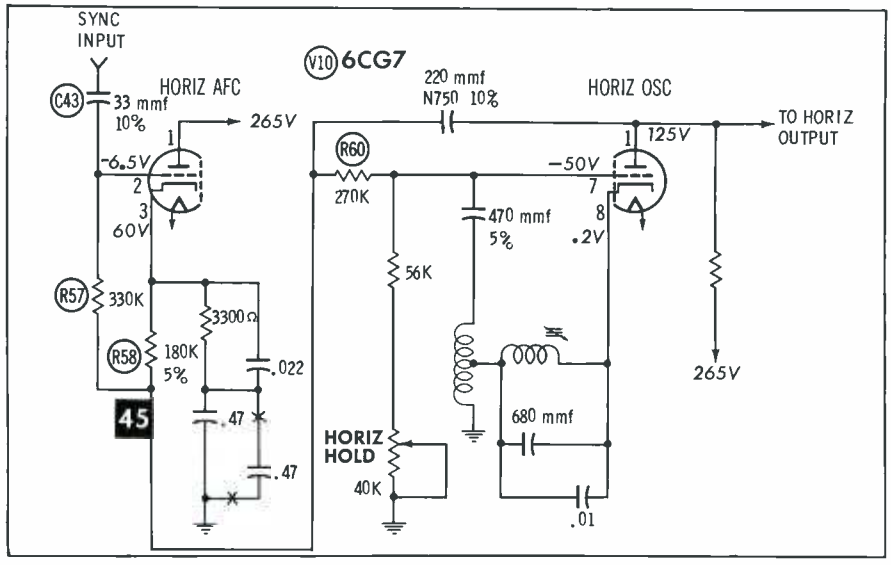
Electric Tachometer

I'd like any and all information you can give me regarding a circuit (and calibration) for an electrical tachometer to use in my 1955 Olds.

CARL J. ARNDT

Chicago, Ill.

Here's a schematic for a tachometer suitable for any 8-cylinder car. All the



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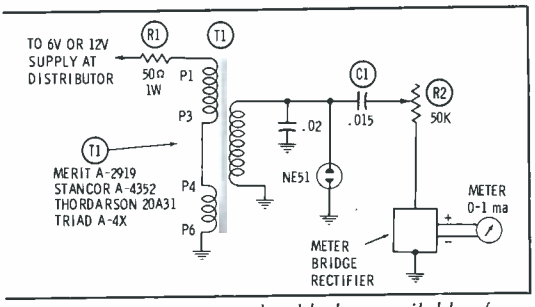


components should be available from your local electronic parts distributor.

In order to calibrate the unit, first convert the meter scale to RPM. Use 5400 for full-scale deflection, and equally divide the scale into divisions of 900, 1800, 2700, 3600, 4500, and 5400. Set the horizontal sweep rate of a scope to lock in a 60-cycle signal applied to the vertical input; this automatically sets your scope to sweep 3600 times per minute.

Connect the scope's vertical input and the tachometer's input to the 6- or 12-volt ignition supply voltage where it connects to the distributor, and start the engine. Since the distributor breaker points "fire" four times for each revolution of the engine (for 8-cylinder engines), these pulses can be used to calibrate the meter. At little more than idling speed, one pip will appear on the scope. The engine is then running 900 rpm (900 x 4 = 3,600). Increase engine speed until two pips appear (1800 rpm), and adjust R2 for a correct reading. The neon lamp should glow steadily at speeds over 1500 rpm; if it flickers at higher speeds, reduce the size of R1. Use your scope to check the calibration at 900 and 2700 rpm (one and three pips). If the readings are high, increase the size of C1 and readjust R2 at 1800 rpm. If the readings are low at the 900 and 2700 speeds, reduce the size of C1 and recalibrate.

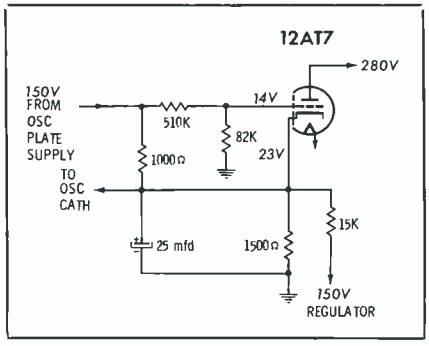
Bum Bias

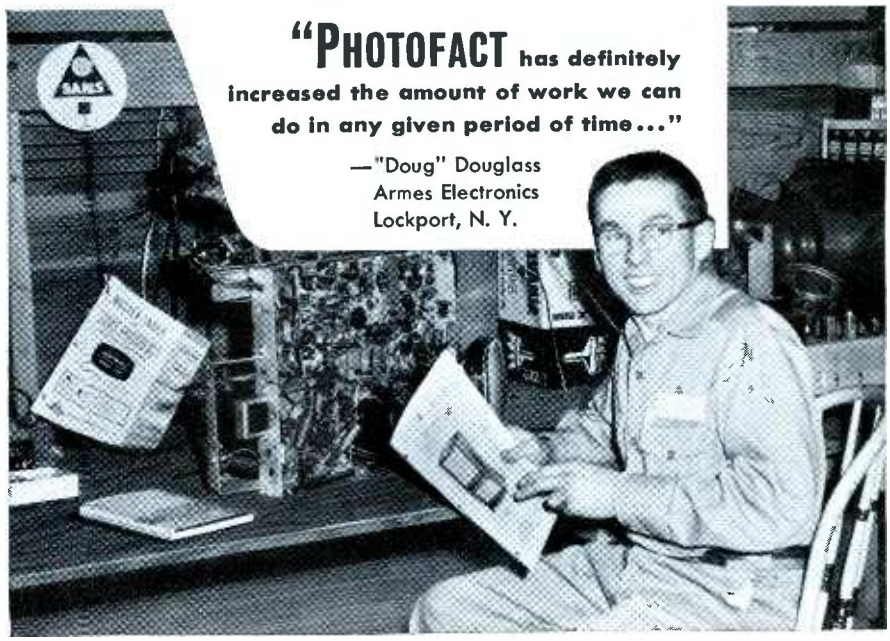
In your November, 1960 column you answered a letter from Mr. Edwin C. Myhre concerning a problem with a Thomas organ. I've found incorrect oscillator bias to be a common cause of this trouble. When the bias is incorrect, the tube may sustain oscillations even though it's supposedly cut off. Changed resistance values in the cathode circuit of the oscillator-cathode regulator tube normally causes this trouble.

