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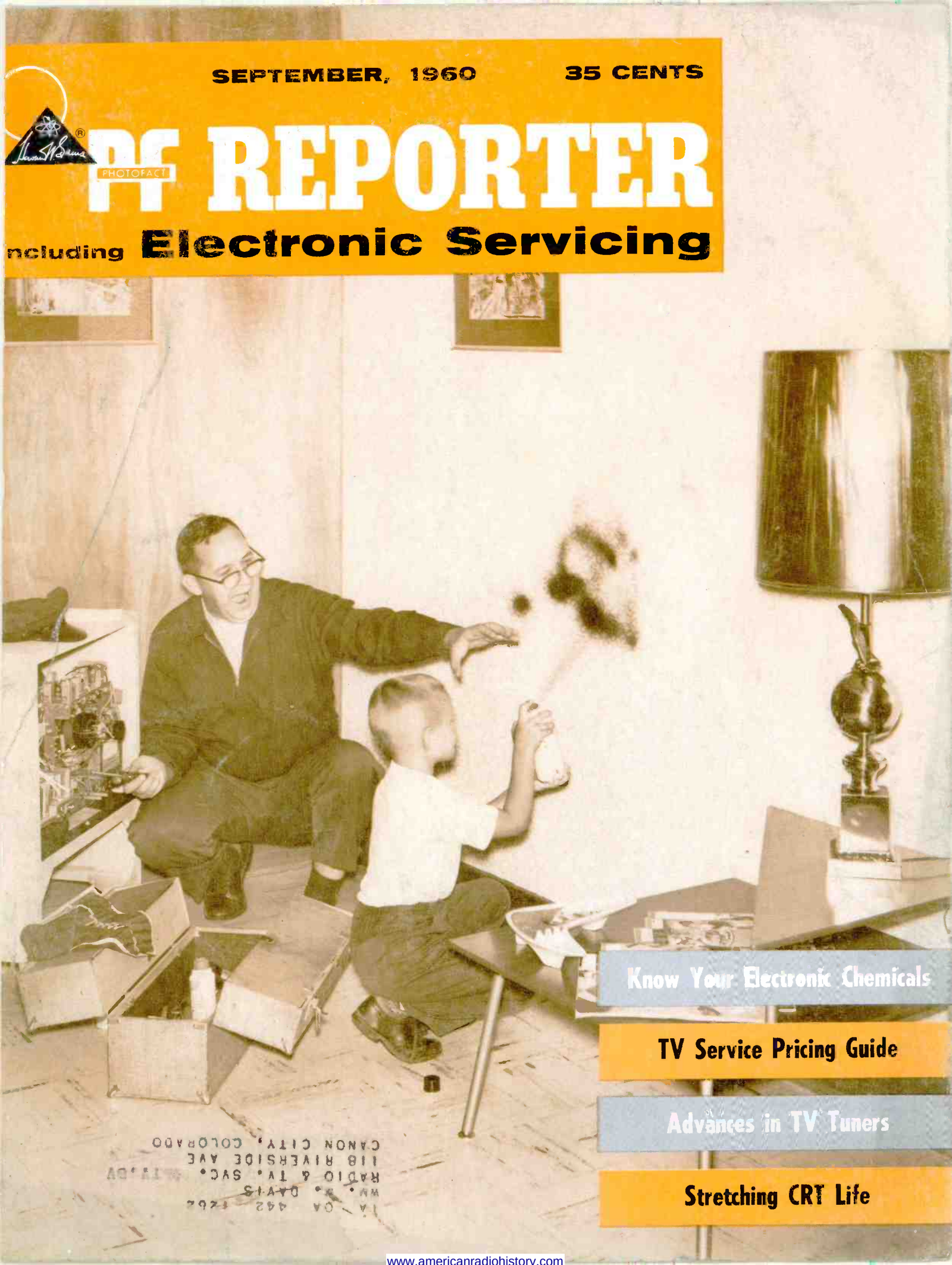

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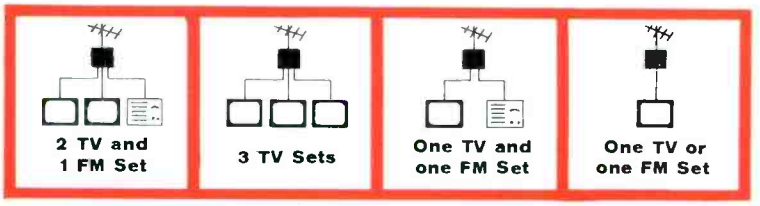

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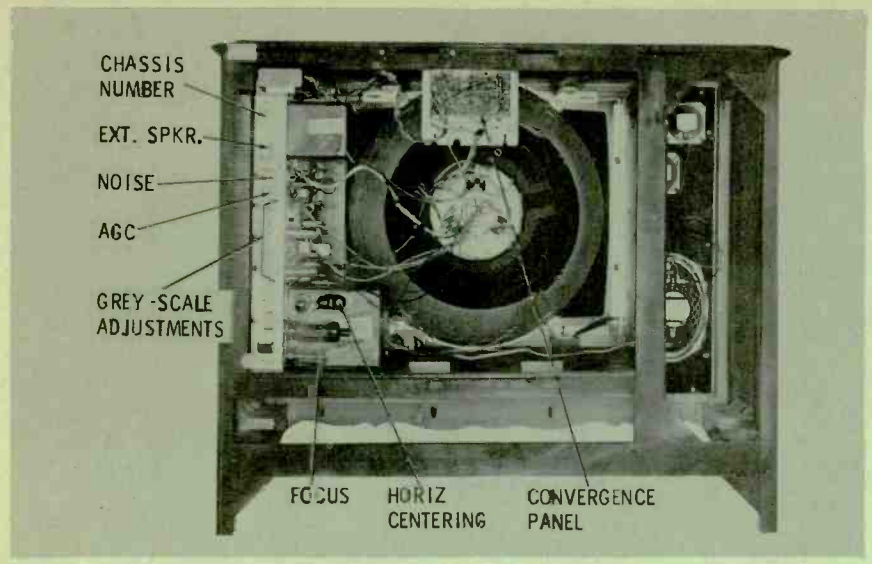
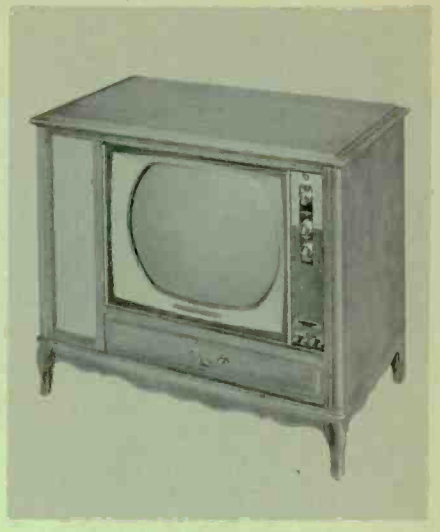
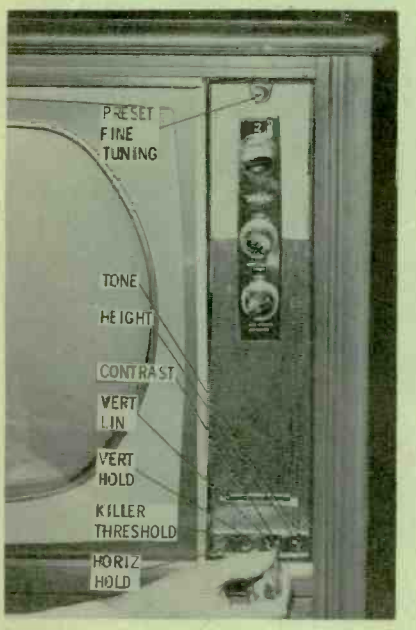
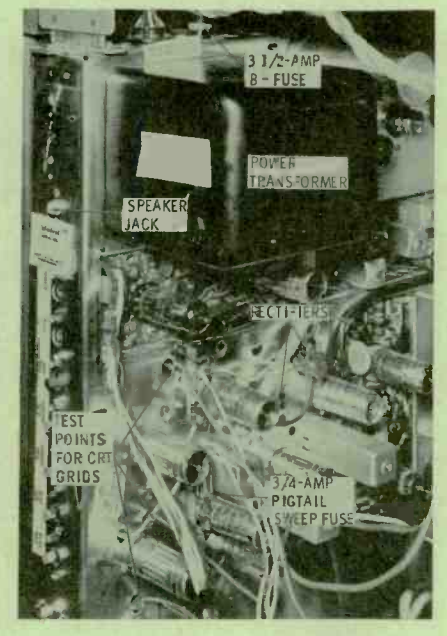
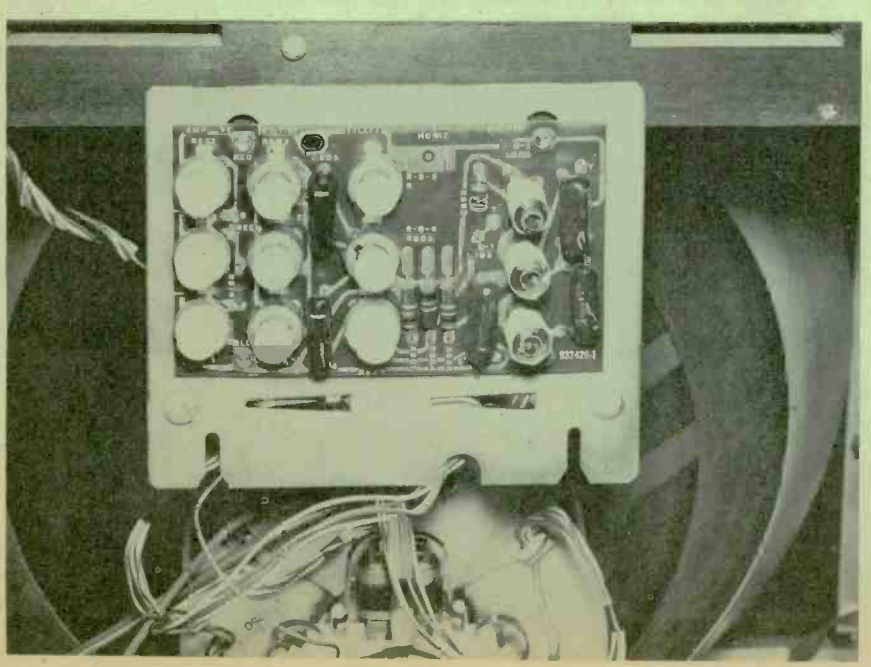
Admiral











Admiral Model L71N57 Chassis 25B6

With 26 color TV models in their 1960 line, Admiral has gone all out for color. Although four chassis are used, the only variations are in the type of tuner. Operational controls are grouped to the right of the picture tube; the control labeled *color fidelity* functions as a hue control. Safety glass cleaning procedure varies with the cabinet. Metal-cabineted models have a trim strip held along the top edge by metal screws, while those with wood cabinets have two "pry-out" metal strips hiding the glass retainers.

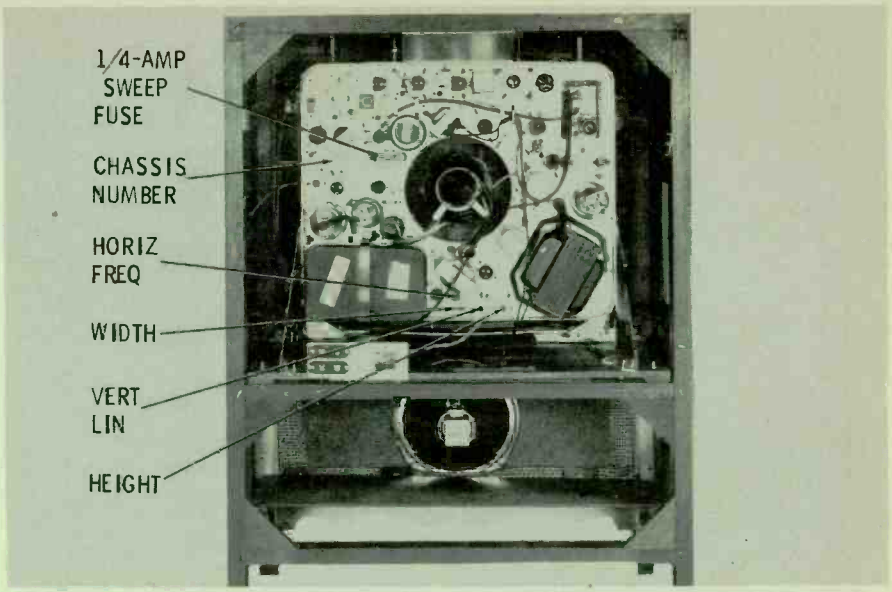
The 24-tube, vertically-mounted chassis incorporates printed boards for most of the monochrome stages while all color and horizontal deflection circuits are conventionally wired. As an aid in making grey scale adjustments, each control is color-coded and labeled for quick identification. A 4-ohm external speaker jack is provided, although the cabinet already houses a 6" x 9" woofer, crossover network, and dual 3½" tweeters.

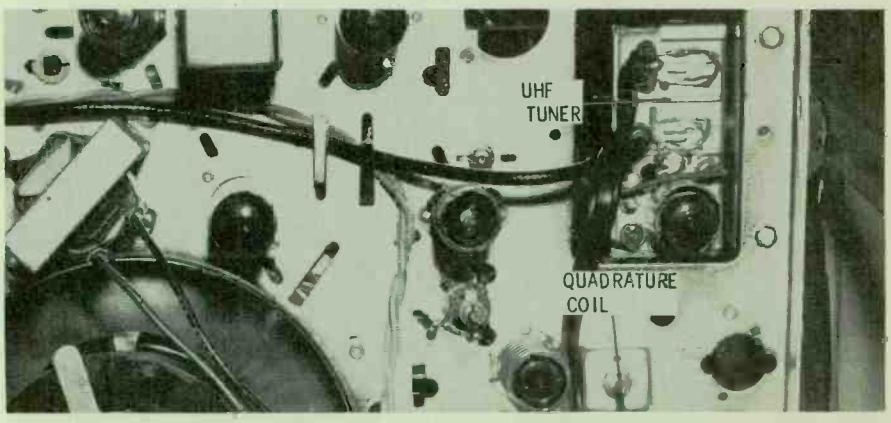
Height, vertical linearity, and color-killer threshold adjustments are accessible through the hollow shafts of three front-panel service controls. The 25B6 and 25UB6 chassis have "do-it-yourself" fine-tuning adjustments; the others employ a regular manual control. VHF oscillator adjustments are accessible after removing the upper group of knobs and escutcheon.

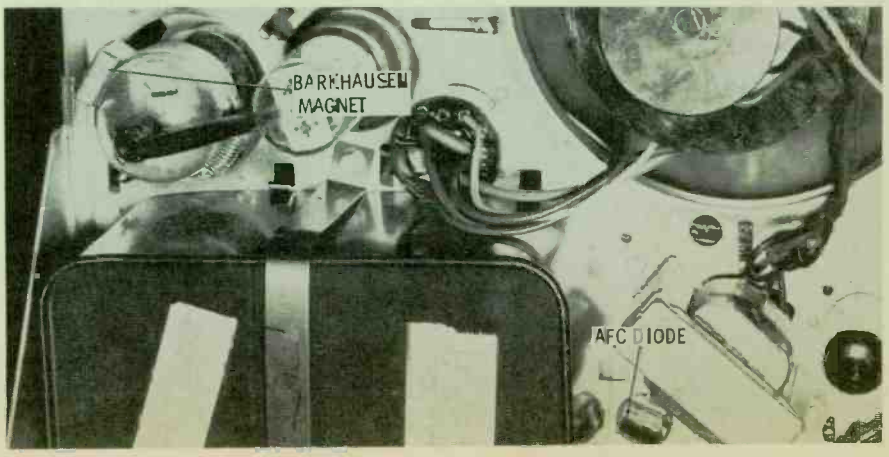
The chassis is equipped with a rather massive shielded power transformer; a pair of silicon rectifiers are used in a full-wave voltage doubler configuration to supply the B+ requirements. Protective devices include a 3½-amp, type-C fuse for B+; a ¾-amp fuse for the sweep circuits; a 2½" length of #21 wire (located beneath the chassis near the external speaker jack) for tube filaments; and a thermistor (rated at 70 ohms cold) located beneath the chassis near the B+ fuse and connected in the AC line to control tube warm-up. Appropriate wire insulation colors are used for CRT grid connections to make test point identification easier when checking color purity.

Dynamic convergence controls are mounted on a removable printed-board panel which can be easily mounted to the top rear of the cabinet when adjustments are necessary. All are clearly labeled for easy identification.

Magnavox Model U163L
Chassis U28-04-11







You'll encounter either a 24" or 21" model the first time you're called to service a set in this new 28 Series. The U/V28-03, -04, -10 chassis use a 21DLP4 while the U/V28-07, -08 use a 24AUP4. Both are 90° tubes, focused by connecting a strap from pin 6 to either pin 1 or 10. Controls are top-mounted on all chassis except the U/V28-08-11, which has a plug-in control panel. In addition to the channel selectors, conventional fine tuning, push-pull switch and volume, contrast, vertical hold, brightness, and horizontal hold controls, the LSD adjustment is an AGC switch which provides different RF and IF AGC bias levels for local, suburban, and distant reception.

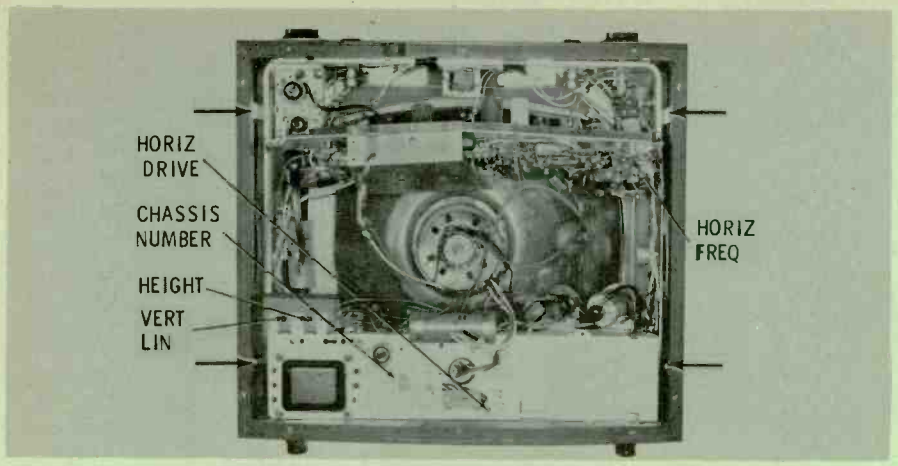
From the rear, the 18-tube UHF-VHF chassis has a clean, spacious look. Setup controls are grouped at the bottom of the conventionally-wired, vertically-mounted chassis. The massive power transformer in the lower right corner serves as a landmark for the power supply section. The filament supply includes a 1½" length of #24 fuse wire for protection of the tube heaters. A ¼-amp, slow-blow fuse to the left of the picture tube provides sweep circuit protection.

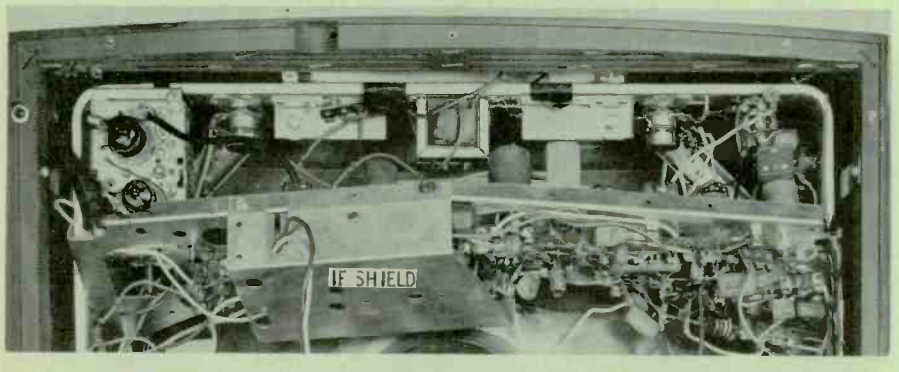
One of the unusual features of this chassis is the location of the VHF tuner, which mounts on the wired side of the chassis. Due to the placement of the *Fireball* tuner, the oscillator adjustments can be reached through a hole stamped in the chassis. The -11 suffix of the chassis number denotes major differences in this chassis from earlier versions. An entirely new video IF strip is used, incorporating additional traps for both adjacent channel sound and video carriers.

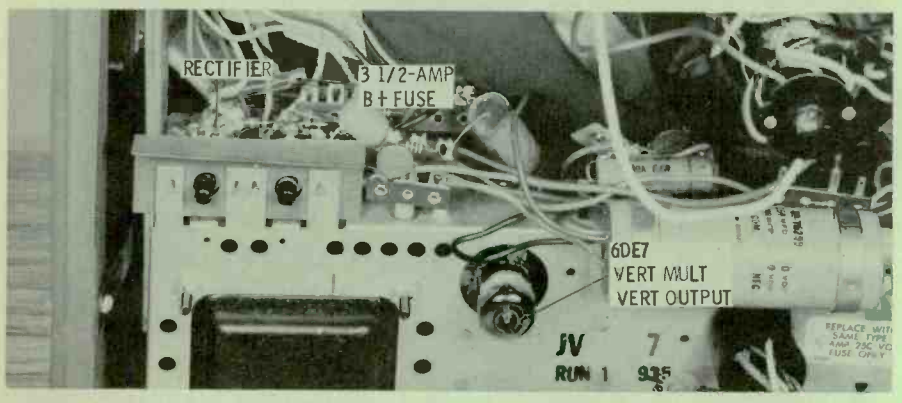
The rectangular hole in the upper right corner of VHF versions is filled with the UHF tuner in this set. The quadrature coil is at the base of the hole, and at the left are the sound and sync circuits.

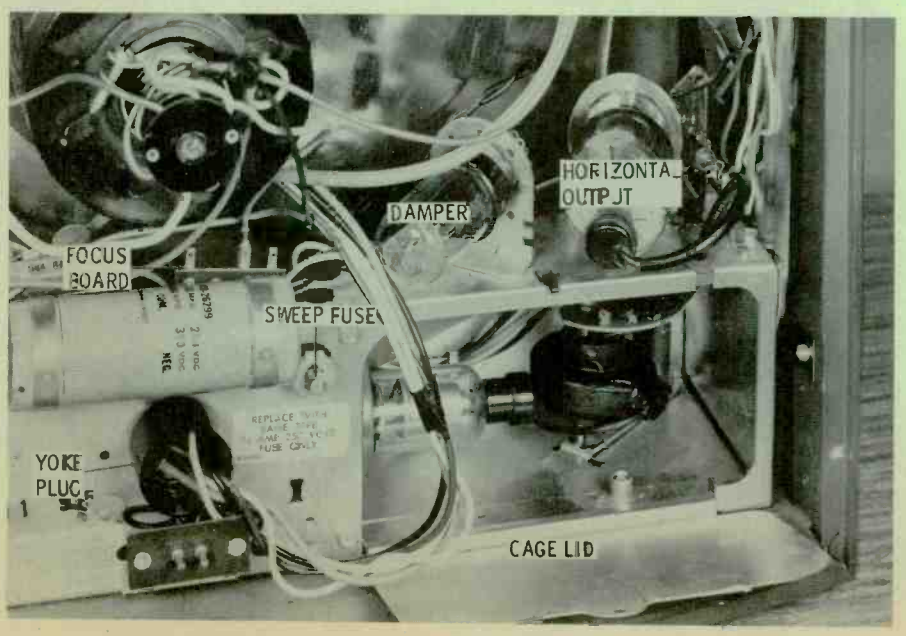
This -11 version of the 28 Series uses the same type of plug-in horizontal AFC diode, and essentially the same sweep circuits, as its predecessor. However, component combinations have replaced individual parts in the AFC, sync, and sound circuits. It's interesting to note that the chassis comes equipped with a magnet attached to the horizontal output tube to reduce Barkhausen oscillations.

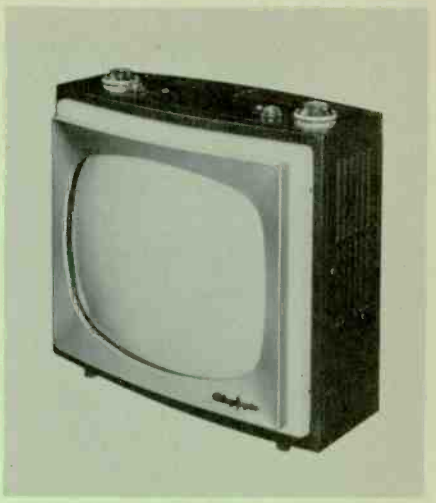
Olympic











Olympic Model 7TV11M Chassis JV

Seven other models of the 1960 Olympic line use the same basic chassis as this 17", 110° table model. All operational controls are top-mounted and include one labeled POWER. Both the cathode and grid of the picture tube are driven by video signals. The POWER control is in the cathode circuit of the video amplifier and varies the signal fed to the CRT cathode; the contrast control regulates the amount of signal fed to the grid.

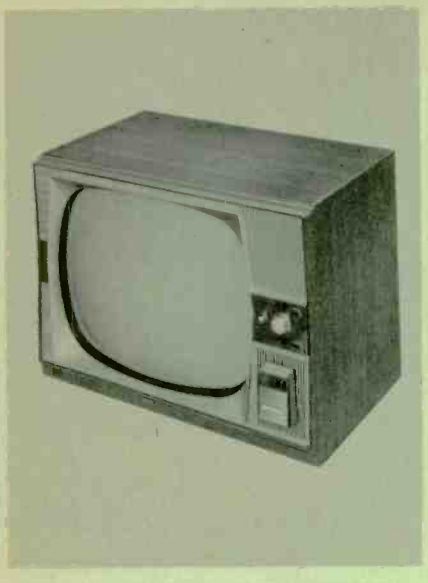
Although chassis wiring is conventional, the layout is quite unusual—with a control bracket extending around the side of the cabinet, and an "upper deck" mounted horizontally over the CRT neck. Another unusual feature has to do with the way the safety glass is attached. Removing the four screws (pointed out by the heavy arrows in the photo) permits the glass to be removed. All setup controls are easily accessible and clearly identified.

Leading the way to easier chassis servicing, the upper deck sets at a slight angle so both sides can be reached. Alternate tube types are used for the first video IF and audio output stages. Either a 6BZ6 or 6DK6, and 6CU5 or 6CA5 may be used in these respective positions. A large shield covers the bottom of the IF strip, but is easily removable to permit troubleshooting.

The power supply and vertical circuits occupy the left side of the base chassis. Notice the horizontal mounting of the 6DE7 vertical oscillator-output tube. A pair of silicon rectifiers (hidden behind the height and vertical linearity controls in the photo) are used in a full-wave, voltage-doubler configuration. Protective devices include a 3½-amp pigtail fuse for B+, a 3½" length of #26 wire for filaments, and ½-amp type-C fuse for the sweep circuits.

At the right side of the base, the horizontal sweep circuit is laid out in an unusual manner. The cage cover is a drop-down door on the rear apron, and both the damper and horizontal output tubes are mounted on separate subchassis. This, of course, makes for easier servicing. Just above and to the left of the sweep-circuit fuse is the focus terminal board (with a slip-on connector), which provides choices of 275-volt, ground, and 135-volt potentials.

Zenith ..... PREVIEWS of new sets



Zenith Model E3002W
Chassis 16E21Q

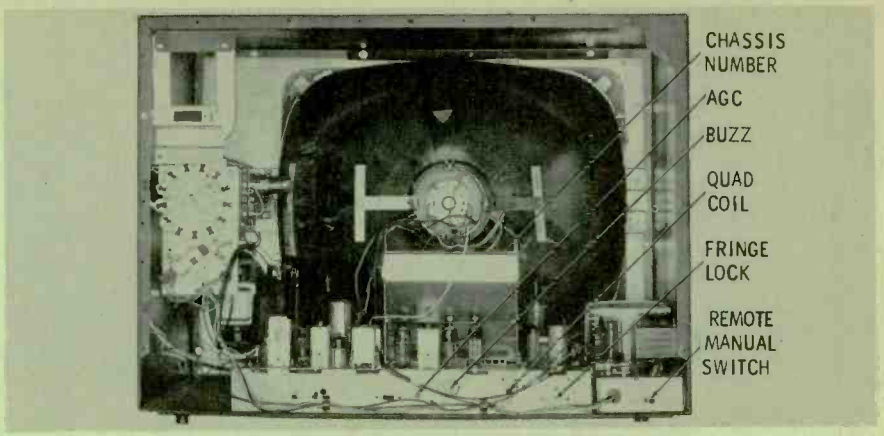
The words *Space Command 300* on the gold escutcheon announce that this model is equipped with remote control. One of 52 models using the same basic chassis, it has 28 counterparts without the remote feature. Except for the push-push off-on switch, volume control, fine tuning, and power tuning push buttons to the right of the tube, all front panel controls are covered by the door below the picture tube.

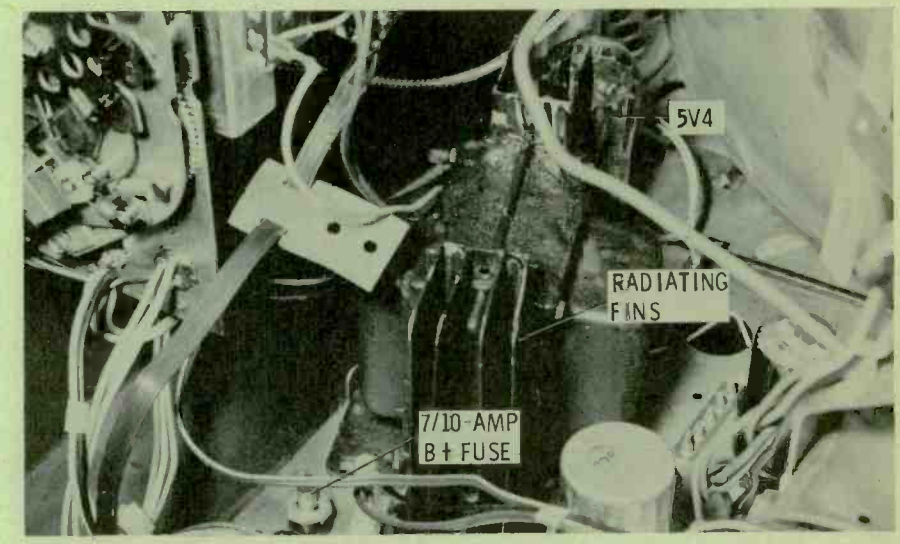
The 90°, 16-tube, conventionally-wired chassis follows typical Zenith layout with rear adjustments for AGC, buzz, *fringe lock* (sync stability), and quadrature coil. Tube filaments are wired in parallel, and are protected by a 1" length of #24 fuse wire (located beneath the transformer). The vertical sweep circuit may employ either a 6EA7 or 6EM7, and the damper may be a 6AX4, 6DA4, or 6DE4.

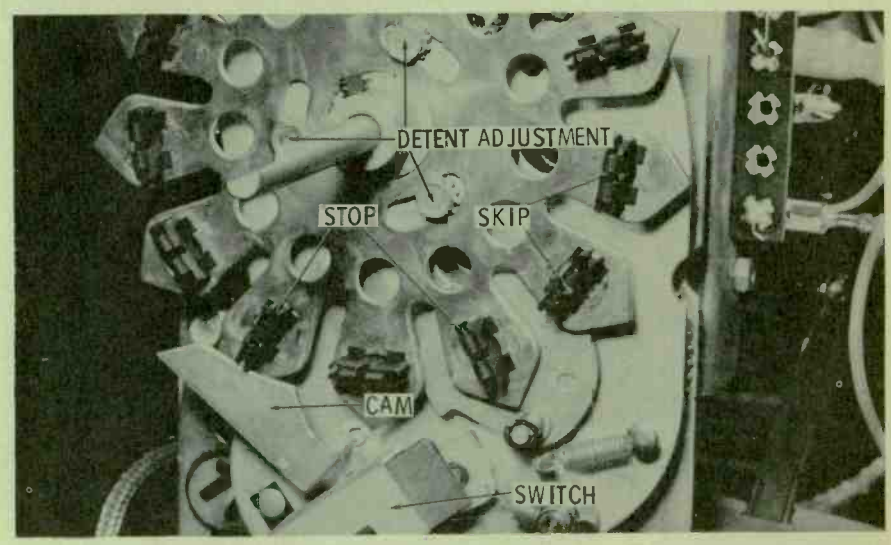
The power supply utilizes a fully-shielded transformer with radiating fins, and a 5V3 rectifier. A 7/10-amp type-N fuse is used for B+ protection, while a 5-amp slow-blow fuse (which may be either accessible from the top or mounted benath the chassis near the transformer) is connected in the AC line.

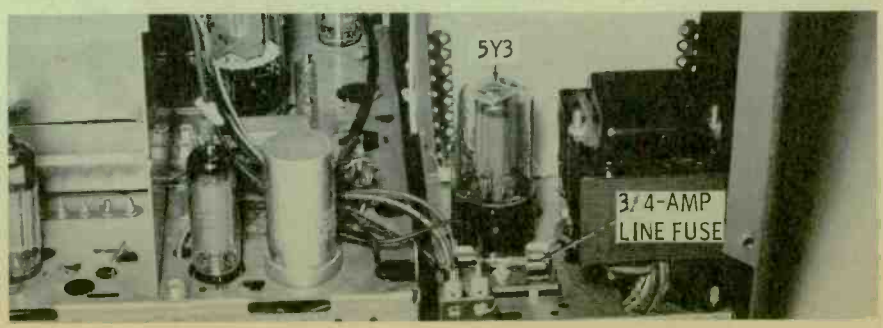
Programming adjustments for the power tuner are very simple; a quarter-turn in either direction positions the metal clip to miss or actuate the cam-operated switch controlling the motor. Three ¼" metal screws (through the elongated slots of the cam wheel) can be loosened to adjust the electrical stop point so that it coincides with the detent stop of the tuner.

To the right of the TV chassis is the remote control receiver, which contains its own power supply and ¾-amp slow-blow line fuse. The remote units in the 300 Series use a six-tube chassis to provide unidirectional channel selection, step volume control, and off-on switching. The 400 Series *Space Command* uses an eight-tube chassis, permitting bidirectional channel selection, step volume control, off-on switching, and audio muting between channels. Both systems operate on the supersonic principle, whereby the control signals are transmitted from a mechanically actuated transducer.









See PHOTOFACT Set 481, Folder 1

See PHOTOFACT Set 481, Folder 1

Mfr: Motorola **Chassis No. TS-564**

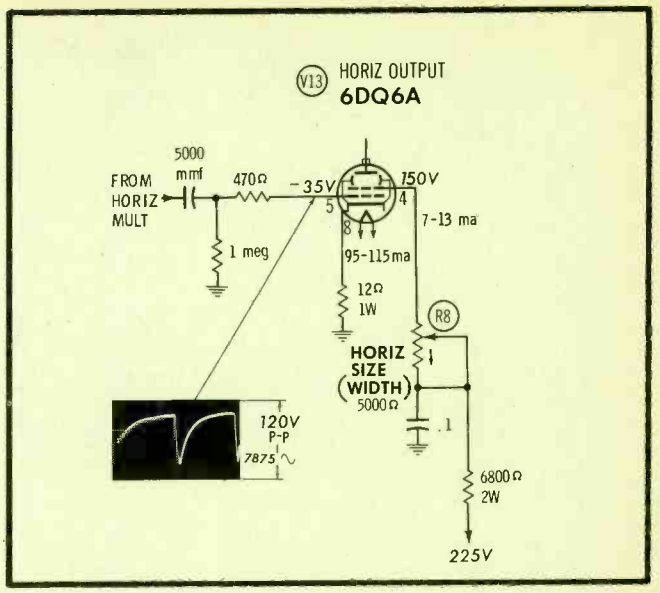
Card No: MO 564-1

Section Affected: Raster.

