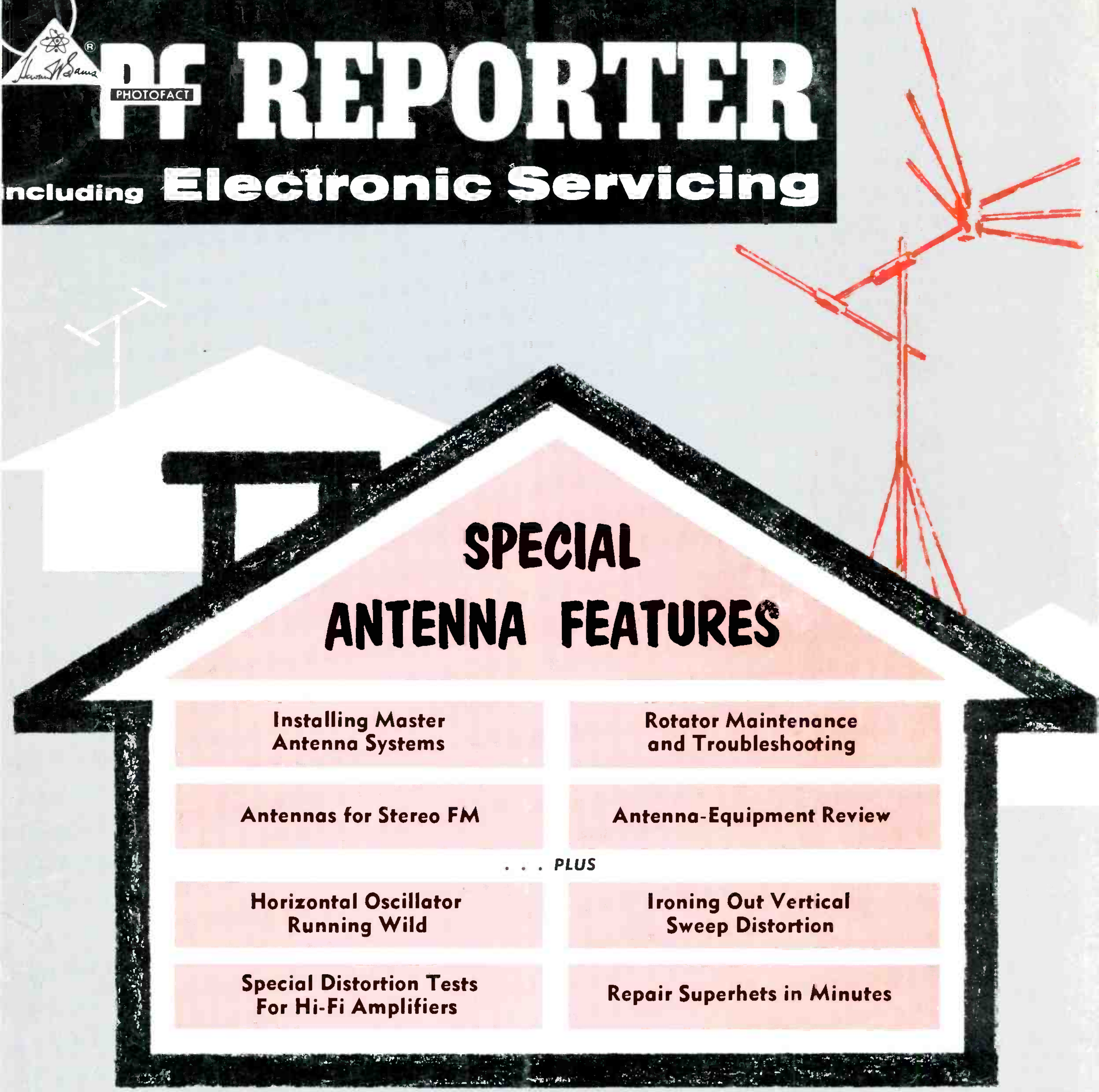
AUGUST, 1962 35 CENTS

PF REPORTER

PHOTOFACT

including Electronic Servicing



FINALLY!

A SUPERIOR LIQUID CONTACT CLEANER

Ultra-New CONTA·CARE KIT II

$1.25

Cleans Almost Instantly with Minimum Rubbing

After years of painstaking research, Standard Kollsman *for the first time* can honestly recommend a liquid contact cleaner. You'll find it in the new ContaCare Kit II. You'll also find a soft tough cloth—lint-free to avoid fouling . . . and a tube of non-evaporating grease for permanent channel lubrication and contact protection. Instruction sheet is clear, brief, and complete. Kit is compact and sturdy. Try it soon . . . and save your elbow grease for jobs that need it.

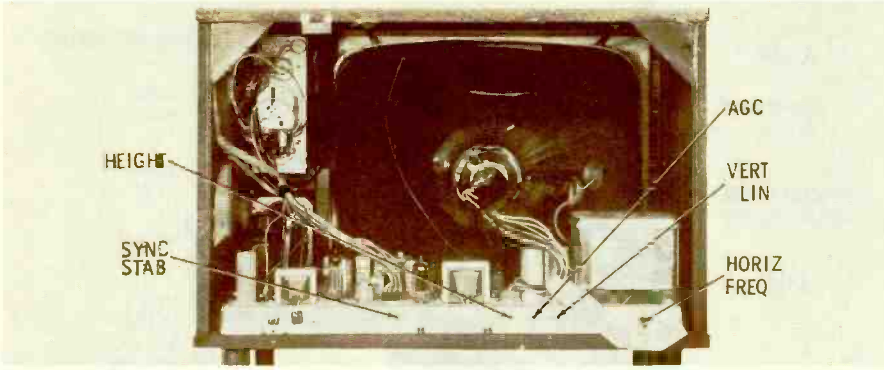
- NO RESIDUE
- NO SUBSEQUENT CORROSION
- NON-FLAMMABLE
- NON-CONDUCTIVE

INSIST ON THE GENUINE CONTACARE KIT II

standard kollsman® INDUSTRIES, INC.