JAMES A. WIEST

Decatur, Ga.

Thanks for the tip.





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RAY D. LOEWEN
Inola, Okla.

You've embarked on a very worthwhile project, Ray. If you expect to use a crystal-type mike, which has a high-impedance output, a matching transformer and probably two stages or more of preamplification will have to be used. If, however, you are going to use a carbon mike, about the only thing that will be required is a simple audio amplifier circuit for preamplification prior to feeding the signal to the high side of the volume control.

Worked To Death

Is it true that continuous fringe-area reception will shorten the life of an RF amplifier tube? If so, why?

E. A. BAILLIE-DAVID
Megantic, P. Q., Canada

Definitely. With extremely weak signals, no AGC voltage is developed; in fact, bias may be slightly positive if no AGC clamper is used. The RF amplifier is thus permitted to run "wide open." This, of course, reduces tube life even though rated limits are not exceeded.

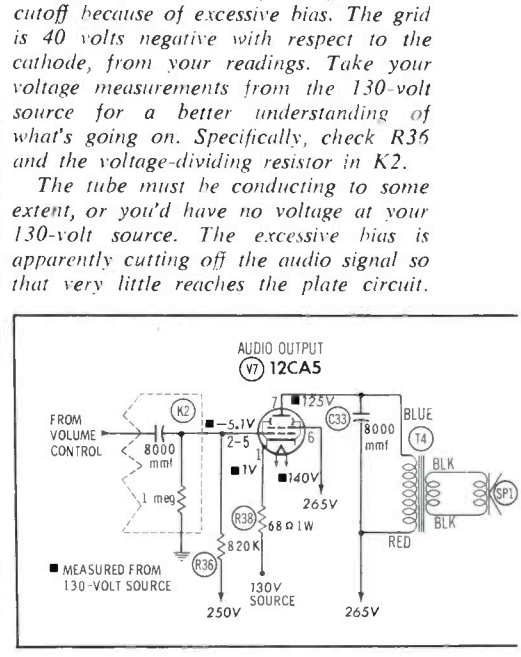
What Say?

A Philco Chassis 8H25 has a good picture but no sound. There is a signal at the grid of the audio output tube, and I've substituted for the output transformer, speaker, and C33. Voltages are: pin 1, 180 volts; pins 2 and 5, 130 volts; and both the plate and screen have 270 volts. May we please have your analysis?

G. H. MORSE
Drumheller, Alberta

The output tube is operating close to cutoff because of excessive bias. The grid is 40 volts negative with respect to the cathode, from your readings. Take your voltage measurements from the 130-volt source for a better understanding of what's going on. Specifically, check R36 and the voltage-dividing resistor in K2.

The tube must be conducting to some extent, or you'd have no voltage at your 130-volt source. The excessive bias is apparently cutting off the audio signal so that very little reaches the plate circuit.



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Upgrading Courses

(Continued from page 59)

and Sound Servicing (12 texts), High-Fidelity Sound Reproduction (12 study guides with book), Television Servicing (20 texts), Color TV (11 texts). (R) also available.

ITI—(C) Radio-Television Electronics (24 mo*—$395).

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NBS—(C) Electronic Organ Servicing (27 lessons).

RCA—(C) Television Servicing (60 wks*—$90 without equipment kits, $255 with kits); Color Television (24 wks*—$59.50); Transistors (30 wks*—$59.50). (R) also available.

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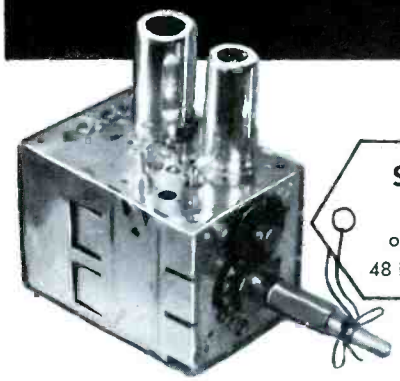

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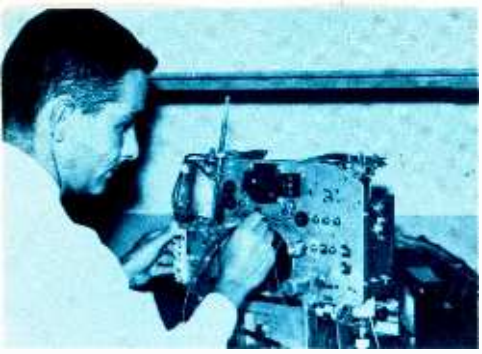

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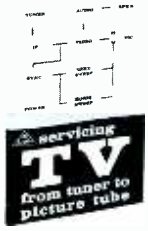

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Small Radios

(Continued on page 28)

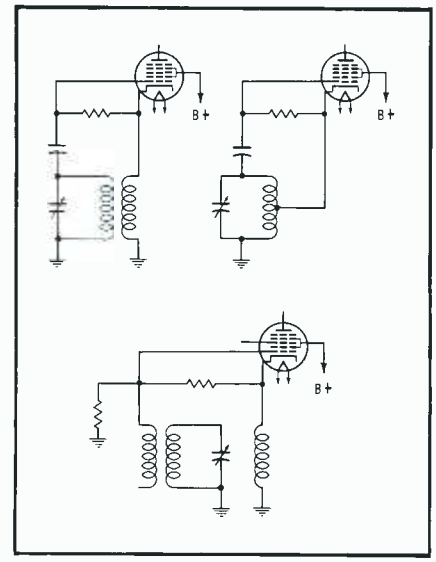

Fig. 2. Oscillator-circuit variations. Common fault is open cathode coil.

the output transformer. Voltages at both points should be only slightly lower than B+ (about 100 volts).

On the first audio tube there is usually only one connection to B+, and the voltage here measures only 60 to 75 volts because of the large-value plate-load resistor. However, there are some pentode-type audio stages in use, and these will have two hot terminals.