Symptoms: Flashes and streaks of bright light in raster.

Cause: Arcing inside width control.

What To Do: Replace R8 (5000 ohms).



Mfr: Motorola **Chassis No. TS-564**

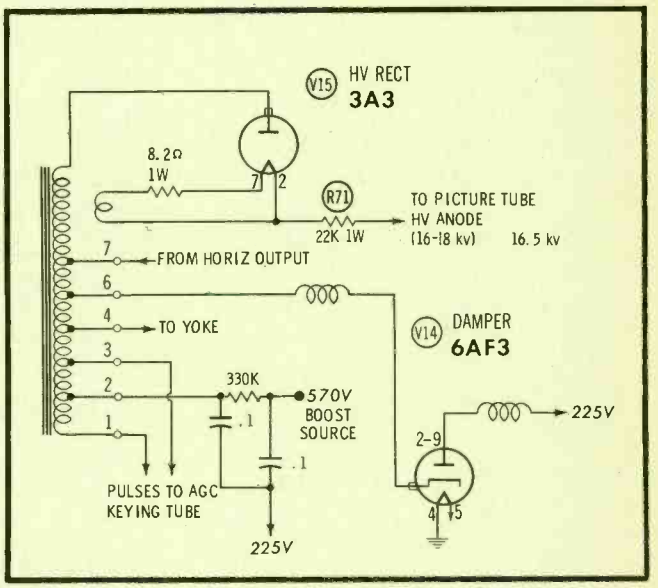
Card No: MO 564-2

Section Affected: Raster.

Symptoms: Flashes and streaks.

Cause: Defective resistor in series with picture-tube anode lead.

What To Do: Replace R71 (22K—1W).



Mfr: Motorola **Chassis No. TS-564**

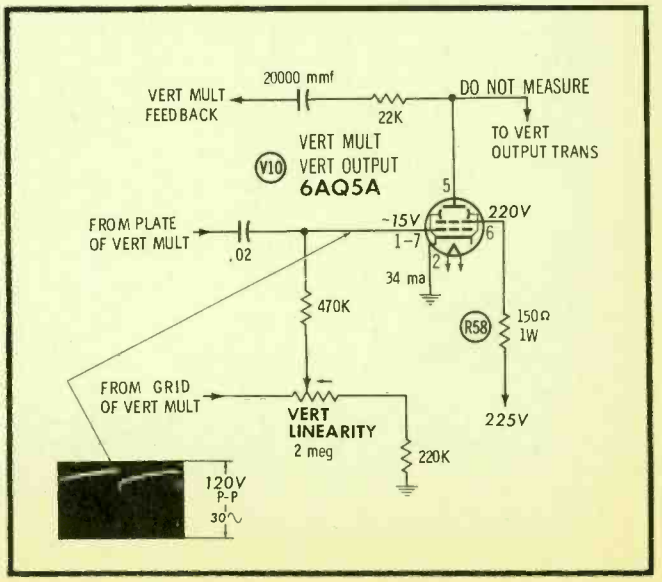
Card No: MO 564-3

Section Affected: Raster.

Symptoms: Poor vertical linearity.

Cause: Resistor in screen circuit of vertical output stage has changed in value.

What To Do: Replace R58 (150 ohms—1W).



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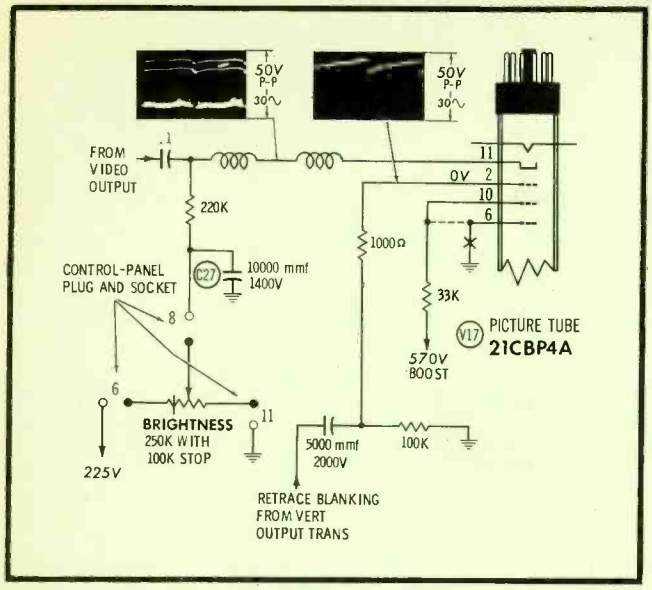
See PHOTOFACT Set 481, Folder 1



See PHOTOFACT Set 481, Folder 1

Mfr: Motorola **Chassis No. TS-564**

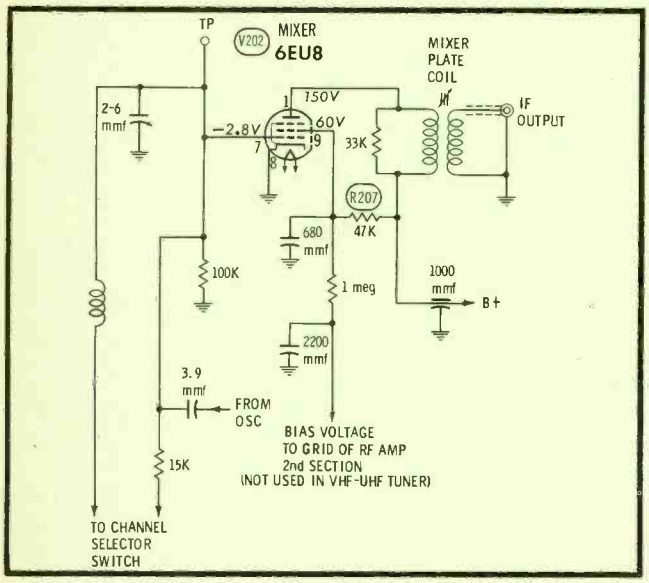
Card No: MO 564-4

Section Affected: Raster.

Symptoms: Brightness at maximum; cannot be reduced by turning brightness control.

Cause: Shorted bypass capacitor in brightness-control circuit.

What To Do: Replace C27 (10000 mmf—1400V).



Mfr: Motorola **Chassis No. TS-564**

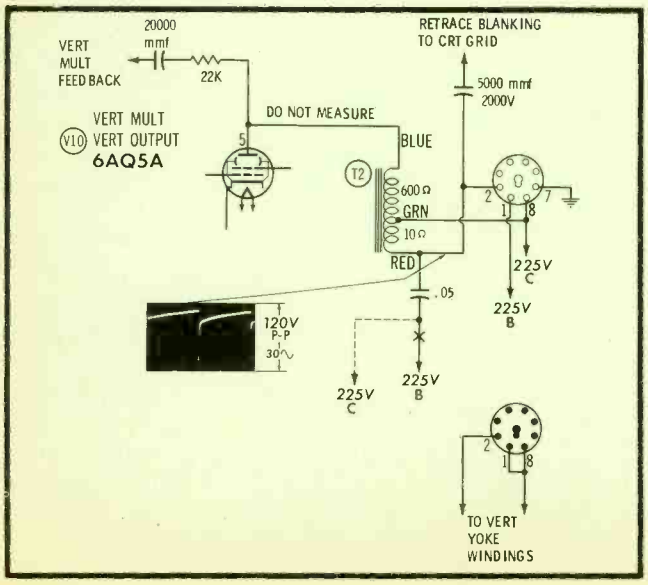
Card No: MO 564-5

Section Affected: Pix and sound.

Symptoms: No picture or sound; raster normal.

Cause: Open screen resistor in mixer stage of tuner.

What To Do: Replace R207 (47K).



Mfr: Motorola **Chassis No. TS-564**

Card No: MO 564-6

Section Affected: Raster.

Symptoms: Vertical jitter.

Cause: Defective vertical output transformer.

What To Do: Replace T2.

See PHOTOFACT Set 477, Folder 2

See PHOTOFACT Set 477, Folder 2

Mfr: Sylvania **Chassis No. 1-544-1**

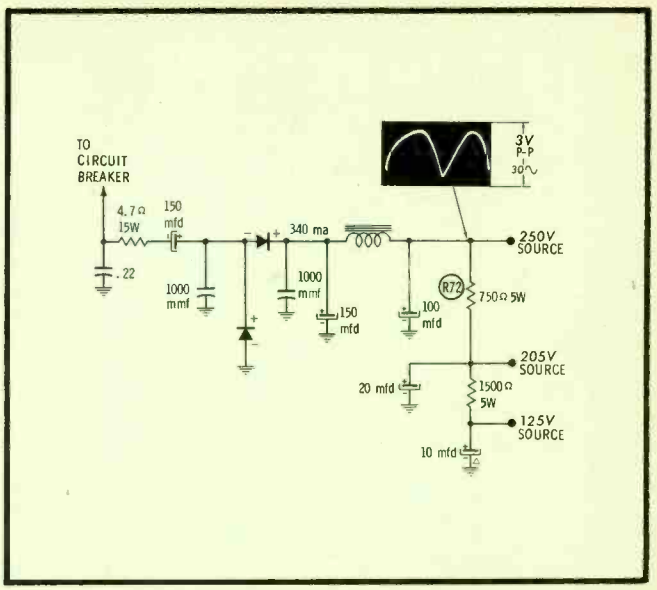
Card No: SY 544-1-7

Section Affected: Raster and sound.

Symptoms: No raster; no sound.

Cause: Open bleeder resistor in low-voltage power supply.

What To Do: Replace R72 (750 ohms—5W).



Mfr: Sylvania **Chassis No. 1-544-1**

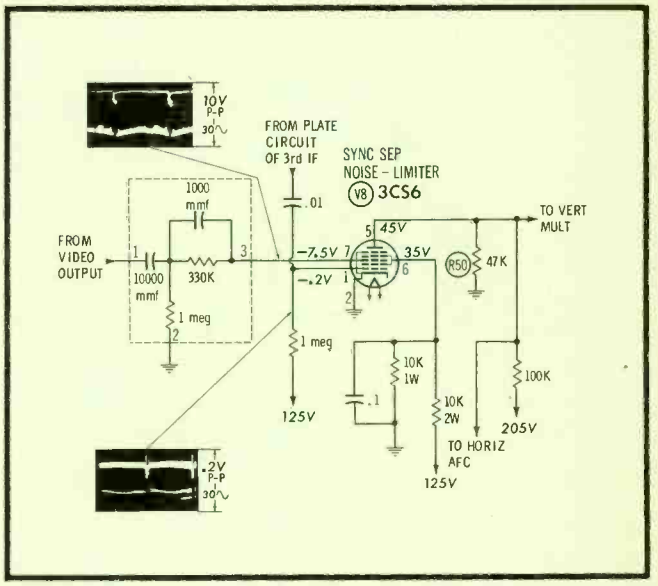
Card No: SY 544-1-8

Section Affected: Sync.

Symptoms: Loss of vertical and horizontal sync after set plays awhile.

Cause: Voltage-divider resistor in plate circuit of sync separator decreases in value.

What To Do: Replace R50 (47K).



Mfr: Sylvania **Chassis No. 1-544-1**

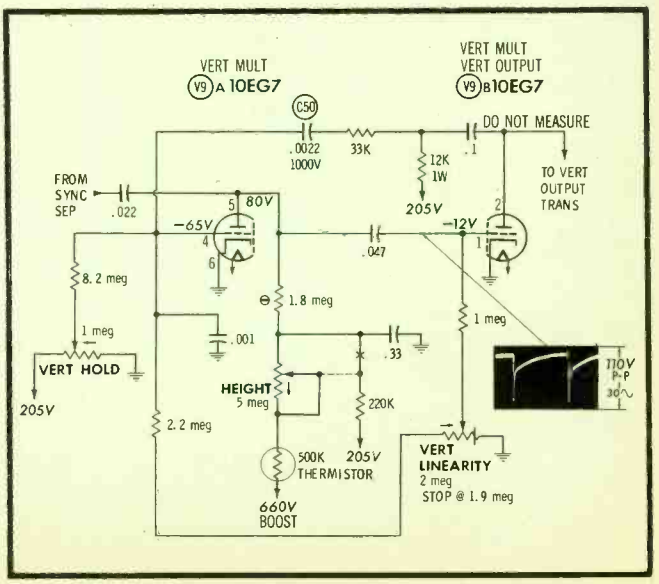
Card No: SY 544-1-9

Section Affected: Raster.

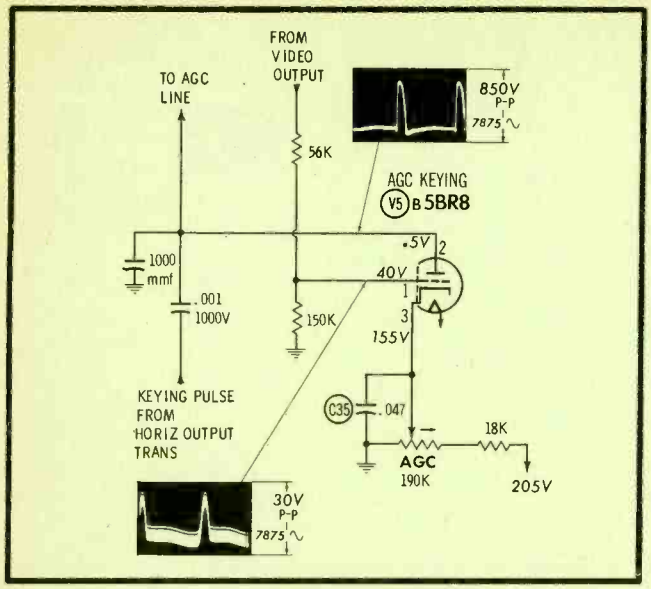
Symptoms: No vertical sweep.

Cause: Shorted feedback capacitor in vertical multivibrator.

What To Do: Replace C50 (.0022 mfd—1000V, 10%).



See PHOTOFACT Set 477, Folder 2



See PHOTOFACT Set 477, Folder 2

Mfr: Sylvania **Chassis No. 1-544-1**

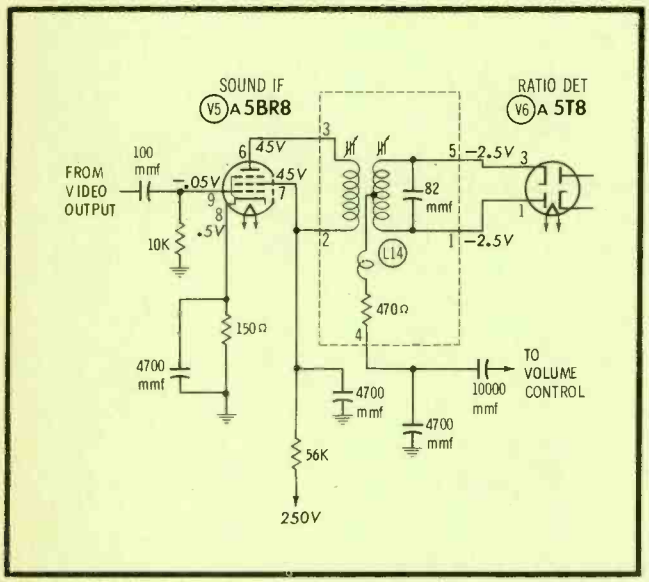
Card No: SY 544-1-10

Section Affected: Pix and sound.

Symptoms: Both picture and sound disappear after short period of operation.

Cause: Shorted cathode-bypass capacitor in keyed AGC stage.

What To Do: Replace C35 (.047 mfd).



Mfr: Sylvania **Chassis No. 1-544-1**

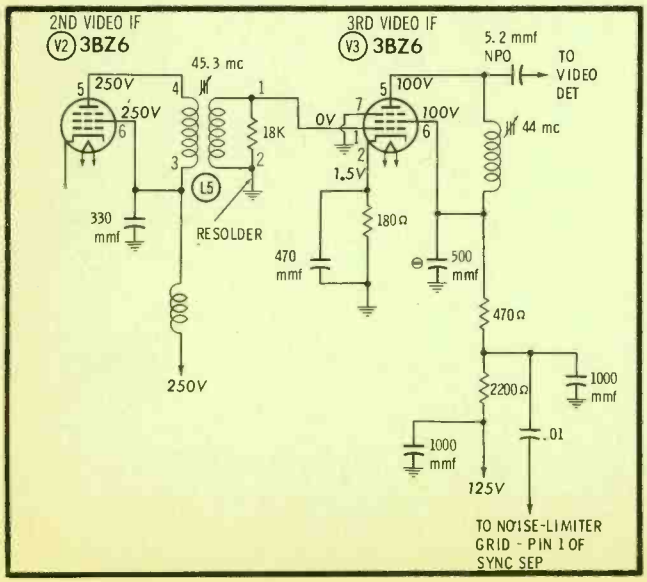
Card No: SY 544-1-11

Section Affected: Sound.

Symptoms: Sound goes off intermittently.

Cause: Defective ratio-detector transformer.

What To Do: Replace L14.



Mfr: Sylvania **Chassis No. 1-544-1**

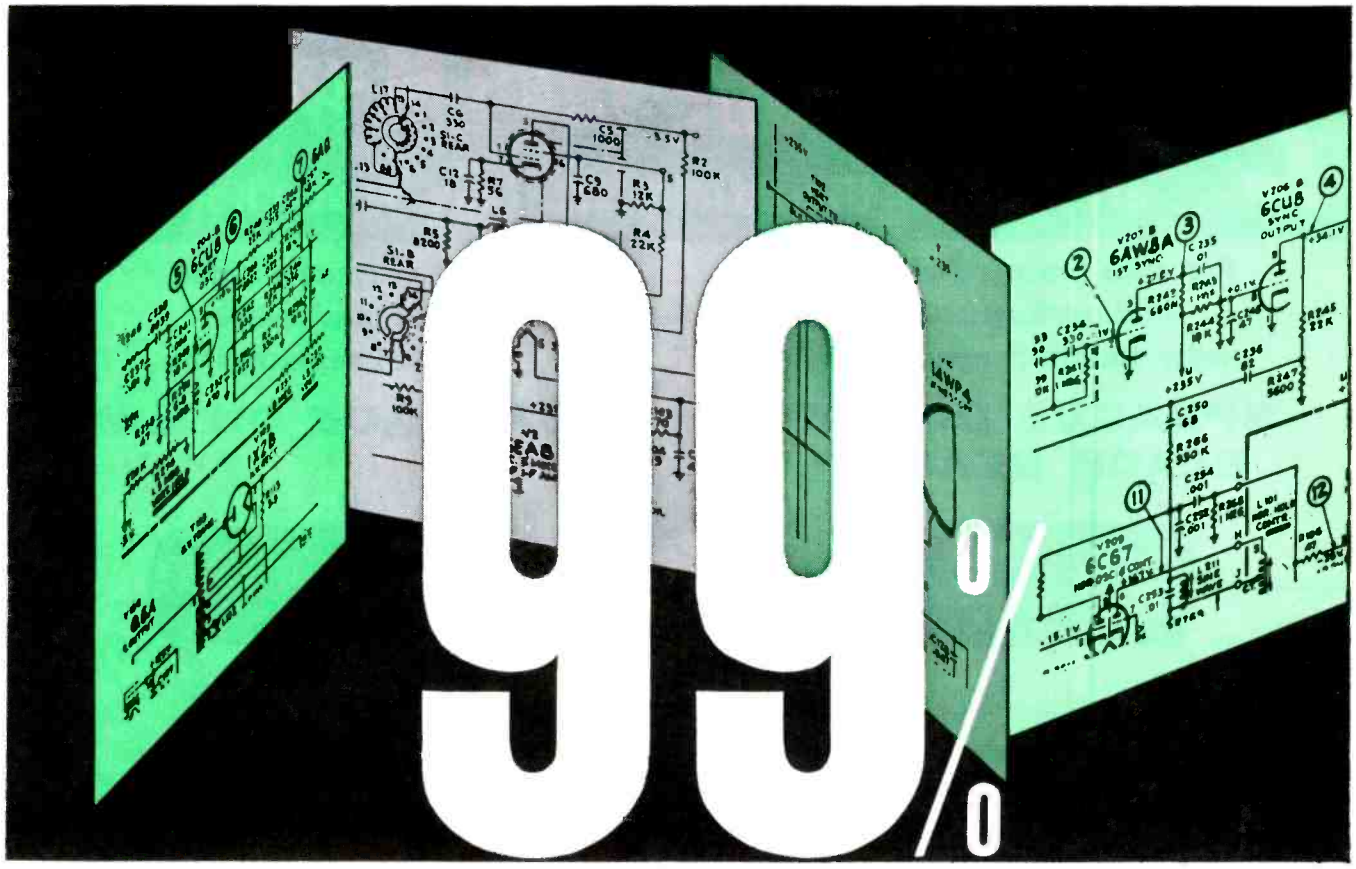
Card No: SY 544-1-12

Section Affected: Pix and sound.

Symptoms: Intermittent loss of picture and sound.

Cause: Open ground connection to third video IF transformer.

What To Do: Resolder ground connection of L5.



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The heart of these Sprague Difilm Capacitors can't be beat! **It's a dual dielectric combination of Mylar® polyester film and special capacitor tissue—resulting in capacitors which are superior to all other comparable tubulars. Sprague's rock-hard solid HCX® impregnant fills voids and pin holes in the film. Difilm capacitors have high insulation resistance, low power factor, and excellent capacitance stability and retrace under temperature cycling!**

For extremely small size and exact original replacement

SPRAGUE DIFILM® ORANGE DROP®

Sprague Difilm "Orange Drops" are a "must" for your service kit where only an exact replacement will fit. They are the perfect replacement for dipped capacitors now used by leading manufacturers in many popular television receivers. And when a dipped tubular is called for, you'll find that Orange Drops outperform all others, safeguarding your work and reputation for quality service.

Orange Drops are specially designed for easiest possible installation. Radial leads are crimped to assure neat mounting parallel to printed wiring boards . . . extremely small size makes them fit handily in tight spots. They'll beat heat and humidity because the solid, rock-hard capacitor section, double-dipped in bright orange epoxy resin, is well protected against moisture. A perfect team-mate for Black Beauty.

±10% CAPACITANCE TOLERANCE IS STANDARD AT NO EXTRA COST

Difilm Black Beauty and Difilm Orange Drops are packaged in sturdy, reusable rigid plastic Kleer-Pak® boxes. Your distributor is stocked in all the popular ratings. Order some today. You can count on Difilm.

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THE MARK OF RELIABILITY

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PF REPORTER including Electronic Servicing

VOLUME 10, No. 9 SEPTEMBER, 1960

CONTENTS

ABOUT THE COVER

You don't think "Mama's little boy" is going to be blamed for this "accident" to her new wallpaper, do you? Our guess is the serviceman will do well to forget about the charges on this call to make up for his "carelessness" in letting Junior gain access to his Aerosol chemical spray. For a rundown on the proper uses for electronic chemicals, turn to page 34.

Letters to the EDITOR

Dear Editor:

Each month you bring to the service technician the best articles published anywhere relative to "tough dogs" and other interesting data. But the back issues pile up as the months pass, and when one of those "rare birds" comes to the service bench, it requires considerable time to locate an article needed for reference.

Would it be asking too much to work out some method of eliminating lost time caused by hunting for articles in past issues? I wonder how my fellow techs feel about this, or what methods they use to locate articles?

CHARLES ORTH
Preston Radio & TV Service
Baltimore, Md.

As a new service to our readers, part of the Catalog & Literature card bound in at the back of each issue will contain a monthly reference index. This can be filed according to issue, thus providing you with a handy source for technical data published in PF REPORTER. *Suggestions for improving the index format are welcome.—Ed.*

Dear Editor:

This is me and my new helper, Halfjohn. He's a pretty good boy, even if he isn't really all there. However, that doesn't make too much difference; all we use him for is the legwork anyway. (No matter what you may think, I'm the one *inside* Der Düdelbugg!)

JACK DARR
Mena, Ark.

In addition to being a top-notch technician, engineer, and technical writer (see "Stretching CRT Life" in this issue), you're also a comedian?—Ed.

Dear Editor:

I would like to get in touch with manufacturers of business and industrial electronic equipment who are interested in obtaining service representation in the Kansas City area (Western Missouri and Eastern Kansas).

Very briefly, my qualifications include a BS in Electrical Engineering, 25 years of experience, and a well-equipped service shop.

Any help you can give me in establishing contacts will be sincerely appreciated.

FRED E. BRADY
P. O. Box 21
Olathe, Kan.

We always knew our readers were well-educated, Fred. I'm sure some of the many manufacturers who read our magazine will be in touch with you.—Ed.

Dear Editor:

As a subscriber to PF REPORTER, a regular user of Sams PHOTOFACT Folders, and the possessor and constant user of a large library of Sams publications, I want to thank you most sincerely for making the problems of electronic servicing so much easier.

Since I expect to have my FCC license in a few weeks, it is the plan to gradually turn this business into the two-way mobile radio field, perhaps even exclusively later on. I notice that a few Citizens band outfits are now covered in PHOTOFACT, and further that PF REPORTER is featuring articles on mobile radio equipment. I also have Mr. Helmi's very fine book on 2-Way Mobile Radio.

PF REPORTER is superb, and my technicians as well as myself read it from cover to cover every month. We have also found the fine volumes on "Servicing Transistor Radios" immeasurably helpful. In actual practice we find our Sams publications really surpass our instruments in usefulness in solving our servicing problems.

Please accept my sincere thanks.

HOWARD J. KINDIG
Akron, Ohio

Thanks. When we help make your work easier, we feel we're doing our job. —Ed.

Dear Editor:

While recuperating from a recent illness, I went through some back issues of PF REPORTER. The September, 1959 issue contained a chart of "Common TV Troubles and Their Causes." I thought to myself, "Boy, what an aid this would have been to me when I started out in TV servicing back in 1949."

As I went through later issues, I ran across several good articles by Milton Kiver on servicing different sections of TV receivers. Illustrations giving enumerated steps for troubleshooting a specific section, such as Figs. 1 and 2 on page 24 of the November, 1959 issue, are *very helpful.*

My thoughts began to drift to the problems I have in isolating TV troubles. Then I thought about my student technician helper, and the problems he has in troubleshooting. As a result, I have gone through all my back issues and clipped out all of these diagrams, and I plan to file them in a notebook for easy reference.

I hope in the future you will assemble all this information into a single troubleshooting guide.

NAME WITHHELD BY REQUEST

We had planned all along to publish the complete test analysis chart in the last installment of Mr. Kiver's TV troubleshooting series. You'll find it in this month's "Shop Talk" column.

We decided against showing all the enumerated diagrams again because of space problems, but your suggestion for clipping them out of past issues and pasting them in a reference notebook will undoubtedly be followed by a number of others.—Ed.

MULTIPLE SOCKET TESTING *for speed*

AUTOMATIC PUNCH-CARD TESTING *for flexibility*

NOW the best of both in ONE complete new B&K instrument!

expedites tube test / doubles tube sales

- ***Tests present tube types***
- ***Tests new and future tube types including the NUVISTOR***
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- ***Tests many industrial tubes***

All the features professional servicemen want are here in this advanced-design, *obsolescence-proof* tube tester. Gives you the speed of multiple-socket testing *plus* the flexibility of punch-card testing for new tube types. *Measures true dynamic mutual conductance* (not just emission). Makes complete accurate test in seconds under the actual dynamic operating conditions of the set.

Tests each section of multiple tubes separately. Checks for Gm and all shorts. Makes highly sensitive grid emission and gas test. Checks for leakage and life. Gives instantaneous heater continuity check for series filament sets. Shows tube condition on "Good-Bad" scale in micromhos. *Patented B&K bridge circuit* automatically adjusts for line voltage variation. Lists most commonly used types right on socket panel for quick use. Net, **$199.95**

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DYNA-QUIK
TRUE DYNAMIC MUTUAL CONDUCTANCE
AUTOMATIC TUBE TESTER

Shows exact tube condition • Saves customers
Sells more tubes on-the-spot • Stops costly call-backs
Makes more money for you • Pays for itself over and over again

Issues of helpful new tube information 4 times a year available on subscription

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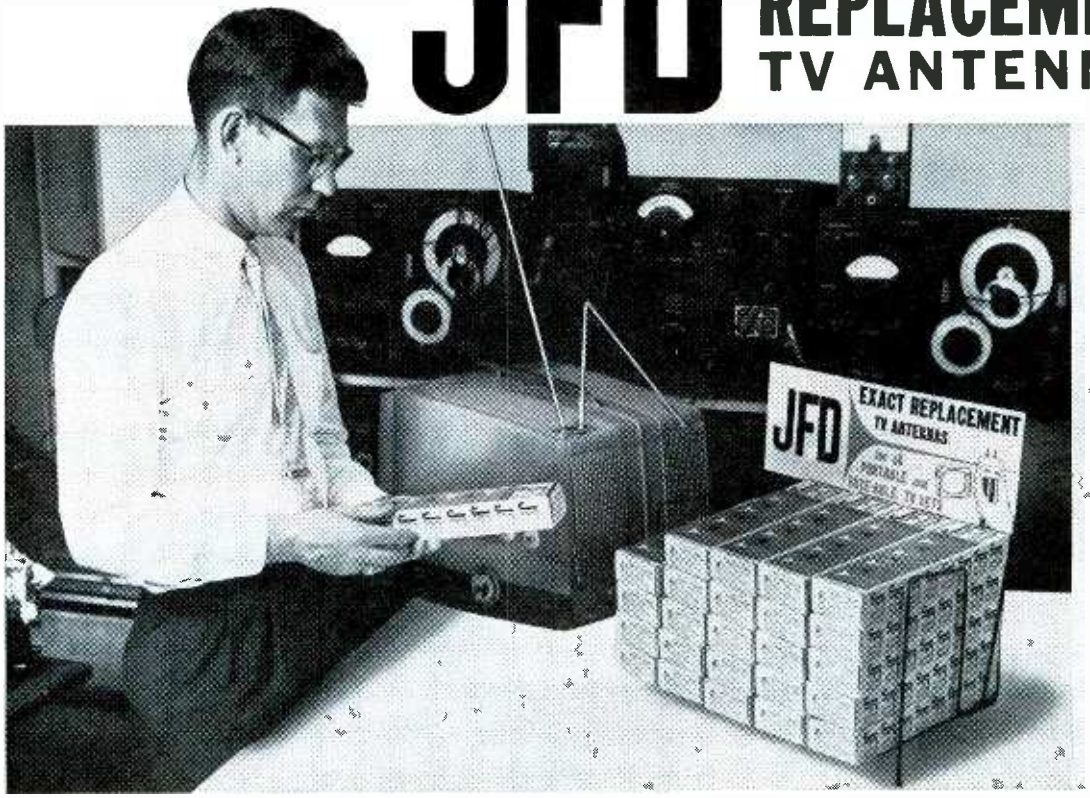
Why are more Service-Dealers Switching to JFD EXACT REPLACEMENT TV ANTENNAS?



because

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

because

as JFD Exact Replacement Specialists, service-dealers can get out of the unprofitable "rabbit-ear" business—earn a *profit* on the antenna *sale* (at full mark-up) *and* on the *installation*.

because

with the JFD PA500 and PA515 Exact Replacement Kits, dealers are ready and able to service *90%* of antenna replacements for portables and tote-ables.

because

with JFD guides, streamers, and sales helps, service-dealers get the merchandising *know-how* that nets them a bigger slice of the *3,500,000* dollar portable antenna replacement market.

NOW IS THE TIME TO WRITE JFD OR ASK YOUR JFD DISTRIBUTOR FOR YOUR EXACT REPLACEMENT PROFIT PLAN PORTFOLIO!

Check Sams Photofact folders for JFD Exact Replacement information. Only JFD keeps you up-dated with the 1960 Portable TV Antenna Guide covering every portable TV set made since 1956 (compiled and edited by Howard W. Sams & Co., Inc.)

THE BRAND THAT PUTS YOU

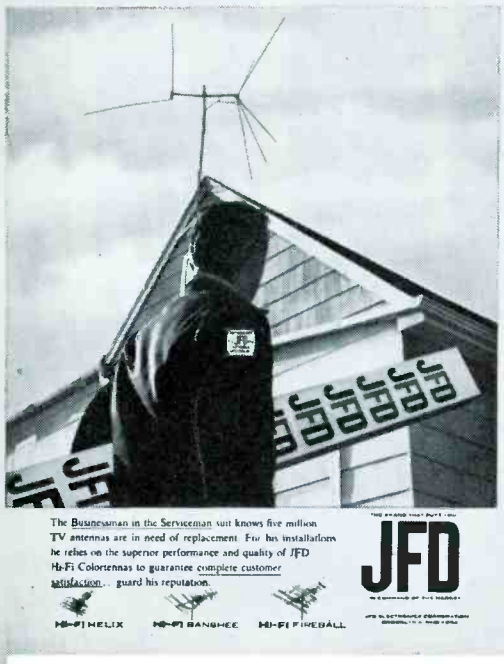
JFD

IN COMMAND OF THE MARKET

JFD ELECTRONICS CORPORATION BROOKLYN 4, NEW YORK

JFD International, 15 Moore Street, New York, New York • JFD Canada, Ltd., 51 McCormack Street, Toronto, Ont., Canada

Why are more Service-Dealers Switching to JFD HI-FI TV ANTENNAS?



The Businessman in the Serviceman suit knows five million TV antennas are in need of replacement. For his installations he relies on the superior performance and quality of JFD Hi-Fi Colortennas to guarantee complete customer satisfaction... guard his reputation.

JFD

HI-FI HELIX HI-FI BANSHEE HI-FI FIREBALL

because

they know *5 million* antennas need replacement—that *JFD* HI-FI TV antennas assure them a *bigger* share of this profitable market.

because

JFD is the *total* antenna line with the *right* model, at the *right* price for every location—does the *most* for them in mile-shrinking *performance* and customer *confidence*.

because

JFD all-out advertising *sells* for them in powerful national mass media—such as Look, TV Guide, Successful Farming, Farm Journal, Progressive Farmer.

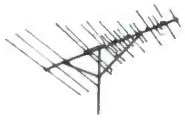
because

JFD sales stimulators such as cloth patches, decals, mobiles, banners, displays and direct mail give them the *complete* package to *sell* new customers.

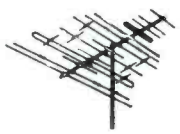
HOW MUCH INSTALLATION BUSINESS ARE YOU LOSING BY NOT SWITCHING TO JFD? THE TV ANTENNA LINE AMERICA KNOWS BEST!