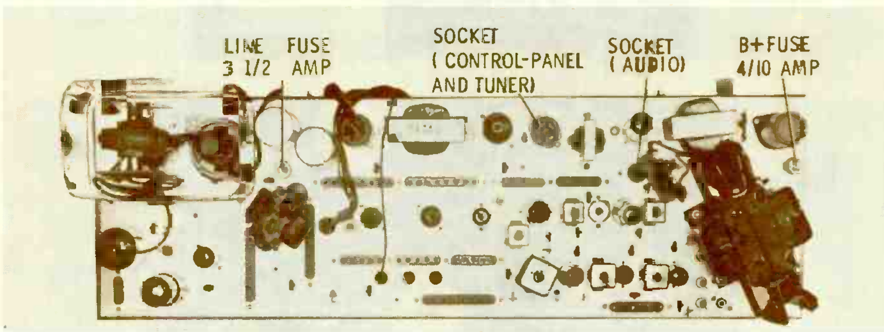
FORMERLY STANDARD COIL PRODUCTS CO., INC., MELROSE PARK, ILLINOIS

WORLD'S LARGEST MANUFACTURER OF TELEVISION TUNERS



Curtis Mathes Model 196-23 Chassis 6D

This is one of the consolette TV sets introduced by Curtis Mathes, containing their 6D chassis. In physical shape, this long, thin chassis is similar to the 6 series introduced earlier in the year. In the new 6D models, however, the low-voltage circuit differs from the previous design—two silicon rectifiers are used rather than a tube. The B+ circuit is protected by a bayonet-type 4/10-amp fuse, while a 3½-amp fuse protects the input winding of the power transformer from overload. For the 6-volt filament circuit, you'll find a #26 wire fuse located on the underside of the chassis.



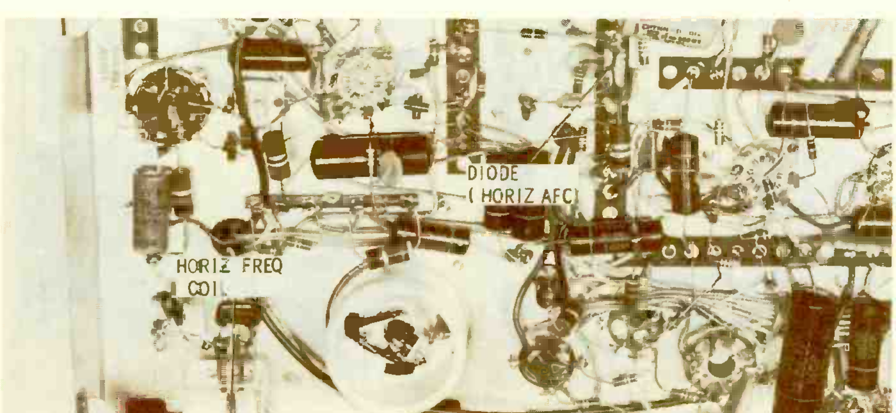
Operating knobs—brightness, contrast, channel selector, fine tuning, vertical and horizontal hold, and the on-off-volume assembly—are located on the front control panel. The fine-tuning knob, when rotated, engages and adjusts each individual oscillator slug.

This chassis has three stages of IF amplification, and a soldered-in diode is used as the video detector. The diode is located inside the third IF can, and you must unsolder the cover to get at it.

A buzz control, shown in the close-up photo, is mounted on the topside of the chassis. The control is in the cathode circuit of the 6BN6, and can be adjusted for minimum intercarrier buzz in the sound.

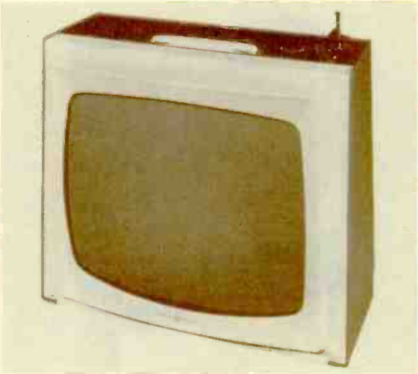
A 6AN8 functions as a sync amplifier and keyed AGC tube. You can adjust the AGC-range control in the following manner: Tune the receiver to the strongest station in the area, while observing the sound and picture. Turn the control clockwise until overloading takes place; then rotate the control a few degrees counterclockwise from this point. The sync-stability control may be set in the same manner. Both of the above controls —and those for vertical linearity, height, and horizontal frequency—are accessible from the rear of the cabinet.

A soldered-in dual diode (see photo) is used for horizontal AFC. To replace this component, you must first remove the chassis from the cabinet.



The control panel and the tuner are connected to the main chassis via a cable, plug, and socket. The audio-signal path, to and from the volume control, is completed through shielded leads and a separate plug.

The safety glass can be removed for cleaning if you'll remove the metal trim (held in place with four screws) from along the top front of the cabinet.



General Electric Model M200XGN (Chassis LX)

Shown here is General Electric's 19" portable television which uses the newly introduced LX chassis. This chassis is very similar to the LW series previously built by G-E, the main difference being the use of six compactrons in the newer chassis. As shown in the close-up photo, a compactron has 12 small pins located around the outer edge of the large glass tube envelope. The "pin" in the center is an exhaust tip used in evacuating the tube. This set is one of the first to use so many compactrons in its design.