B+ is also fed to the plate and screen of the IF amplifier. Converter tubes in use for about the past 10 years incorporate the oscillator plate and the converter screen grid into one element. As a result, this and the plate are generally the only "hot spots" on the converter socket.

You don't necessarily need a diagram to identify the tube functions. The rectifier is easily identified by its type number, or by its "flat" elements, and the output tube is pinpointed by the wires from the output transformer. The IF amplifier usually sits between the two IF cans. The oscillator is near the tuning gang and is connected to its smaller section. The only stage still unidentified *has* to be the first audio. This can be verified by tracing the coupling capacitor from the grid of the output tube.

Now, let's listen to the set for awhile. If it sounds weak with excessive hum, it is trying to tell you the filters are bad. Weak, gargly

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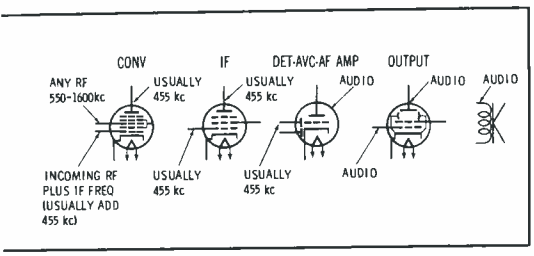

Fig. 3. Signal-injection points. Modulate all RF-IF signals with audio.

sound without excessive hum indicates a weak rectifier. Distortion after a few minutes of playing is usually due to a defective output tube, particularly if the type number ends in "L6." The same symptom may mean an off-value grid resistor in the first audio stage, or a leaky coupling capacitor. I make it a standard practice to change these two components in any tube-equipped set over a year or two old.

If the set is as hot as a firecracker, picking up every scratch and pop, suspect the oscillator. If it is inoperative, you can scratch the chassis with a screwdriver and get a response from the speaker. To check the oscillator, tune a signal generator to a frequency above the dial setting by 455 kc (or whatever the IF frequency may be), and listen. No connections are necessary if the lead from the generator is close by; poking the lead directly into the oscillator coil is a sure way to inject the signal. An output means the oscillator circuit is inoperative. For some typical oscillator layouts, see Fig. 2.

The IF and audio circuits can be checked most rapidly by signal injection from the generator, as diagrammed in Fig. 3. Signal amplitude should increase as you work back from the speaker to the IF grid.

The much discussed printed circuits aren't too bad if you adopt a technique. For one thing, you have no business under the board unless you're looking for a broken conductor. All voltage and signal-tracing tests can be made from the top side with the use of socket adapters.

If you are looking for cracks, make like Sherlock Holmes with a magnifying glass, because even the minutest break will cause an intermittent trouble you may not find any other way.

There's your technique, and although you may develop several innovations once you get the hang of it, you'll find you *can* fix small radios—and at a profit, too! ▲

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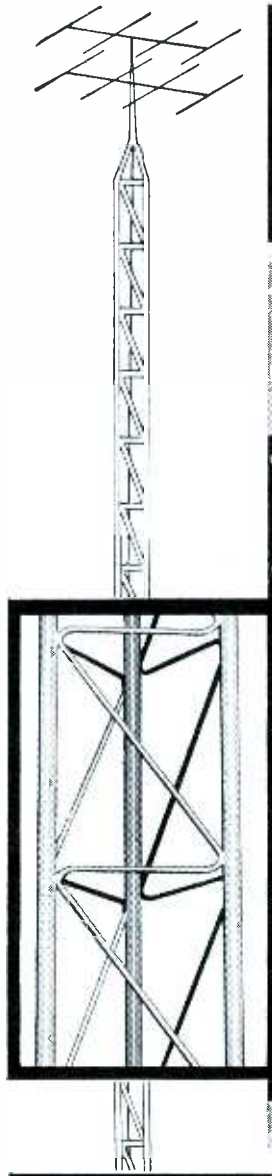

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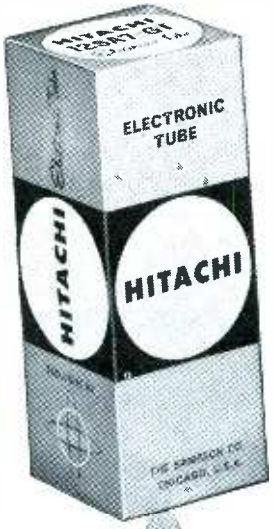

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Operation Vertical

(Continued from page 25)

conduction. The bias level in a vertical discharge stage is affected by the amplitude of the feedback pulse, which determines the amount of grid-leak bias developed. Another factor which must not be overlooked is the possibility of a coupling capacitor becoming leaky and allowing an unwanted positive voltage to reach the grid. Also, unless the cathode is grounded, it is necessary to determine whether or not the cathode voltage is correct.

This last consideration does not apply to the circuit of Fig. 2, which depends strictly on grid-leak bias. The peak-to-peak amplitude of the signal fed back from the output section, and the values of the components in the RC time-constant circuit, determine the running speed of the multivibrator. A check of W3 will tell you whether or not the feedback signal has the correct amplitude. Remember that the straight, steeply negative-going portion of this signal represents the rapid charging of C52 during retrace time, and that the rising, slightly curved part of the waveform shows the bleeding off of this charge through the hold-control circuit while V7 is in cutoff. Also, with the multivibrator running at the wrong frequency, don't forget that you'll have to adjust the scope-sweep vernier control to a value slightly off 30 cps in order to obtain a stationary pattern for W3. Stationary or not, you can still measure the waveform's peak-to-peak amplitude — and this is what counts the most.