HI-FI HELIX
Silver or Gold Anodized

HI-FI BANSHEE
Silver or Gold Anodized



HI-FI FIREBALL
Silver or Gold Anodized



THE BRAND THAT PUTS YOU

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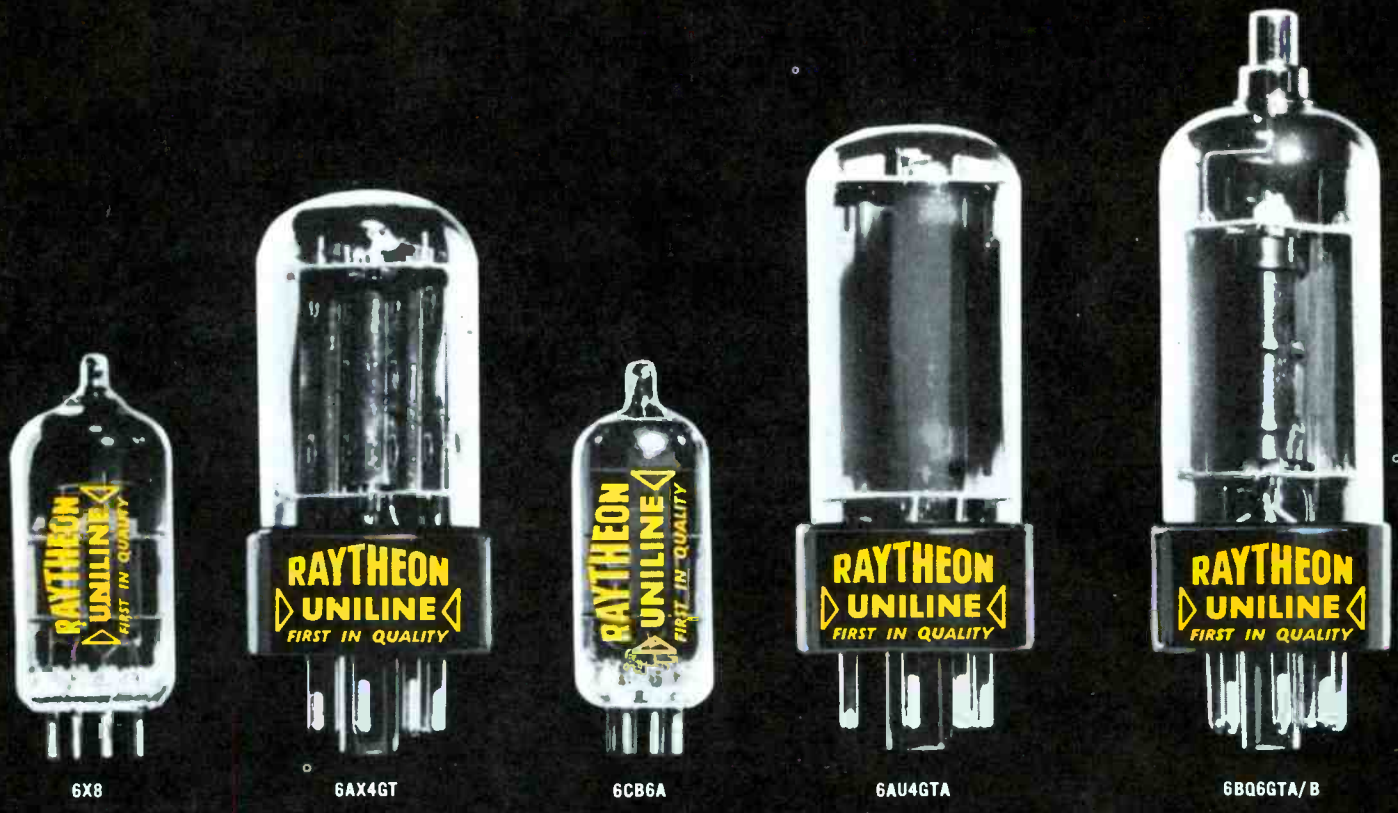
Your votes made these Raytheon tubes



THE TEN MOST

UNILINE—Raytheon's new standard of receiving tube quality is the result of your votes in our Crusade Against Call-Backs.

Raytheon took the ten tube types you voted to be the greatest troublemakers (regardless of brand) and made them the front-runners in our new line of tubes—UNILINE. With new improvements, new packaging, and a unique sampler "Ten-Pack," these tubes were introduced to the market only three months ago. Result? Tremendous acclaim from every section of the industry!

UNILINE receiving tubes give you trouble-free performance, highest quality in the industry, happy service customers . . . minimum call-backs.* You can prove UNILINE superiority to yourself . . . simply call your Raytheon distributor today!

**See your distributor for literature describing unique Uniline features.*

6CG7 12AT7 1X2A/B 1B3GT 6SN7GTB

WANTED!

"Take 10 and See"

RAYTHEON COMPANY

DISTRIBUTOR PRODUCTS DIVISION

WESTWOOD, MASSACHUSETTS

RAYTHEON

TV•Radio•Hi-Fi shop owner ELMER MAUTER says:

"MALLORY quality replacements keep customers happy"

"Courtesy in handling customer service has been one factor responsible for our growth . . . that's why I chose the name Courtesy for my business. We have always used only quality replacement products . . . that's why I use Mallory components. I know that I can depend on Mallory quality. The Mallory label on replacement parts reassures my customers; it's a name they know they can rely on for top performance."

When electrolytics need replacement, Elmer Mauter, like thousands of other service technicians, knows that Mallory FP's will stand up at the high temperatures common in the small cabinets now being built for TV and hi-fi. Even when they're mounted next to a hot rectifier or output tube, where ordinary replacement filters would wilt, the FP gives extra service. It's the original 85°C capacitor. Its combination of new shock-resistant construction with leakproof seal and etched cathodes, available without premium price only in the Mallory FP, assures long life and hum-free performance.

Whatever your component needs, Mallory supplies the widest line of quality products at sensible prices. See your Mallory distributor for a full selection of the parts you need.

Put an end to call-backs with these quality Mallory products . . .

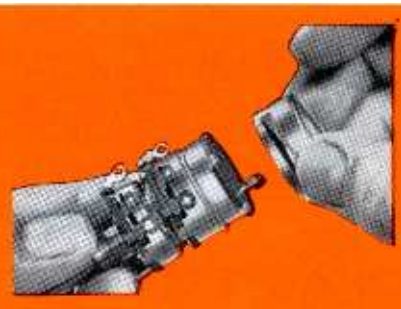
GEMS

5 rugged, moistureproof, Mallory "Gem" tubular capacitors in a handy dispenser that keeps your stock fresh and clean—easy to find—prevents kinks in lead wires. Unequalled for service in buffer, by-pass or coupling applications.

RMC DISCAPS®

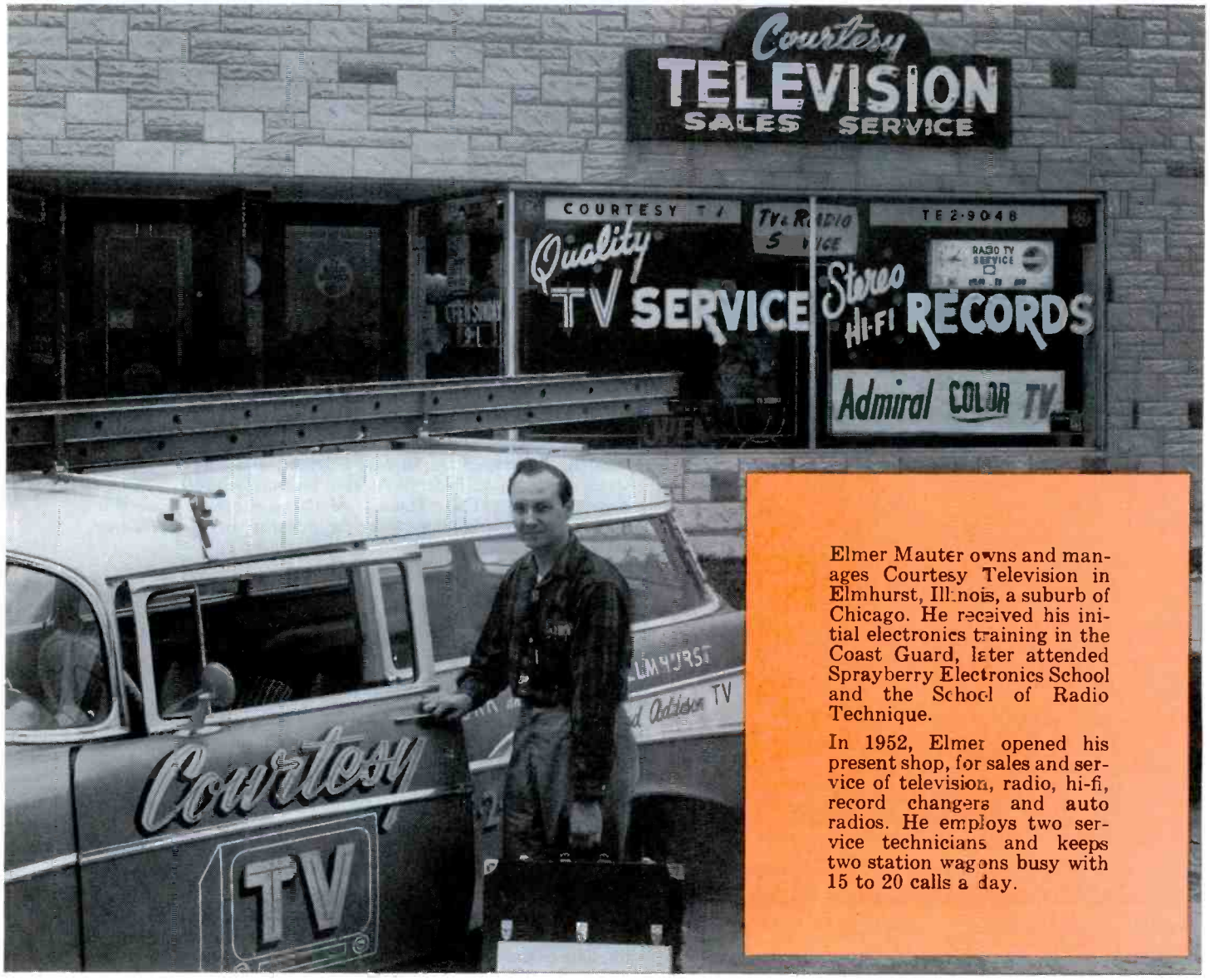
Made by the world's largest producer of ceramic disc capacitors . . . long the original equipment standard, they are available for replacement in a handy 3" x 5" file card package . . . easy to stock, simple to use.

® Trademark of Radio Materials Company, A Division of P. R. Mallory & Co. Inc.



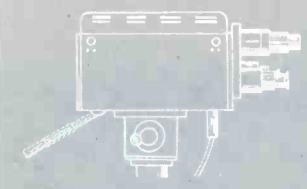
STA-LOC® CONTROLS

No more waiting for out-of-stock controls. Your distributor can custom build, in just 30 seconds, any of over 38,000 combinations. You can replace the line switch by itself, without unsoldering control connections.



Elmer Mauter owns and manages Courtesy Television in Elmhurst, Illinois, a suburb of Chicago. He received his initial electronics training in the Coast Guard, later attended Sprayberry Electronics School and the School of Radio Technique.

In 1952, Elmer opened his present shop, for sales and service of television, radio, hi-fi, record changers and auto radios. He employs two service technicians and keeps two station wagons busy with 15 to 20 calls a day.



The Electronic Scanner

Aids to Promote Growth and Profit

Latest phases in the **RCA** Electron Tube Division's "Set Up for Greater Profits" program are designed to help the service dealer improve the layout and appearance of his shop, his service and salesmanship, and obtain new business. Included are space-saving shelf units and utility drawers, a "quick-call" 162-tube caddy, a 12" LP record on using successful selling techniques, and an 11-lesson home study course on color TV.

All are available through authorized **RCA** tube distributors.

New Association Officers

A report from David J. Baird, publicity director of **E.S.D.A. of Western Pennsylvania,** informs us that newly-elected officers include: B. A. Bregenzer, President and Director to NATESA; Norman Falck, Vice President; Joseph Doyle, Secretary; Charles Colerich, Treasurer; Taylor Thompson, Board of Trustees; B. A. Bregenzer, Thomas Scholler, and David J. Baird, delegates to State Federation; and Thomas Scholler, alternate Director to NATESA. The aim of the new officers is to continue the association's work for the integrity and independence of TV service technicians.

Techs See CRT's in the Making

A program sponsored by Stack Electronics, Inc., electronic parts distributor in Binghamton, N. Y., made it possible for 28 service technicians to take a tour of the **General Electric** cathode-ray tube plant at Electronics Park. Getting the story on a small picture tube held by Dell A. Love, manager of replacement CRT operations, are (left to right) Gerald Homer of Holloway-Cooper TV Service in Binghamton; John Kaminsky of Kaminsky Electronics Service, Binghamton; Vernon Wales, sales manager for Stack Electronics; and Anthony Ferrigno of Colonial TV Appliance, Johnson City.

Speakers Guaranteed for Life

All popular replacement speakers manufactured by **Utah Radio & Electronic Corp.** now have a "no-strings-attached" lifetime guarantee, providing for repair or replacement of any unit which fails during the lifetime of the owner. No charge is made except for return postage from the Utah plant in Huntington, Ind.

Parts & Accessories Manual

Zenith Sales Corp. is currently making available a new Parts, Tubes, and Accessories Manual. The over 375 pages of the 20-section tab-indexed loose-leaf manual include information on parts and accessories ranging from antennas and batteries to tubes, knobs, tuners, wrenches, etc. Also included are more than 400 large illustrations and principal components charts, plus suggested retail prices, as well as data on the interchange and substitution of parts, tubes and accessories. The manual is available through Zenith distributors, and is now being sold at a special introductory price.

This "Snowballing" Hi-Fi Industry

In their continuing program to increase the number of authorized service stations for their equipment, **Sherwood Electronic Labs, Inc.** of Chicago has added four more independent hi-fi service shops. Chosen especially for their ability to perform quality repairs on hi-fi amplifiers and FM tuners were Baker's Hi-Fi Service of Baton Rouge, La.; Pittman TV Service, Knoxville, Tenn.; Scherrer Instruments, St. Louis, Mo.; and Audio Service Labs of Irvington, N. J.

Cartridge & Pickup Division Purchased

In a transaction which becomes effective Sept. 1st, **Electro-Voice, Inc.** acquired the "Featheride" phono pickup and cartridge division of **Webster Electric Co.** The purchase included all parts, tooling, existing inventory, patents, and distribution. Electro-Voice "Featheride" products will be manufactured in the firm's new plant at Eureka, Ill.

Again this Fall . . . you can

TURN OLD TUBES INTO CASH

See your PHILCO Distributor!

By popular demand, "one humdinger of an offer" is back!

YES, turn your old, burned out tubes into cash by trading them in on new Philco tubes you use every day. Last spring you told us it was "one humdinger of an offer"—so now it's back!

We'll SMASH all old tubes you bring in

LIMITED TIME ONLY

Round up your old tubes, and turn them into cash on this "bigger than ever" trade-in offer. For years, Philco has led the industry with TUBE RACKET-SMASHING CAMPAIGNS to help knock out the tube racketeers. Don't buy another tube until you SEE YOUR PHILCO DISTRIBUTOR.

. . . BUT no limit on the number of old tubes you can trade in

The growth of the entire Electronic Industry in famous PHILCO Firsts

HOW MANY SERVICE TECHNICIANS REMEMBER THE WORLD'S FIRST BATTERY PORTABLE RADIO . . . introduced to the industry by Philco 22 years ago? It opened up a whole new business. Thirty million portables in use today represent a giant service market.

It's just one example of increased profit opportunities for you, resulting from Philco creative engineering through 30 years of electronic progress. 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

Service Business is reflected

1st

1st Portable Battery Radio Introduced by Philco in 1938

The first self-powered Portable Battery Radio—invented by Philco—created a sensation when it was put on sale in 1938. It's shown above—the famous **Model 71T.** It was the same year that Philco invented and introduced—

- **1½ Volt Battery Farm Radio**
- **Wireless Remote Control**

—two more famous Philco Industry Firsts!

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

NEW! WINEGARD BOOSTER COUPLER WBC4

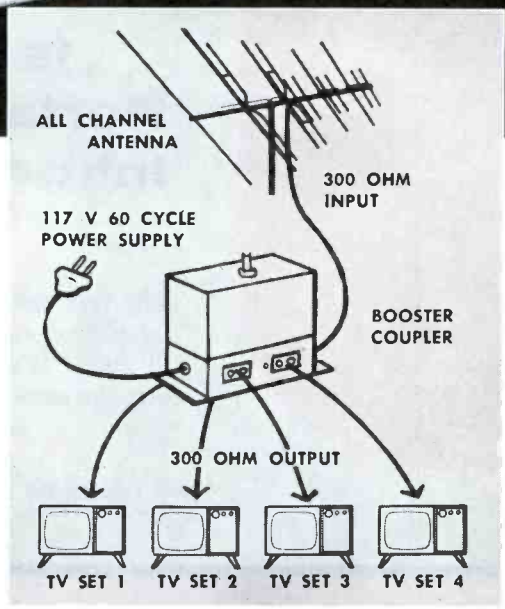
Operates 1 to 4 TV Sets and delivers more signal power. Amplifies all channels 2-13 plus FM.

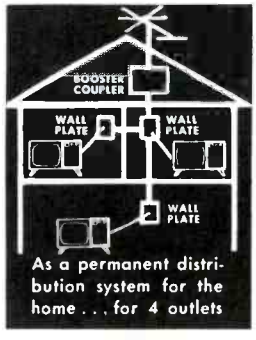
More features, more power, easiest to install

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

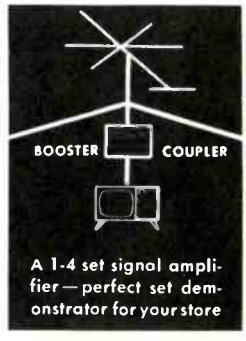
Now with one compact package of power, you can install one to four TV sets and get sharper, clearer TV reception even in fringe areas. Ordinary couplers reduce signal going to the set, but the Winegard WBC4 gives the signal power boost you need for perfect television. Installs quickly, easily—4 no-strip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

$27.50 LIST





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



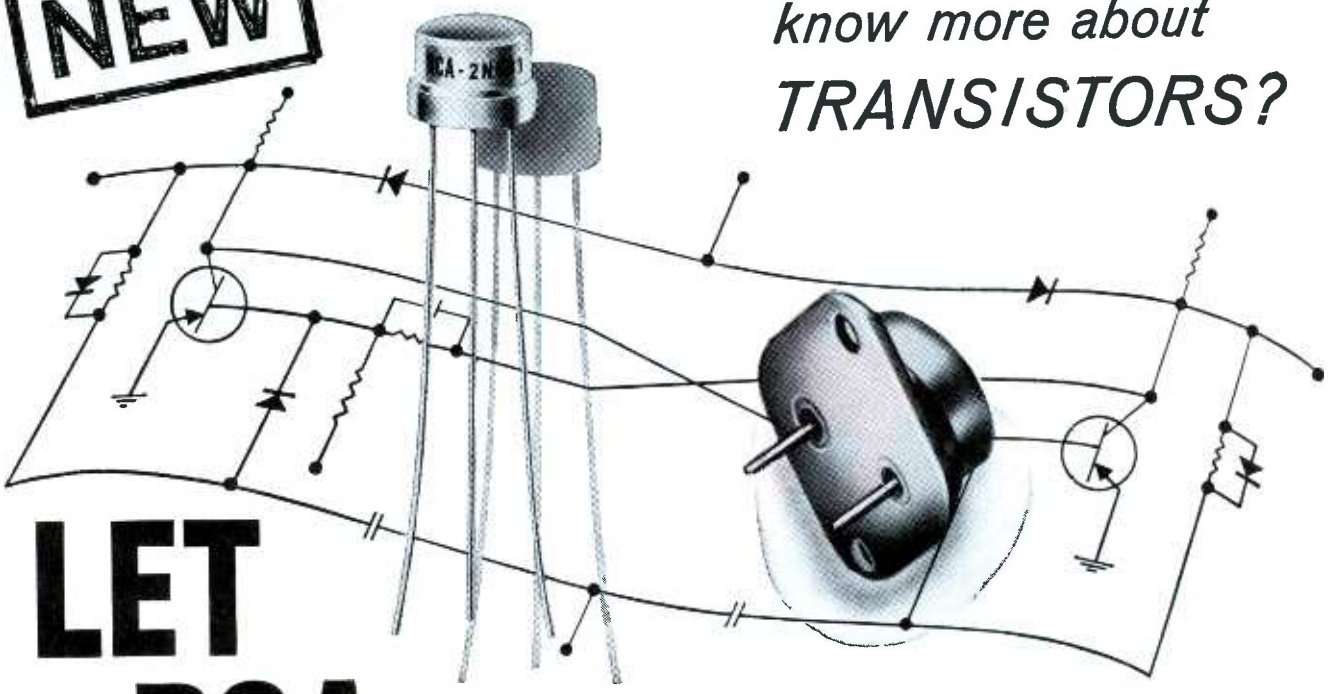
A 1-4 set signal amplifier—perfect set demonstrator for your store

Winegard ANTENNA SYSTEMS

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

NEW

Need to know more about **TRANSISTORS?**



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in semiconductor physics and transistor applications

RCA Institutes Home Study School now has a new course created for men and women in the field of electronics who realize the growing importance of semiconductor technology. The new course covers transistor characteristics and testing methods . . . prepares you to move up in your job as you increase your knowledge and skills.

RCA's liberal Pay-As-You-Learn Plan is the most economical possible home study method *because you never pay for lessons that you do not receive!* You pay for your next study group only when you order it! Should you drop out at any time, you do not owe RCA Institutes one penny.

Courses also available in Electronic Fundamentals, TV Servicing, Color TV, and Electronics for Automation.

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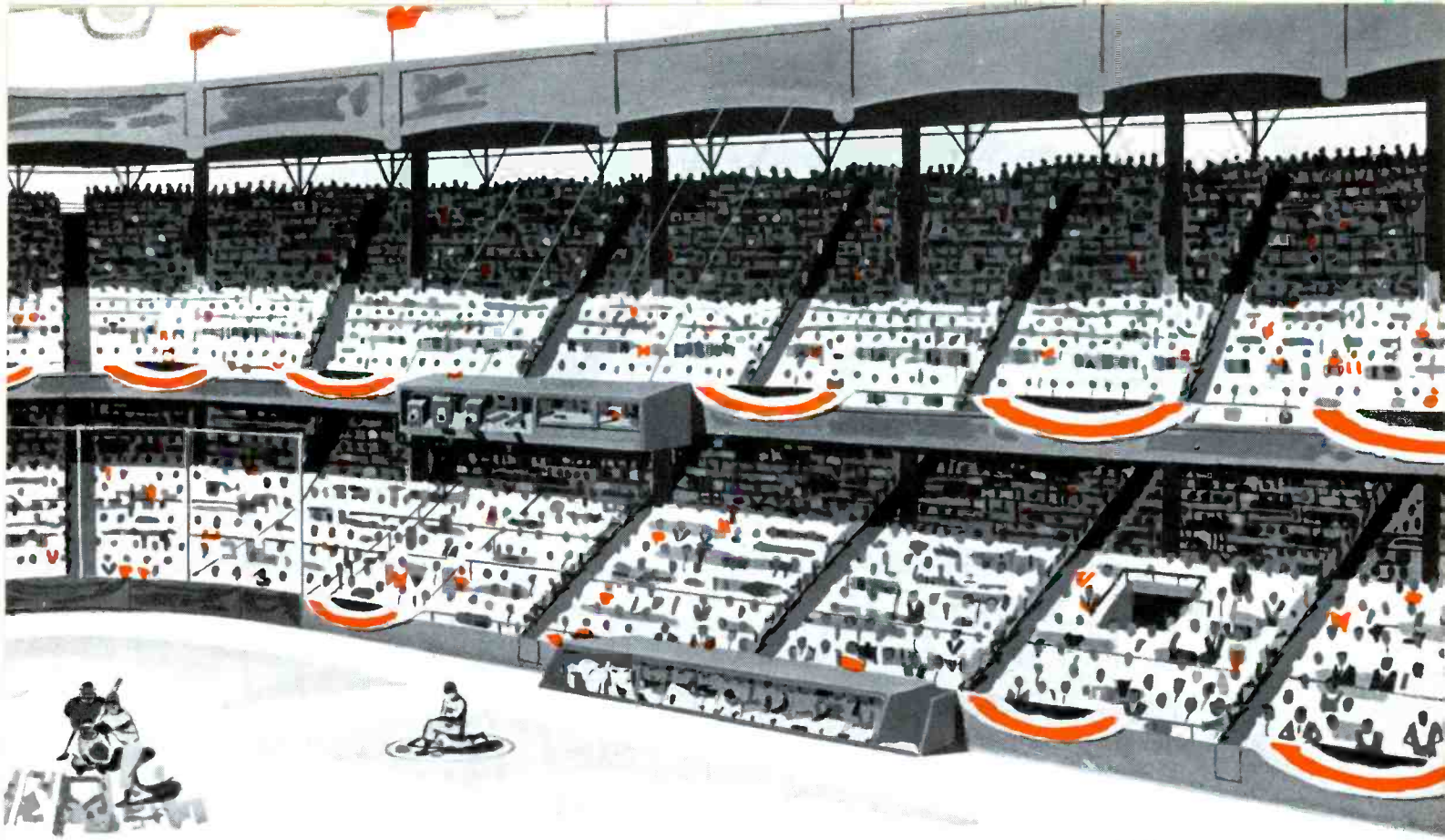

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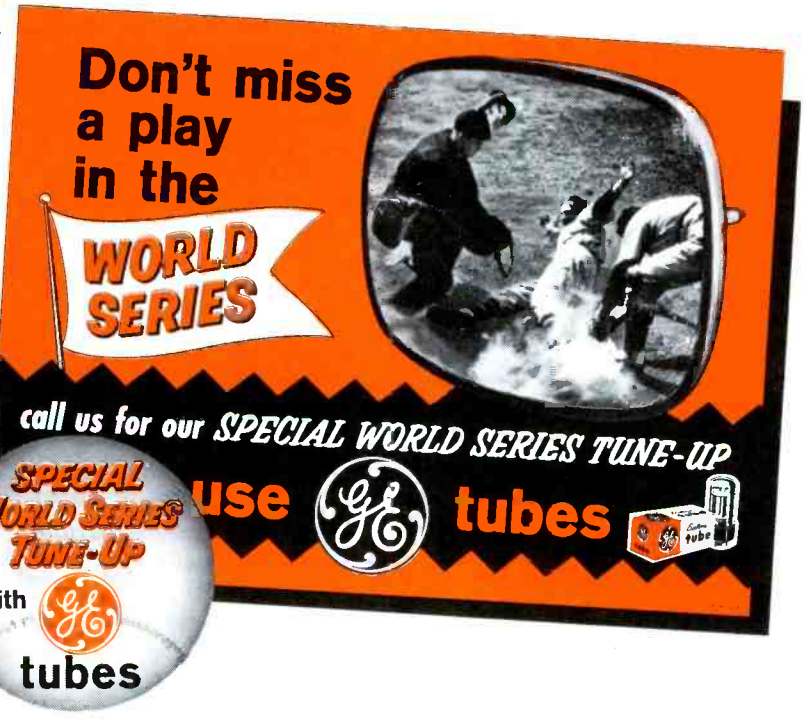

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STRETCHING CRT LIFE

by Jack Darr

Just what do brighteners do? How do you "rejuvenate" a weak tube or weld an open element? Here are some answers.

The saddest words of tongue or pen are these: "Lady, your picture tube's bad!"

Sad for the customer, that is. A CRT gone "kaput" is looked upon as a financial catastrophe in the average household. Strange as it may seem, the average customer will lay out fifty or a hundred dollars for a set of new whitewall tires, fishing equipment, and the like — but it hurts him terribly to pay fifty dollars for a new picture tube!

At this sad moment, the conduct of the "attending technician" can make or break him, as far as future business from the bereaved family is concerned. By displaying a properly sympathetic attitude, he can make them feel he is really their friend in a time of trouble. In this way he can gain a lot of good will, a quality badly needed in the TV maintenance profession at all times.

Using good psychology in breaking the news to the customer is very important. *Never* say, "Yer picture tube's dead. New one'll cost ya fifty bucks!" A much more humane way to break the news is to bring in a picture-tube tester and let the customer (and his family) see the results of your tests. Explain what has happened. If the tube is fairly old, tell them that the emission of the cathode has simply weakened from old age, which is quite true. Compare it with a flashlight battery going down, a tire wearing out, or some other item they understand, to get the idea across. Then, just when they're feeling the worst, with that sinking feeling in the stomach, you spring the snapper. Tell them that there are methods of bringing the tube back to life—at least for a while—and that you're going to try your very best to restore their precious tube to them! (At this point, you gradually begin to change from a heartless ogre to something resembling the Kindly Old Family Doctor! Instead of a mortal enemy you're beginning to look like a Real True Friend!)

You're not making false promises, either. Field experience has shown that a high percentage of defective CRT's can be restored to useful life, if not to "like-new" performance, for varying periods of time by the use of brighteners or rejuvenation treatments. Even though an open filament can seldom be mended, a number of other troubles can be temporarily remedied. Customers are inclined to feel that the added life is worth the small cost of treatment, as long as the inevitable CRT replacement is postponed.

If they agree to having the tube rejuvenated, let them watch the operation. Show them the reading on the emission test, and have them note the quality of the picture. Then "shoot" the tube with the rejuvenator, and show them exactly what happens. If the emission comes up almost to normal, as it will in most cases, act happy! If the reading comes up, but then slowly sags down again, explain what this means—and install a brightener. (I always say "brightener," avoiding the use of the word "booster" whenever possible. For some unknown reason, the latter seems to have a misleading connotation to the nontechnical mind.) You might further explain that the brightener's only function is to raise the heater voltage about 10-15% above normal. Make it very clear that this has absolutely *no* effect on the high voltage, and that adding a brightener will under no circumstances make the tube likely to "explode". This sounds like a lot of trouble, but a few words of explanation are often necessary; you'd be surprised what silly notions some customers have in their bonnets!

• *Please turn to page 74*

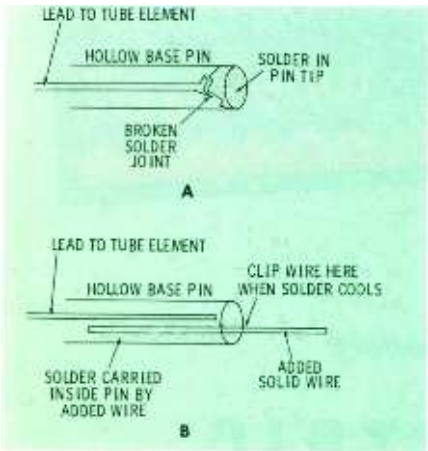


Fig. 1. Extra wire pushes solder down inside base pin for solid connection.

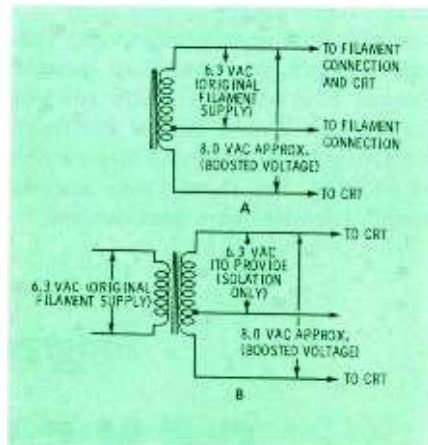


Fig. 2. Some brighteners are autotransformers; others provide isolation.

Questions & Answers ON TV

Part 2—a "service meeting" about the techniques of

BILL: Everybody back from coffee break? You all look ready for another bench session, and I've got my voice back—so let's begin.

Just before break time, you asked me to demonstrate the over-all IF alignment check once again. Here's a set we could use; Dan, will you help me move it over there next to the scope?

DAN: Sure. Is the alignment for this set the same as for the other one we worked on?

BILL: The over-all response check will be practically the same. If we go on to the complete step-by-step alignment, it will be simpler than for the other set—but we'll get to that after awhile.

Here's the alignment instructions [Fig. 9]; go ahead and pass them around, Dan, while I get the equipment ready.

FRED: The instruction sheet says, "Signal generator coupling to ungrounded tube shield floating over mixer-oscillator tube." I think I know what they mean, but I'm not sure; would you show me?

BILL: All I do is pull the shield off the mixer tube and rest it loosely over the top of the tube. Notice how I angle it so it won't slide down and come into contact with the chassis. You see, by "floating" they just mean "ungrounded."

Now I clip the generator's hot lead to the tube shield, and—as usual—the ground lead to chassis. The shield and the mixer-tube plate then form a neat little coupling capacitor—just a few mmf, but that's all you need at 40 mc.

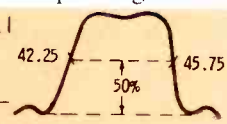
GEORGE: What would you do if the tuner uses captive, riveted-down shields the way most of them do nowadays—get a drill and hacksaw?

BILL: Naw—there's an easy way to get around this. Just take a thin strip of metal—a piece of copper or aluminum about 1/4" by 1 1/2" would be fine. Cover both sides with plastic insulating tape, except for a small spot at one end; then poke it down between the tube and shield, leaving the bare tab sticking out at the top. Clip the generator lead to

PRE-ALIGNMENT INSTRUCTIONS

USE AN ISOLATION TRANSFORMER TO PROTECT THE TEST EQUIPMENT.
The HighVoltage lead should be securely taped and kept away from the chassis.
Allow a 20 minute warm-up period for the receiver and test equipment.

FIG. 1



VIDEO IF ALIGNMENT

Connect the negative lead of a variable bias supply to point Ⓐ. Positive to chassis. Adjust bias to obtain response curve showing no signs of overloading.
Use only enough generator output to provide a usable indication on VTVM.

	DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	CHANNEL	CONNECT VTVM	ADJUST	REMARKS
1.	Direct	High side to ungrounded tube shield floating over mixer osc. tube (V202). Low side to chassis.	41.25MC (Unmod)	Any non-interfering channel	DC probe thru 10K to point Ⓑ. Common to chassis. (Across video det. load).	A1	Adjust for MINIMUM deflection.
2.	"	"	47.25MC	"	"	A2	"
3.	"	"	42.3MC	"	"	A3	Adjust for maximum deflection.
4.	"	"	45.3MC	"	"	Mixer Plate Coil	"
5.	"	"	"	"	"	A4	"
6.	"	"	41.5MC	"	"	A5	"
7.	"	"	42.0MC	"	"	A6	"
8.	"	"	43.5MC	"	"	A7	"

OVERALL VIDEO IF RESPONSE CHECK

Connect bias as under "Video IF Alignment".
Connect the synchronized sweep voltage from the sweep generator to the horizontal input of the oscilloscope for horizontal deflection.
The sweep generator output lead should be terminated with its characteristic impedance, usually 50 ohms.
Use only enough sweep generator output to provide a usable pattern on scope.

	DUMMY ANTENNA	SWEEP GENERATOR COUPLING	SWEEP GENERATOR FREQUENCY	MARKER GENERATOR FREQUENCY	CHANNEL	CONNECT SCOPE	ADJUST	REMARKS
9.	Direct	High side to ungrounded tube shield floating over mixer-osc. tube (V202). Low side to chassis.	44.0MC (10MC Swp)	42.25MC 45.75MC	Any non-interfering channel	Vert. Amp. thru 10K to point Ⓑ. Low side to chassis. (Across video det. load).		Check for response similar to Fig. 1. If necessary, retouch A3 thru A7 for desired response.