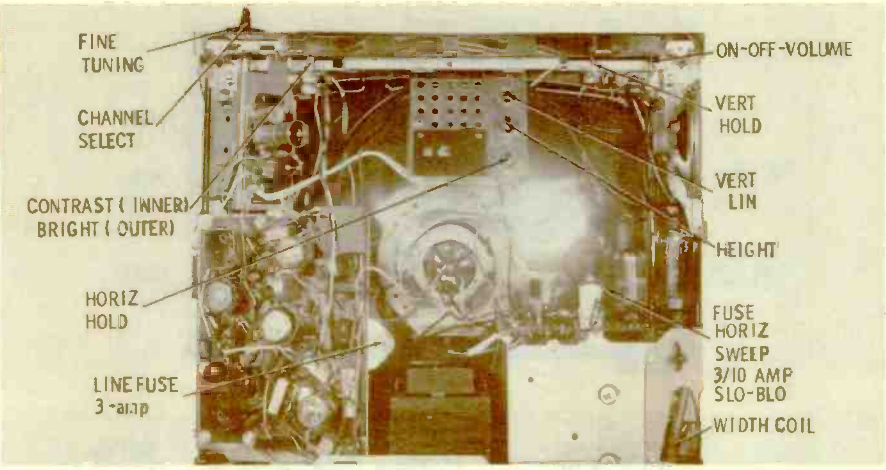
To become acquainted with a few of these tubes, let's examine the circuits in which they function. The two pentode sections of a 6AR11 serve as the first and second IF amplifiers, while a 6AS11 operates as the video output, sync separator, and sound IF amplifier. A 6G11 is the audio detector-audio output tube. For the horizontal phase detector (AFC) and the horizontal multivibrator, a 6B10 is used, while a 6GF5 serves as the horizontal output tube. The combined vertical multivibrator and output stage includes a 6FJ7. The remaining circuits in the set make use of conventional tube types such as the 5U4GB, 6W4GTA, etc.

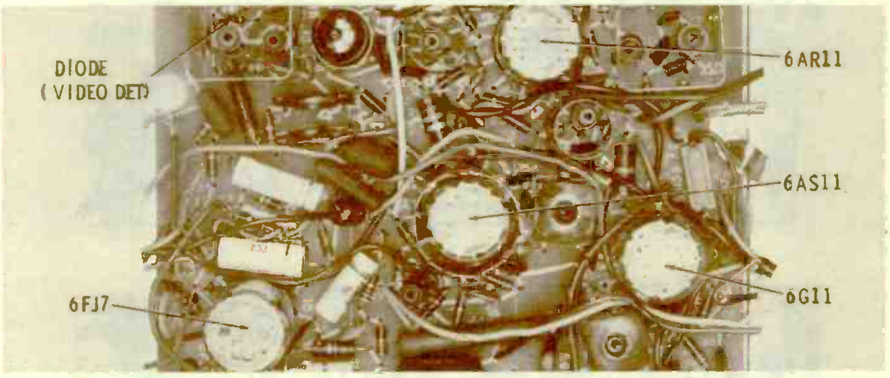
Vertical hold, brightness, contrast, channel-selector, fine-tuning, and on-off-volume controls are located at the top of the cabinet. The vertical sweep adjustments (linearity and height) and the horizontal hold control are accessible at the rear of the cabinet.

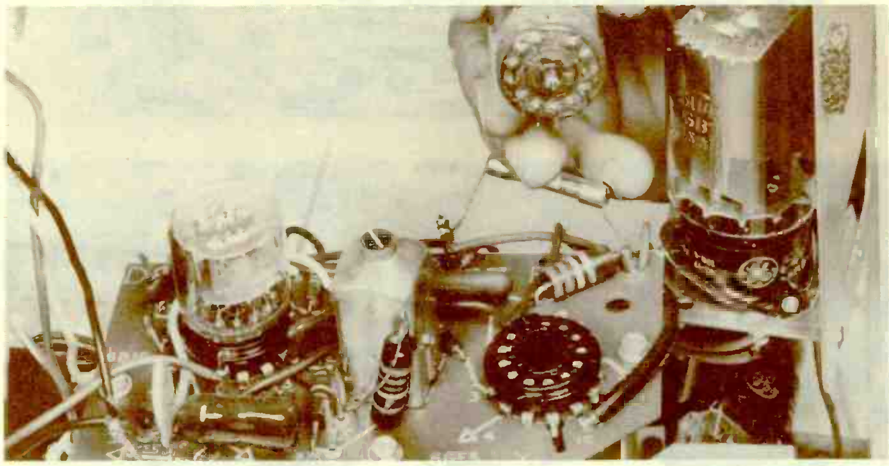
The width coil. mounted on the lower right side of the chassis, may be adjusted by turning the plastic extension knob which moves the slug (via a flexible cable) in or out of the coil form.

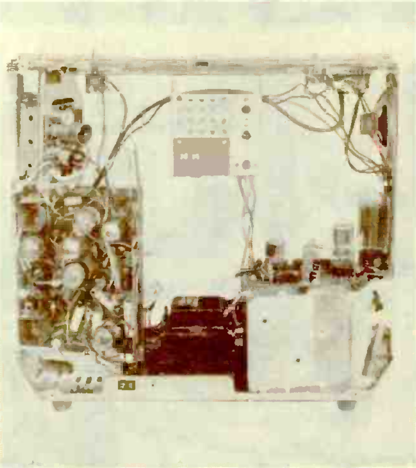
Three fuses provide overload protection in this chassis: a 3-amp line fuse in the power-transformer primary, a wire fuse in the filament circuit, and a 3/10-amp slow-blow fuse located in the B+ line to the horizontal sweep circuit. However, in some production runs of the LX chassis, only *one* fuse is used to protect the B+ circuits. Connected in the main B+ line from the LV rectifier, this fuse is a 6/10-amp slow-blow type.

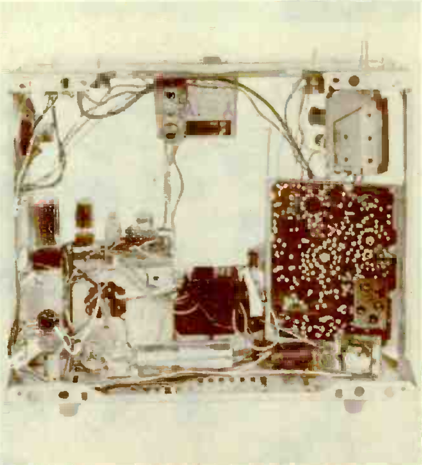
To pull the chassis for servicing, you must first remove the control knobs, the rear cover, four screws holding the chassis to the front of the cabinet, the anode lead, the picture-tube socket, and the yoke clamp. To provide access to the 114° picture tube (a 19CFP4), the chassis must first be removed from the cabinet.