Feedback-Signal Amplitude

Undoubtedly, the peak-to-peak amplitude of the grid waveform will

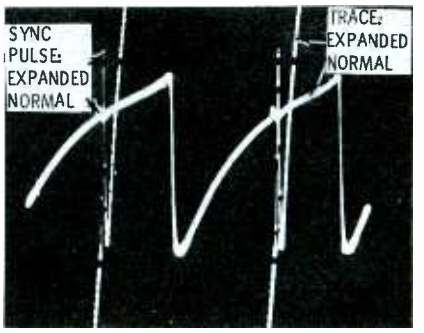

Fig. 3. Discharge-tube grid waveform expanded to measure the sync pulse.

be wrong when you have roll problems, but if you'll stop and ask yourself *how* it is wrong, you'll be on your way to a solution. If there's too much amplitude, the chances are better than 10 to 1 your trouble is caused by decreased capacitance in C52 (Fig. 2), or by a change in the value of a control or fixed resistor in the grid circuit. It's a simple matter to check the resistors with an ohmmeter, and it should also be short work to unsolder and test or replace the capacitor.

When the waveform amplitude is low, there are several possible reasons why. Knowing the exact peak-to-peak value will help you determine the most probable cause. If your scope is equipped with a low-capacitance probe, it'll be no strain to trace the signal back through the feedback circuit to see where the signal loss is occurring (Notice W4 and W5 in Fig. 1, as well as W4, W5, and W6 in Fig. 2.) As long as the scope is protected by the additional isolation of the probe, you can get away with viewing the signal at the plate of the vertical output tube. The reason why this point is labeled *Do Not Measure* is that the high-amplitude pulses here might damage the input network of a voltmeter.

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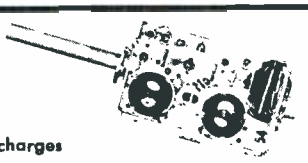

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A scope is subject to the same sort of damage if used with a direct probe.

Perhaps a "refresher course" on how pulses are developed across an AC voltage divider will aid you in tracing feedback-circuit troubles. While it is not necessary to compute the capacitive reactance of capacitors, it is often helpful to take note of the approximate ratios of reactance and DC resistance in various parts of the circuit. In Fig. 1, for example, C45 is in parallel with the rest of the feedback filter circuit, and this whole network is in series with C44 between the output-tube plate and ground. The lower half of the resulting voltage divider has somewhat less total reactance than C44; thus, less than half of the 800-volt plate signal (actually 340 volts) appears at the junction of C44 and C45. Similarly, the combination C46-R71 has much less reactance than R73 at the frequencies involved, and so the waveform amplitude is further reduced to 50 volts at the midpoint of this second voltage divider (see W3).

A similar reasoning process can be applied to the circuit of Fig. 2. The slight AC voltage drop across C58 indicates that this component presents only a low reactance. On the other hand, the resistance of R58 is roughly equal to the reactance of the circuit between its "lower end" and ground, judging from the amplitude of W6—which is barely more than half that of W5. A further signal reduction takes place by division between C52 and the grid-to-ground circuit; some fluctuation in grid-signal amplitude can normally be expected as the hold control is turned.

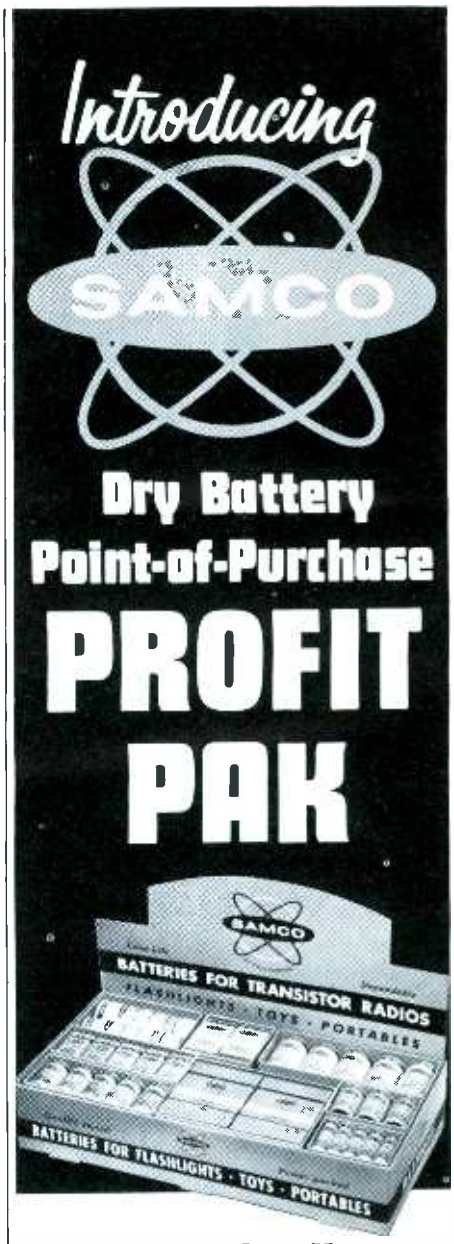
Here's another clue to help you in tracing feedback-circuit defects: Some component failures, such as a leaky C58 in Fig. 2, will increase the current drain on the output tube. This type of trouble may affect size or linearity before becoming severe enough to produce a hold problem.

". . . I thought it was the repairman with our TV, but I guess the kids are ringing doorbells."

Summary

Now that we've run the gamut of troubles associated with the combined vertical multivibrator-output circuit, let's review our findings. As a general rule, we've found it best to ignore any interaction between stages, and to concentrate on the part of the circuit most likely to be directly associated with the specific trouble. We've also seen that the visual symptom on the face of the CRT points to a definite trouble area in most cases.

As for pinpointing troubles to specific components, we've recognized the need for a better method than the laborious, time-wasting mass substitution of components. We can lay the groundwork for this improved approach by increasing our understanding of the whole vertical circuit and its individual sections. ▲



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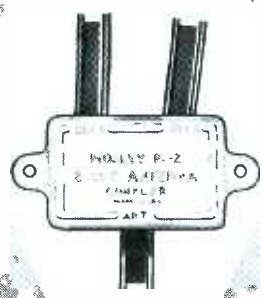

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RCA KCS68C

(Continued from page 27)

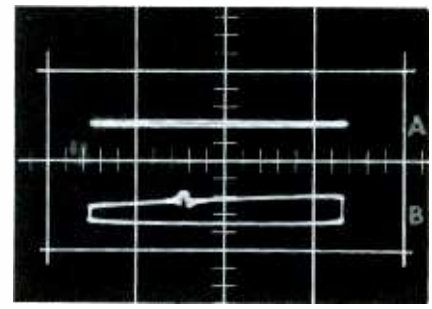

Fig. 5. Scope response shows attenuated signal caused by shorted capacitor.