Fig. 9. Step-by-step procedure for aligning IF strip with VTVM, followed by over-all sweep-alignment check.

ALIGNMENT

aligning a stagger-tuned IF strip.

this, and you're in business.

FRED: You haven't connected the bias pack. Is this next?

BILL: We could just as well go ahead and do this. The value of the bias doesn't appear to be too critical in this set, since the directions just say to adjust for a response curve showing no signs of overloading. I'm sure we'll come out all right if we use at least a couple of volts of bias. When you're aligning sets, there's no such thing as a "standard" bias voltage. I've seen values as low as –1.5 volts, and I noticed a recent Philco where the instructions called for –8 volts on the AGC line.

Okay, the bias supply is hooked up. What do I do next?

DAN: Connect the scope.

BILL: All right; you tell me how.

DAN: Well, uh—"vertical through 10K to point B." Let's see—you could trace through a peaking coil from the grid of the video output tube, and you'd be there.

BILL: On this 3900-ohm resistor?

DAN: That must be it. Oh—and ground the scope to the TV chassis. Seems to me there's something else.

GEORGE: Connect the scope to the sweep generator.

BILL: That's right; but where?

DAN: I remember—horizontal input of the scope to the CRO jack on the generator.

BILL: Now we should get a curve. There it is, but it needs a touch-up. Go ahead and practice adjusting the controls, as I showed you before the break.

JOHN: We need a marker on the curve, don't we?

BILL: Yes, we do. Let me see how you would turn on the marker generator . . . that's right. Now I've got something new to demonstrate. I need another RF signal generator that will cover the TV-IF range; show you why in a minute. Fred, will you hand me that one on the shelf next to you? Thanks.

When I clip its output lead to the TV chassis and tune it in, notice that I get a second marker on the curve. [Fig. 10] The one on the left slope is set at 42.25 mc, while the one on the right falls at 45.75 mc.

DAN: The marker on the high-frequency side looks too close to the base line. The alignment curve in the instructions [Fig. 9] shows that both markers should be no less than 50% of the distance to the peak.

BILL: You're right, Dan, it doesn't look too good. Since I don't think we can hurt it any, let's try to broaden the response out a little bit to bring up that 45.75-mc marker. For this, we'll have to go into the step-by-step procedure. We won't need a scope and sweep generator to align this type of set—only a VTVM and a "straight" signal generator.

You just saw that an ordinary RF generator can put a marker on the curve. Turn about is fair play; we can also use the sweep generator's marker output as an unmodulated RF signal, as called for in the instructions.

DAN: That never occurred to me before. I always thought the marker was a sort of accessory for the sweep generator, and you had to have a sweep curve to produce anything usable from the marker unit.

JOHN: The instructions say that the generator signal should be unmodulated. Well, then, what do you use as an output indication? Don't you need 400-cycle audio or something to make the meter register a reading?

BILL: Nope; we just connect a VTVM across the video-detector load and feed in our marker signal at the mixer. Even though the signal

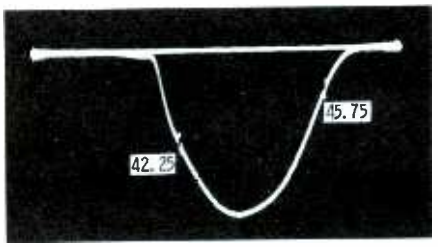
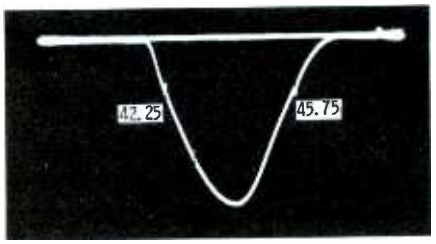
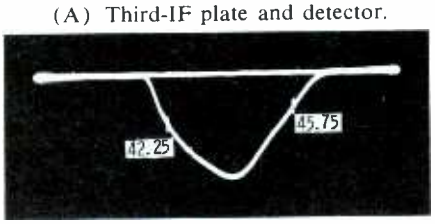


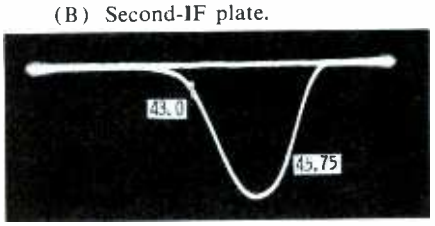
Fig. 10. Response curve obtained before performing step-by-step alignment.



(A) Third-IF plate and detector.



(B) Second-IF plate.



(C) First-IF plate.

Fig. 11. Single-stage responses.

is unmodulated, it will be rectified by the detector to produce a negative DC voltage across the load resistor. The stronger the signal, the greater the voltage. This is the same idea you put to work when you align a radio using the AVC voltage as an indicator.

Watch me hook up the meter. I'll switch it to the "–DC volts" position, and leave it on the 15-volt scale at first. Once we get set up, I'll reduce the generator output to a low level for a more sensitive alignment indication; then I'll drop the meter down to the 5-volt scale.

Now watch the meter as I tune the marker generator back and forth across the IF band—from about 40 to 50 mc. Whenever I'm within the actual IF bandpass of the receiver, the meter pointer will swing over. Outside this range, there'll be little or no reading unless you have a stray signal feeding through from the tuner. In this case, you may note a very high peak occurring on one side of the IF band.

• *Please turn to page 71*

Shop Talk

by Milton S. Kiver

Servicing TV Sync

This is the last in a series of seven articles which have developed a systematic troubleshooting procedure for all of the basic functional sections of a TV receiver. It has been seen that the method of approach varies from section to section—not only from the standpoint of what to check first, but also in terms of the test instruments best suited to each individual section.

Of the 11 basic "blocks" into which we initially divided the TV receiver for analysis, only two remain to be discussed. One is the sync section, and the other comprises the sound IF and FM detector. These final sections are covered this month; in addition, Table I has been compiled to furnish a review of the different test-equipment requirements for servicing different portions of a television set.

SECTION	PRIMARY TESTS	SECONDARY TESTS	
		1	2
POWER SUPPLY	VOM OR VTVM	SCOPE	———
AUDIO	SIGNAL INJECTION	VOM OR VTVM	SCOPE
VIDEO AMPLIFIER	SCOPE	VOM OR VTVM	LISTENING TEST OR SIGNAL INJECTION
VERT DEFLECTION	SCOPE	VOM OR VTVM	6.3 VAC SIGNAL INJECTION
HORIZ DEFLECTION	SCOPE	VOM OR VTVM	SAWTOOTH SIGNAL INJECTION
HORIZ AFC-OSC	SCOPE	VOM OR VTVM	———
VIDEO IF	VTVM	SIGNAL TRACING OR INJECTION	ALIGNMENT CHECK
AGC	"CLAMPING" WITH BIAS SUPPLY	SCOPE	VTVM
RF TUNER	VTVM	SIGNAL INJECTION	ALIGNMENT CHECK
SYNC	SCOPE	VOM OR VTVM	———
SOUND IF AND FM DETECTOR	SIGNAL INJECTION	VOM OR VTVM	ALIGNMENT CHECK

TABLE I—TEST METHODS FOR TROUBLESHOOTING TV RECEIVERS

The Sync Section

Once a defect has been localized to a sync separator or sync amplifier stage, the troubleshooting procedure is very simple and straightforward because of the simplicity of the circuitry involved. (See Fig. 1.) In remedying a loss of synchronization, the real difficulty comes in determining whether it is due to an actual sync-circuit defect or to a trouble elsewhere in the receiver. For this task, you need proper test equipment—specifically a scope.

The critical test of sync-circuit performance is whether or not its output signal has the proper shape and amplitude. The sync separator normally has at its plate a clean sync-pulse signal, completely free from picture information. This waveform is shown in Fig. 2A at a scope-sweep rate of 7875 cps, in order to display the details of the horizontal sync pulses. Fig. 2B shows the same signal again, at a slower sweep rate of 30 cps, so that the vertical pulses can be seen. (Note: The latter waveform shows only the principal features of the signal. If the intensity of the scope trace were increased, the whole area between the base line and the sync-pulse tips would be filled in with a hazy band of light representing many horizontal sync pulses crowded close together.) If this sync-separator plate signal is normal, the trouble must not lie in the sync separator or any preceding stage; therefore, it must be in some following sync stage or in the vertical or horizontal sweep section.

On the other hand, if the sync-separator output is *not* as shown in Fig. 2A or 2B, the input signal at the grid of the separator should be checked. This should be a typical composite video signal, similar to the output of the video amplifier—although some sets contain special circuit features which accentuate the sync pulses in this signal before it arrives at the separator. The input should look like Fig. 2C at the 7875-cps scope-sweep rate (two horizontal lines of video information), or like Fig. 2D at 30 cps (a complete vertical frame of information). If the input signal is normal and the output is not, you can only assume that the separator itself is defective. There are usually very few parts in this circuit, so voltage and resistance checks or capacitor

and Sound

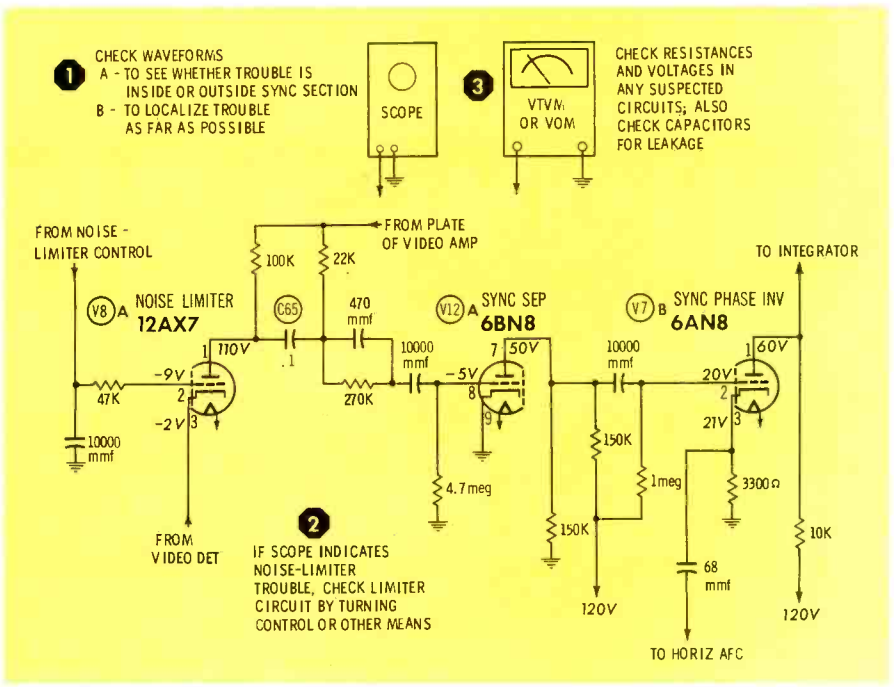


Fig. 1. General hints for troubleshooting TV sync circuits.

substitution will quickly localize the culprit. But beware of large changes in voltages between "signal" and "no-signal" conditions — these can be very misleading even when stage operation is normal!

One type of distortion often seen in the sync-separator input signal is compression of the sync pulses, as illustrated in Fig. 3A. (Note that the pulse amplitude, from blanking level to tip, is less than 1/4 of the total signal amplitude.) The defect causing this symptom might be located in any one of a large number of stages. The fault might be in the separator grid circuit itself, or in the video amplifier, video detector, IF strip, or RF tuner. It is also quite possible that a defect in the AGC network might be causing the AGC-controlled RF and IF amplifiers to operate at higher-than-normal gain as a result of insufficient bias. This can readily lead to overloading of a later amplifier stage, with subsequent sync compression. When the distorted signal reaches the sync separator, the positive peaks of the picture signal reach a voltage level almost as high as that of the sync-pulse tips. Consequently, it becomes impossible to accomplish a clear-cut separation, and some of the video reaches the plate of the separator.

It may even be fed through to the final output of the sync section. For example, Fig. 3B shows video contamination in the sync phase-inverter plate signal as a result of overloading in the video amplifier. This signal fault tends to cause unstable sync or critical operation of the hold controls, especially in the vertical circuit. In the horizontal system, the AFC network helps to prevent the picture from falling entirely out of sync. However, distortion in the sync signal is likely to result in an abnor-

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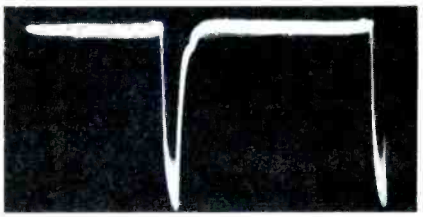
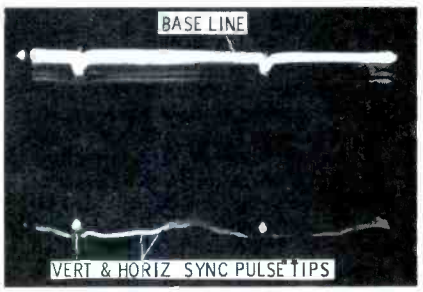
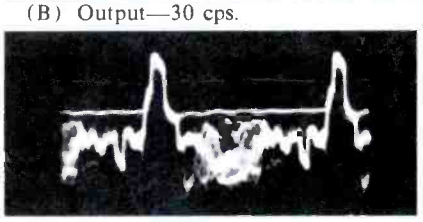


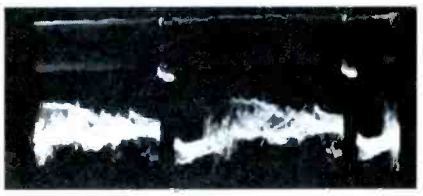
(A) Output—7875 cps.



(B) Output—30 cps.



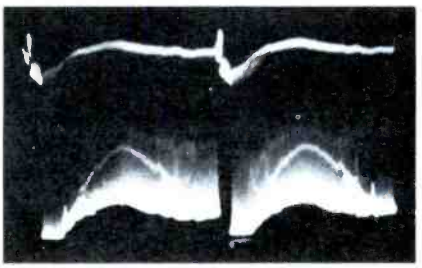
(C) Input—7875 cps.



(D) Input—30 cps.

Fig. 2. Normal sync-separator signals.

(A) Faulty separator input.



(B) Resulting phase-inverter output.

Fig. 3. Results of sync compression.

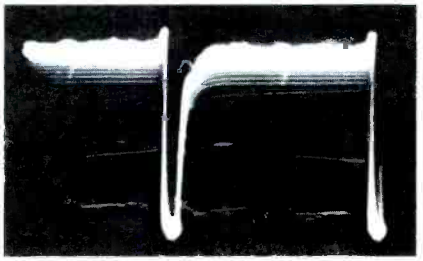
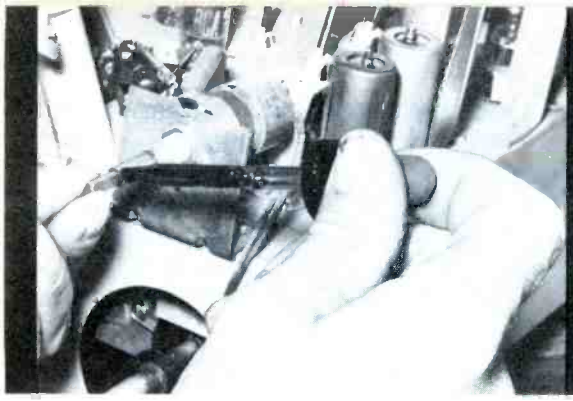
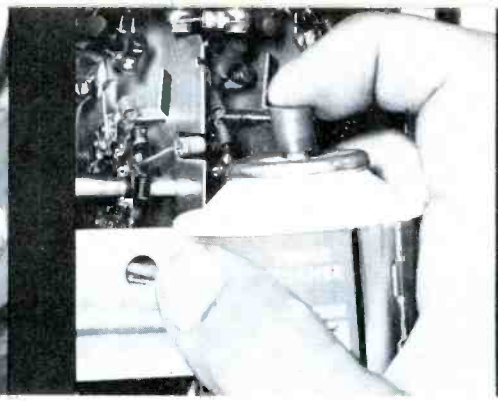


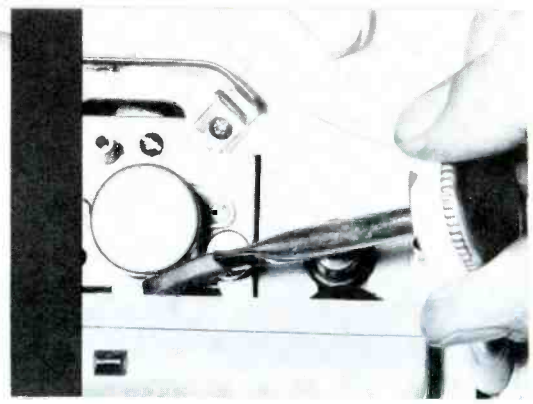
Fig. 4. Slight amount of video "hash" in separator output is often normal.



Control cleaners are designed to restore good electrical contact between rider and element. In order to accomplish this, they must clean both contact surfaces without damaging them, and then deposit a thin film (lubricant) to reduce further wear. Most control chemicals even help in re-surfacing the carbon element, making it possible to temporarily repair an open control.



Just as control cleaners are designed for application to carbon surfaces, tuner cleaners work to remove metal oxidation. (Some products will do both jobs.) Carbon tetrachloride, lighter fluid, etc., may do a fair job of cleaning, but they increase oxidation. The thin oil used in cleaning chemical solutions reduces future oxide formation and contact wear.

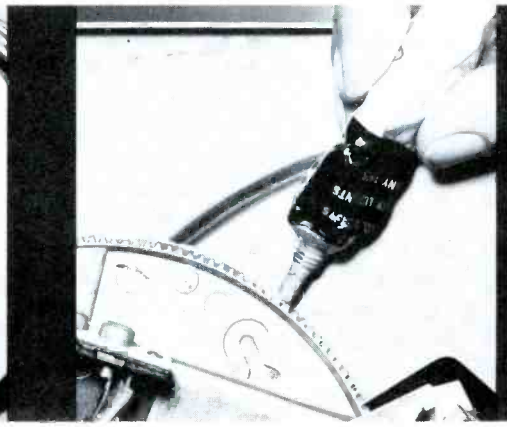


Tape cleaners are also designed to do a specific job. Iron oxide, deposited by tape transit, must be removed without damaging heads or pressure pads. Most tape cleaners contain a lubricant to reduce tape and head wear without damage.

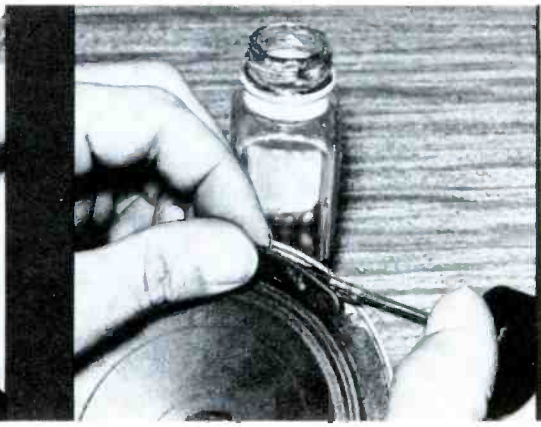
KNOW YOUR ELECTRONIC CHEMICALS

Glance around the next time you visit your local electronics parts distributor's store. You'll find a number of chemicals on display that can save you countless man-hours and help you do a far better service job. This article will aid you in choosing the right kinds of chemicals for various applications.

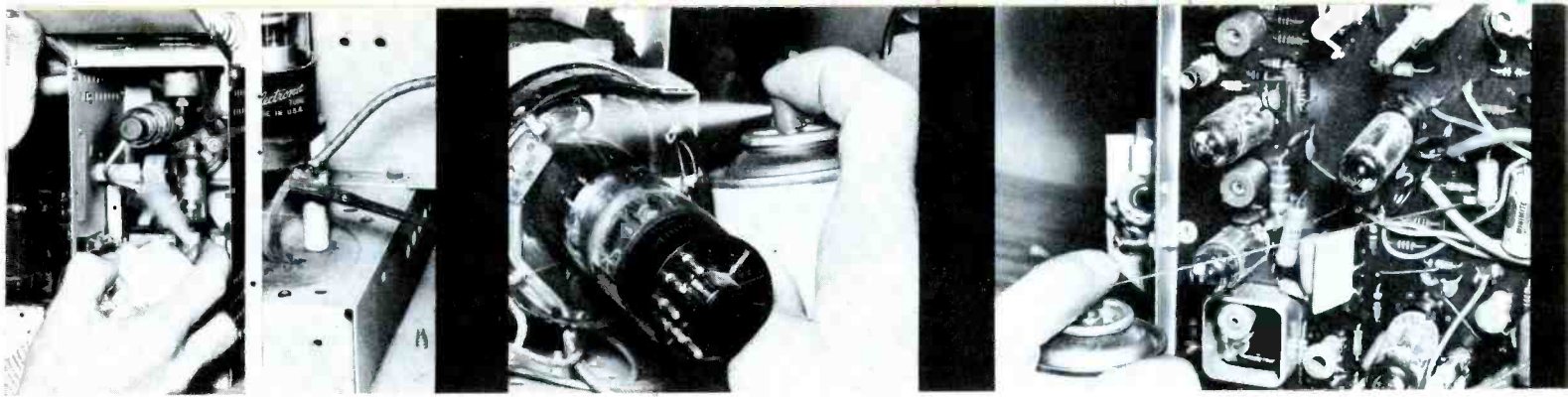
Anti-static cleaners are used principally on picture tubes and phonograph records. Fluids for both applications leave a protective film that reduces attraction of dust and grime. Chemicals designed for use on records will not harm the grooves; on the contrary, they serve as a lubricant to prolong life.



Lubricants used in electronic servicing range from fine oils to fairly heavy greases. Since they are normally used around rubber or composition drive systems and near exposed electrical contacts, care must be exercised in their application.



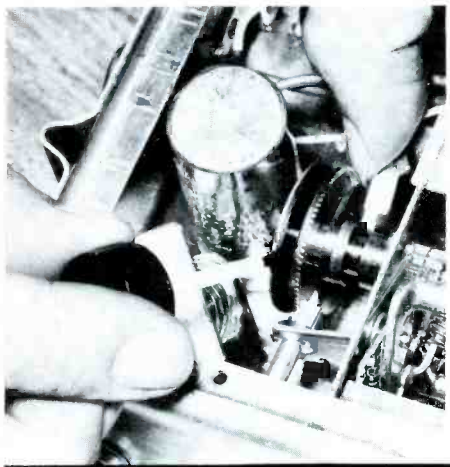
The uses for adhesives range from cementing speaker cones to patching up broken knobs and cabinets. The primary consideration in selecting the correct adhesive is simply this: Will it stick, without harming the materials being joined?



High-voltage insulating sprays and brush-on corona dopes have exceptionally high dielectric strength, and are impervious to moisture and temperature variations. While they aren't a cure-all for poor solder jobs, they are very useful in controlling corona discharge and arcing. Be sure to remove all dust and grime so the insulating chemical will bond solidly.

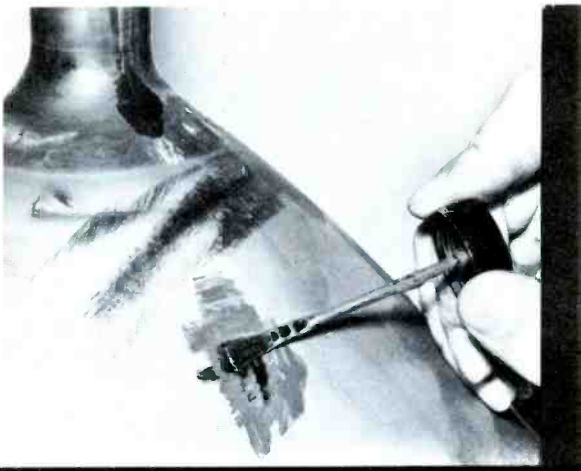
Yoke-removing fluids must penetrate the area between the "stuck-on" coil windings and the picture tube, and must dissolve the adhesive bond without damaging varnished yoke windings. Paint removers and thinners, lighter fluid, and the like are not suitable for this job.

Chilling chemicals are extremely helpful in tracing intermittent or thermal problems. Designed to cause an instantaneous reduction in a component's operating temperature, the mist is nontoxic, nonflammable, and harmless to components. (Incidentally, we cooled an operating 5U4 in less than two seconds, and the tube withstood the shock.)



Anti-slip liquids may be designed for general use or for some specific job. In either case, they form a high-friction bond between two surfaces. They are harmless to rubber, composition materials, felt, or dial cords. When using, allow the chemical to dry thoroughly before permitting anything to come in contact with it.

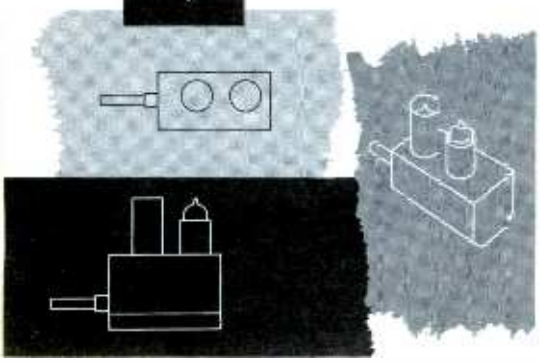
Aquadag paints contain the same ingredients used for the original outer coating on picture tubes. In repairing worn or flaked-off areas, be sure the surface has been thoroughly cleaned so the paint will stick and will not become contaminated.



MANUFACTURER	Control Cleaner	Tuner Cleaner	Tape Cleaner	High Voltage And Corona	Yoke Remover	Chilling Chemical	"Anti-Slip" Chemical	Aquadag Paint	Anti-Static Cleaner	Lubricant	Adhesives
Chemical Electronic Engineering, Inc.	Ever-Quiet	Hush		Plastic Sealer Spray					Ever-Kleer		
Chemtronics, Inc.	Trol-Aid	Tun-O-Lube	Tape Recorder Cleaner (TR-2)	No-Arc High Voltage Insulator (501-1)						Trol-Aid (506-5)	TV-Radio Cement (502-2) All Purpose Glue (503-6)
Colman Electronic Products, Inc.	Lub-A-Trol	E-Z-Kleen Rid-Ox		Rid-Arc		Freeze Spray	Slip Stop	CRT Paint	Sparkle	Lubra-King	Grid Cap Cement Pliobond Service Cement Tube Base Cement
Eastern Jewel Corp.					F.Y.R. (Frozen Yoke Remover)						
Electronic Chemical Corp.	No Noise Volume Control & Contact Restorer	No Noise Tuner Tonic		No Noise Rubber Coat Spray			No Noise Rubber Coat Spray				
Electronic Solvents, Inc.	Mute Tuner & Volume Control Tonic	Mute Tuner & Volume Control Tonic									
Fiske Bros. Refining Co. Lubriplate Div.										Lubriplate	
G-C Electronics Co. Div. of Textron Electronics Inc.	De-Ox-Id Carbon Control Cleaner	De-Noiz 51 Kleen-O-Matic (5 types)	Mag-Netik Recording Head Cleaner	Red-X Corona Dope		Zero-Mist	Non Slip Powder (1210) Non Slip Liquid (1211)		Rek-O-Magic Reco-Static-Chaser	Lube-Rex Grafolene Carbon-X 6 Others	Plastic Cement Pliobond Cement Service Cement 12 Others
Injectorall Co.	No. 999 Contact Cleaner	No. 899 WN Tuner Cleaner	No. 250 Tape Cleaner	Hi-Volt No. 129	No. 40 E-Z Off Yoke Remover					No. 10 "Spot" Oil	No. 101 Speaker Cement
Krylon, Inc.				Krylon Clear 1302					Foaming Window Spray	Silicone 1325	
Montgomery Chemical Co.	Swish Electrokleen	Swish Electrokleen	Swish Electrokleen								
Plytex Products, Inc.	Jetkleen Lubekleen	Jetkleen Lubekleen Quikleen				Quikfreeze				Quiklube	
Quietrole Co.	Quietrole	Quietrole Spray Pack									
R-Columbia Products Co., Inc.	Kleentrol Magic Solvent			E-Z Ply Anti Corona Dope			Fono-Magic			Miracle Lube	E-Z Ply Cement
Superex Electronics Corp.	Rx	Rx			Yoke-Off						
Walsco Electronics Mfg. Co. Div. of GC-Textron Electronics Inc.	Contactene K-T-K Kon-Trol-Kleen No-Ox	Tunerclean Tunerlube	RH Cleaner	Anti-Corona Lacquer Red Corona Dope	E-Z Off	Freez-Mist	No-Slip		Stati-Clear Walscoclear	Carbonex "Lubriplate" Walscolub-B	Plastic Cement Pliobond Cement Radio Cement 8 Others
Workman TV, Inc.	Wissh (H6) Super Wissh (S6)	Wissh (H6) Super Wissh (S6)		Sil-O-Lube (SG6)	Ease-It (ETI)	Freeze-It				Precision Oiler (POI)	

The applications shown for the products in this chart indicate the uses for which they were designed, according to manufacturers' recommendations. Many of the products are listed under their registered trade names.

Servicing NEW DESIGNS



ADVANCES IN TV TUNERS

by Thomas A. Lesh

Fig. 1. RCA switch-type tuner employing a 6CW4 *Nuvistor* as RF amplifier.

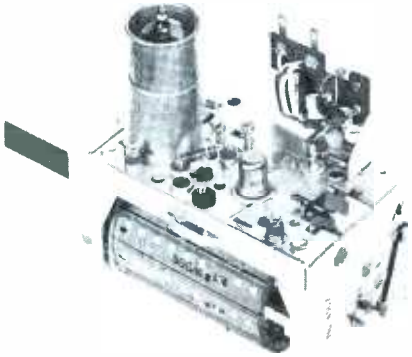


Fig. 2. *Nuvistor* type tuner built by Standard Kollsman Industries, Inc.

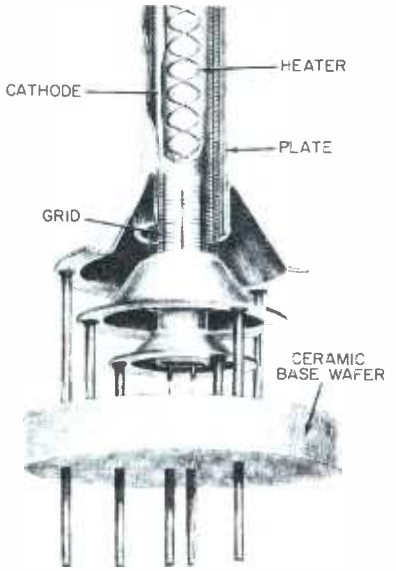


Fig. 3. Internal view of 6CW4 triode showing method of construction.

The tuners in Figs. 1 and 2 may look like hybrid units of some sort, but appearances are deceiving. The thimble-like metal dome, hardly larger than a transistor, is a *tube*. This is the new 6CW4 RF amplifier, the first commercially-available tube type utilizing the *Nuvistor* design developed by RCA.

The switch-type tuner in Fig. 1 is RCA's own KRK98A, used in 1961 *New Vista* models. Another 6CW4-equipped tuner in current production is the turret-type unit shown in Fig. 2, made by Standard Kollsman Industries, Inc. (formerly Standard Coil Products). Although circuit details differ, both tuners use the *Nuvistor* in a neutralized triode amplifier with grounded cathode.

What's the advantage of reducing a tube to such small dimensions? Miniaturization for its own sake, to reduce the size of electronic equipment, is an eventual goal; however, this is only a small part of the answer. There are a number of more immediate benefits. For example, reducing the area of the tube elements makes it possible to place them closer together without causing an increase in interelectrode capacitance — an important consideration in a tube designed for VHF operation. In turn, the closer element spacing decreases the transit time of electrons traveling from cathode to plate; this is also a factor in obtaining good VHF performance. Another favorable feature of the small tube structure is that less thermal noise is generated than in a conventional tube, resulting in less snow in the picture. An added advantage of the *Nuvistor* is its comparatively low power-input requirements. While voltage and current ratings are not nearly as low as for an RF transistor, they are modest by usual tube standards.

Table I compares several typical operating characteristics of a 6CW4 with those of a 6FH5, one of the most up-to-date conventional RF-amplifier tube types. (The 6FH5 is also a triode, with additional "shield plates" in the region between grid and plate; at present, it is being extensively used by the same manufacturers who are building *Nuvistor* tuners.)

The almost subminiature size of the 6CW4 is made possible by a number of new ideas in design and manufacturing. Constructed entirely of metallic and ceramic materials, the *Nuvistor* can be processed at higher temperatures than a glass tube. This has several advantages. For one thing, the tube is vacuum-sealed with enough heat to eliminate practically all contaminating gases; therefore, no "getter" is needed. In addition, the whole tube-element structure (except the outer metal shell) is assembled in a simple, one-step brazing process instead of being spot-welded together. The surfaces to be joined are given a thin copper coating, all the parts are fitted together as shown in Fig. 3, and the entire assembly is heated until the copper melts and fuses the pieces together.

The brazing process is said to be effective in preventing stresses and deformation of the elements—often a problem when the spot-welding process is used. This is one of the factors which permit close element spacing in the *Nuvistor* design. Another factor is the tubular shape of the elements, which permits tight dimensional tolerances to be maintained with a minimum of trouble. In Fig. 3, note that the cathode, grid, and plate are concentric cylinders, each with its own bell-

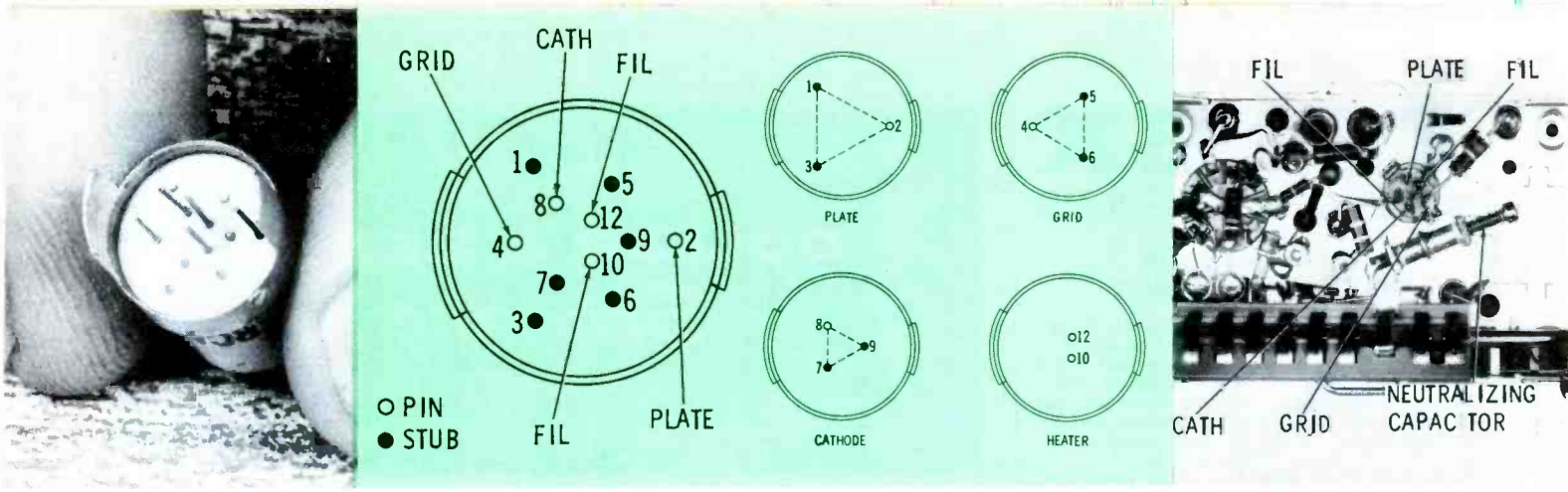


Fig. 4. Base of 6CW4. (A) Actual photo (B) Pin numbers (C) Pins corresponding to elements. (D) Underside of tube socket.

like base support. Each element base stands on a tripod consisting of three wire pins firmly imbedded in a ceramic base wafer. The tripods support the small, light tube elements so rigidly that no additional spacers or supports are needed.