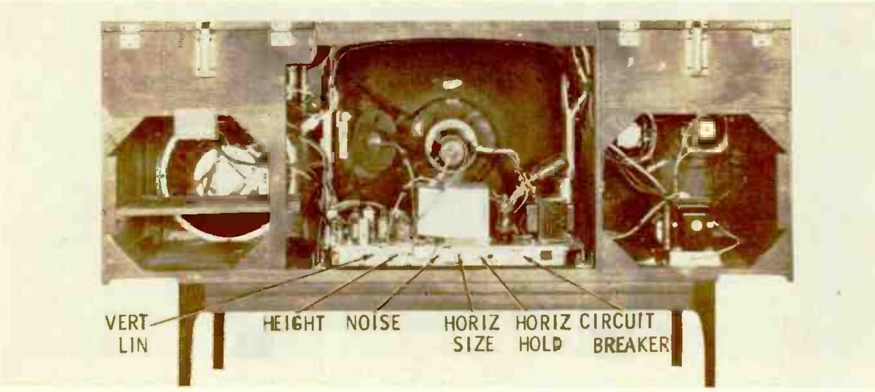


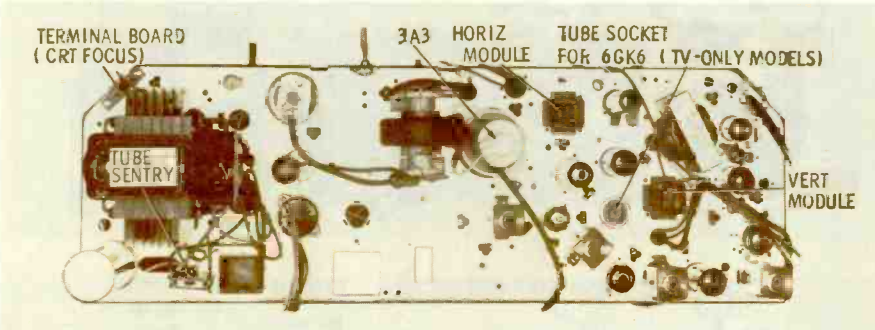


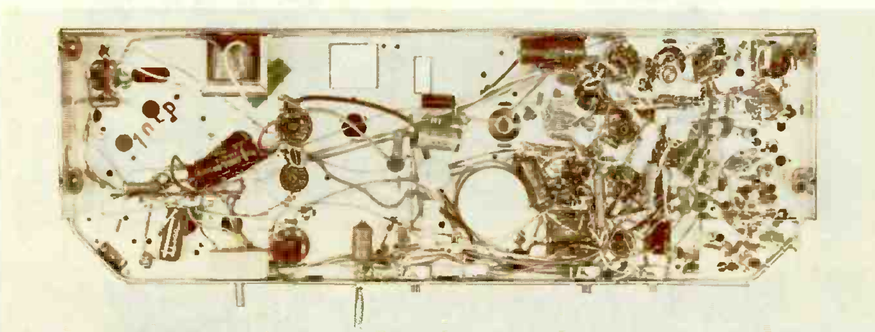


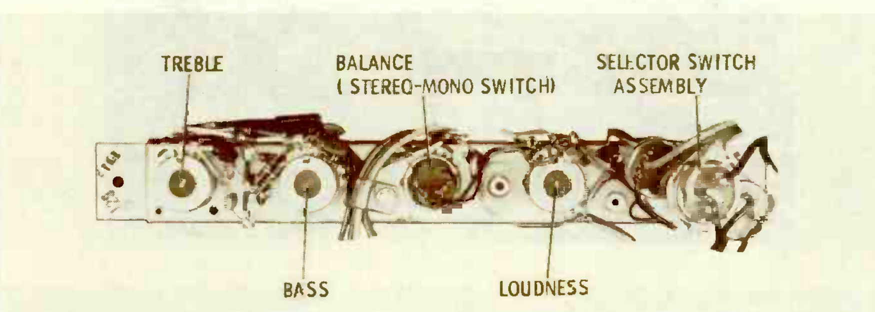


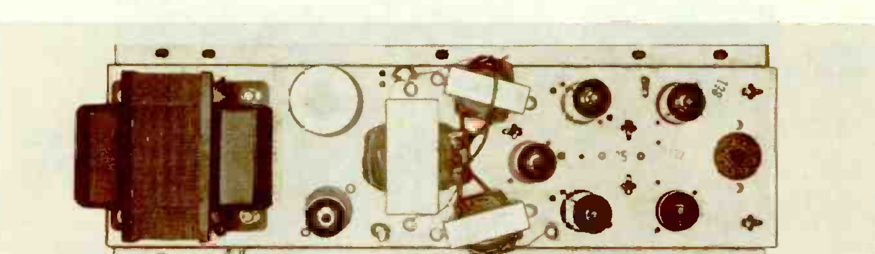











STEREO AMPLIFIER CHASSIS

Motorola Model 23SF5MAF TV Chassis TS-579B-03 Amplifier Chassis HS-979A

The combination model shown here represents the Motorola line of 23" sets which contain the TS-579 series chassis. This model includes a 14-watt stereo amplifier chassis, with provisions for adding an AM/FM tuner if desired. Some of these sets contain an all-transistor remote-control system; still others are shipped complete with tuner, preamp, and stereo amplifier already installed.

In combination models, the audio-detector output is coupled from the TV chassis to the stereo amplifier; there is no need for a TV audio-output tube (or transformer) in the these sets. In TV-only models, the empty tube socket seen in the photo will contain a 6GK6.