1500-mmf bypass capacitor paralleling the cathode resistor in the cathode circuit of the RF amplifier stage. Remembering that gain is reduced by the degenerative effect of an unbypassed cathode resistor, I cut the leads of a ceramic unit very short and installed it in the circuit. As with the other corrections, performance was improved somewhat, but again, not quite enough. It was the simple input-circuit correction that really did the most good, although I console myself with the thought that these other marginal defects would have had to be located and corrected before the set could be returned.

Anyway, while troubleshooting the tuner, I learned a few other time-saving facts you can put to good use. These were gained when I checked the antenna-input circuit. With the sine-wave output of the sweep-marker generator connected to the horizontal input of the oscilloscope, and with the signal output of the generator and the demodulator probe of my scope both connected to the antenna-input socket of the tuner, the generator response appeared as shown in Fig. 3. Tracing through the input circuit to points A, B, and C in Fig. 2, I observed the tuner-input response shown in Fig. 4. If C8 or C9 had been shorted, the signal at D would have dropped to nothing (A of Fig. 5). If C10 had shorted, the signal amplitude would have been considerably reduced as in E of Fig. 5. Had C11 opened or shorted, or if any of the coils had developed trouble —except a total short—there would be little noticeable effect at 70 mc. On the other hand, had C10, C9, or C8 opened, the output waveform would have dropped to nothing at this frequency. ▲

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A Service-Keyed Advertising Program

Last month's *Dollars & Sense* column introduced you to a unique series of ads designed specifically for radio-TV-electronic service dealers. Each month throughout 1961 we'll present a selection of five brand-new ads from this series.

These ads were produced by topnotch copywriters and artists who are familiar with your problems. Some of the messages are seasonal; others emphasize specialized services on hi-fi, auto radios, antenna systems, color TV, etc.; and some are designed for special offers.

To make sure they will get results, this program has been carefully developed and field-tested. Each month's selection of 5 ads is available to you *at cost* in two forms—durable newspaper mats at $1.75 per set, or high-quality reproduction proofs 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. To obtain your set of this month's ads use the convenient order form on page 78. Your ads will be sent to you postpaid.

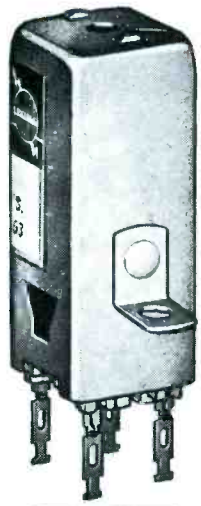
ES-23: 1⅞" x 4¾"
Ad copy which assures the consumer of high-quality work at fair prices always gets good results . . . and answers in advance the customer's fear of being cheated.

ES-37: 1⅞" x 2⅝" Here's a small ad for more restricted budgets. Gets your name before the public and promises prompt service.

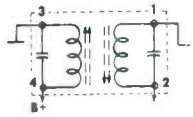
ES-40: 1⅞" x 4½"
Notice the emphasis on guaranteed service — very reassuring to consumers who have experienced recurring troubles.

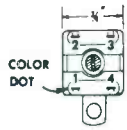
ES-43: 1⅞" x 4¼"
Not only does this ad get immediate attention, but its simple message contains all the key words needed to get action.

ES-57: 3¾" x 3½"
Want to boost your audio and hi-fi business? This ad portrays you as a service and conversion expert in this specialized field, yet points out that you also handle TV and radio repairs.



MODEL 12-C11





MILLER Model 12-C11
455 kc IF transformer

– an exact replacement for G. E. RTL-143 and RTL-163 – at your MILLER distributor

Here's the IF transformer used in a broad line of G.E. clock and table radios—available from any Miller distributor. It comes to you complete with schematic and base layout, to speed installation.

This unit is one of many miniature IF transformers designed for replacement use.

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12-C11	Home Radio	RTL-143 and 163
12-C13	Home Radio	RTL-172
6206-PC	TV Ratio Det.	RTD-026 (WT56X38)
6207-PC	TV Ratio Det.	RTD-025 (WT56X37)
6208-PC	TV Ratio Det.	RTD-020
6209-G1	TV Ratio Det.	RTD-024 (WT 56X36)

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5917 S. Main St., Los Angeles 3, Calif.

The Model 88 . . . . A New Combination

TRANSISTOR RADIO TESTER and DYNAMIC TRANSISTOR TESTER

The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no adequate provision for servicing this ever increasing output.

The Model 88 was designed specifically to test all transistors, transistor radios, transistor recorders, and other transistor devices under dynamic conditions.

AS A TRANSISTOR RADIO TESTER

We feel sure all technicians will agree that the instruments and methods previously employed for servicing conventional tube radios and TV have proven to be impractical and time consuming when used for transistor radio servicing. The Model 88 provides a new simplified rapid procedure—a technique developed specifically for radios and other transistor devices.

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble whether it be a transistor, some other component or even a break in the printed circuit is located and pin-pointed. The injected signal is heard on the front panel speaker as it is followed through the various stages. Provision has also been made on the front panel for plugging in a V.O.M. for quantitative measurement of signal strength.

The Signal Tracing section may also be used less the signal injector for listening to the "quality" of the broadcast signal in the various stages.

At your local radio parts jobber.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors including NPN and PNP, silicon, germanium and the new gallium arsinide types, without referring to charactistic data sheets. The time-saving advantage of this technique is self evident. A further benefit of this service is that it will enable you to test new transistors as they are released!

The Model 88 will measure the two most important transistor characteristics needed for transistor servicing; leakage and gain (beta).

The leakage test measures the collector-emitter current with the base connection open circuited. A range from 50 ohms to 100,000 ohms covers all the leakage values usually found in both high and low power transistor types.

The gain test (beta) translates the change in collector current divided by the base current. Inasmuch as the base current is held to a fixed value of 50 microamperes, the collector current calibrated in relative gain (beta), is read directly on the meter scale.

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-On Cables for Transistor Testing, an R.F. Diode Probe for R.F. and I.F. tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! Only .....