Understanding the internal structure of the tube is a big help in figuring out its base configuration. As Fig. 4A demonstrates, the bottom of the tube holds five whiskerlike pins and a number of metal stubs, arranged in what at first seems to be a random scattering. Actually, there is more logic and order to this base arrangement than you might suspect. The key to understanding it is remembering that the supporting pins continue through the ceramic base wafer. One pin of each tripod is extra-long and is utilized as a plug-in connector. The other two supports of each element are cut off almost flush with the bottom surface of the base wafer, accounting for the various stubs.

Active or not, the pins are numbered clockwise in an inward spiral pattern as illustrated in Figs. 4B and 4C. Pins 1, 2, and 3 are for the plate (No. 2 being the active one); 4 (active), 5, and 6 are for the grid; 7, 8 (active), and 9 connect to the cathode; and 10, 11 (omitted in the 6CW4), and 12 are for the heater.

Fig. 4D is a bottom view of the

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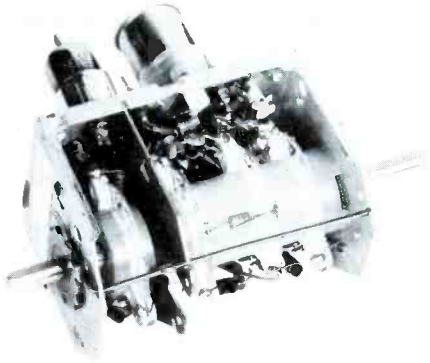


Fig. 5. Sarkes Tarzian *Silver Sealed* tuner with enclosed switch contacts.

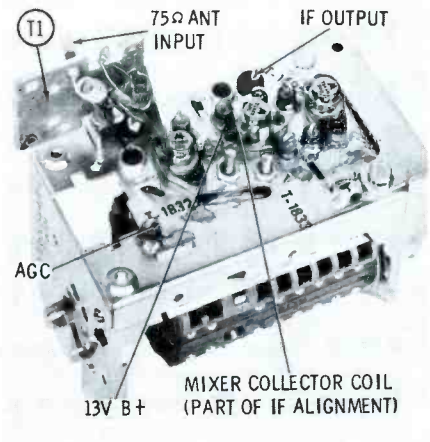


Fig. 6. Standard's transistor tuner used in Motorola *Astronaut* 19" TV.

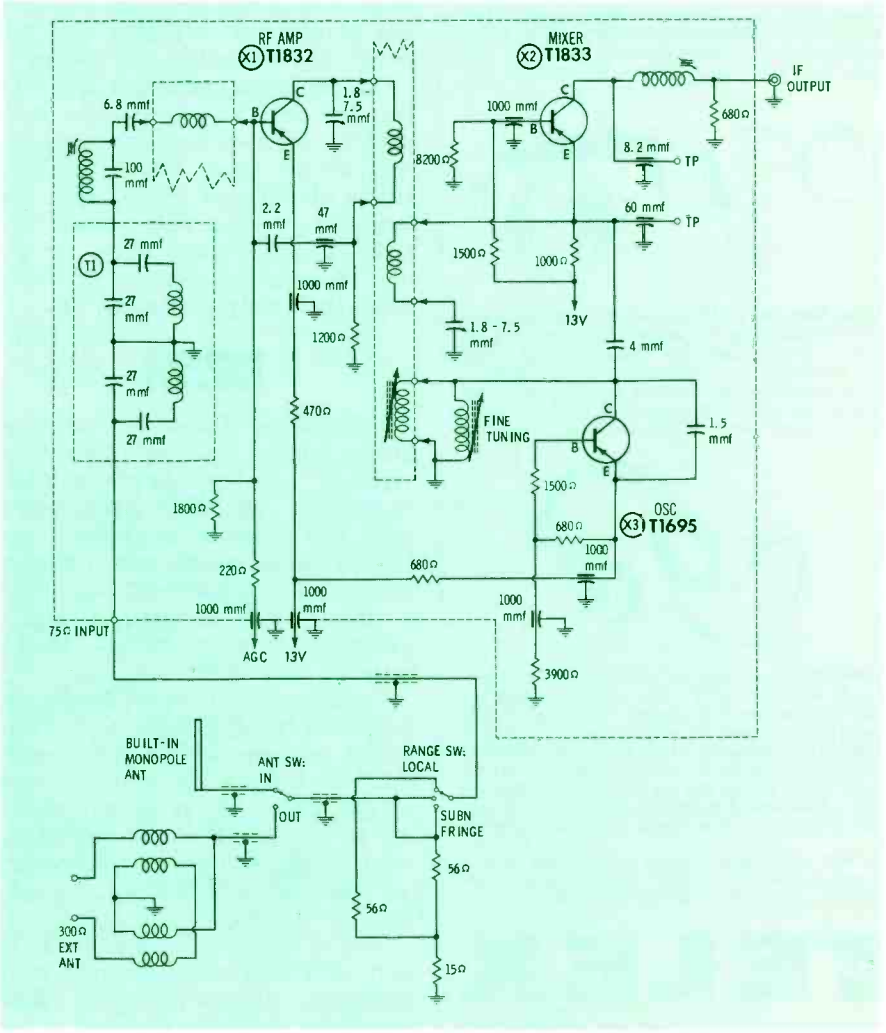


Fig. 7. Complete schematic diagram of TT-602A all-transistor tuner.

School Daze. The kids are off to school. Mom sits down to another cup of coffee (peaceful this time), and all of a sudden the stillness of the house closes in.

We busy males will never be fully able to understand the situation. Radios and record players that haven't played all day long for months will be turned on again. Kids' TV shows that have rung through the house during the summer months will be replaced with something Mom likes. How then, gentlemen, can we permit this fair damsel in distress to listen to a radio with a bad filter, or to a record player with a needle that was ready for replacement last spring?

To the rescue, men! Let her know that for only $....., she can have a radio without hum, or a phono that sounds good. Just a small ad telling about your special offer can win you a friend. Don't forget, the little lady will most likely be the one who finally calls the TV man when the family's set goes bad.

$ & ¢

Campaign Time. All sorts of business firms are tying in their advertising with this year's political campaigns; you find election-time puns and cartoons everywhere you look. Whether or not you choose to ride on the political bandwagon, this is still an excellent time to stage a campaign of your own — in advertising and sales!

Summer's fun is over. People are beginning to settle down to fall and winter patterns of life. Of course, this isn't new. Nor is it new to have all the regular TV programs returning to the air. With the added attraction of election year, servicing will automatically pick up; but why not help it along?

The 27th of this month will be only 90 TV-viewing days away from Christmas. Here's the germ of an idea for a campaign designed to sell both service and new sets. If you're an average service dealer, you give a 90-day guarantee on your work. As an inducement to have service work done (and paid for) now, you might offer to add the full amount of the service charge to the trade-in value of a customer's set at Christmas, if he comes back by then to buy a new set. This not only greatly improves his chances of getting winter-long television viewing without service interruptions, but he can get a good deal on a new TV just in time to be presented as a Christmas gift. You get a trade-in that will probably be all ready for a year-end sale without the need for additional repairs.

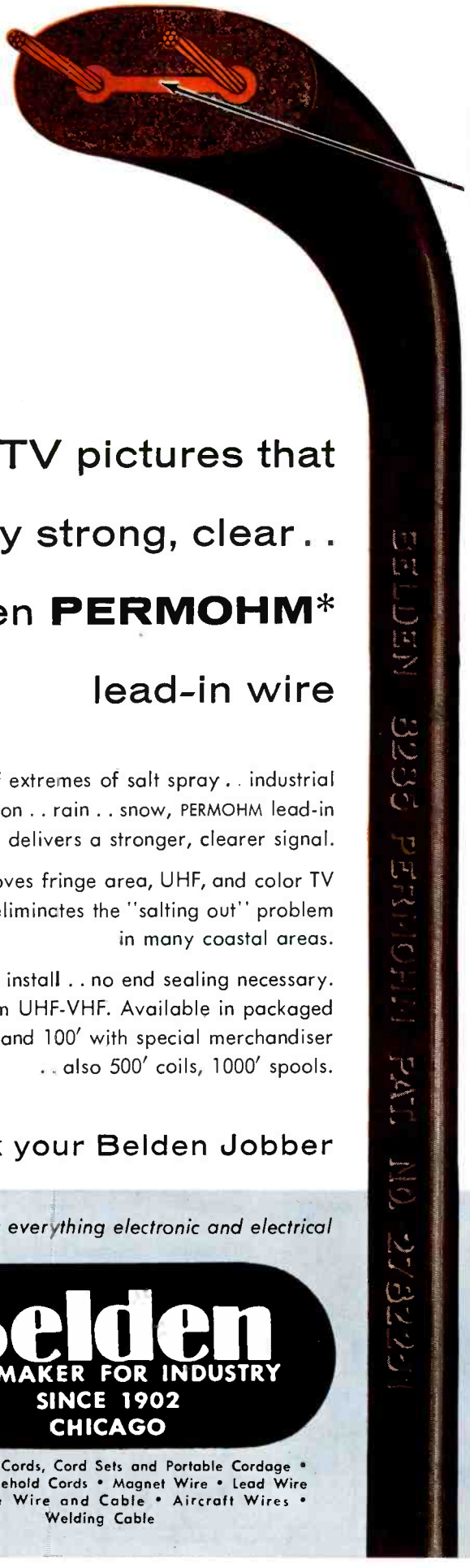
Such a sales campaign will allow you nearly two additional months of Christmas selling. Also, you won't have such a hectic last-minute rush of obtaining sets and preparing them for delivery. Daily ads — "Only 90 more viewing days till Christmas," "Only 89 more . . .," etc. — would be an eye-stopper or "ear-perker-upper."

$ & ¢

Callback Stopper. Heard of a fellow the other day who has NO callbacks. That's right — once he was out of the house, all the customers swore they'd never call him again.

He won't be around for long, to be sure, but he should make you think — how do you rate with your customers? Do you have quite a few *repeat* calls?

There's no avoiding the fact that customer satisfaction is very important in any field. Even though electronics servicing is basically a technical business, intangibles such as appearance, politeness, and sociability often account for more word-of-mouth advertising than you can ever earn by technical competence. How about making this the topic of your next meeting with your home-call men — or, if you're running a one-man operation, sit down



PERMOHM* means constant impedance . . because its conductors are protected by encapsulation in cellular polyethylene.

for TV pictures that stay strong, clear . .

NEW Belden PERMOHM* lead-in wire

In spite of extremes of salt spray . . industrial contamination . . rain . . snow, PERMOHM lead-in wire delivers a stronger, clearer signal.

PERMOHM improves fringe area, UHF, and color TV reception, and eliminctes the "salting out" problem in many coastal areas.

PERMOHM is easy to install . . no end sealing necessary. 300 Ohm UHF-VHF. Available in packaged lengths of 50′, 75′ and 100′ with special merchandiser . . also 500′ coils, 1000′ spools.

ask your Belden Jobber

one wire source for everything electronic and electrical

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

Power Supply Cords, Cord Sets and Portable Cordage • Electrical Household Cords • Magnet Wire • Lead Wire • Automotive Wire and Cable • Aircraft Wires • Welding Cable

*Belden Trademark and Belden Patent . . U. S. Patent No. 2782251

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and talk this problem over with yourself.

$ & ¢

Yankee Ingenuity. Americans in the electronics era are carrying on in the spirit of the old-timer who said, "I seen a need and I done it." As an example of someone's being "on the ball," one small company (a chrome plating outfit) has the wildest antenna-rotator setup you ever saw. Used in an industrial application, the rotator opens and closes a valve some 30′ to 40′ away from the operator's normal position. The 360° swing of the rotator gives complete control of the valve, a simple installation which has saved its cost many times over.

Hats off to the fellow who did this selling job. You don't have to see money everywhere you look, but in the world of business it helps.

$ & ¢

Poor Advertising. Recently, I've had the misfortune of encountering some very poor advertising by a couple of TV servicemen.

Maybe it's a personal quirk, but I read signs on trucks. That's where the poor advertising came from. Oh, the trucks were nice and clean, and they had $50 to $100 worth of very neat lettering on them. What was so bad, then? Simple: Driving courtesy; there wasn't any!

I'll admit every driver makes an occasional boo-boo; however, these fellows couldn't have done a more complete job of exasperating potential customers. Remember, your driving speaks for you just as plainly as the signs on your truck.

$ & ¢

Professional Mail. Many technicians would like to send out direct mail advertising, but don't know where to start. Fortunately, help is just around the corner . . . well, almost. Any letter shop (listed under "Letter Shops" or "Advertising — Direct Mail" in the *Yellow Pages*) will be glad to prepare a direct mail campaign for you from start to finish. This includes helping you write the copy (some will even write it for you), getting the artwork together, printing, addressing, stamping, and even taking the finished pieces down to the post office. Few servicemen are familiar with these letter shops — more should be!

universal acceptance!

miniaturized

ELMENCO

Dipped Mylar*–Paper Capacitors

The exclusive Elmenco dip-coated Mylar-Paper capacitors (Arco type dp) represent a double breakthrough in capacitor design. They combine missile and computer quality and compare favorably in price with commercial general purpose units. The "dp" series is designed for **universal use,** from TV by-pass to critical industrial applications requiring stringent electrical and environmental characteristics. New high levels of ruggedness, stability and reliability have been achieved in a miniaturized body.

54,745,000 SOLD IN LESS THAN 2 YEARS

NOW . . . OPERATING AT 125° C WITHOUT DERATING

Reliability Elmenco dp Mylar-Paper Capacitors have achieved a reliability that meet missile and computer requirements. They are thoroughly and continually tested during production to insure outstanding performance. For example a 0.1 mfd. dp capacitors operated at full rated voltage and at 105° C will have a life expectancy of more than 7,168,000 unit hours.

Moisture-Proof Elmenco dp Capacitors are specially processed and vacuum dipped to obtain solid impregnation and a rugged moisture-proof coat designed to withstand 4 times more humidity than the best molded capacitors used in the past.

Miniaturized These capacitors are up to 50% smaller than other types and can be used in printed circuit and transistor applications.

±10% Standard Tolerance

* DuPont Reg. Trademark

Write for catalog dp 110.

ARCO electronics inc.

64 White Street, New York 13, N. Y. • *Branches: Dallas 19, Los Angeles 35*

QUICKER SERVICING

by Calvin C. Young, Jr.

A TV DEHUMIDIFIER

The original complaint on a Zenith Model H2227R was that the raster was missing, although sound was good. Since the receiver was quite old (ten years to be exact), the customer was naturally concerned over the state of the picture tube. After removing the rear cover and checking for an arc from the picture tube anode lead, the serviceman discovered there was no high voltage.

After new tubes failed to restore operation, a quick conference with the customer was all it took to obtain permission to take the set in for shop analysis. Actually, the customer seemed disposed to give the "go-ahead" on any repairs which were financially within reason. A strong factor in this case was that the set was part of a built-in music and entertainment center in the basement recreation room.

On the bench, voltage measurements revealed a lack of screen-grid potential on the horizontal output tube. Continuity tests then showed that the 15K-ohm, 10-watt, wire-wound screen-dropping resistor had opened. Visually, the "sugar-coated" resistor didn't seem to have been subjected to any abnormal currents, so the serviceman surmised it had simply deteriorated over the years. A thorough check of the output tube and the screen bypass capacitor added evidence to support this theory.

The installation of a new screen-dropping resistor produced a satisfactory raster. Upon making operational checks, however, it was found that the raster couldn't be extinguished by any combination of brightness- and contrast-control adjustments. The symptoms again pointed to the possibility of a bad picture tube. Voltage checks at the picture-tube base revealed near-normal potentials. At one end of the brightness-control range, the cathode potential was reduced to zero—a condition that produced maximum brightness. (See Fig. 1 for circuit details.) However, the other extreme setting of this control produced a suspiciously low cathode potential of only +32 volts. Control-grid voltage was zero, proving that the retrace-blanking coupling capacitor wasn't shorted or leaky. Accelerating-grid potential checked out at 335 volts—well within tolerance. Referring to the service literature, the serviceman had his suspicions confirmed; the maximum voltage obtained on the picture-tube cathode was but half that indicated in the voltage chart. A check of voltage drop across components in the brightness-control circuit made him suspicious of R51. Ten times as much voltage was dropped across this part as across the brightness control, and this definitely wasn't normal in view of the three-to-one resistance ratio. A resistance check

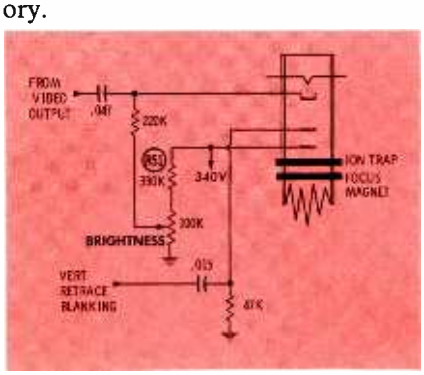

Fig. 1. Raster could not be blanked out because R51 had changed value.

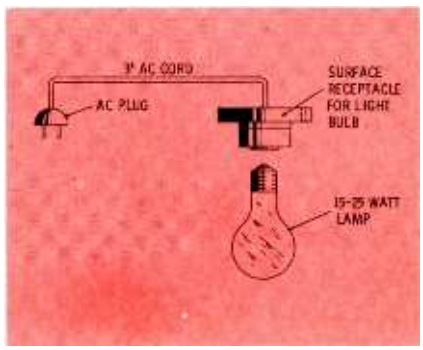

Fig. 2. Lamp was installed in basement TV cabinet to reduce humidity.

SYLVANIA-6AU4-GTA

WITH

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HELPS YOU

"WRAP-UP" PROFITS!

NEW life-giving, profit-building features are built into every SYLVANIA-6AU4-GTA TV-damper tube. Consider, for one feature, the SYLVANIA SARONG CATHODE and how it adds dependability to tube life. SARONG provides uniform spacing between cathode and plate—reduces possibility of plate-to-cathode arc-over. SARONG prevents the build-up of "whiskers" inside the cathode sleeve that can develop during other types of coating processes—reduces possibilities of cathode-to-heater arc-over.

Consider, too, the "pigtail" heater in SYLVANIA-6AU4-GTA. Welded securely to the stem-lead, it reduces heater "hot spots" and the possibilities of heater burnout. More . . . rectangular top and bottom micas with exceptionally wide slots increase the resistance of dc leakage paths, further reduce the possibilities of internal arc-over and breakdown.

There's extra profit assurance, too, with SYLVANIA-6AU4-GTA. Every one of them is tested for shorts, emission and the ability to withstand arc-over at 5000-volts peak inverse on the anode.

So, "wrap up" the profits you make by putting a "damper" on call-backs. When you ask your distributor for 6AU4-GTA's, always specify SYLVANIA.

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

SYLVANIA

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of R51 revealed that it had increased in value to approximately 900K ohms. Replacement of this unit restored normal brightness-control action, and the raster could then be extinguished.

Even though the receiver was now operating normally, two resistor defects (both probably caused by corrosion) were enough to indicate the need for further checking. Careful inspection revealed the tell-tale "green tarnish" signs of corrosion where the leads entered the bodies of several more small resistors and one or two bypass capacitors. These units were replaced as insurance against call-backs. Because the TV set was located in the basement and was not operated every day, it was possible that moisture would continue to cause corrosion and eventually cause other more serious failures.

Moisture Control Installed

Remembering that an extra AC outlet was available in the music center cabinet, the serviceman made up a small lamp fixture (see Fig. 2). This was mounted in the customer's equipment cabinet and connected for continuous operation. After a brief explanation to the customer, he was quite willing to pay the small cost for operating the bulb—particularly when the expense was compared to that for potential repairs to the TV set. The heat generated by the small bulb is adequate to dissipate any moisture, but isn't enough to cause increased component failure.

Repeated RF Amplifier Failure

Recently, I was called to service a Magnavox U74-01AA chassis which was literally "eating" 4BQ7A RF amplifiers. The tube failed on the average of once a month; yet, strange as it seems, replacing the tube produced a picture that was normal in every way. (The set operated satisfactorily on both local and distant stations, the picture definition was excellent, and snow and noise content were very low.)

This particular customer was a do-it-yourself fan and had installed four new RF tubes, at approximately monthly intervals, before calling for service. On receiving this report, I knew at once that simply plugging

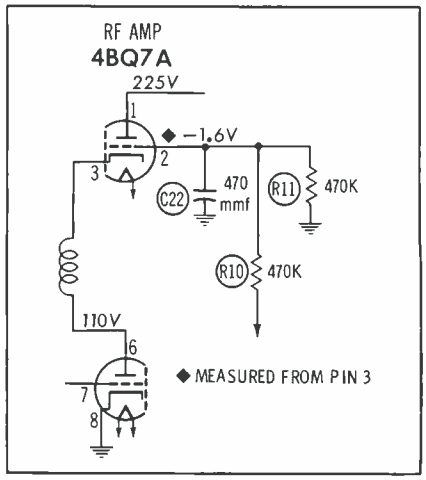

Fig. 3. Nothing checked wrong in RF amplifier circuit of Magnavox set.

in a new tube wouldn't provide a lasting repair. The customer, tired of changing tubes, readily agreed to let me take the set into the shop.

With the set on the bench, the first step was to remove the shield from the tuner and make visual and electrical checks of the biasing network associated with the second half of the cascode RF stage. Both resistors (R10 and R11 in Fig. 3) checked satisfactorily, as did the value of C22 and all voltages in the stage.

The next step was to pull out the service literature for a careful analysis of the entire tuner circuit, including the voltage-supply lines. The network connected to terminal 11 of the tuner connection strip (see Fig. 4 for details) provided the answer to the problem. This set employs a selenium-rectifier low-voltage power supply that produces B+ voltage as soon as the set is turned on. In addition, the 4BQ7A warms up before the 5AN8 AGC keying tube starts to produce a negative output. These factors, coupled with an open AGC clamp diode M3, permitted a positive voltage to be impressed on the AGC-controlled grid of the 4BQ7A for a brief interval each time the set

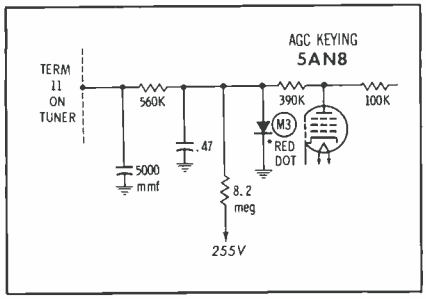

Fig. 4. Open AGC-clamp diode caused frequent failure of RF amplifiers.

QUALITY IS A SEVEN-LETTER WORD

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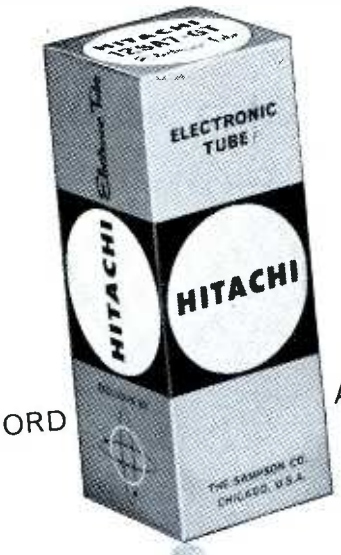

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was turned on. Since B+ was already applied to its plate circuit, excess current was passed by the RF stage during the period when positive voltage was applied to the grid. This short-term overload was sufficient, over the period of a month, to cause the elements in the tube to sag and short. Replacement of the open AGC clamp diode took care of the problem.

If the customer had been the type to play the set for long periods, rather than to turn it on and off several times each day, the failure period could have been lengthened to several months. Even so, the consistent and periodic failure of RF amplifiers at intervals even as long as 6 months would warrant more than just tube changing. Here's another pointer: Some sets employing selenium or silicon rectifiers have utilized a diode section of a tube for clamping the AGC line. Since this diode may not warm up rapidly enough to provide the required protection for the RF amplifier, installation of a silicon, selenium, or germanium diode is a logical step whenever you encounter periodic RF tube failure that cannot be otherwise explained.

Alignment Tip

Do a lot of radio alignment? Here's a tip that will save some time on each job and reduce the "knob-twirling" required.

Currently-produced AM receivers have an upper band limit of 1620 kc and a lower limit of 540 kc. By some strange quirk of fate, 1620 just happens to be the third harmonic of 540. By setting your signal generator to 540 kc and radiating a signal into the receiver's loop antenna, you can set the dial at its top end and adjust the oscillator trimmer to the third harmonic. Move on down the dial to the second harmonic (1080 kc) and align the antenna trimmer; then go on down to the lower end for the padder or oscillator-coil adjustments. There! You've aligned the oscillator and antenna circuits (also the RF, if so equipped), and checked oscillator tracking—all with one generator setting. Of course, you should touch up all adjustments once again to insure maximum performance. ▲

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NOTES ON TEST EQUIPMENT

by Les Deane

Beta and Battery Barometer

Fig. 1. B & K's new two-in-one test instrument for transistor radios.

By this time of the year, most portable radios have been through a concentrated period of hard use, but they're not yet ready to return to their closets, drawers, and other winter hiding places. Thus, the time is ripe for some sort of repair or adjustment to many portables. Since most of these little jewels are now transistorized, the service technician is confronted with a pressing need to "retool" and modernize his servicing techniques in order to cope with today's transistor circuits.

Perhaps this is the stimulus that prompted the introduction of a new piece of equipment by B & K Mfg. Co. of Chicago. Pictured in Fig. 1, their Model 160 Dynamic Transistor Tester and Power Supply is primarily designed to test the two principal components of portable radios—transistors and batteries.

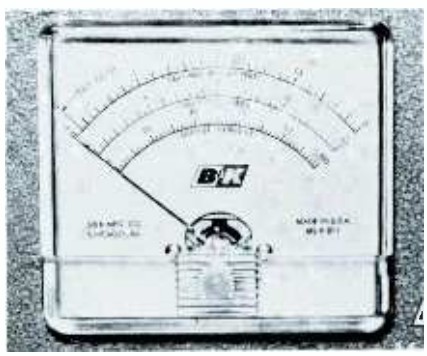

Fig. 2. Built-in meter of the Model 160 reads leakage, beta, ma, and volts.

Specifications are:

1. *Power Requirements — 117 volts, 50/60 cps; power consumption variable with load; transformer provides line isolation.*
2. *Transistor Tests — checks* PNP *and* NPN *power and low-signal types for shorted, open, or leaky conditions; measures current gain (beta) dynamically, with inherent accuracy of 3%; tetrode transistors tested directly; transistor data charts supplied.*
3. *Battery Substitute — DC output adjustable from 0 to 20 volts, maximum current 100 ma; 3 1/4" panel meter provides monitoring of output current and voltage.*
4. *Other Features — transistor test socket and leads; voltage output jacks and detachable leads; transistor type selector, voltage control, function switch, and calibrated* BETA *dial provided on panel.*
5. *Size and Weight — 6 3/4" x 9" x 2 5/8", 4 1/2 lbs.*

The Model 160 is portable in size and light in weight. Rubber feet on two surfaces of its case permit it to be operated either in an upright position or on its back. The four transistor test leads, which pull out from the panel about 4" or 5", are terminated with *Minigator* clips fitted with color-coded insulated sleeves for identification purposes.

The meter (Fig. 2) features three individual scales plus a calibration mark labeled SET BETA for determining the current gain of a transistor. The lower scale, which is calibrated from 0 to 100 milliamperes, is used for monitoring direct current drawn from the power supply. The middle arc indicates the supply-voltage output from 0 to 20 VDC. The top scale, with small divisions of .05 from 0 to 2 milliamperes, plays an important part in the transistor leakage test. Now that we have an idea of what each scale of the meter is for and can depict the various operating controls from Fig. 1, let's see how the instrument is used to check a transistor.

At this point, I might mention that the B & K manual includes a special section listing over 1300 transistors. These charts give type (PNP or NPN), nominal beta figures, Ico in microamperes, and maximum acceptable leakage values.

The first step in actually testing a transistor is to look up the transistor type in the manual. With the function switch in the off position, the PNP-NPN switch is set to its correct point and the transistor is plugged into the test socket or connected to the proper clip leads. When the function switch is turned to the LEAKAGE position, power transistors (those units with more than 150 milliwatts collector dissipation) will produce a direct Ico reading in milliamperes; however, the indication for small-signal transistors will be equal to the product of Ico and transistor beta. This value is given in the leakage column of the charts. To obtain an exact Ico value for low-power transistors, the leakage reading is divided by the beta figure (determined in the next phase of the test).

The function switch is now moved to the BETA position and the large BETA dial adjusted until the meter needle comes to rest at the SET BETA mark on the top scale of the meter. The BETA dial, which is calibrated from 0 to 325, is then rotated slowly from its high end; at a certain point, a sharp upward meter deflection will be noted. The minimum reading on the dial may then be compared to that given in the beta column of the transistor charts. An oscillator circuit is employed in this test; if a meter deflection cannot be obtained for any setting of the BETA dial, it indicates that the transistor will not function in the oscillator circuit and is therefore defective.

The voltage supply section of the Model 160 may be used to power just about any transistor portable. Although its maximum DC output is rated at 20 volts, I found that I could obtain as high as 25 volts with a current drain of 10 ma. I also noted that the output was sufficient up to 20 ma to power a receiver which normally employs a 22 1/2-volt battery.

Since the percentage of ripple content in a transistor supply is important, I performed several experiments in the lab to check this characteristic of the unit

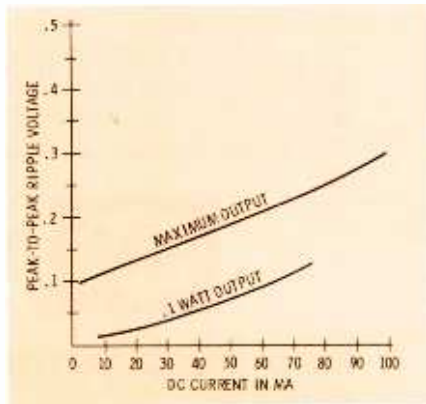

Fig. 3. Graph showing ripple measurements taken with various DC loads.

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I was examining. In the graph of Fig. 3, I have shown the peak-to-peak AC ripple voltage as a function of current—both at maximum voltage output and at 1/10 of a watt dissipation. At maximum current and voltage, the percentage of AC ripple in comparison to DC output was .05%; however, transistor radios seldom exceed a power rating of .1 watt, and under these typical conditions I found that the ripple dropped down to approximately .004%. This low ripple content means that the supply is well filtered and will not cause AC-hum interference when powering transistor radios.

Sensitive RMS Meter

Simpson Electric Co., Chicago, has recently developed a new AC VTVM which will measure AC sine-wave voltages from .2 mv through 300 volts rms. It also affords a db scale, high input impedance, and a wide frequency response. Designed for hi-fi and general low-level audio work, the Model 715 is pictured in Fig. 4.

Fig. 4. New Simpson VTVM is geared for measuring small AC voltages.

Specifications are:

1. *Power Requirements — 110/125 volts, 50/60 cps; power consumption approximately 10 watts; power transformer provides AC line isolation;* ON *indicator on panel.*
2. *AC Voltmeter — 10 rms ranges of from zero to .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts; maximum sensitivity 10 mv full scale; minimum input impedance 1 megohm at 1 kc; accuracy ± 5% of full-scale deflection; 3½′ shielded cable supplied.*
3. *DB Meter—10 ranges from –52 db to +52 db; direct-reading scale of from –12 to +2 provided; zero db equals 1 mw of AC power across 600 ohms; range switch calibrated in db correction figures.*
4. *Frequency Response—sine-wave input 10 cps to 400 kc, ± 1 db up to and including 100 volts rms; 10 cps to 40 kc, ±2 db on 300-volt range.*
5. *Panel Meter — 200-ua DC movement; 4½" face with 3 individual scale arcs.*
6. *Size and weight — 7½" x 5½" x 3", 3¾ lbs.*

In examining the Model 715 instrument at first hand, the most unusual thing I noticed about its physical makeup was the fact that it had only one operating knob on the front panel. This knob automatically turns the AC-operated instrument on and selects the appropriate voltage or db range for meter readings. The unit also features a sturdy carrying handle and a large, easy-to-read meter face.

There are only two panel connections. One (color-coded red) is for the hot test lead, while the other (color-coded black) is chassis ground. Each is a combination banana-type jack and universal binding post. As with many meters, the chassis ground terminal is connected to the instrument's case; therefore, the operator must be careful not to make physical contact with the case when measuring isolated AC voltages. In using the Model 715, you are reminded of this fact by a caution note on the front panel.