A separate amplifier-control panel—on which the loudness, balance (pull for *mono* operation), bass, and treble controls are mounted—also contains the FUNCTION switch. This four-position switch selects the desired receiver function—OFF, PHONO, RADIO, and TV. The operating controls for the TV chassis are mounted on another control panel and include the contrast, brightness, vertical hold, channel selector, fine tuning (push to adjust), and (something new for Motorola this year) an OPTIMIZER control. This last control is a 7000-ohm pot which, when adjusted, affects the video-detector load circuit.

No printed circuits appear in this chassis, but you'll find a module unit in each sweep circuit. These modules are plug-in types, and can be replaced easily.

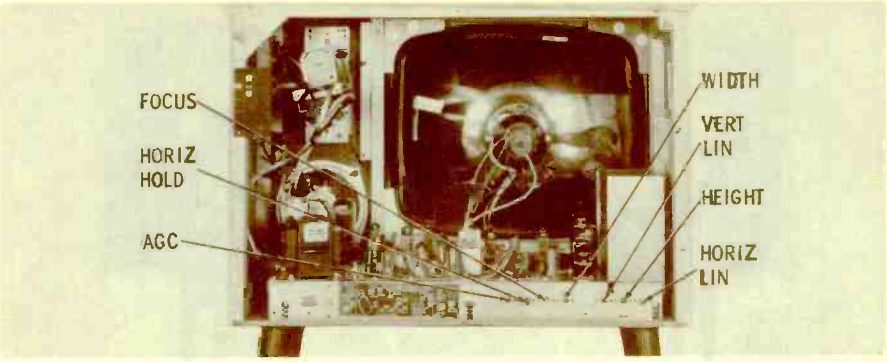
The *Tube Sentry*, a familiar component of Motorola sets, is found in this chassis. This thermal switch delays the application of B+ to tubes until the filaments reach operating temperature. A circuit breaker protects the power transformer.

Mounted on the rear of the chassis are the vertical linearity, height, horizontal hold, horizontal size (width) and NOISE controls. The latter adjustment sets the operating conditions for both the AGC and the sync circuits.

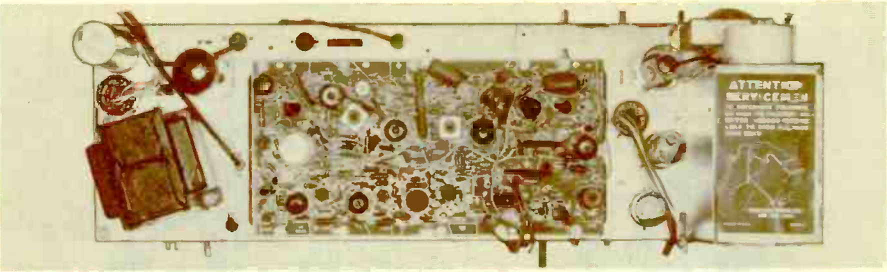
Don't look for a semiconductor dual diode if you have horizontal-frequency trouble in this receiver; a 6BL8 is used as a combined horizontal AFC and oscillator.

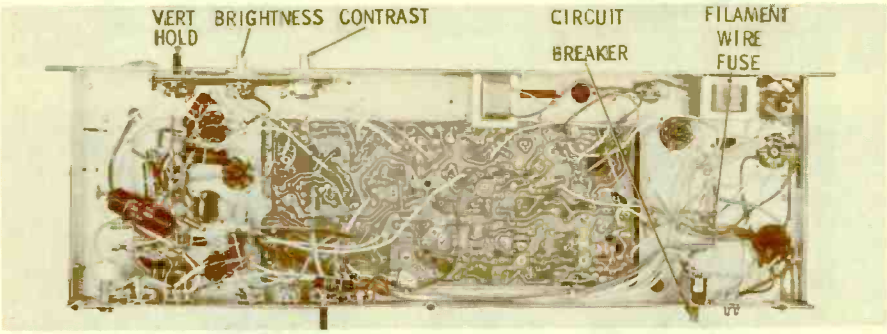
The HV rectifier may be a 3A3 (as in many previous Motorola sets) or a new alternate type, the 3AW3.

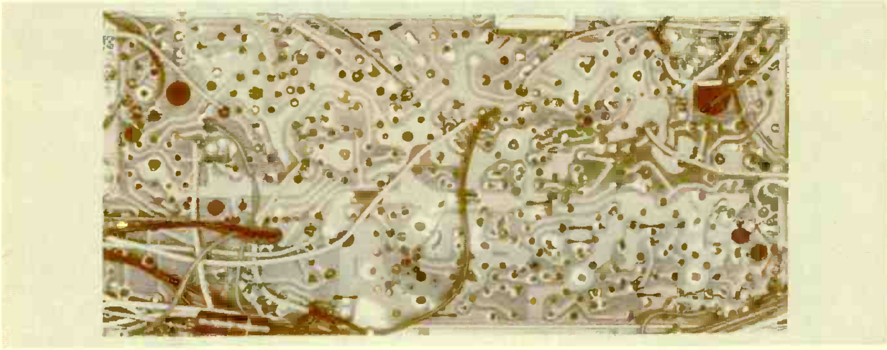
PF REPORTER for August, 1962, Vol. 12, No. 8. PF REPORTER is published monthly by Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis 6, Indiana. Second-class postage paid at Indianapolis, Indiana. 1, 2 & 3 year subscription price: U.S.A., its possessions, and Canada: $4.00, $7.00, $9.00. All other countries: $5.00, $9.00, $12.00. Current single issues 35c each; back issues 50c each.