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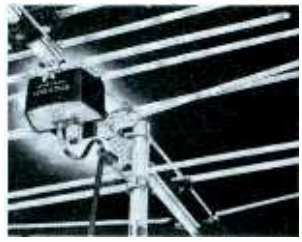
PRODUCT report

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

Special Replacement Tubes (39Y)

Mullard "Caddy 8-Paks" offer three different selections of eight tubes each. Type A, for the high-fidelity field, includes the ECC81/12AT7, ECC82/12AU7, ECC83/12AX7, ECL82/6BM8, EL84/6BQ5, EZ81/6CA4, 7025, and 7189; Type B, for foreign equipment, comprises the EABC80/6AK8, ECC82/12AU7, ECC85/6AQ8, ECF80/6BL8, ECL82/6BM8, EL84/6BQ5, and EZ81/6CA4. Type C, for TV and FM tuners, includes the EC95/6ER5, EC97/6FY5, ECC189/6ES8, ECC91/6J6, EF183/6EH7, EF184/6EJ7, ECC85/6AQ8, and XC95/2ER5. Dealer price of each "8-Pak" is $10.

Antenna-Amplifier Combination (40Y)

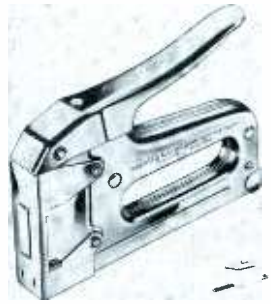


A broadband VHF amplifier employing a frame-grid 6DJ8 tube is an integral part of the **Winegard** "Powertron" fringe-area antenna. A fused 24-volt supply feeds power to the amplifier through the antenna lead-in wire. Among the special applications practical with this antenna are remote installation (antenna up to ¼ mile from set), fringe-area attic installation, and multiple-set operation with no additional amplification. Models are available with 14, 21, and 30 elements at $74.95, $91.90, and $104.95 list.

Ceramic-Cartridge Conversion (41Y)

The **Sonotone** "Velocitone" Assembly includes a "9T" high-compliance ceramic cartridge and a matched pair of equalizer units for connecting the cartridge to the magnetic or velocity inputs of a stereo preamplifier. The adapters modify the output signals to conform with a velocity-type response curve having RIAA equalization. The complete assembly has a list price of $20.50 with dual sapphire styli, or $23.50 with one diamond and one sapphire.

Gun-Tacker Attachments (42Y)



To increase the usefulness of the **Arrow** T-50 gun tacker, three new special-purpose snap-on attachments have been devised. The wire attachment (in photo) is for fastening down electric wiring, etc.; the screen attachment is for use on window screens; and the window-shade attachment is for tacking cloth or other materials onto round surfaces such as dowels or window-shade poles. The attachments cost $1 each.

Receiving Tubes (43Y)

New types in the **Sylvania** replacement-tube line are the 1N2A TV high-voltage rectifier diode; 12FX8 triode/heptode RF amplifier and converter for hybrid auto radios; 60FX5 miniature audio output tube; 2FQ5 triode RF amplifier (with strap-frame grid) for TV; and 13EM7 dissimilar dual triode for vertical sweep use in TV receivers with 450-ma strings.

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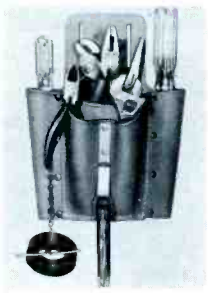
Tool Holster (44Y)



Made of saddle leather, **Xcelite's** new tool holster has pliable belt slots and a contoured back so that it can be worn comfortably on the hip. There are five pockets for carrying various hand tools such as pliers, screwdrivers, and wrenches; in addition, a clip is provided for attaching a pocket knife, and a roll of electrical tape can be hung from a convenient chain.

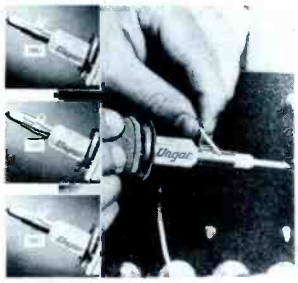
Constant-Value Capacitors (45Y)

Two new assortments of **Sprague** "Isofarad" capacitors (a type with plastic-film dielectric and zero temperature coefficient) are packaged in compartmented, clear plastic cases. The TK-22 box (shown) contains 11 capacitors in the following seven values often required in close-tolerance tuned-circuit applications: .001, .0022, .0039, .0047, .0056, .01, and .022 mfd. Price is $5.88. A larger TK-8 assortment ($9.18) includes 17 capacitors.

Bench Lamp for Close Work (46Y)

The 5" magnifying lens in the **Acme Lite** "Magniflex" lamp has a focal length of 13" and a power of 3 diopters. The work is illuminated by a 22-watt, ring-type fluorescent lamp that surrounds the lens. The 26" swinging arm can be mounted on the bench with screws or a clamp, except in one model which has a weighted base and requires no attachment.

Wire-Stripping Aid (47Y)

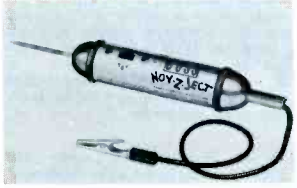


For conveniently removing rubber and plastic insulation from #8 to #24 gauge wire, **Ungar** has introduced a thermal wire-stripping clip that slides onto the barrel of any 4000 Series soldering tip. A choice of three types is offered — No. 7951 with V-shaped cutting edge, 7952 with "pull-through" circular cutter, and 7953 with round-notch edge. List price is 75c each.

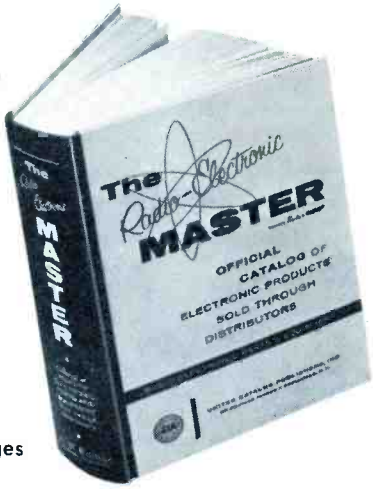
Silicons to Replace Tubes (48Y)

Mounted on standard tube bases, two new **International Rectifier Corp.** silicon diode units are direct plug-in replacements for several types of rectifier tubes widely used in auto radios and communications gear. The octal-based ST-8 can be substituted for an 0Z4 or 6X5, while the miniature 1N570 replaces the 6X4 or 12X4. Both have an operating-temperature range of —65° to +75° C. Price is $13 for the ST-8 and $30 for the 1N570.