Slipping the unit out of its case by removing only two screws from the back, I found that it incorporates a conventionally-wired chassis employing three vacuum tubes. (See Fig. 5.) Referring to the schematic, I noted that the AC voltage to be measured is coupled to a voltage-divider network—either directly

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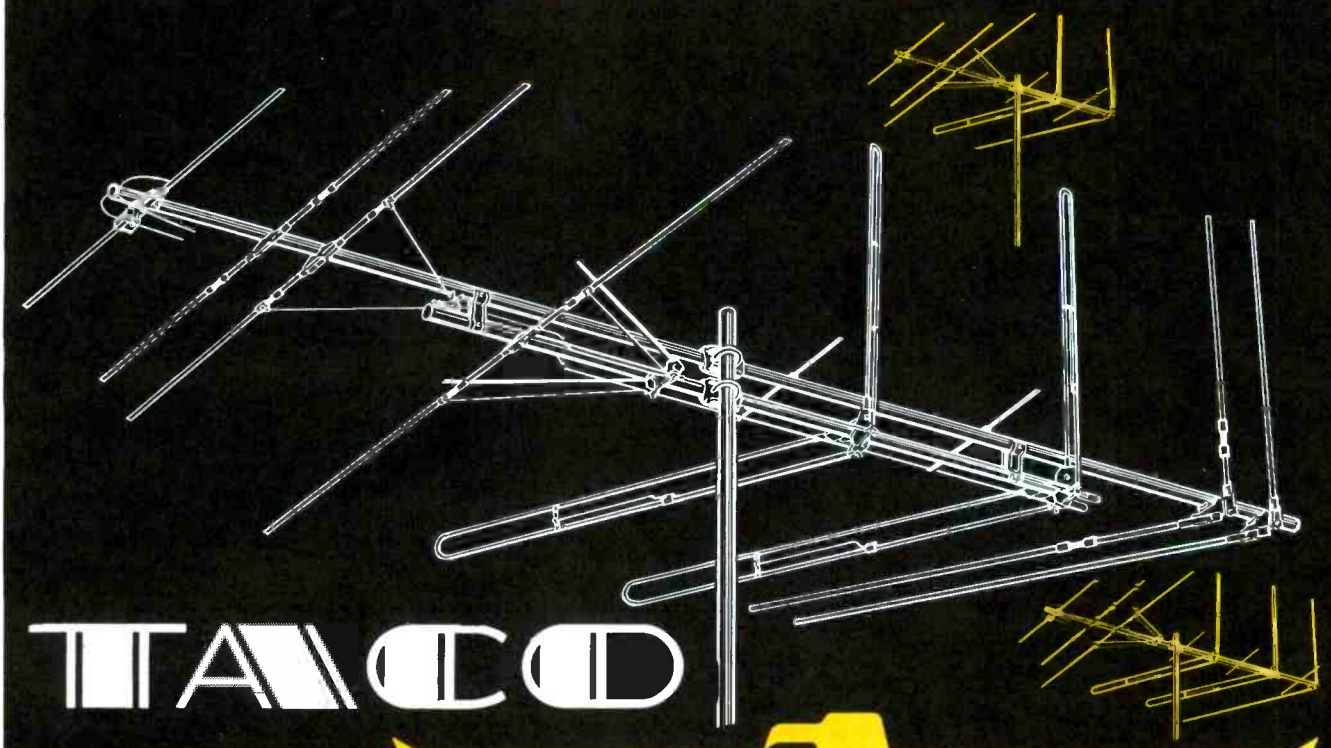

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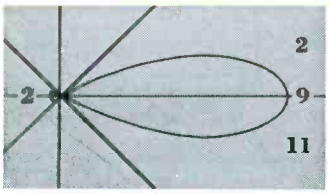

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or through cathode follower V1 depending upon the voltage range selected. This arrangement offers a very high impedance to any circuit under test.

A portion of the input signal is then fed to a cascode amplifier system and on to a full-wave bridge rectifier that supplies DC for the meter movement. The voltage dividers pointed out in Fig. 5 are 1% precision resistors, while the bridge diodes are 1N295 germanium units. The only calibration adjustment provided on the instrument is the small potentiometer located between the diode pairs.

An AC or audio VTVM like the Model 715 finds many applications in trouble-shooting audio equipment. Here's how I used the instrument to check for the presence of hum in an audio system. With a speaker connected to an operating audio amplifier, I applied a test signal from an audio generator to the amplifier's input jack. Setting the volume control to maximum, I adjusted the output of the generator to produce a high average listening level from the speaker.

I next connected a resistive load in place of the speaker so that the audio tone from the generator would not disturb my thinking. Leaving the generator's output set at this level, I placed the test leads of the Model 715 across the dummy load. I obtained a reading of .6 volts, which is equivalent to approximately –2 db. In this case, I was able to read the db scale directly, since the position of the range selector called for no correction figure. After recording this reading, I removed the generator lead from the input jack and used a shorting plug to effectively ground the input.

I then reduced the setting of the range selector until I obtained another reading. It was necessary to use the most sensitive range of the instrument in order to achieve a reading high enough to fall on the somewhat shorter db scale. This meter deflection represents the internal hum or noise level of the amplifier under test. In this particular example, I obtained a reading of .003 volts, which was equivalent to approximately –48 db. Referring to my original reading, this gave me a difference of about –42 db between a normal signal and the inherent hum of the amplifier.

Hum and noise levels in a high-quality

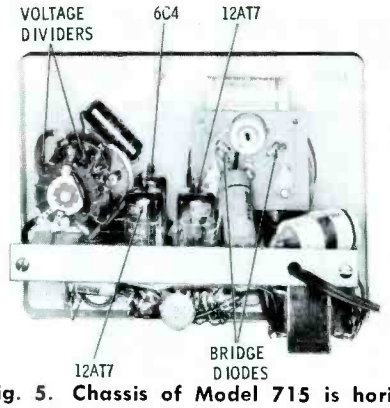

Fig. 5. Chassis of Model 715 is horizontally mounted behind front panel.

system should be from 50 to 60 db below a fairly high signal level. Since this amplifier displayed a little more hum than average, I employed the Simpson meter to monitor the amplifier's output while adjusting the hum level control provided on the chassis. I turned this control until the meter needle dipped to a minimum point. After this simple operation, I found that the amplifier's hum level had dropped below the 60 db mark I was shooting for.

When excessive hum or noise is encountered in an amplifier, you can often isolate the cause by merely monitoring the hum level as you ground various points in the system. As illustrated in Fig. 6, hum distortion or other interfering noise can be grounded out at points A, B, and C. When the voltage indication drops considerably, you have then isolated the stage in which the distortion is occurring. Following this same procedure you can also isolate troubles such as B+ ripple and turntable rumble. ▲

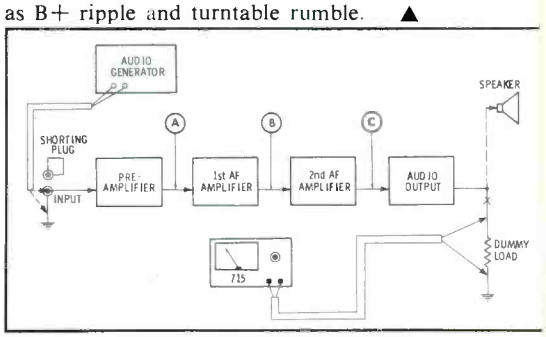

Fig. 6. A simple method for checking amplifier hum employing an AC VTVM.

TV SERVICE PRICING GUIDE

Got a pencil handy? Use it to figure out how much you must charge to make a fair profit . . . by Joe A. Groves

Table I — Overhead Expense Chart

Heat	
Light	
Rent	
Phone	
Gas & Oil	
Truck Expense	
Advertising	
Breakage	
Inventory Shrinkage	
Callbacks	
Warranty Parts Handling	
Shipping Charges	
Office Supplies	
Lost-Time Wages (Illness)	
Vacation Pay	
Social Security	
Retirement Plan	
Hospitalization Plan	
Insurance (All Types)	
Legal Expense	
Accounting Expense	
Interest on Loans	
Bad Debts	
Truck Depreciation	
Equipment Depreciatian	
Property, Fixtures & Furniture Depreciation	
Hand Tool Replacement	
Repair (Property & Equipment)	
Decorating	
State Taxes & License	
Federal Taxes	
Total Overhead	

"What should my service charge be?" "Is it advisable to use some of the available pricing charts when it comes to figuring service charges?" "The other fellows are charging $5 per call. I tried it, but I'm not making any money." "The two big department stores downtown are getting $6.95 for a call; is this a good guide for me?" "The full-time serviceman I employ is making more money than I am — something's wrong!"

Do these comments sound familiar? They should — because they come from others just like yourself.

Don't think for one moment that the electronics servicing industry is the only one ever confronted with such problems. *Every* businessman must figure out how to charge fair and competitive prices and still make a reasonable profit. Failing to do this, he ends up working for someone else — sadder but wiser.

No one should start a business and expect to succeed without at least a basic knowledge of business principles and practices. Just because you can fix an automobile, resole a pair of shoes, or repair a TV set doesn't automatically qualify you to run your own shop. Being successful in business is as simple as taking in more money than you pay out. If a business is in financial trouble, the management either has forgotten this rule or has let the scales become dangerously unbalanced. Perhaps the outgo has raced ahead of the income — or, for reasons the management has yet to discover, there is little or no income to balance a normal outgo!

But we're heading into areas we can discuss some other time. At the moment, let's assume there is some demand for your services, that you're capable of fixing a reasonable number of sets in a reasonable number of hours (or employ others who can), and that you want to know what prices to charge.

First Step

The first thing to do is assemble your records and find out what it costs to open your door every morning — or, for that matter, what it costs to have it closed in the event of illness or some other unexpected cause. This is known as the break-even point in bookkeeping circles, and you must take in at least enough to reach it.

This "cost of doing business" figure is obtained by adding overhead expenses, wages of employees, and a wage for yourself. Yes, you've got to figure this last item, too, but be realistic about it. Just because you're the boss is no reason to pay yourself far in excess of what you need to live comfortably.

So far, so good; now comes overhead. Beastly thing to figure, isn't it? But take some time to fill in your own

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The 6GH8's cool-running cathode also is made of a low-sublimation alloy that cuts grid emission. Tube performance *stays* dependable. Keep both barrels of your gun loaded with superior G-E 6U8-A's and 6GH8's! You're bound to hit more targets. See your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

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estimated expenses for the items listed in the Overhead Chart (Table I). If you're lucky enough not to have some of the overhead items listed — good deal. If you haven't got the information to fill in, but know the expense is there, figure it out the best way you can. You'll need to insert at least an approximation of every item if you want to end up with the right answer. Notice the blank lines at the bottom of the list (just above the spot for total); these are for your own little pet expenses others may not have. If your figures for any of the items are lumped as an annual expense, just divide by 52. You'll come up with a weekly figure which is far easier to work with.

Now, add them up.

My wage ....._____

Employees' wages ....._____

Overhead ....._____

Total Weekly Expense _____

Did you know it cost you that much to do business every week? If so, that's good; if you didn't, let's hope you found out in time. Divide this total by the number of days you're open each week, and you'll learn what it takes just to open your doors every morning. You aren't through yet, though. Divide the weekly total by the weekly hours you're open for business to come up with the cost per hour. List it here so you'll be able to find it as we progress.

Hourly expense _____.

Step Two

Now that you've determined your hourly cost of doing business, let's find out how much of this cost is offset by profit from the sale of parts, antennas, and other accessories. If you sell TV's or other major items, don't count them in on this — just figure those items actually connected with your servicing activities.

If you don't have parts and labor separated in your daily or monthly records, you'll hit a snag here. To break the deadlock for the time being, assume that profit on sales is equal to 30% of the total cost of doing business. Start right now to split your income into "parts" and "labor" categories in your records, and after a month or two you can check the assumed value against some actual figures — which you should use from then on.

Once you know your profit on parts and accessory sales, you can break it down into an average weekly figure and subtract it from your total average weekly expense arrived at in step 1. The balance is the amount you must take in from labor charges every week to meet your necessary expenses.

Total weekly expense _____

Weekly profit on parts _____

"Must" labor total....._____

"What Profit?"

So far you've found what your weekly income from labor must be to break even. Nothing has yet been figured in for your profit on the money invested in the business — only your time. Also, the figures are based on a hypothetical average week, and you know there are going to be slack weeks that you won't be able to come close to the average figure. There must be a "slush fund" for these slow weeks, which comes under the general heading of profit. Your profit on the business (not wages) should be expected to fluctuate up and down as business picks

up and slacks off. Profits are also to be used for expansion, new equipment (not replacements), bonuses, and the like; therefore, profit must also be figured into your basic service charges.

There are several ways to go about determining a workable percentage to use in figuring your anticipated profit. One of the simplest is to consider the return your money would bring if invested in bank savings or bonds — investments with guaranteed returns ranging from 3 to 5%. Surely, if you can get returns such as these without any risk, the risk you take in business should be worth much more. Go ahead and admit you like the idea of making money — choose from 10% to 30%, depending on volume.

Find out how much money you have invested. If necessary, take an inventory—basing its worth on what you paid for it before any additional discounts were allowed. Add to this your investment in shop equipment, furnishings, signs, trucks, etc. Now take your chosen profit percentage of the total and divide it by 52 (or vice versa if it's easier) to find the dollar profit for each week. Add this to the "Must" Labor Total of step 2, and you come up with the total weekly income needed from your labor or service charges.

"Must" Labor Total....._____
Profit ....._____
Weekly Service
Charges ....._____

Final Step — Almost

Having arrived at the total income per week to be derived from service charges, it's time to break it down to a "per call" value. Here we come to another variable: How many jobs can you count on getting and completing in an average week? 20? 50? More? If your records will supply you with this information, use them as your guide. Now divide the total weekly service charges by the average number of service jobs, and you'll wind up with an average service charge per set: _____. Don't forget that this is an average for all types of jobs—"tough dog" shop jobs as well as quick home calls. It's up to you to determine how much less to charge for the easier jobs, and how much more for the harder ones.

Final Step

OK — now you know what your service charge must be in order to pay your way in the TV business, and make you some profit besides. However, is it a workable figure? Is it above or below the prices of your competition? If it's above "the going price of TV service" in your area, can you justify this higher charge? Here are some thoughts for you to consider if you think your charge sounds too high.

Are your overhead expenses and wages too high for your volume of business? Does any part of your overhead seem excessively high? Do you need to revise your operating policy in order to improve efficiency and reduce overhead? Unless there is a very positive indication of too much expense, your computed service charge is probably correct.

One thing more to be considered is competition. If your computed charges are considerably higher than those of your competitors, why are they? Are they more efficient than you? Are their overhead costs lower? Are their services as good? The answers to these questions will help you meet and beat competition.

Table II
Typical TV Flat-Rate Labor Chart

Home Call	
Black & White	$6.25
Color	8.25
Pick-Up & Delivery	3.50
Callbacks (Other Trouble)	6.25
Bench Fee	
Black & White	10.00
Color	15.00
Estimates	8.50
AC Input	.80
Antenna (Built-in)	1.00
Alignment	
Horizontal	1.50
Sound	6.00
Tuner (Osc.)	1.50
Video	10.00
Capacitor	
Bypass	1.00
Filter	3.50
Coils	2.75
Controls	
Single	2.00
Multiple	3.50
Cord (Drive)	3.00
Modifications (Hourly Rate)	6.25
Open Circuit (Printed Board)	7.00
Picture Tube	9.00
Rectifiers	6.75
Resistor	1.00
Shorted Wiring	5.50
Transformer	
Audio	3.00
Horizontal	8.50
Power	8.50
Vertical	4.50
Tuner Cleaning	5.00
Tuner (Repair or Replace)	
Turret	12.50
Wafer	15.75
Yoke	3.75

Publication of these figures does not constitute recommendation or endorsement by this magazine.

What Is Competitive?

Competitive prices vary in different parts of the United States. The cost of living is higher in the West and Northwest than anyplace else. Take the example of Jake, Jack, and John Doe — servicemen in New Orleans, Chicago, and Los Angeles. Jake makes $5 service calls, Jack gets $6.50, and John charges $7.95. These are only hypothetical people and prices, of course. However, it illustrates the point. The important thing is that each of these fellows

followed a procedure similar to the one given here when determining their charges.

How To Charge

There's a big difference in knowing what to charge (as you have just computed) and knowing *how* to charge. There is a growing trend toward a flat-rate pricing system wherein the labor is itemized according to the specific work done. The other common pricing technique is based purely on an hourly basis, and charges are made in accordance with hours and parts of hours spent on the job. The latter has met with opposition from consumers in some areas, since labor charges normally exceed parts charges; this lump fee looks larger than a series of itemized flat-rate labor charges, and consequently has an adverse psychological effect upon the customer.

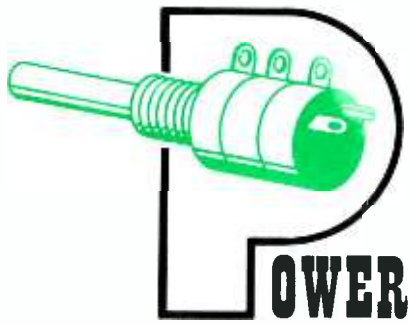
Flat-rate pricing therefore has an advantage over the "straight time" lump fee (even though the total labor charge is the same), for it pinpoints all of the charges to show exactly what work was done. In addition, flat-rate pricing provides a good basis for estimates on TV service. The flat-rate technique has already been accepted by the public in the automotive and medical fields. For example, you can find out how much the "labor" will be to have Susie's tonsils removed or the wheels balanced on your car.

While flat-rate pricing has the advantage we've just listed, it also has a disadvantage — no provision for extra charges on "dogs." These are supposedly offset by the number of easy jobs encountered. If you operate in an area where the big percentage of your service jobs fall into the "dog" class, you'll have to increase "conventional" flat rates in order to achieve the service charges you've found to be correct for your own operation.

The typical flat-rate pricing guide in Table II is based on national average charges. As with most charts of this type, the itemized charges can be added together as required to arrive at the total charge for each job. This guide is published only for your convenience and does not imply any recommendations or endorsements. That's up to *you*! ▲

SERVICING INDUSTRIAL ELECTRONICS

by Allen Lytel



POWER CONTROL DEVICES

Many industrial operations, such as welding, induction heating, and motor speed regulation, demand precise control of input power. A mere on-off switch in the AC power line is not sufficient; the *rate* at which power is delivered to the unit must be variable.

One common way of achieving this exact control is to allow current to flow in the load circuit during only a portion of each cycle of AC input current. The average power supplied to the load is then proportional to the length of time the load circuit receives current on each cycle.

Turning the load current on and off at a 60- or 120-cps rate requires the use of a switch with split-second accuracy and great power-handling ability. One widely-employed device which meets these requirements is the *thyratron,* a gas-filled electron tube (Fig. 1). Unlike a vacuum tube, it has only two states of operation — either completely cut off or fully conducting. With a positive voltage on the plate and a variable bias voltage on the grid, the thyratron will remain in cutoff as long as the grid voltage is more negative than a certain critical value. However, when the grid voltage rises above this value, the tube "fires" — in other words, the gas ionizes and sustains a heavy plate current. After this point, the grid no longer has control, and the plate voltage must be removed or made negative in order to halt the flow of current through the plate circuit.

Fig. 1 is a highly simplified diagram of a control circuit utilizing a thyratron. The plate is connected to an AC source so that the plate voltage will be driven down to a negative value 60 times each second, thereby giving the grid a periodic chance to regain control. The grid

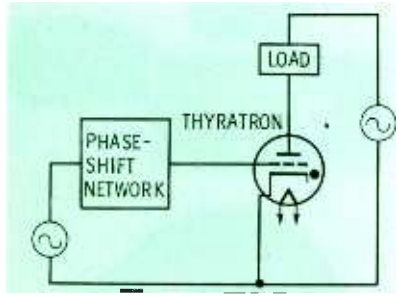


Fig. 1. Simple thyratron circuit has AC applied to both plate and grid.

also receives an AC input; however, the *phase* of the grid voltage can be varied with respect to that of the plate voltage. This means the grid circuit can be adjusted so that the grid will reach the firing point at any desired time during the positive half cycle of plate voltage.

Suppose the grid voltage lags the plate voltage, so that the former is steeply rising while the latter has just passed its positive peak. When the grid reaches the firing point (Fig. 2A), a pulse of plate current instantly occurs. As shown in Fig. 2B, this pulse lasts for the remainder of the positive half cycle of plate voltage. An advance in the phase of the grid signal would cause

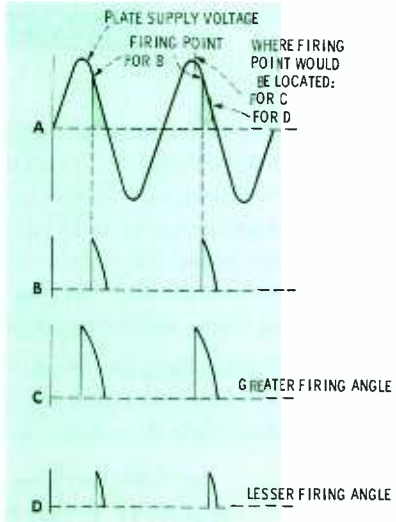


Fig. 2. Tube can "fire" anytime in positive half cycle of plate voltage.

the plate pulse to begin earlier in the cycle, and thus to have a longer over-all duration (Fig. 2C); or we might say that the "firing angle" (actually the time ratio between the conduction period and the complete cycle) would be increased. Fig. 2D shows the opposite case, where the grid voltage lags farther behind the plate voltage and causes a decrease in the firing angle. It should be readily apparent that more power would be delivered to the plate load in the case of Fig. 2C than in the case of Fig. 2D.

Silicon Controlled Rectifiers

A "solid-state thyratron," the *controlled rectifier,* is one of the latest additions to the rapidly growing list of semiconductor devices. Neither a transistor nor a rectifier, but combining features of both, the controlled rectifier opens up many new fields of application for semiconductors. Circuits now utilizing transistors or rectifier diodes may be greatly improved by adding controlled rectifiers, and many new applications may also be found for semiconductor circuits. An outstanding feature of the new device is its ability to change AC to DC and simultaneously to control the power fed into a load. Its efficiency is excellent, too; when switching load current on and off at full rating, the controlled rectifier dissipates only about 0.5% of the controlled power.

As illustrated in Fig. 3, the controlled rectifier is a PNPN semiconductor consisting of three rectifying junctions. The circuit is arranged so that the end piece of type N material acts as a "cathode," while the P material at the opposite end serves as an "anode." With a positive voltage on the latter element, the two outer PN junctions are forward-biased, but

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current through the unit is held to an extremely low value by reverse bias on the center junction. However, the *gate* lead — which is comparable to the grid of a thyratron — provides an injection point where a signal can be fed in to cause *breakdown* of the center junction. (This term doesn't mean "burnout" in semiconductor lingo — just a condition in which heavy current is allowed to flow in the reverse direction from normal.) This breakdown effect occurs at speeds approaching a microsecond. Afterwards, the voltage drop across the controlled rectifier is so low that the current through it is essentially determined by the load it is feeding.

One type of controlled rectifier can perform switching in a 1500-watt load circuit by the application of only 0.02 watt on the control gate. Peak current is as high as 150 amperes. For industrial control applications, this unit can replace thyratrons, circuit breakers, relays, power transistors, ignitrons, and other devices.

The gate signal is generally applied from a comparatively high-impedance source which may be either AC or DC. To "fire" the unit, the gate voltage should be positive with respect to the cathode terminal. Gate input impedance ranges from 10 to 100 ohms at the firing point. As the gate current is increased, a critical point will be reached, past which the device will break down at any positive anode voltage greater than a few volts. (Prior to this point, the rectifier can be caused to conduct only by applying the *Zener* or *avalanche breakdown* voltage to the anode — and this is likely to be on the order of 200 volts.) The gate loses control after breakdown, and

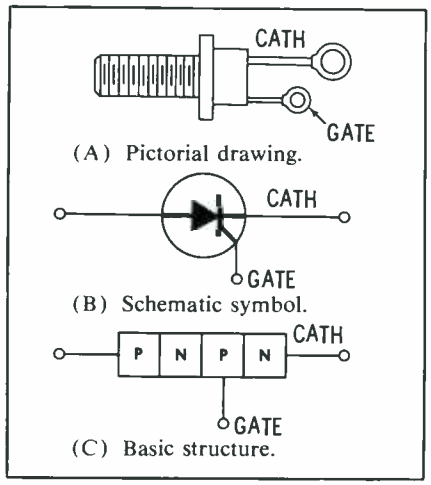

Fig. 3. Silicon controlled rectifier.

cutoff can be restored only by reducing the anode voltage to zero. This action is like the loss of grid control in a thyratron. However, the gate of a controlled rectifier has a much lower impedance than the grid of a thyratron, and it relies on current rather than voltage for control.

The controlled rectifier has a wide range of potential applications in industry. Firing may be accomplished in as many ways as have been devised for firing thyratrons — and that's quite a few! Fig. 4 demonstrates one use for this device in controlling DC power supplied to a load R1. Momentarily closing S1

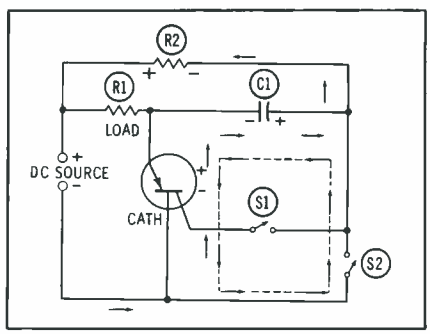

Fig. 4. Proportioning DC power to load by means of a controlled rectifier.

completes a circuit to the DC source through R2, thus raising gate current to the critical point and firing the controlled rectifier. Current is then fed to the load; in addition, C1 charges through the rectifier and R2. Closing S2 causes C1 to discharge and apply a reverse voltage across the rectifier, thereby cutting off the load current.

Magnetic Devices

Coils with iron cores, called saturable reactors and magnetic amplifiers, can also be used for power control. They may directly regulate the delivery of small amounts of power to a load, or they can be used as an intermediate stage to control other devices (such as thyratrons) which can carry larger currents.

Saturable Reactor

A coil in series with the load and an AC power source (Fig. 5) is a saturable reactor if the peak current supplied by the source is sufficient to saturate the coil's iron core. In an unsaturated condition, most of the IR drop in the circuit is across the coil L, with very little voltage appearing across the load. However, when the current increases to the core-saturation level (point 1 in Fig. 5B), no further increase in the magnetic field is possible—and a greater voltage drop then appears across RL. This condition is maintained for the remainder of the positive half cycle of source voltage. Then, due to the reversal of current through the coil, the core becomes unsaturated once again. The voltage drop across

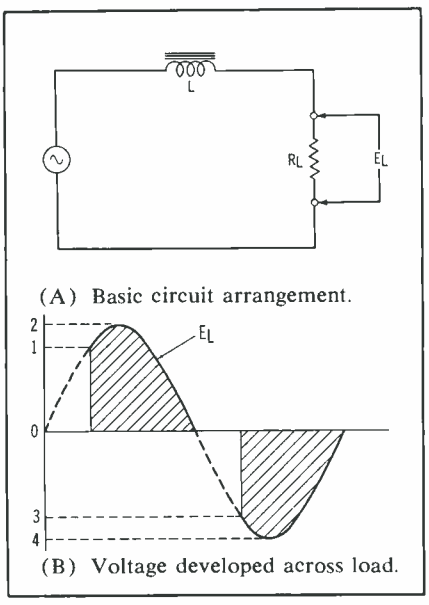

Fig. 5. Saturable reactor.

the load remains very low until saturation occurs once more at point 3. For the shaded portions of each half cycle, power is delivered to the load.

A "square - loop" characteristic for the core material is desirable in coils intended for saturable-reactor applications. This is to say that saturation of the core occurs abruptly rather than gradually as the magnetizing force applied to the core is increased in either direction. An abrupt effect is essential for precise, fast-acting control. The term "square loop" refers to the *hysteresis loop* (graph of magnetizing force versus resultant magnetization) for materials being considered for use in cores. The loop of an unsuitable material has a rounded shape (Fig. 6A), while that of a desirable material has a squared-off appearance (Fig. 6B).

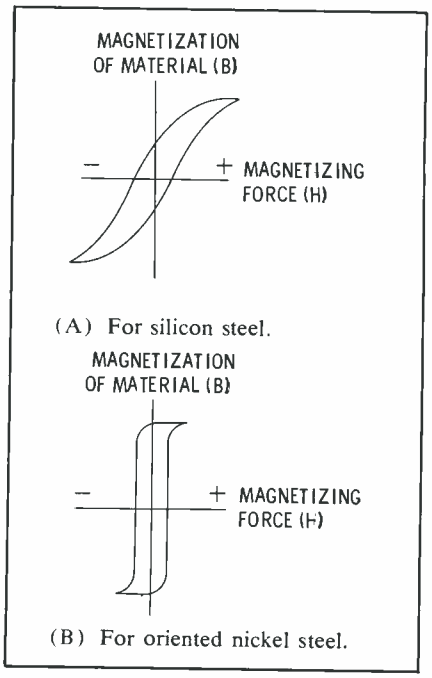

Fig. 6. Typical hysteresis loops.

Magnetic Amplifiers

A more complex device based on the saturable reactor is the *magnetic amplifier* (Fig. 7). Note the rectifier diode in series with the main winding, and the extra *control winding* which supplies additional current for magnetizing the core.

At the beginning of the positive half cycle of supply voltage in the circuit of Fig. 7A, the same situation exists as we saw in Fig. 5B. Nearly all of the supply voltage is dropped across the high reactance of the magnetic amplifier, up to the point when its core becomes saturated. From this time through the rest of the positive half cycle, the effective reactance of the magnetic amplifier is very low, and nearly all of the supply voltage appears across the load. When the applied voltage starts into its negative half cycle, the diode in Fig. 7A becomes reverse-biased and shuts off practically all current through the magnetic amplifier *and* the load.

The direct current in the control winding influences the operation of the magnetic amplifier by providing a means to vary the magnetization of the iron core. If there is no current in this extra winding, there is a large impedance in the signal winding and a small output across the load. If an appreciable amount of current is fed through the control winding, the magnetic field contributing to core saturation is created partly by the control current and partly by the pulsating DC in the main winding. This results in a lower impedance in the signal winding — hence a greater average output voltage across the load.

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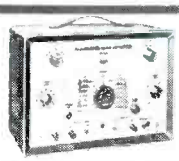

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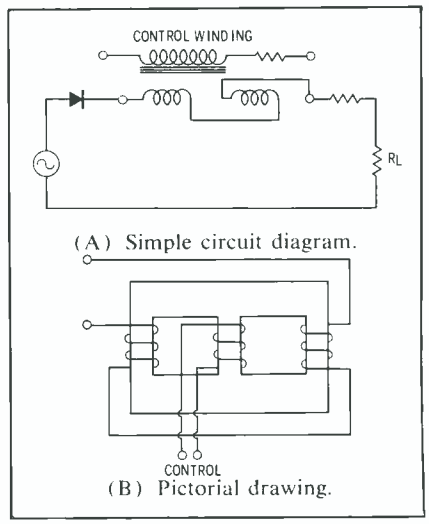
magnitude and direction passing through the control winding, it is possible to select a "bias point" on the hysteresis loop, just as an operating point on a tube's characteristic curve can be selected by use of a proper bias voltage. In other words, adjustment of the control current makes it possible to determine the amount of current which can be passed through the coil's main windings before saturation will occur. The amount of average power delivered to the load resistance can thus be controlled. An effective gain is achieved, since a small amount of bias current will result in a large change in load current.

In Fig. 7, note that the main winding is split-wound. The magnetic fields due to the pulsating currents in the two sections will cancel each other in the center leg of the core, thus preventing the load current from inducing an unwanted current in the control winding.

Although the discussion up to this point has considered only half-wave rectification, the same principles hold true for the more complex arrangements shown in Fig. 8. Part A of the figure is a full-wave rectifier, B is a bridge rectifier, and C shows the use of a feedback winding to increase the gain.

Magnetic amplifiers of many different types are commercially available. These units provide output pulses having a fast rise time on the leading edge, somewhat as shown in Figs. 2 and 5B. This steep wavefront is ideal as an input to a thyratron or controlled rectifier, which in turn can control the flow of large amounts of current.



(A) Simple circuit diagram.

(B) Pictorial drawing.

Fig. 7. Magnetic amplifier.

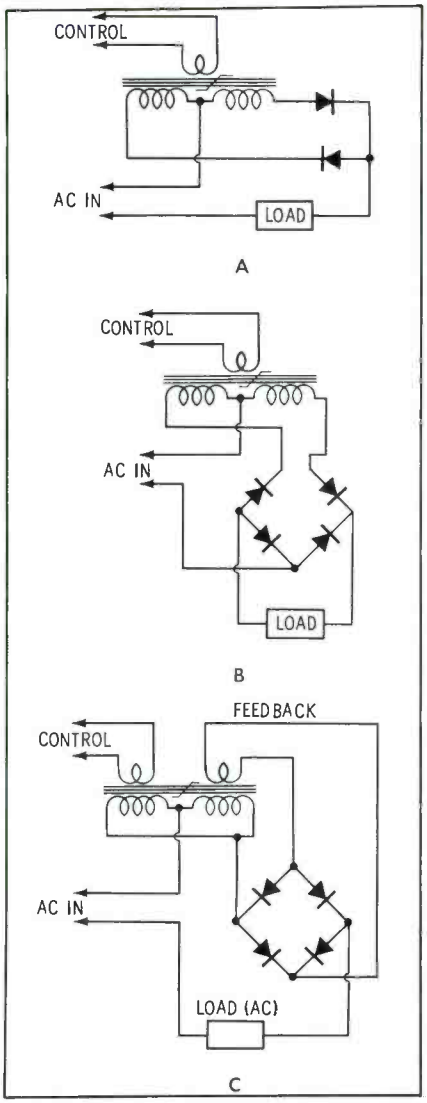


Fig. 8. Several ways of using magnetic amplifiers in full-wave circuits.

A wide range of different sensing devices may be used as inputs to the magnetic amplifier. Fig. 9 summarizes a variety of typical applications in which a "magamp" can be used as a middleman between the control-signal source and the device which actually couples the power to the load. ▲

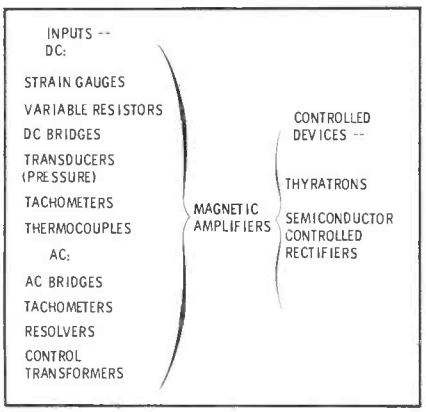


Fig. 9. Typical devices used in combination with magnetic amplifiers.

THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

Blows Out

In an RCA Chassis KCS107D, the 3/10-amp fuse protecting the sweep circuits keeps blowing at intermittent intervals. Sometimes the set will operate for several weeks, sometimes only hours. The fuse is only carrying 130 mils; all voltages check okay, including the peak-to-peak amplitude of the drive signal.

D. RECKTENWALD

Seattle, Wash.

Generally, this is caused by one of two things. Either the damper or horizontal output tube develops an intermittent short, or the horizontal oscillator fails to work. In each case, the horizontal output tube draws excessive current. Try a very careful tube test, or substitute for all three tubes to be reasonably sure of solving the problem if nothing shows up in the tube test.

Suppressed Headache

I've been trying to get ignition interference out of an AM-FM-short wave auto radio in a 1960 Saab. I know the interference is being radiated, because it isn't present with the antenna disconnected. The standard AM signal comes in nice and clean, but both FM and short wave have heavy motor interference.

So far, I've tried the following: (1) Installed two ground straps from hood to engine and engine to frame, (2) grounded all cables going through the firewall to the dash, (3) wrapped the lead from the coil to the distributor with metal braid and grounded each end, (4) installed suppressors at each plug, coil feed, coil, generator, fuel pump, and starter. I've even used a separate antenna with shielded lead to probe all around the car for a less noisy spot. Nothing has helped—what now?

EDWARD F. MCCLENAHAN

Arlington, Va.

Two things are quite apparent: You've chased auto interference before, and you've got a "dog" this time. My first suggestion would be to try touching up the detector alignment in the FM section to see if you can eliminate the interference that way.

Since you are troubled only with high-frequency reception, and you have proved it to be a radiated interference, be on the lookout for even small areas of the car's body which may not be making a good ground. Bumpers, braces, and all other supports become likely suspects in high-frequency radiation. Perhaps a dragging ground strap, to provide an earth ground, will help.

Installation of small-value ceramic or mica capacitors of approximately 1000 mmf to provide RF grounding or bypassing of such things as fuel gauges, or other electrical wiring harnesses, may provide the solution.