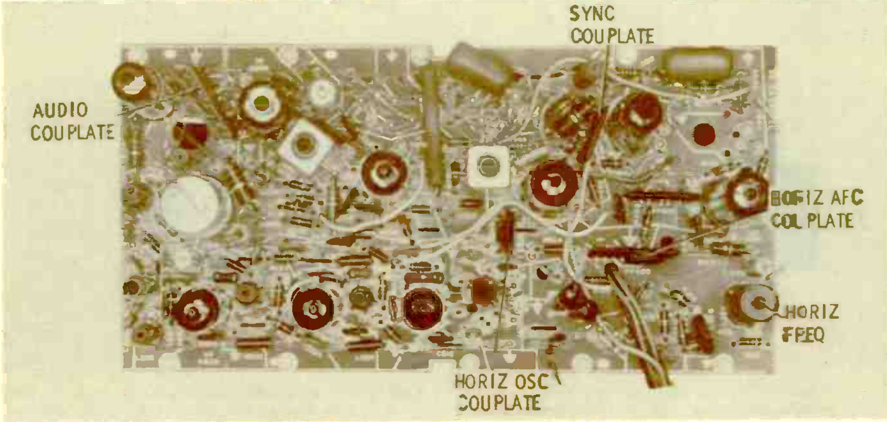


Sylvania Model 19L17W Chassis 558-1









This 19" model contains one of the 558-series chassis being produced by Sylvania. Like the 555 series introduced last year in 23" receivers, this chassis is transformer-powered and uses 6-volt tubes. A circuit breaker in the center-tap lead of the transformer secondary provides protection for the rectifier circuit, while the filament wiring is protected against short circuits by a #28 wire-link fuse (see the photo for its physical location).

The 114°, bonded-shield picture tube may be either a 19BNP4 or a 19BQP4. Both types are identical, except for a frosted screen on the latter. The accelerator grid (pin 3) operates at an unusually low potential of approximately 70 volts, and a 5-megohm focus pot permits varying the voltage on the focusing grid (pin 4) from 0 to 660 volts.

Most of the tubes and components used in this set are mounted on one large printed-circuit board. Servicing checks are easily made from the top side of this board because its large size permits components to be well spaced. Any repair or component replacement needed is fairly simple—the underside of the board is clear of obstructions which might interfere with soldering operations.

Four printed-component units — one each in the audio, sync, horizontal AFC, and horizontal oscillator circuits — are used in this chassis. These multiple-component units are labelled in the photo.

The contrast, brightness, and vertical hold knobs are located at the bottom front of the cabinet and have plastic extension shafts for connection to the actual controls.

Controls which must be adjusted from the rear of the set include the AGC, width, focus, vertical linearity, height, and horizontal hold and linearity.

For chassis disassembly, remove the following items: the operating knobs, the rear cover (fastened with seven screws), four connecting plugs (tuner, IF, yoke, and volume assembly), the CRT socket and anode lead, and the speaker leads. One screw from the tuner bracket, the tuner, and three bolts from the bottom of the chassis must all be removed. As you pull the chassis to the rear, the plastic extensions on the three panel controls will disconnect from the control shafts. During the reassembly operation, you must reconnect these extensions before pushing the chassis to the front of the cabinet.

See PHOTOFACT Set 583, Folder 2

Mfr: Philco **Chassis No.** 12J27

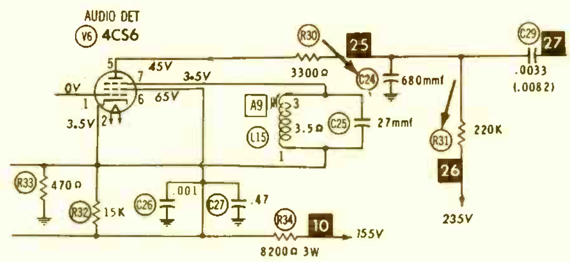
Card No: PH 12J27-1

Section Affected: Sound.

Symptoms: No sound.

Cause: Shorted plate-bypass capacitor in audio detector, resulting in burned plate-load resistor.

What To Do: Replace C24 (680 mmf) and R31 (220K).



Mfr: Philco **Chassis No.** 12J27

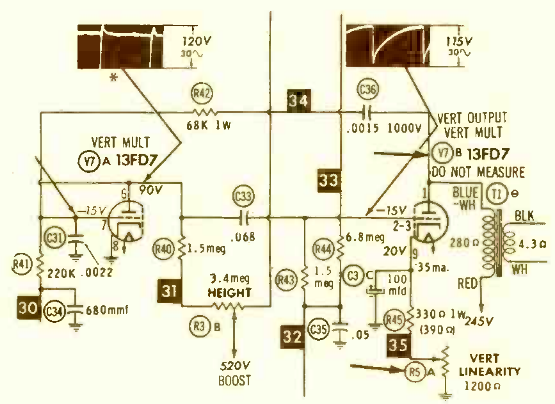
Card No: PH 12J27-2

Section Affected: Raster.

Symptoms: Impossible to fill screen vertically, or to obtain good vertical linearity.

Cause: Burned vertical-linearity control; internal short in vertical-sweep tube.

What To Do: Replace R5A (1200 ohms) and V7 (13FD7).



Mfr: Philco **Chassis No.** 12J27

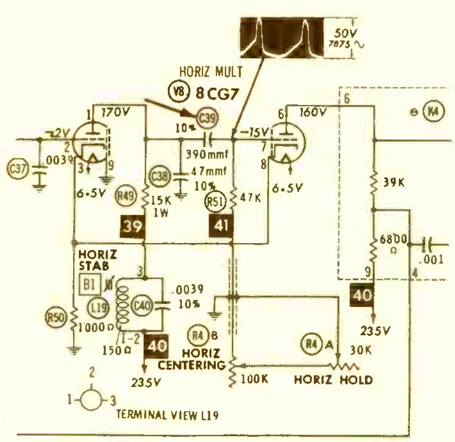
Card No: PH 12J27-3

Section Affected: Sync.

Symptoms: Horizontal sync completely lost.

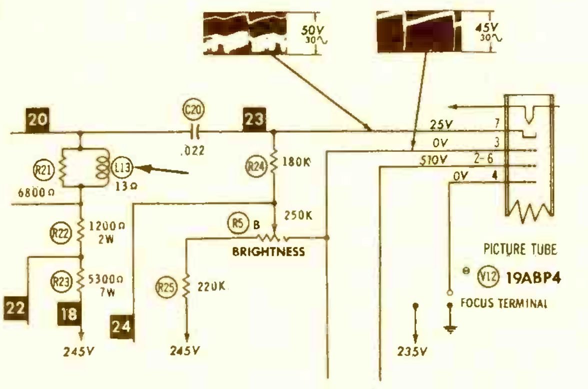
Cause: Leaky coupling capacitor in horizontal multivibrator.