Signal Injector (49Y)



A transistorized 1000-cps oscillator in the **Doss** "Noy-Z-Ject" produces a square wave with very fast rise and fall time. When the probe is applied to an RF or IF stage, the sharp edges of the square wave shock-excite the tuned circuit. The resulting damped oscillations act as a carrier for the basic audio wave, enabling the signal to pass through high-frequency stages. The device is self-powered and has a long, sharp probe for convenience in servicing printed-circuit transistor radios.



1600 pages

IT'S NEW. Covers all the latest products for servicing radio-TV-hi-fi and industrial equipment: • miniature and sub-miniature components • printed circuit components • silicon rectifiers • stereo equipment • automatic test equipment • citizens band, SSB and mobile ham gear, etc.

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IT'S THE EASIEST TO USE. Quickest way to get current catalog data on the products of more than 330 manufacturers. Systematically organized in 32 product sections for rapid reference.

SAVES TIME AND MONEY FOR SERVICE TECHNICIANS. Whether you're servicing radio, TV, audio or industrial electronic equipment, you find the right part to do the job best in The MASTER. The reason: you're shopping in the electronic supermarket. The MASTER is easy to sell from because it contains list prices. It's easy to buy from because your distributor has it and all you need do is select the item you want and order by part number. No matter what product or component you require, you'll find it faster in the 1961 MASTER.

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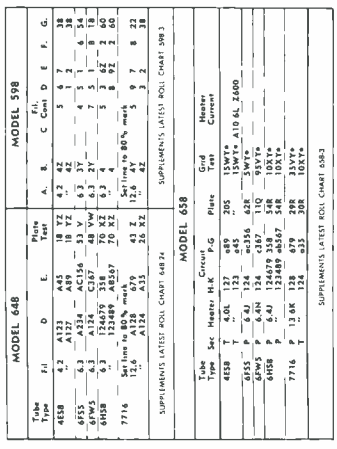
INDEX TO ADVERTISERS

CATALOG AND LITERATURE SERVICE

February, 1961



ANTENNAS AND ACCESSORIES

1Y. BLONDER-TONGUE—New literature on Model AB-3 Mast-Mounted TV/FM Amplifier with remote power supply, and on Model IT-3 Four-Set TV/FM *Power Booster*. *See ad page 65.*

2Y. JFD—New 1961 *Exact-Replacement Antenna Guide Wallchart for Portable and Toteable TV Sets.* 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 1961 line of natural silver and gold anodized *Hi-Fi* TV antennas, mounts, masts, and accessories. *See ads pages 36, 41.*

3Y. MOSLEY—Catalog of TV antenna and audio accessories; also sample mailing piece designed to help service dealers promote Model F-1 PK TV Wall Outlets. *See ad page 76.*

4Y. ROHN—New folder describing complete line of antenna towers and allied accessories; also descriptive literature on heavy-duty communications towers. *See ad page 73.*

5Y. WINEGARD—Catalog sheet describing model A400, 1- to 30-set distribution amplifier with 26-db gain, plus deluxe accessories including line tapoffs, splitters, and transformers. Also 6-page, 4-color brochure on new *Powertron*—"the world's first electronic TV antenna." *See ad pages 20-21.*

AUDIO AND HI-FI

6Y. 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 52.*

7Y. SONOTONE—Literature on the new "Velocitone" ceramic-cartridge assembly for replacement use in any phonograph. *See ad page 59.*

COMPONENTS

8Y. ARCO—Catalog 1060, describing complete *Arcolytic* line of exact replacement twist-mount and tubular electrolytic capacitors. *See ad page 15.*

9Y. 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 9.*

10Y. CLAROSTAT — Information on *ABC Handi-Bin* assortment of A47, B47, and C47 controls, switches, and shafts.

11Y. LITTELFUSE — Literature describing *Fuse Caddies*, assortments of 75 fuses (popular values) packed in handy plastic box having individual compartments for each fuse box plus two spare compartments. *See ad 4th cover.*

12Y. J. W. MILLER—Information on exact TV and home-radio replacement parts for Admiral, G-E, Hotpoint, Philco, RCA, and Westinghouse, plus exact auto-radio parts for Bendix. *See ad page 77.*

13Y. PYRAMID — New "hang-up" Catalog J-10 on expanded line of replacement capacitors. *See ad page 51.*

14Y. 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 74, 75.*

15Y. SPRAGUE — General Catalog C-613A, containing descriptions and ratings of more than 4,000 items, including capacitors, resistors, printed circuits, filters, and capacitor-test equipment for use in the electronics service industry. *See ads pages 11, 12.*

RADIOS

16Y. CHANNEL MASTER — Full-color booklet (excellent for giving to consumers) illustrating complete line of transistor radios. *See ad page 70.*

SERVICE AIDS

17Y. ACME LITE — Literature describing four models of new "MAGNIFLEX" fluorescent lamp for use in precision work requiring both illumination and magnification. *See ad page 34.*

18Y. CASTLE—Leaflet describing fast overhauling service on television tuners of all makes and models. *See ad page 71.*

19Y. CHEMICAL ELECTRONIC ENG'G—Leaflet on *Hush* TV-tuner cleaner, *Ever-Quiet* contact restorer, *Plastic Sealer* spray, *Ever-Kleer* glass cleaner, and *Sure 'n' Easy* wire connectors. *See ad page 75.*

20Y. ELECTRONIC CHEMICAL CORP.—Folder on new *Formula EC-44* contact cleaner. *See ad page 46.*

21Y. E-Z-HOOK—Convenient reference sheet titled, "How to Build the Five Most Useful Scope Probes," with schematics, mechanical component layouts, etc.