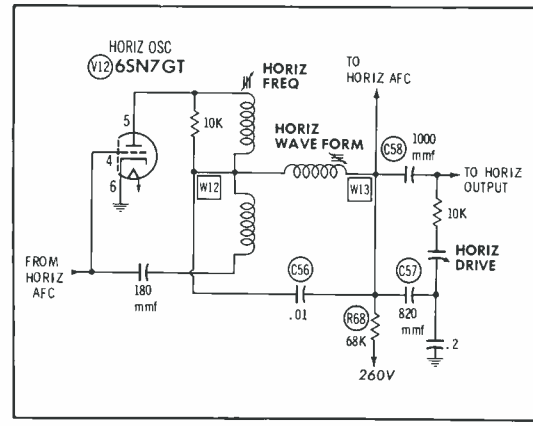
Flat Sawtooth

A Muntz Chassis 17B4 loses horizontal sync after long periods of time. The *Synchroguide* waveform adjustment doesn't rock the humped scope waveform W12 as it should, and the feedback and drive waveforms both are flat-topped rather than sawtooth-shaped. All operating voltages and signal levels appear normal.

F. C. COLLINGS

Wildwood Crest, N. J.

The flat-topped shape of W13 seems to hold the clue to the problem. The reason for the flattening of positive peaks is that the horizontal discharge capacitor C57 is charging too rapidly. Substitute for both R68 and C57, which form the wave-shaping network. If this fails to restore the normal sawtooth, substitute for C58 and C56. Once the proper drive waveform has been provided, the signal sent back to the horizontal AFC stage should be of the correct nature. Also, the action of the waveform adjustment on W12 should be restored to normal.



Meter Pegs

I've noticed in checking electrolytic capacitors with an ohmmeter that after they charge to infinity, the meter continues to climb until it pegs. If the meter is removed and reconnected it hits the peg immediately. (This happens even if you let them sit overnight.) The capacitors check OK on a bridge. What makes them react like this?

R. P. LOESCH

Pittsburgh, Pa.

This is due to an inherent characteristic of electrolytics known as dielectric absorption, a phenomenon that allows approximately 1.4% of the normal voltage applied to the 'lytic to appear across it within a minute or so after being shorted. The 'lytic is effectively shorted by placing the ohmmeter across it to check for a short. Then, the capacitor builds up a charge, not only because of the ohmmeter's applied potential, but also because of the additional charge due to dielectric absorption. This, then, continues to cause current to flow through the meter, causing the needle to peg.

It should be noted that it is possible (although not probable in TV service) for the increased current caused by this dielectric charge to damage a meter. The charge will continue to grow with time, reaching 6 to 7% of the normally applied potential. This explains the immediate pegging "the next morning." It is as though you were connecting your ohmmeter across a 12-volt battery.

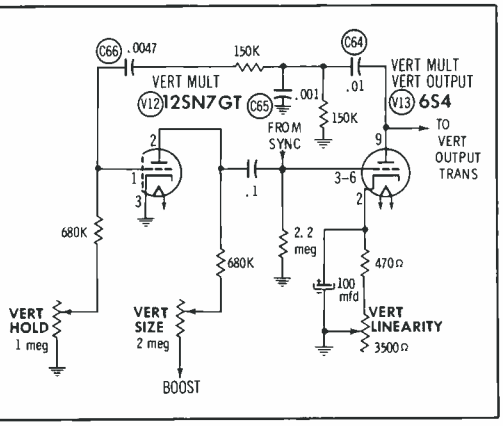
More Feedback Problems

I've replaced the feedback filter capacitor C65 in an Emerson Chassis 120220D three times in the last six months. Even though I've checked every replacement prior to installation, they still short. Can you give me the reason for the short life of this component?

M. L. CHAPIN

Detroit, Mich.

In addition to coupling a signal back from the output stage to the first stage of the multivibrator, C64 and C65 form a pulse-division network. The high-amplitude pulse present at the plate of V13 is divided so that 90% of the original value appears across C65, and the other 10% across C64. Since the highest pulse voltage appears across C65, it is doing the most work. Be sure to check C64 and C66, and use a 1000-volt capacitor as C65 to insure against future breakdowns.



Neon Troubles

I installed a master antenna system in a motel and used RG-59/U cable for the leads. I ran the shielded cable all the way to the antenna and mounted it 100′ away from the building in an attempt to get away from neon-light interference. I've still got the interference. Is there any solution to this problem?

WALTER G. SMITH
McConnellsburg, Pa.

Most neon installations are made with only twisted-wire connections, and these form potent sources of radiation whenever they become corroded or loose. Perhaps the best way to overcome the offending interference would be to make good solder joints on all connections in the neon-light circuit.

It's also likely that a filter will help. Use a pair of .1-mfd capacitors of at least 600-volt rating to make the best possible filter. Connect the two caps together, and attach their junction to a good earth ground; then connect the remaining two free leads to opposite sides of the AC supply line, right at the neon transformer.

Bypass vs. Decoupling

I'd appreciate it if you would clear up a technical point I have been wondering about. Exactly what is the difference between a bypass capacitor and a decoupling capacitor?

Also, I notice that you seldom print articles about servicing the sound section of a television receiver. I'm interested in learning the best way of troubleshooting the sound channel, and I'd like to know what I should expect to see with the scope.

JOSEPH COLLAZO
Union City, N. J.

Bypass and decoupling capacitors both have the same general function—shunting a signal to ground from some point in the circuit where the presence of the signal would be undesirable. However, there's a slight difference in usage of the two terms. In general, a "bypass" capacitor maintains a specific point (such as a tube element) at AC ground potential; on the other hand, a "decoupling" capacitor is intended to keep signals off common feed lines such as B+, AGC, etc., in order to prevent stray coupling between different stages or sections of the receiver.

The scope isn't used very often in TV sound circuits except when you are aligning them. Of course, it would be possible to use a scope in conjunction with a signal generator to make visual checks of distortion and stage gain in audio amplifiers; however, the troubles uncovered by this method can often be found just as well by other means. An effective and widely-used servicing approach is to localize troubles to a particular stage by signal injection, and then to make voltage and resistance checks in the suspected circuit. This method was outlined by Milt Kiver last November in the article, "Tailoring Your Servicing Technique to the Circuit."

Q & A on TV Alignment

(Continued from page 31)

JOHN: Hey, couldn't you say you're "sweeping" the generator frequency by hand? Seems to me you could sweep-align the IF with this test setup. If you had too much or too little gain at some frequency, it would show up on the meter.

BILL: In a way, you're right; but we'll leave the "sweeping" to the sweep generator. The visible scope trace will give more accurate and quicker results than trying to plot a graph, mental or otherwise, of the VTVM readings. For now, we're only going to "spot-check" the IF gain at several different frequencies. The trick is to choose the ones most important to set operation. If they indicate that the alignment is off, we'll make a closer check of the separate coils involved.

Notice the eight steps in the basic IF-alignment directions. In each step, you're told to peak one of the IF tuned circuits at its resonant frequency. You can see that most of the adjustment frequencies are different; this is because the IF section is "stagger-tuned." Each coil is tuned to some definite single frequency and favors some limited portion of the total frequency band. Each stage then amplifies some frequencies more than others. But, since each transformer is tuned to a different frequency, the over-all gain of the IF strip is averaged out so that all frequencies eventually get the right amount of amplification. I'll soon use the scope to show you how this works.

FRED: What do they mean by adjusting for "minimum deflection" in the first two steps of the chart?

BILL: The first two adjustments are traps. You tune for a dip in the meter reading at a certain frequency to show that minimum signal strength is reaching the detector at that frequency.

Now I'm ready to start peaking the other adjustments for maximum negative DC on the meter. Remember, this means maximum detector output. The most important thing to watch out for is the generator frequency; you need to be sure you're tuned precisely where you want to be, before you ever touch a slug. The best insurance is to use the crystal calibrator built into the generator. See, it takes only a couple of

seconds to zero-beat the variable marker oscillator against the crystal oscillator so you can calibrate the dial.

By the way, fellows, I picked up a new alignment-tool kit; so there'll be no excuse for chewing up any more slugs.

DAN: Step 4 in the instructions has me puzzled. How come the mixer plate coil has to be adjusted? I thought it was in the tuner.

BILL: Physically, it is. As far as circuit action is concerned, it's strictly an IF component. See now why you have to adjust this slug on every replacement tuner you install? It matches the tuner output to the IF input.

This set seems to be in pretty good shape, since all the slugs give definite peak indications. If we had a smeary or ghosty picture, and one transformer refused to peak, we'd be on our way to finding a sour stage.

We're not done yet, because we still have to recheck the over-all curve.

GEORGE: Why do you need to do that—haven't you already peaked all the slugs?

BILL: Yes, we have, but there's a catch. What would happen if one of the IF stages happened to have abnormally high or low gain? Remember, they're all peaked at different frequencies.

GEORGE: Oh, I get it. If you had one weak stage, it would cut down the gain at some video frequencies, but not at others.

BILL: Right. And we can discover this at a glance by looking at the sweep-alignment curve. It's not unusual to find some odd humps and hollows even after all the slugs are peaked. But we can generally iron these out reasonably well by slightly juggling the different slugs. If the curve still looks lopsided after the final tune-up, we should suspect trouble in the IF.

The VTVM alignment seems to have helped this particular set. The curve shape looks practically the same as before; but the marker shows that the 45.75 point has risen to the 50% level, as we wanted it to do.

JOHN: The curve in the instructions shows two distinct peaks, but we still have only one wide peak—the way we did when we started. [Fig 10]

BILL: That's true, but I'd say the curve shape is well within tolerance and is good enough to get the job done. The main thing is to have the right amount of gain at 45.75—that's the picture carrier—without throwing off the low-frequency end of the curve.

Let's see if we can get a better idea of what's happening in this stagger-tuned receiver by looking at the response of separate stages. Fred, go over in the stock cabinet and get me three 270-ohm resistors, will you, please?

FRED: What are you going to do now?

BILL: I'm going to set up the sweep generator and scope as I did for the over-all response check. I'm also going to disable different tuned circuits in the receiver so we can see what each stage is contributing to the over-all alignment curve. First, I'm going to shunt the plate coils in the first and second video IF stages with 270-ohm resistors. The curve we now have on the scope screen [Fig. 11A] shows which frequencies are being favored in the third IF and detector tuned circuits. Notice where the 42.25- and 45.75-mc markers

occur on each side of the curve. As I run a marker over the peak, you can see that we get the most gain at about 43.5 mc.

Now I'm going to remove the shunt from the second stage and put one across the plate coil in the third stage. This will effectively disable the tuned circuits in the first and third IF's, and we will be viewing the response of the second stage alone. Notice that the curve is not peaked quite as high. This is mainly because the second stage has AGC bias on it, while the third IF does not. Also note that the markers are not directly across from each other [Fig. 11B] The very peak of this curve is at 44 mc.

JOHN: Could you feed the signal directly into the input of one stage, and connect the scope through a detector probe to the output of the same stage? This would let you see the response of that stage by itself.

BILL: Yes, sometimes you can, if you have sufficient stage gain to develop a usable curve, and if you don't detune the stage by connecting the scope and generator leads. Some sets are designed to be aligned by this method—especially the older ones with complex IF strips that have two or even more tuned circuits in a single stage.

Let's go ahead and see what happens when I transfer the shunt resistor from the first to the second IF transformer. The response curve of the first-IF plate circuit [Fig. 11C] looks a little narrower and is peaked toward the high end. When I run a marker all the way to the peak, I find that it's at 45 mc. The 45.75-mc marker rests at about 70%, and the 42.25-mc marker is not even visible because the response isn't broad enough to provide any gain at the low-frequency end. Let's see where the response falls off. Notice that a 43-mc marker comes pretty close to the base line. Beyond this point, gain is almost zero—but not quite. The lower-frequency portion of the signal is coupled through the first IF transformer, but that's about all. It receives its gain at a later point—mostly in the plate circuit of the second stage.

FRED: I see now what's happening—the different stages are all peaked to different frequencies, but when you put them all together they spell flat response!

BILL: Now you've got the idea. Simple, isn't it?

FRED: Could we have used the VTVM procedure on the other set, too?

BILL: No, it has a somewhat more complicated design, and the different adjustments probably have more tendency to interact with each other. For this reason, I don't think you could have adjusted the various slugs for such clear-cut peak indications on the meter.

Generally, the VTVM method of point-to-point alignment is dependable only in sets where the correct VTVM procedure is given in the service data. Otherwise, you can figure that a sweep alignment will be quicker and more accurate in the long run. And to visualize the overall IF response of *any* receiver, you *must* use sweep alignment.

Whew! Any more questions?

(*Silence*)

GEORGE: We'll probably have plenty by tomorrow, but I think we all need some time to think over what you've told us already.

BILL: All right — this would be a good time to adjourn. Let's go get something to eat! ▲

Stretching CRT Life

(Continued from page 28)

(This is by no means limited to female customers.)

Some people are easily alarmed because of articles that have appeared in popular magazines and newspapers. For example, a doctor (who should certainly have known better!) came out last year with a flat statement that "picture-tube boosters" were a menace to society, because *they raised the high voltage on a tube to such an extent that the tube gave off hard X-rays, gamma radiation, and other deadly emanations!* Apparently, no one took the time to tell the good doctor that raising the high voltage to the figure he named would result in a picture on the average screen about 4" square, with a brightness rivaling the sun! Absurd as it may seem to us, some people accept as gospel any statement of this nature, simply because it has appeared in print. It is up to us to educate them, as far as we may, in the facts of TV tube life.

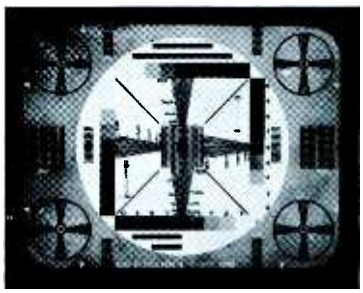
The majority of defective tubes have simply lost emission. The picture grows dim and loses contrast. Tubes like this can frequently be brought back to nearly normal brightness by rejuvenation; or if the cathode's emitting surface is very far gone, increasing its operating temperature by means of a brightener will restore some of the lost performance. Tell these facts to the customer, as far as possible, without going into a long dissertation on CRT structures. We've found it helpful to explain that the cathode is a small tube about the size of the end of your ball-point pen, with the active material all concentrated on the end facing the CRT screen. Explain that all you're going to do is heat it up a little more, so it will give off more electrons. (You might, in the case of "nervous old ladies" of either sex, avoid the use of the word "overheat"; use the phrase "heat it up a little more" to avoid any connection with the thought of overloading the tube. Proper choice of words is very important at this time.)

The main idea you should try to get across is that you are *not* trying to sell them a new picture tube! This suspicion will inevitably occur to them, from all the unnecessary bad publicity our profession has received since the beginning of TV service! By making a very obvious effort to cure the trouble without having to replace the tube, you are bound to make a good impression.

Now, with the human aspect of the subject out of the way, let's look at the actual mechanics of the operation. Loss of emission is due to partial exhaustion of the chemical compound on the end of the tiny cathode cylinder, resulting in a decrease in the quantity of electrons available for beam current. 'Way back in the good old days, radio tubes were built with the same basic type of cathode, consisting of a tungsten wire coated with thorium or some other active material. "Rejuvenation" for tubes was popular in that era, and exactly the same means was employed then as now. The filament was overheated so as to "boil" more active material to the cathode surface. It was then cooled slowly to avoid flaking of the cathode material.

"Tester-Rejuvenators"

There are several makes of picture-tube testers and rejuvenators



TV TIPS FROM TRIAD

NO. 9 IN A SERIES

"It's this kind of job that makes me envy the box boy's career at a supermarket," said Joe, the Junior PTM, as he gloomily eyed the job on the bench.

"You should be an expert on them, since that's the second one in three days," said Bill.

"Same set, same trouble, but not same cure," said Joe. "The first set came in with a short between the yoke windings. I went down and picked up the replacement, compared terminal numbers, connected it, and it worked fine. This set came in, same type of short, so I bought the same yoke as before, compared numbers, connected it, and got a fine picture, but it was upside down and backwards. When I reversed the leads to make it read right I had the worst case of 'ring ripple' I have ever had."

"Did you, by any chance," asked Bill, "buy a replacement with all the parts wired in?"

"The counterman said it was an 'exact' replacement," answered Joe defensively. "But why was it perfect in one case, and like this in the second?"

"Hm," said Bill, as he looked, "did you notice where the leads came out of the first yoke when you had it mounted?"

"Out the bottom," said Joe promptly.

"Well, they come out the top the way this one is mounted," said Bill. "If I remember correctly they used different mountings in different runs. When you installed this yoke you had exactly the right anti-ring network on exactly the wrong terminals, because you had to reverse polarity to make the picture read 'right.' If you follow my system, use new parts to duplicate the wiring (and mounting) of the original, you would never know about this kind of trouble."

MORAL: It is probably impossible to "exactly" replace over four thousand yokes from a line of less than a hundred. If you use the correct basic unit (proper deflection and inductance) plus a Network Kit to duplicate the original installation, you will find that nearly all jobs can be done quickly and easily. Review your yoke fundamentals as outlined in PTM #3, a copy of which is available from your Triad Distributor or from Triad in Venice. **Triad Transformer Corporation,** 4055 Redwood Avenue, Venice, California.

available. Most of them provide means of rejuvenating the tube by applying above-normal heater voltages. A typical unit combines an emission and shorts tester with a three-step rejuvenator circuit and a "flasher" circuit for correcting open or shorted elements. Emission is read directly on a meter calibrated both in microamperes and according to a BAD-GOOD scale. Taps on the filament transformer, through a selector switch, provide heater voltages of 6.3, 8, and 10 volts (LOW, MED, and HIGH). The flasher circuit applies about 1000 volts between the cathode and the remaining elements through a momentary-contact push-button switch.

This type of tester will check any standard black - and - white picture tube; generally, adapters are also available for accommodating both types of 110° tube bases, color tubes, and CRT's with special filament voltages.

Adapter harnesses for checking picture tubes for shorts and emission on a standard tube tester are also available. These are simply plugged into the tester, and the checks made as in any other tube test. As far as shorts and emission checking are concerned, these tests are very accurate. Of course, no flashing voltage is included, but picture tubes may be rejuvenated by raising the filament voltage of the checker. (Remember, the highest setting should not exceed 10 volts.)

CRT Trouble Symptoms

Unless the tests are a matter of routine (as they are in our shop), the CRT tester need not be used unless the symptoms definitely point toward picture-tube trouble. Typical clues are a decided loss of brightness, lack of contrast, a "pearly" appearance to the picture, loss of focus, and a darkening of the "highlights" in the picture when the brightness control is turned all the way up. The high voltage should always be measured to be sure it is up to normal, since insufficient brightness could be due to a weak HV supply rather than a bad CRT. Low gain in the video amplifier could be responsible for poor contrast, while other troubles could account for such symptoms as loss of focus and poor resolution. However, with the tester so simple to use, checking the CRT is often the quickest way to tell whether or not it is defective.

A very low reading on the emission test indicates trouble. However, the meter readings on either the microamp or BAD-GOOD scale are arbitrary, and must be correctly interpreted. For example, one popular CRT tester shows BAD below 300 microamperes. In actual use, however, we have found that a tube reading as little as 100 microamps will produce a fairly good picture. This depends greatly on the condition of the tube in other respects—gas content, interelement leakage, etc. Tubes which are gassy will show erratic meter readings and will usually produce very poor-quality pictures.

Interelement shorts and other allied symptoms will be detected by the shorts test. However, you will probably not even need to use the tester to spot a heater-cathode short; this defect is easily recognized because the brightness control has no effect. Grid-to-cathode shorts, G1-to-G2 shorts, etc., may also occur once in a while. These are usually caused by flakes of getter or other

conductive material lodged between the elements or the support rods.

The flashing voltage is intended for use in curing this condition. Applying the high voltage between elements burns the shorting material away. The same method may be used to repair an open element, such as the cathode, by literally welding it together. The best procedure for this is to overheat the cathode by raising the filament voltage to the top notch on the rejuvenator control, and then to tap the flasher button. Tapping the neck of the tube GENTLY with the handle of a screwdriver will sometimes help to make a weld.

This is a "last-resort" treatment for open elements, however. A great many open elements in picture tubes can be traced to bad solder joints between the wire leads of the tube and the hollow base pins (Fig. 1A). These bases are in general use in picture tubes with deflection angles of 90° or less, as well as in a few 110° types. (Most 110° tubes have wire-pin bases like those on miniature receiving tubes.) Before trying to flash an open element on a tube with a rigid-pin base, resolder the base pins (or use a pin-crimping tool) and recheck. Merely melting the solder on the pin is often not sufficient. A more effective method is shown in Fig. 1B. Heat the pin, then insert a short piece of solid wire—well-tinned and lightly covered with paste flux—inside the pin. Work this wire back and forth several times, to get some solder down inside the pin; then allow it to cool. Do not insert over 1/2" to 3/4" of the wire into the pin; too long a wire might go on through and cause a short to another wire lead inside the base. Clip off the excess wire and recheck.

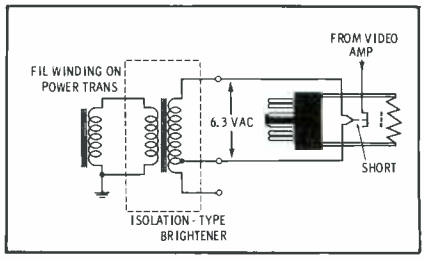


Fig. 3. CRT with heater-cathode short may be salvaged by using brightener.

A pin-crimping tool, especially made for repairing loose base connections, indents the hollow pin to compress the wire lead and restore contact. Some technicians crimp the pins crosswise, using diagonal cutters. This must be done with extreme care; some poor unfortunates have cut pins completely off with an unwary squeeze!

Rejuvenation Techniques

There is a certain amount of skill involved in using the rejuvenation feature of any tester. Improper use of the equipment can result in damage to even a good tube. The following method has been worked out over a period of several years in the field:

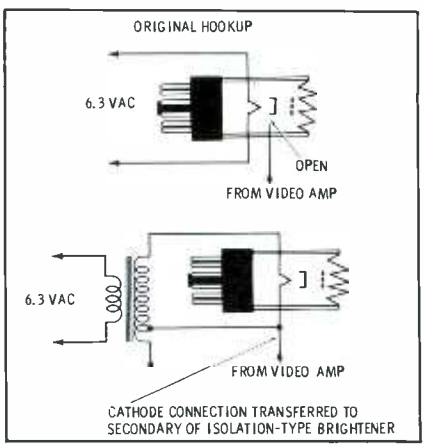


Fig. 4. Sometimes an open cathode can be tied to filament to restore CRT.

After emission of a tube has been found low, apply the high filament voltage. If the emission is *very* low, use the highest tap (10 volts). Allow the increased voltage to remain on the tube for 30 seconds, timing it by a watch. Then turn the switch to the medium tap (8 volts), and allow the cathode to cool for 15 seconds. At the end of this time, drop back to the normal or low tap for another 15 seconds; then recheck the emission. In many cases, a fairly high reading will show up (300-400 microamps), but the emission will "sag" down as the cathode cools. If this happens, switch the filament control to the medium tap again for 30 seconds, and touch the flasher button once or twice. Retest. Sometimes the flashing will burn off an inactive outer "crust" on the cathode, and the emission will come up again.

In general, unless the tube shows an open element, *do not* flash it at the 10-volt filament level. Cathode leads have been completely burned off under such conditions. This is probably due to the almost molten condition of heater and cathode when greatly overheated. To clear shorts, flash at either normal or medium filament-heat levels.

To weld open elements, apply 10 volts to the filament, and allow the cathode to heat for at least 30 seconds. In stubborn cases, where the tube is a "goner" anyway, heat it for a full minute. Then flash it, holding the button down for a longer period than usual. (About one second is an average time.) In most testers, you'll hear a "humm" inside the tester if the element is being welded. When you hear this, release the flasher button immediately! Stubborn welds can sometimes be helped along by tapping the base of the tube and the flasher button simultaneously. It might also be of some help to change the position of the tube; you could turn it faceplate down, on either side, etc.

Brighteners

If the emission of the tube comes up to a good level after the rejuvenation tests, but drops slowly to about 50-75 microamps, the use of a brightener is indicated. These are simply small transformers which raise the heater voltage of the tube to about 8 volts. Some of them are simple autotransformers (Fig. 2A), while others have isolated secondaries (Fig. 2B). Different types are supplied for use in series and parallel filament circuits; the correct type for the set under test must be selected. The isolating-type brightener usually has a tap on the secondary winding, allowing the selection of either normal or boosted voltage.

Some brighteners are a combination of series- and parallel-circuit types, the switch from one to the other being made by a selector plug contacting different taps on the windings. The simpler types are quite small, and can be easily stowed away in the back of the TV set—even the smallest portable.

The isolation-transformer type may be used to isolate heater-cathode shorts in the picture tube. If the video signal is injected into the cathode of the picture tube, a heater-cathode short will completely ground the signal, because the heater winding is always at or near ground potential (even in series strings). By isolating the heater winding from the chassis, the signal is "ungrounded," and in many cases the tube works almost as well as it did before. If the

tube is otherwise good, and fairly new, the brightener should be set on the "normal" tap (Fig. 3). If the tube is low in emission, set the brightener on the "boost" tap.

Even tubes with open cathodes can be restored with the isolating brighteners. Fig. 4 shows this method. Simply tie heater and cathode together on the tube side of the brightener transformer. Isolating the heater from ground and tying it to the cathode enables the heater-cathode combination to function as a signal element. This will restore the picture in most cases, but not in every one. However, it takes very little time to try out.

There are also more elaborate brighteners which bring all the different element leads of the picture tube out to a terminal strip. These use tapped isolation transformers. By making the proper connections, open elements can be cross-connected to others, and performance sometimes can be restored.

Unusual Troubles

Now and then, troubles will be found in the brighteners themselves. If a set comes in with no visible raster, and a brightener has already been installed by someone else, check it! One set was found to have only 4.3 volts on the CRT, due to a defective brightener. Always check to see that the correct type has been used; whoever last worked on the set may have installed a series brightener in a parallel heater circuit, or vice versa.

A Parting Word

As you leave the house after completing the job, warn the customer, "Once in a while a picture tube will respond to this treatment, work fine for a few days, then go back to being as dim as it was. If it's going to do this, it will probably happen inside of the next two or three days. Now, if it does, you call me, and we'll check it again!" This is an important point. We have had to shoot tubes as often as three times before the cure was completed. The above statement protects you in case the tube's emission does go down again; if it cannot be restored, and must be replaced, the customer will think, "Well, he did all he could!" ▲

Sync and Sound

(Continued from page 33)

mally narrow horizontal-hold range. The top of the picture may also appear to bend, with vertical lines or objects curved to the right or left. This effect occurs because the horizontal sync signal is more easily disrupted during the short interval just after a vertical sync pulse has passed through. In extreme cases of horizontal bending, the top of the picture will "flag-wave" or move rapidly from side to side.

In actual practice, the sync-separator output need not be as "clean" as Fig. 2A or 2B to achieve satisfactory lock-in under most circumstances. In some circuits, it is entirely normal to find a certain amount of video along the base line (top) of the separator-plate waveform, as shown in Fig. 4. Even if a small amount of video travels all the way into the horizontal AFC circuit (Fig. 5), this does not necessarily produce instability unless the video has enough amplitude to compete with the sync pulses. In that case, intermittent twitching of the picture can be expected.

In severe overloading due to such causes as AGC trouble or a gassy video amplifier, the sync-input waveform can be compressed to the extent demonstrated in Fig. 6A. There are virtually no sync pulses left, so the separator's output consists mostly of distorted video (Fig. 6B), and sync is extremely touchy or lost altogether. Note the notch in the plate signal each time the stub of a vertical sync pulse is applied to the separator. This regularly-recurring pattern is enough to permit a half-hearted attempt at vertical lock-in, but sync is still likely to be erratic.

Since scope waveforms are so important in sync-circuit trouble-shooting, they should be carefully interpreted to insure best results. Since they can be locked in at either a 30- or a 7875-cps scope-sweep rate, the question naturally arises as to which sweep frequency is preferable. Actually, both have their own advantages and disadvantages.

The 30-cps (vertical) rate gives an excellent over-all view of the signal. The tips and blanking pedestals of the horizontal pulses trace a ribbon-like, double-line pattern which is helpful in revealing faults such as 60-cps hum in the signal (Fig. 7A). In contrast, the 7875-cps waveform (Fig. 7B) has no similarly useful pattern. In the presence of hum, the varying height of the horizontal pulse tips shows up only as a blurring of the pulse outlines—and it's hard to tell whether this indicates signal trouble or merely a scope defect such as astigmatism or poor focus.

On the other hand, the 7875-cps sweep rate provides a clear close-up view of the sync-pulse waveshape, which is impossible to achieve at 30 cps.

Here are some things to look for when examining sync waveforms:

Is over-all amplitude correct? Weak pulses may cause critical sync. A calibrator should be used to check the peak-to-peak value of the signal.

Are the horizontal pulses greater in height than the vertical pulses? This can mean poor low-frequency response in the IF or video amplifier, a defective video coupling capacitor, a weak separator tube, etc. The likely result is unstable vertical sync.

Do the horizontal pulses vary in height in different parts of the waveform pattern? There are many

Fig. 5. A trace of video information may even reach horizontal AFC stage.

causes for this symptom, but the result is likely to be the same (horizontal instability) in just about all cases.

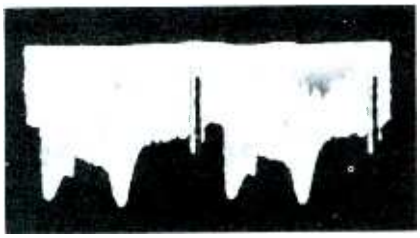
The last two statements bring up a very important point: Sync-circuit trouble will not necessarily affect both vertical and horizontal synchronization. The effect on the sweep circuits will depend on the type of distortion in the waveform.

Sync Amplifiers and Phase Inverters

Most TV sets have one or more sync stages following the separator. These go by many names—amplifier, clipper, phase inverter, etc.—and yet they all have about the same function of modifying the separator output into a form suitable for direct application to the sweep sections. This involves such processes as leveling out variations in pulse amplitude, removing video and other spurious information as much as possible, and sometimes developing output pulses of two different polarities to satisfy the needs of the sweep circuits.

Troubleshooting requirements for these stages are similar to those for sync separators. The scope comes foremost as a trouble-isolating tool; if it reveals that the input signal is

(A) Distorted separator input.



(B) Video at separator plate.

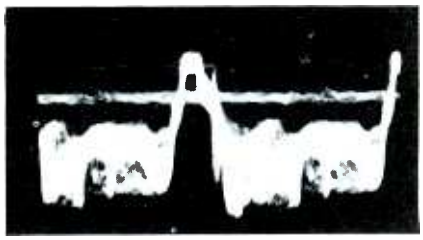
Fig. 6. Severe overloading of video.

normal and the output is distorted, the stage in question must be defective. Servicing then becomes a matter of using a VTVM or VOM to find the exact component causing the trouble.

Noise Limiters

To prevent random-frequency noise pulses from falsely triggering the sweep stages, it is highly desirable to provide some method of preventing noise signals from passing through the sync stages. Therefore, noise limiters or cancellers are widely employed in TV receivers. These

(A) At 30-cps scope-sweep rate.



(B) Not so obvious at 7875 cps.

Fig. 7. Video signal with 60-cps hum.

circuits take various shapes; sometimes an extra triode section is used (like V8A in Fig. 1), and in other sets the sync separator is a multigrid tube (6BE6, 6BU8, etc.) with a built-in noise-limiting feature. Regardless of how they are wired, noise limiters all have the same basic purpose of preventing the sync separator from conducting in response to noise pulses having greater amplitude than the sync pulses.

In Fig. 1, a sample of the video-detector output is fed to the cathode of V8A. A noise-limiter control in the grid circuit biases this tube so that it conducts only on noise pulses more negative than the sync-tip level in the input signal. Each burst of conduction causes a negative pulse to be coupled through C65 to the grid of the sync separator. Meanwhile, the video-detector output signal has also been amplified and inverted in the video amplifier stage, and so a positive noise pulse appears in the regular sync-input signal. This positive pulse is nullified by the noise-limiter output pulse, and the output of the sync separator is undisturbed.

In the multigrid type of sync separator, a portion of the video-detector output signal is simply coupled to a special noise-limiter grid in the separator tube. Any strong noise pulse which occurs in the detector output then drives the separator into cutoff.

If a noise limiter of any type is improperly biased, it may be actuated by the sync pulses themselves—resulting in a loss of sync. Whenever this situation is suspected, the easiest way to check the noise limiter's operation is to disable it temporarily. If there is a control in the circuit, this can be turned to a lower setting. An alternate method is to disconnect a strategic component such as C65 in Fig. 1. Where the noise limiter is housed in a completely separate tube, this tube can often be removed from the set with no visible effect on operation (except in very noisy areas)!

Sound IF and Detector

Barring the usual tube failures, the sound IF and FM sound detector are among the most trouble-free sections of a TV set. On the infrequent occasions when circuit trouble in these stages causes a loss of sound, the fault can be localized by a signal-injection check. The procedure is somewhat the same as for the audio section, except that an RF signal generator tuned to 4.5 mc should be used in place of the audio generator. Either amplitude or frequency modulation may be applied to the RF output. While it is true that the sound detector responds mainly to FM, it does not reject AM so completely that you could not get some sort of audible indication from the speaker. Of course, an FM sig-

nal will give more positive results if you have the proper equipment to produce it (a sweep generator, tunable to 4.5 mc).

Start by touching the generator probe to the input side of the sound detector, and then work back toward the sound take-off point in the video amplifier or detector stage. There are only a couple or three steps to the whole procedure for most sets of fairly modern vintage, which typically have just one sound IF stage. If you reach a point where the injected signal fails to produce an audible output from the speaker, the next step is to pick up the VTVM or VOM probe and localize the trouble by conventional voltage and resistance checks.

Whenever an RF generator is not conveniently available, as in field servicing, it is often possible to perform signal-tracing tests with an RF-type germanium diode (such as a 1N295) or even with a large paper tubular capacitor. The vertical sync pulses in an ordinary station signal are used as an indicator. One end of the diode or capacitor is connected to the grid of the first audio amplifier, and the other end of the component is touched to various points in the sound IF circuit. For these checks, the fine-tuning control is adjusted to emphasize the 4.5-mc beat signal at the video detector (indicated by a "wormy" picture and loud sound). When the improvised

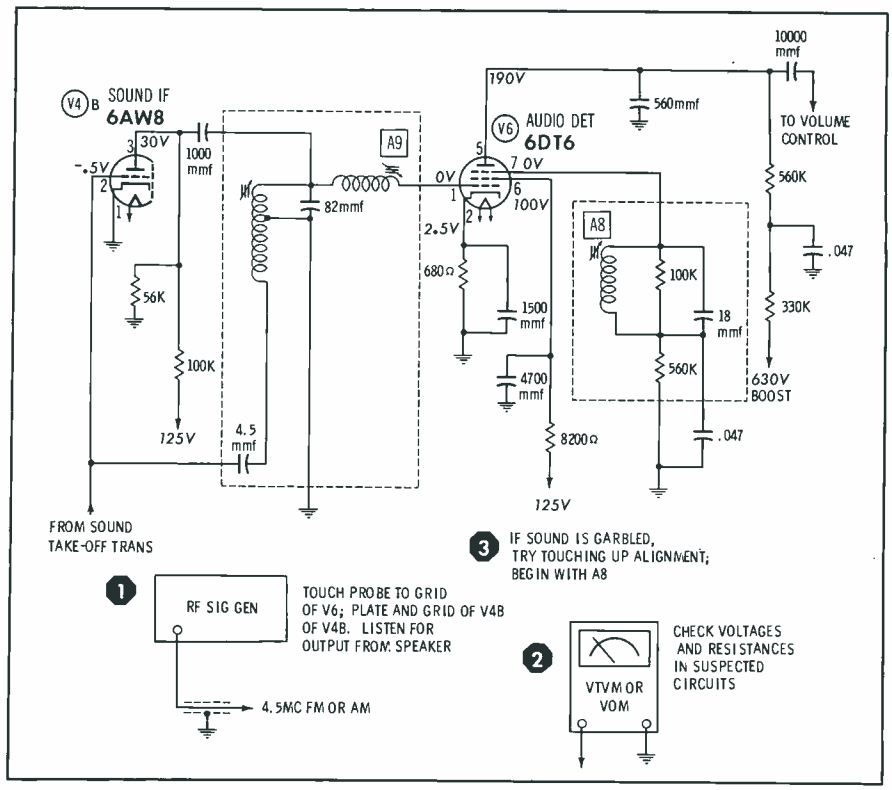


Fig. 8. Suggestions for troubleshooting sound IF and detector stages.

probe is touched to a given point, a loud buzz from the speaker indicates continuity between the sound take-off point and the point being tested.