What To Do: Replace C39 (390 mmf, 10%, silver mica).



See PHOTOFACT Set 583, Folder 2

See PHOTOFACT Set 583, Folder 2



See PHOTOFACT Set 583, Folder 2

Mfr: Philco **Chassis No.** 12J27

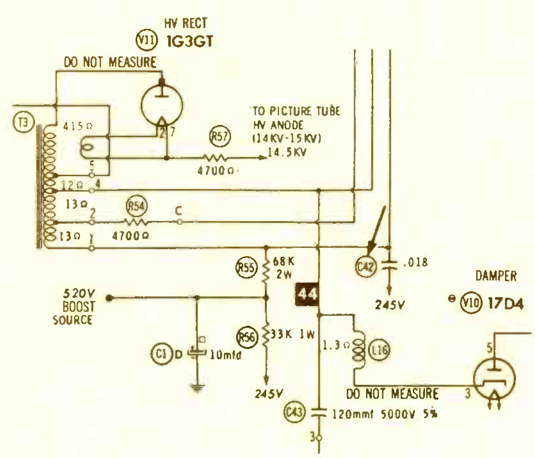
Card No: PH 12J27-4

Section Affected: Pix.

Symptoms: Picture smeared.

Cause: Open peaking coil in plate circuit of video output.

What To Do: Inspect both ends of L13 for visibly open connection. If no repairable break can be found, replace L13.



Mfr: Philco **Chassis No.** 12J27

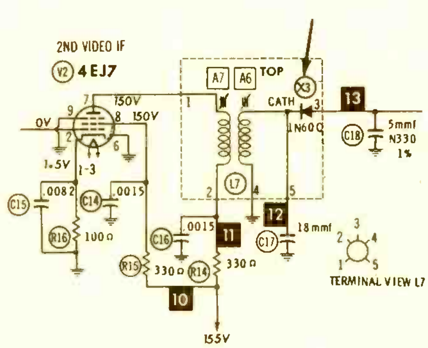
Card No: PH 12J27-5

Section Affected: Raster.

Symptoms: No raster; sound normal.

Cause: Shorted boost capacitor.

What To Do: Replace C42 (.018 mfd—600V).



Mfr: Philco **Chassis No.** 12J27

Card No: PH 12J27-6

Section Affected: Pix.

Symptoms: Video overloading; picture may be negative.

Cause: Defective video-detector diode.

What To Do: Replace X3 (1N60C), located inside transformer L7.

See PHOTOFACT Set 526, Folder 1

Mfr: RCA **Chassis No.** KCS134

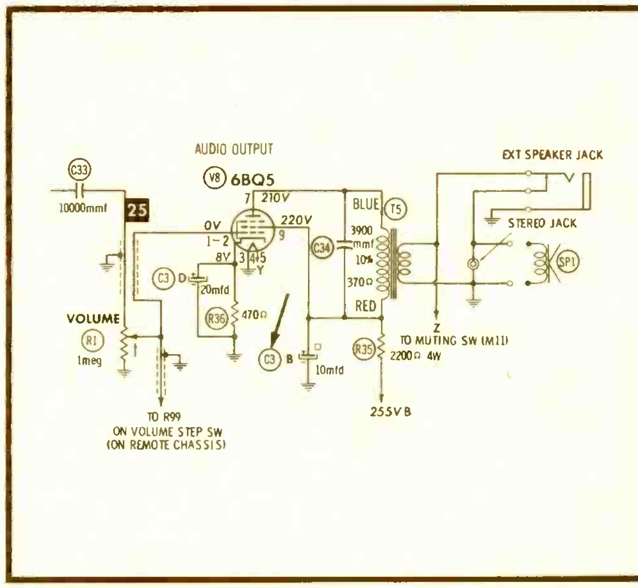
Card No: RCA 134-1

Section Affected: Sound and pix.

Symptoms: Sound bars in picture and hum in sound.

Cause: Defective screen-bypass capacitor C3B in audio-output stage.

What To Do: Replace C3 (100-10-20-20 mfd —350-350-350-25V).



Mfr: RCA **Chassis No.** KCS134

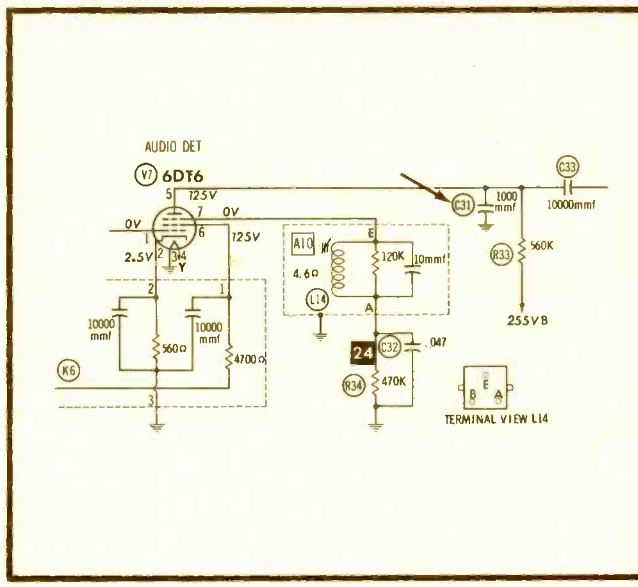
Card No: RCA 134-2

Section Affected: Sound.

Symptoms: No sound; zero voltage at plate (pin 5) of audio detector V7 (6DT6).

Cause: Shorted plate-bypass capacitor.

What To Do: Replace C31 (1000 mmf).