22Y. INJECTORALL — Catalog describing complete line of electronic servicing chemicals and their applications. *See ad page 78.*

23Y. MOTOROLA (Parts & Accessories Div.)—Complete information on special *Dress Up for Profits* premium offer of famous-brand dress shirts with purchase of receiving and picture tubes. *See ad page 48.*

24Y. PERMA-POWER — *Britener Selector Guide*, listing proper britener choice for every picture tube in general use today. *See ad page 56.*

25Y. PRECISION TUNER—Information on repair and alignment service available for any type of TV tuner. *See ad page 74.*

SPECIAL EQUIPMENT

26Y. ATR—Descriptive literature on Universal Inverters, ideal for operating standard 110-volt AC PA systems in mobile applications—*See ad page 14.*

27Y. 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 70.*

TECHNICAL INFORMATION

28Y. GRANTHAM — Booklet entitled, "Careers in Electronics," outlining training courses available. *See ad page 55.*

29Y. HOWARD W. SAMS—Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics servicing. *See ads page 50, 68, 69, 76.*

30Y. SYLVANIA (Electronic Tube Div.)—Free subscription to *Sylvania News*, a 12-page publication devoted to the TV technician. Contains service hints, business-building ideas, and 4 pages of technical information. *See ad page 13.*

31Y. UNITED CATALOG PUBLISHERS—Complete descriptive literature on the 1961 edition of the *Radio-Electronic MASTER*, 1600-page official buying guide of the electronic-radio-TV parts and equipment industry. *See ad page 79.*

TEST EQUIPMENT

32Y. 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 ads pages 45, 49.*

33Y. HICKOK—Form TT611 describing new 890 In-Circuit Transistor Tester and complete line of other transistor testers. *See ad page 63.*

34Y. SENCORE—New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter*, plus brochure on complete line of *time-saver* instruments. *See ads pages 29, 31, 33.*

35Y. SUPERIOR — Bulletin 107 with complete specifications on combination transistor/transistor radio tester, plus complete line of VOM-VTVM units, tube testers, and picture tube tester-rejuvenator. *See ad page 77.*

TOOLS

36Y. 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 70.*

37Y. XCELITE — Condensed catalog pages on line of tools for the electronics service industry. *See ad page 16.*

TUBES

38Y. 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 74, 75.*

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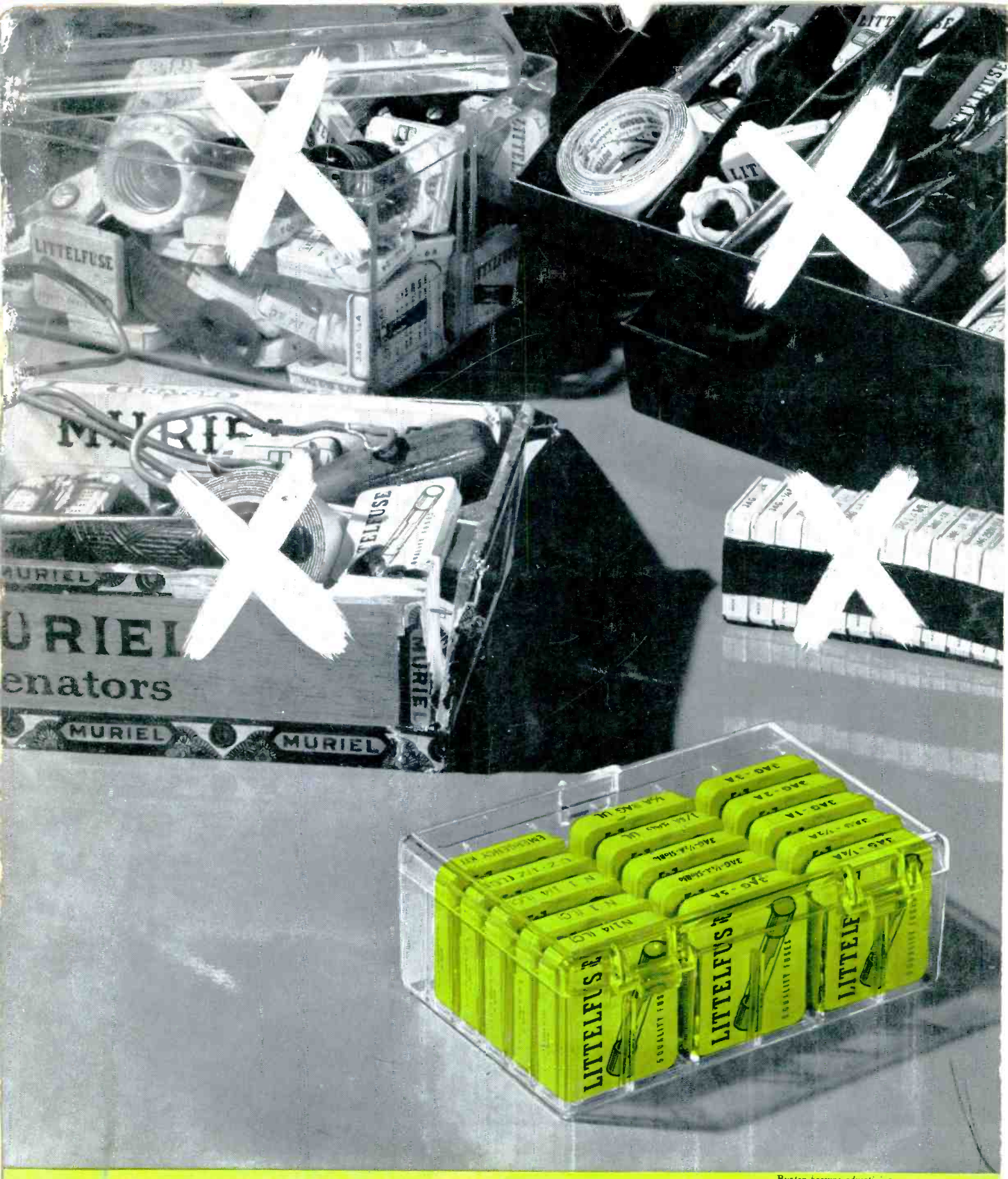

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