Alignment Check

Especially in older sets, a fairly common complaint about the sound is distortion or buzzing due to misalignment of the FM detector. In circuits using quadrature-grid detectors (6BN6 or 6DT6), the alignment is regularly performed by using a station signal as an indicator—so you won't do any harm by trying an alignment touch-up. In the 6BN6 circuit only, the first thing to check is the *buzz* or *quieting* control, a variable cathode resistor which sets the proper operating bias for the detector to insure efficient AM limiting. The next thing to check—or first thing, in the case of the 6DT6—is the slug in the quadrature coil (A8 in Fig. 8). One manufacturer (Olympic) has even designated this slug as a service adjustment, labeling it a *sound clarifier*. If slight rotation of this slug does not improve the sound, you might try the other sound - IF alignment adjustments; but, before you do, be sure to *reduce the input signal strength* until a hiss appears in the sound. This insures maximum sensitivity of adjustment. In case you cannot obtain clear sound by realignment, further troubleshooting is needed. Voltage and resistance checks are a good start.

The older-type dual-diode detectors (discriminator and ratio detector) are more critical to align, and indiscriminate slug-turning without a regular test-equipment setup is not advisable. There's one exception to this rule: The secondary adjustment of the detector transformer may be turned *slightly* in an attempt to clarify the sound by balancing the detector. If this does not help, you will probably save time by making some other troubleshooting checks before proceeding with complete alignment. Although the dual-diode detectors do not receive DC supply voltages, you can sometimes gain helpful clues by taking voltage readings. In a ratio detector, for example, voltages which conform to those on the schematic are an indication that the diodes are in balance and the electrolytic capacitor across the diode circuit is functioning.

Summary

When we first began to discuss this subject of developing a logical troubleshooting approach for television circuits, we worked out a three-step outline of the initial steps:

1. Find out all you can about set behavior from the set user before any service work is done.
2. From the way the set operates, determine the section of the receiver where the defective component is likely to be located.
3. After the section in question has been located, check tubes in this section as a first step.

To these, we can now add a fourth and final step:

4. If tubes do not cure the trouble, select the test equipment which can be used most effectively in the circuit being serviced—and use it to make the tests which will give the most information with the least difficulty. (Table I will help you remember which instruments are best suited for different jobs.)

Using this outline will give you a servicing "short cut" which is flexible and versatile enough to save time for you on all TV service jobs.

TV Tuners

(Continued from page 37)

tuner in Fig. 2, with the turret removed to show the arrangement of the five-terminal *Nuvistor* socket. Compare it with the 9-pin miniature tube socket on the left; also notice the variable capacitor (a neutralizing adjustment for the RF stage) just below the RF-amplifier socket.

Another item of interest is the pair of slots on opposite sides of the *Nuvistor* socket rim. These accommodate the locating lugs which project downward from the tube (see Fig. 4A). This thoughtful feature not only guides the tube into place, but is also very effective in protecting the frail pins from being bent while you are trying to seat the tube. Once you have positioned these lugs on the socket rim, you merely rotate the tube until the lugs find the slots and sink in — and the pins will automatically slide into their receptacles. The two lugs are of different sizes so that the tube can be inserted only one way. We tried installing a *Nuvistor* "blind"; and, even though a certain amount of fumbling is entailed in locating the socket, we found that the process is easier over-all than plugging in a conventional miniature tube. By the way, the 6CW4 runs at about the same temperature as any other RF-IF tube. It's likely to be quite warm, though not blistering hot, when you go to pull it out.

Apart from the *Nuvistor* feature, the tuners in Figs. 1 and 2 are generally very much like other recent models. The RCA unit uses a 6EA8 oscillator-mixer tube, and some versions are equipped with a mechanism for preset fine tuning as shown in Fig. 1. The Standard turret tuner employs the "old standby" 6CG8A as an oscillator-mixer, and it has many of the same physical features as the *Guided Grid* series of tuners — including a ball-and-

Table I—Characteristics of *Nuvistor* and 6FH5 Triode.

	6CW4	6FH5
HEATER CURRENT @6.3VAC	120 ma	200 ma
PLATE VOLTAGE	75V	135V
PLATE CURRENT	8 ma	11 ma
TRANSCONDUCTANCE	12,500	9,000
Mu	68	50

spring detent device mounted on the front end of the tuner chassis. (If you have occasion to remove the turret from a late-model Standard tuner, be prepared to catch the detent ball when it drops out!)

"View-Testing" the Nuvistor

The specifications of the 6CW4 indicate an outstanding gain factor and signal-to-noise ratio. To get some idea of what this means in terms of actual fringe-area TV reception, we made a "deep-fringe" viewing test using a *Nuvistor*-equipped '61 receiver. During this test, one thing became clear: The purpose of a "hotter'n a firecracker" RF amplifier is not so much to "pull in" previously-unobtainable signals as to improve the reception on already-available channels.

Due to continual progress over the years in the design of antennas, tuners, IF strips, video amplifiers, and picture tubes, the *consistent* reception range of TV signals has already been extended almost to the practical limit — at least in the more thickly-populated areas of the country. Co-channel interference, intermittent severe fading, and virtual drowning of the signal in atmospheric noise are among the inescapable factors which limit the effective range. Of course, modern TV sets will receive pictures from beyond this boundary — *sometimes*. But let the atmospheric conditions change, and *blooie*! There's not enough signal left to stir up the snow on the screen, let alone produce a viewable picture.

However, this definition of a "consistent" reception range assumes only a minimum standard of picture quality — sometimes not much more than an ability to follow the action on the screen. Many people 50 to 100 miles from stations have regularly been watching anemic and snow-spotted pictures, because these are the only ones to be had. This group of viewers will benefit most from the new tuners, which promise to provide a welcome increase in picture contrast and "sparkle."

Covered Switches

In the new Sarkes Tarzian *Silver Sealed* wafer-switch tuner (Fig. 5), the switch contacts are completely enclosed by a protective cover which

guards against dust, moisture, probing screwdrivers, and other common causes of intermittent or noisy tuner operation.

Tuning coils of the incremental type are mounted outside the switch enclosure. Those for the low channels are conventional, but the high-channel coils (most of which can be seen in Fig. 5) are somewhat unusual. Attached to each wafer switch is a thin, perforated strip of metal divided into a half-dozen small "grilles" which can be independently bent one way or the other to achieve proper alignment on individual channels.

The *Silver Sealed* tuner has no oscillator-adjustment slugs; if oscillator frequency ever needs adjusting, this can be done by bending the sections of the high-channel coil strips and squeezing or stretching the low-channel coils.

An interesting mechanical feature of this tuner is its torsion-bar detent system. In Fig. 5, note the long slender bar across the bottom of the chassis. One end is held under tension by a clip on the front cover, causing the opposite end to press down on a notched wheel fastened to the tuner shaft just outside the rear cover. When the shaft reaches an "on-channel" position, a V-shaped kink in the torsion bar comes to rest in one of the notches of the wheel — thus holding the shaft in place.

This tuner falls into the modern "compact" class, with a chassis measuring approximately 3½" long, 2¼" wide, and 2½" deep. The RF amplifier being used in current production is a 2-, 3-, or 6EV5, a tetrode based on the 6CY5 design but modified for "hotter" performance. A 6CY5 can be used in this socket as an *emergency* replacement, but you should anticipate that it will throw the tuner somewhat out of alignment and decrease its gain. Teamed with the 6EV5 is a 6CL8A oscillator-mixer, the same tube type being used for this function in other Sarkes Tarzian tuners.

The Real McCoy

No fooling this time — the unit in Fig. 6 is a completely transistorized TV tuner, the TT-602A built by Standard for Motorola's new *Astronaut* 19" portable (Chassis TS-432). All three of the PNP

transistors are of a special *micro-alloy diffused-base* (MADT) type, capable of VHF operation.

In Fig. 6, note that only one lug is provided for connecting an antenna lead. Instead of the usual 300-ohm balanced input, this tuner has a 75-ohm unbalanced input circuit connected directly to the set's built-in "monopole" antenna. For operation from an outside antenna, a matching transformer (mounted separately from the tuner) is switched in series with the external antenna leads. (See lower left corner of schematic, Fig. 7.) Another unusual feature of the input circuit is an attenuator network which cuts down the input-signal strength when the range switch is placed in the LOCAL position.

The RF stage is a transistorized version of the *Neutrode* circuit, using a T1832 transistor in a common-emitter arrangement. The incoming signal is fed through the high-pass filter and wave-trap assembly (T1) to the base of X1. The 2.2-mmf neutralizing capacitor between the base and collector circuits is not adjustable, like its counterpart in a tube circuit; however, trimmers *are* provided in the RF-output and mixer-input tuned circuits.

DC voltage distribution for all three transistors follows typical practice for PNP circuits, with the collector returned to ground and the emitter connected to a positive voltage source. The base circuits also receive their required positive voltages through voltage-divider networks.

The RF transistor's base voltage is controlled by the AGC system of the receiver. As signal strength rises, the base voltage becomes less positive, thus increasing the forward bias on the transistor and driving it toward saturation. This limits the gain of the RF stage at high signal levels. Due to the characteristics of the transistors used, this method of control is more effective and more linear than the conventional system in which the AGC bias drives the controlled stage toward cutoff.

The RF signal is inductively coupled to the emitter circuit of the mixer through the tuning coils. Mixer transistor X2 operates in a common-base circuit, comparable to a grounded-grid setup for a tube. (Note the 1000-mmf RF bypass capacitor from base to ground.) The collector circuit of the mixer, tuned to the IF band, furnishes an input signal to the IF strip. Note that two test points are furnished in the mixer circuit — one for input, and another for output.

X3, operating in a common-base Colpitts oscillator circuit, injects a signal into the emitter of X2 through a 4-mmf coupling capacitor. There is an inductive fine-tuning adjustment in parallel with the oscillator coil; in addition, the coil for each channel has an adjustable core which is accessible in the usual manner from the front of the tuner.

When servicing this tuner, be sure to observe an important precaution concerning the plug-in transistors. There are *four* possible ways to insert each transistor into its socket, only *one* of which is correct. Each of the original transistors is marked with a spot of color which lines up with a similar spot on the socket when the transistor is properly installed. If you replace a transistor, you'd be wise to mark the new unit in the appropriate place. ▲

PRODUCT report

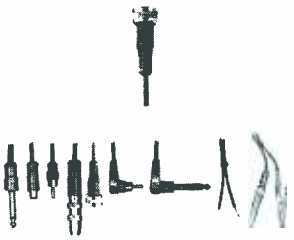
For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

Filament Continuity Checker (45T)

A neon lamp on the front panel of the PACO Model T-5 *Rapid Filament Tester Kit* glows to indicate continuity of a tube filament, fuse, or other low-resistance circuit being checked. Sockets are provided for 7- and 9-pin miniature, octal, and loctal tubes; other types can be checked using clip leads. A pair of screw heads at the bottom of the front panel serve as contacts for a quick test of cartridge fuses. Net price is $4.50 (kit) or $6.50 (wired).

Improved Cable Connector (46T)

A more rugged molded type of female connector has replaced the soldered connector formerly used on certain cable assemblies manufactured by Switchcraft. The new feature is available in combination with any of the opposite-end connectors illustrated in the photograph.



Scope Stand on Wheels (47T)

PBR Mfg. Co.'s Model 32957D *Scope Dolly*, an all-steel unit 17" wide and 23" long, is mounted on ball-bearing casters with 5" rubber-tired wheels. The top platform is tilted 20° and has retaining devices to hold the scope firmly in place. One AC line input and three outlets are built in. Price is $67.50; an alternate model, without drawer, is $62.95.

TV Twin-Lead (48T)

Alpha Wire is now supplying 300-ohm flat TV lead-in cable in two different web thicknesses, .060" and .100". Both types contain #20 AWG stranded copper conductors. The twin-lead is packaged in coils of four different lengths—25', 50', 75', and 100'—all with preassembled lugs at one end.

CRT Brighteners (49T)

Four new types of picture-tube brighteners have been introduced by Perma-Power. Model C 412 is usable on all 110° "button-base" tubes with series-type heaters, regardless of heater-voltage rating; companion type C 403 is for series-string CRT's with standard duodecal bases. The other two new brighteners, both for use with "button-base" 110° tubes, are the C 411 (for parallel heaters) and the C 311 (for universal use).

Sweep Components (50T)

Three new Stancor flyback transformers have been developed for exact-replacement service in 141 models of Emerson receivers. Part No. HO-309 replaces original part 738138/-A; HO-310 replaces 738142; and HO-311 replaces 738155. Also just introduced are two 90° yokes — the DY-36A to replace Emerson part 708353, and the DY-35A as an exact replacement for Philco part 76-9173-13 or 14.

Speaker Systems (51T)

Decorator Group speaker systems are available in four different furniture styles from Jensen Mfg. Co. The TR-30 *TRIette* three-way system (shown) and the GS-3 *Galaxy III* (center-bass unit with satellites) are offered in Danish styling (walnut wood), provincial (cherry), traditional (mahogany) or contemporary (limed oak). Either system may also be obtained in an unfinished hardwood cabinet. Net prices are as follows: Model TR-30, $159.50 (furniture) or $134.50 (unfinished); Model GS-3, $229.50 (furniture) or $195.50 (unfinished). Floor stands are $9.95 extra.

Soldering-Tip Lubricant (52T)

It's exasperating to find a soldering-iron tip "stuck" when you attempt to unscrew it from the barrel of the iron. To prevent this trouble, Ungar has introduced an *Anti-Seize* lubricant for tip threads. A light coating not only protects against corrosion, but also improves heat transfer from heating element to tip. The lubricant (No. 8001) is packed in 2-oz tins priced at 69¢.

CB Microphones (53T)

Six models are offered in American Microphone's new line of high-impedance mikes for Citizens band transceivers. The B-208-A (ceramic) and X-208-A (crystal) have a normally-open switch; the B-208-B and X-208-B are similar except for having a normally-closed switch. All of the above have a "slide-lock" switch feature and a list price of 12.50. Two other models, B-208 and X-208 ($10.50 each), have a simple "push to talk" switch.

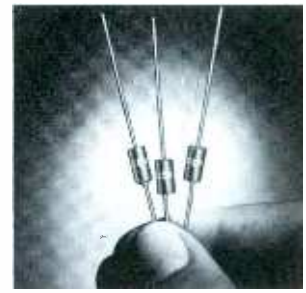
High-Frequency Speaker (54T)

A super tweeter with flat response within ±2 db from 3000 cps to well beyond the audible range, the University Model T202 *Sphericon* features a wide dispersion pattern. Added features are a built-in 3000-cps crossover network and a brilliance control on a 36" extension cable. Power capacity, rated according to "integrated program material," is 30 watts; impedance is 8 ohms; dimensions are 4 5/8" in diameter by 4" in depth; price is $24.94.

Ignitron for Welding (55T)

The spiral cooling coil around the Amperex Type 7585 ignitron is specially designed to concentrate cooling action around the discharge chamber, thereby reducing the problem of arc-back. This tube, used for single-phase welding control and similar applications, is compatible and interchangeable with all existing C-size tubes. Its electrical characteristics are identical to those of Type 5552A.

Silicon Rectifiers (56T)



For industrial and certain specialized TV applications where a miniature rectifier must handle high power, International Rectifier has introduced the X5A series of diffused-junction silicon diodes. Four types are offered, with peak reverse voltage ratings of 200, 400, 500, and 600 volts. All have a maximum DC output of 750 ma and a peak surge-current rating of 50 amps.

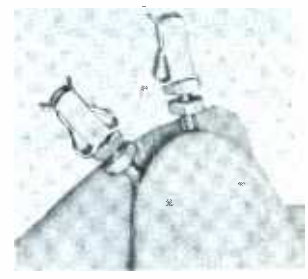
Tape-Recorder Cleaning Fluid (57T)

Guaranteed by the manufacturer not to stain or damage plastic parts of recorders, *Tape Recorder Cleaner* by Chemtronics is intended for use in removing tape oxide and other contaminants from parts such as tape heads and pressure rollers. A 2-oz bottle, with felt-tipped applicator attached inside the lid, has a dealer net price of 89c.

Top-of-Set Antenna (58T)

The Clear Beam *Slim Line* indoor antenna is offered in two different finishes to harmonize with cabinet colors — mahogany (Model H6M) and blond (Model H6B). Each of the four-section telescoping dipole arms can be extended to 36". The base is heavily weighted, for improved stability; in addition, the bottom surface is covered with felt to protect the TV cabinet top from scratches.

Test Clips (59T)



Grayhill, Inc., manufactures miniature test clips (with ⅜" threaded stud) for fastening small components to "breadboard" layouts or for connecting parts together in test setups. The component lead snaps into a spring clip, the tension of which is adjustable by means of a hex nut. Single clips have a list price of 25¢ each; dual clips on a common post are also available at 30¢.

Tube Manual (60T)

The *RCA Receiving Tube Manual* has again been revised and enlarged. The new 432-page RC-20 edition contains up-to-date technical specifications on 760 receiving tubes and 173 picture tubes, plus basic theory articles and an expanded section on tube applications. The *Circuits* section features a number of new schematics for high-fidelity amplifiers and related circuits. Price is $1 per copy.

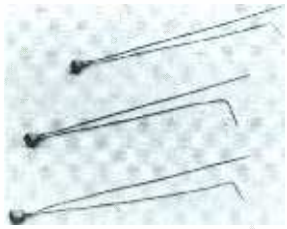
Pencil Iron (61T)

The No. 863 *Radioman* pencil-type soldering iron made by Wall Mfg. Co. is a 40-watt unit weighing 2 oz and measuring 8½" in length. Tip temperature is 800° F, but a silicon spacer keeps the handle cool. A number of differently-shaped, interchangeable tips are available for special jobs.

Stereo Power Amplifier (62T)

Dual amplifiers, each with an rms power-output rating of 50 watts, are mounted on the 15" x 11" chassis of the EICO Model HF-89 stereo power amplifier. Push-pull EL84 output tubes in each channel are driven by a cathode-coupled phase inverter preceded by a direct-coupled voltage amplifier. Shipping weight is 37½ lbs.; price is $99.50 (kit) or $139.50 (wired).

Small Selenium Diodes (63T)



Eight types of subminiature, plastic-encapsulated selenium diodes are available at low cost from Radio Receptor. Peak inverse voltage ratings range from 50 to 400 volts at 3.75 ma, and the units can operate in ambient temperatures from -50° to 100° C without derating. Maximum case length is .188" for all types, and widths range from .188" to .350".

Subminiature Transistor Amplifier (64T)

The Centralab TA-12 is a complete four-stage transistorized amplifier in a package .531" in diameter and .228" high. Over-all gain is 73 db; power output is 0.5 mw; input impedance is 2500 ohms; frequency response is flat within ±5 db from 300-20,000 cps; net price is $45.00.

Recording Tape (65T)

"Scotch" brand *Tartan Series* magnetic recording tape is now available with 1-mil polyester backing, in addition to the previously-announced 1- and 1 1/2-mil acetate backings. Retail prices for the new No. 142 tape are $2.85 for a 900′ (5") reel or $4.95 for an 1800′ (7") reel. Acetate tapes are priced as follows: 1 1/2-mil, No. 141, $1.75 for 600′ or $2.95 for 1200′; 1-mil, No. 140, $2.50 for 900′ or $4.25 for 1800′.

Miniature 115-Volt Irons (66T)

Oryx Model 115-10W and 115-15W pencil-type soldering irons operate directly from an AC power line without requiring a step-down power transformer. The standard version of the 10-watt unit has a 3/32" tip which heats to 672° F in 70 seconds: the 15-watt iron, with 7/32" tip, achieves 717° F in 50 sec. Other tip sizes can be installed. Net price of each iron is $6.95.

INDEX TO ADVERTISERS

September, 1960

TUBE TYPE	MODEL 648 CIRCUIT FIL.	D	PLATE E.	TEST
4GM6	4.2	AC1234	567*	24XZ
5GM6	5.6	AC1234	567*	24XZ
6GK6	6.3	1234	B579	28W
6DFX5	Set Line to 80% mark			
	50	AC123	A456	482
	Latest Chart Form 648-23			

TUBE TYPE	SEC.	HEATER	MODEL 658 CIRCUIT H-K	P-G	PLATE
4GM6	P	4.0P	127	ac356	50S
5GM6	P	5.0P	127	ac356	50S
6GK6	P	6.4K	1234	h579	22Q
6DFX5	P	64F	123	467	28S
	Latest Chart Form 658-3				

TUBE TYPE	MODEL 598 FIL. A	B.	C. CONT	D	E.	F.	G.	GRID TEST	HEATER CURRENT
4GM6	4.2	32	—	4	5	1	6Y	10WY	A10.6KZ800
5GM6	5.6	32	—	4	5	1	6Y	10WY	A10.6GZ450
6GK6	6.3	4	9	5	7	2	8	40VY	
6DFX5	Set Line to 80% mark							3WY.	
	50	3	5	4	7	2	6		
	Latest Chart Form 598-2								

ANTENNAS & ACCESSORIES

1T. JFD—1960 *Exact-Replacement Antenna Guide for Portable and Toteable TV Sets* (20 pages), compiled and edited by Howard W. Sams & Co., Inc. Gives TV receiver model number, manufacturer's antenna part number, and model number of corresponding JFD exact-replacement antenna. Also Form 940 dealer catalog illustrating and describing 1960 line of natural silver and gold anodized *Hi-Fi* TV antennas, mounts, masts, and accessories. *See ad pages 14-15.*

2T. JERROLD—Data sheet on Model HSA-43 *TV/FM Amplified 3-Set Coupler*, which permits simultaneous operation of three receivers — with 5 db gain across the entire TV-FM band on two outlets and unity gain on the third. *See ad 2nd cover.*

3T. SOUTH RIVER—New 20-page catalog, listing and illustrating an expanded line of antenna mountings and accessories for all types of TV, FM, Citizens band, and "ham" antenna installations.

AUDIO, HI-FI & COMMUNICATIONS

4T. CBS—Folder RPA-374 on *Harmony* line of phonographs (also available from CBS Electronics Sales Corp. distributors). *See ad page 47.*

5T. DUOTONE—Wall chart of replacement phono needles, giving cross-reference data, illustrations, and prices.

6T. JENSEN MFG. CO.—New data sheet No. 168 describing *Concert* and *Viking* speakers for replacement and general-purpose applications. *See ad page 29.*

7T. ROBINS—Catalog No. 14 of audio accessories, condensed catalog for consumer distribution, No. RRP-3 *Phono/Recorder Drive Reference Guide*, and No. RMM-2 *M/M* head guide.

8T. SONOTONE — Illustrated leaflet on CM-17 *Flex-Mike*, a ceramic microphone with flexible stand for permanent installation in language labs, classrooms, PA systems, paging systems, and two-way radios. *See ad page 40.*

9T. TELEX—Literature on new *Dyna-Twin* headset for high-fidelity monaural or binaural listening, *Magna-Twin* headset designed for language-learning laboratories, and complete line of headsets, microphones, and other communications accessories. *See ad page 38.*

10T. UNITED SCIENTIFIC LABS.—Folders on Model TR-800 *Radio-Phone* Citizens band transceiver and DeWald stereo and monophonic high-fidelity components.

11T. UTAH—Catalog featuring radically new thin-profile wall speaker-baffle combinations and new inverted speakers.

COMPONENTS

12T. ARCO—12-page *Arcolytic* capacitor catalog, listing 1120 twist-mount types, 176 tubular types, and 49 printed-circuit twist-mount types of electrolytic capacitors. *See ad page 41.*

13T. BERNS—Data on *Ion* adjustable beam bender. *See ads pages 66, 78.*

14T. 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 61.*

15T. CORNELL-DUBILIER—Bulletin ESS-460 describing new *Wide-Range* CDE electrolytic capacitor for replacement of many different units with various ratings often found in modern table radios and clock-radios. *See ads pages 44, 53.*

16T. MERIT—New Simplified Replacement Guide for Service Technicians of Merit, a cross-reference of original manufacturers' part numbers with Merit replacement part numbers, arranged alphabetically by manufacturer. *See ad page 71.*

17T. SAMPSON—Catalog No. 558 of *Hitachi* components; full-color folder describing line of *Hitachi* radios. *See ad page 45.*

18T. SPRAGUE—36-page Catalog No. C-613 of service-type capacitors, transistors, and test equipment. *See ad page 10.*

19T. TRIAD—New brochure TY-61 on transistor transformers, containing complete electrical data on 26 types. Schematics for circuit applications include suggested transistors and rectifiers for use with each transformer. *See ad page 74.*

20T. VIDAIRE—Data sheets B212A-3 on power transistors and silicon rectifiers, B215-4 on replacement IF transformers, and B214-3 on line-voltage regulator capable of handling loads up to 350 watts.

21T. WORKMAN—New transistor cross-reference chart, listing more than 800 entertainment-type transistors of domestic, private-label, and Japanese types. *See ad page 72.*

KITS

22T. 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 20.*

SERVICE AIDS

23T. CHEMICAL ELECTRONIC ENG'G.—Descriptive folder on *HUSH, EVER QUIET, EVER KLEER*, and *SURE-N-EASY* electronic chemicals. *See ad page 50.*

24T. GC ELECTRONICS—Wall chart of exact-replacement knobs for TV receivers and record changers, with cross-reference information and photographs of all 235 types of knobs available.

25T. INJECTORALL—1960 catalog of electronic chemicals. *See ad page 82.*

26T. PERMA-POWER — Colorfully illustrated brochure describing complete line of brighteners, featuring new low-voltage series and 110° types. *See ad page 56.*

27T. PRECISION TUNER—Information on repair and alignment service available for any type of TV tuner. *See ad page 86.*

28T. SUPEREX—Catalog of products "designed to make life easier for the serviceman," featuring repair shafts for broken studs on tunable coils such as width and horizontal frequency adjustments. *See ad page 64.*

29T. YEATS—Information about dolly for delivering TV and hi-fi sets or appliances, and about padded TV, radio, and appliance covers. *See ad page 90.*

SPECIAL EQUIPMENT

30T. ACME ELECTRIC—Catalog 091-BL01 giving detailed information on automatic voltage stabilizers and manual voltage adjustors for TV receivers and other electronic applications. *See ad page 90.*

31T. SWITCHCRAFT—2-color, 4-page brochure on Language Laboratory components, with illustrations and electrical specifications. *See ad page 70.*

TECHNICAL PUBLICATIONS

32T. CLEVELAND INSTITUTE OF ELECTRONICS—32-page brochure describing new instructional material for radio and TV servicemen who want to know more about computers, industrial electronics, pulse circuits, magnetic amplifiers, FCC licensing, and many other related fields. Also copyrighted *Pocket Electronics Data Guide.*

33T. GENERAL ELECTRIC—10-page guide to profitable servicing, *Techni-Talk*, containing information on new circuits, work-saving short cuts, and photographic reproductions of TV faults. *See ads pages 26-27, 55.*

34T. GERNSBACK — Descriptive literature on Gernsback Library books. *See ad page 63.*

35T. RIDER—Summer 1960 Catalog. *See ad page 72.*

36T. HOWARD W. SAMS—Literature describing all current publications on radio, TV, amateur radio, communications, audio and hi-fi, and industrial electronics servicing. *See ads pages 68, 69, 78, 86.*

TEST EQUIPMENT

37T. B & K—Bulletin ST25-R, digest of information on Model 1075 *Television Analyst*, Models 1070 and A107 *Dyna-Sweep* circuit analyzers, Models 550, 650 and automatic 675 *Dyna-Quik* mutual conductance tube and transistor testers, and Model 440 CRT rejuvenator-tester. *See ad page 13.*

38T. CLAROSTAT—Information on power-resistor decade box covering range from 1 to 999,999 ohms. *See ad page 9.*

39T. HICKOK—2-color broadside (form TT-601) describing complete line of tube and transistors testers, including roll-chart and punch-card types. *See ad page 57.*

40T. JACKSON—Information and specifications on Model 605 *Audio Sine/Square Wave Oscillator*, with suggestions for service uses. *See ads pages 58, 92.*

41T. RCA—New brochure 1Q1003 on line of electronic instruments. *See ads pages 50, 62, 65, 70.*

42T. SECO—Data on new Model 500 test set which cuts servicing and installation time on Citizens band and other crystal-controlled two-way radio equipment; also information on new version of *Grid-Circuit Tester*. *See ads pages 87, 89, 91.*

43T. SENCORE—New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter*. *See ads pages 73, 75, 77, 79, 81, 83.*

TOOLS

44T. BERNS—Information on 3-in-1 picture-tube repair tool and *Audio Pin-Plug Crimper*. *See ads pages 66, 78.*

FACTS

to help you sell more

RCA Silverama Picture Tubes

••• the All-New replacement picture tubes that command premium price and profits.

Here are the facts—proof that RCA Silverama is your customers' best picture tube buy.

1 FREE OF GLASS DEFECTS. Glass cord lines, scratches, chips, or buffed faceplates are common defects found in many brands of tubes made with used glass. Surest way to avoid these defects and also obtain the latest optical advances in faceplate engineering: an All-New RCA Silverama!

2 ALL-NEW. Of the three largest-selling brands of replacement TV picture tubes, only RCA Silverama is guaranteed 100% all-new—new glass, new gun, new phosphor, new everything! You'll get written proof—right on the warranty card.

3 FINEST SCREEN QUALITY. Advanced screen coating and bonding processes combined with RCA's giant vibration-free screen settling machines assure the maximum in picture screen quality and uniformity.

4 RCA "KNOW-HOW". RCA's continuous product research and advanced design engineering have resulted in RCA Silverama picture tubes being steps ahead of all other brands.

5 WORLD'S FINEST. RCA Silverama is manufactured in the world's most modern manufacturing plant using all-new premium-quality materials. Result? RCA Silverama is the world's finest picture tube.

® Silverama

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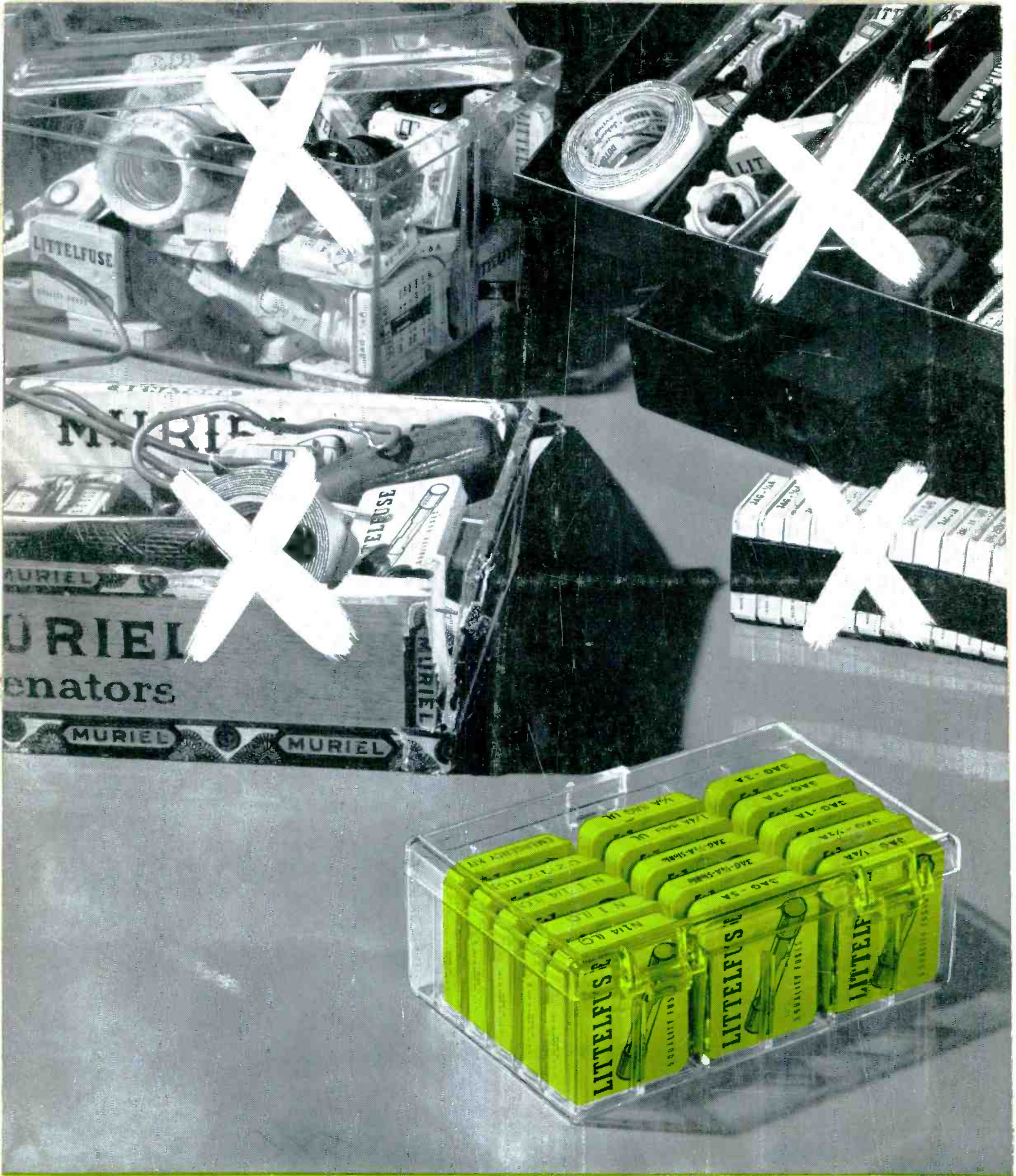

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THERE'S ONLY ONE RIGHT WAY

A *fuse caddy* for your *tube caddy:* 18 individual compartments for fingertip selection. The fuse caddy is complete with the 15 boxes of fuses required to service 93% of all TV sets. Three spare compartments are provided for additional fuses of your own selection.

LITTELFUSE *Des Plaines, Ill.*