Mfr: RCA **Chassis No.** KCS134

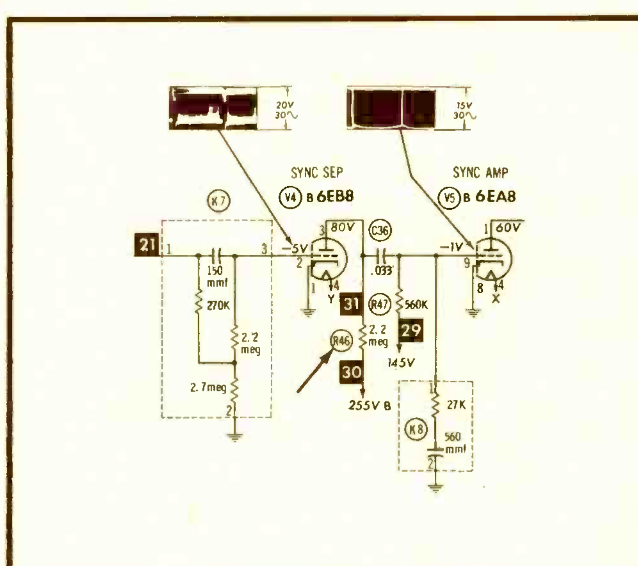
Card No: RCA 134-3

Section Affected: Sync.

Symptoms: No horizontal or vertical hold. No voltage at plate (pin 3) of sync separator V4B (6EB8).

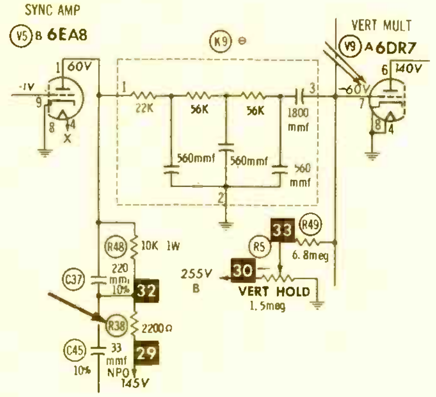
Cause: Open plate-load resistor.

What To Do: Replace R46 (2.2 meg).



See PHOTOFACT Set 526, Folder 1

See PHOTOFACT Set 526, Folder 1



Mfr: RCA **Chassis No.** KCS134

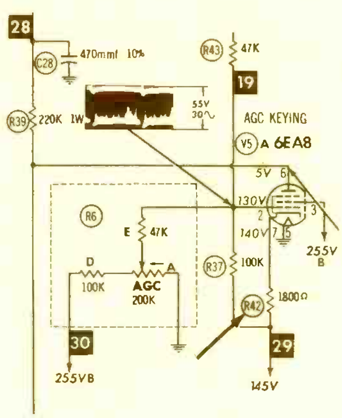
Card No: RCA 134-4

Section Affected: Sync.

Symptoms: Erratic horizontal hold.

Cause: Decrease in value of plate-load resistor in sync amplifier.

What To Do: Replace R38 (2200 ohms).



Mfr: RCA **Chassis No.** KCS134

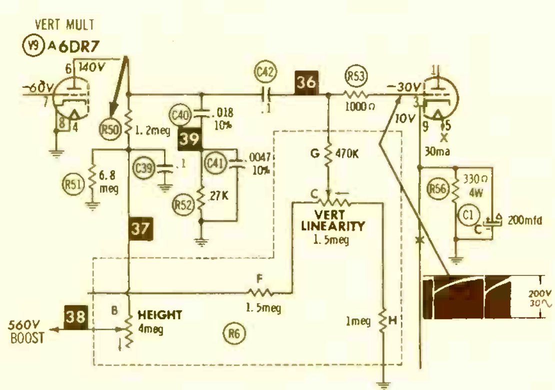
Card No: RCA 134-5

Section Affected: Pix.

Symptoms: Video overloading.

Cause: Cathode resistor of AGC keying tube V5A (6EA8) has overheated and decreased in value.

What To Do: Replace R42 (1800 ohms).



Mfr: RCA **Chassis No.** KCS134

Card No: RCA 134-6

Section Affected: Raster.

Symptoms: Insufficient vertical sweep.

Cause: Plate-load resistor of vertical multivibrator V9A (6DR7) has increased in value.

What To Do: Replace R50 (1.2 meg).

Tarzian offers

FAST, DEPENDABLE TUNER REPAIR SERVICE

ONLY

$8.50 INCLUDING

ALL PARTS (EXCEPT TUBES) and LABOR

ALL MAKES

It just makes sense that a manufacturer of tuners should be better-qualified, better-equipped to offer the most dependable tuner repair and overhaul service.

Sarkes Tarzian, Inc., pioneer in the tuner business, maintains a complete, well-equipped Factory Service Dept. —assisted by Engineering personnel—and staffed by specialized technicians who handle ONLY tuner repairs . . . on ALL makes and models.

Tarzian-made tuners received one day will be shipped out the next. There is a 12-month guarantee against defective workmanship and parts failure due to normal usage. And compare our cost of $8.50 and $15 for UV combinations. There is absolutely no additional, hidden charge for ANY parts except tubes. Replacements available at low cost on tuners beyond practical repair.

Tarzian-made tuners are identified by this stamping. When inquiring about service on other tuners, always give tube complement . . . shaft length . . . filament . . . voltage . . . series or shunt heater . . . IF frequency . . . chassis identification. All tuners repaired on approved, open accounts. Check with your local distributor for Sarkes Tarzian replacement tuners, replacement parts, or repair service.

24-HOUR SERVICE

1-YEAR WARRANTY

Tuners Repaired on Approved, Open Accounts

See your distributor, or use this address for fast, factory repair service

SERVICE MANAGER • TUNER DIVISION • DEPT. 3A

SARKES TARZIAN INC

east hillside drive • bloomington, indiana
edison 2-7251

MANUFACTURERS OF TUNERS . . . SEMICONDUCTORS . . . AIR TRIMMERS . . . FM RADIOS . . . AM-FM RADIOS . . . AUDIO TAPE . . . BROADCAST EQUIPMENT

Address all correspondence to PF REPORTER, 4300 W. 62nd Street, Indianapolis 6, Indiana

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

PF REPORTER

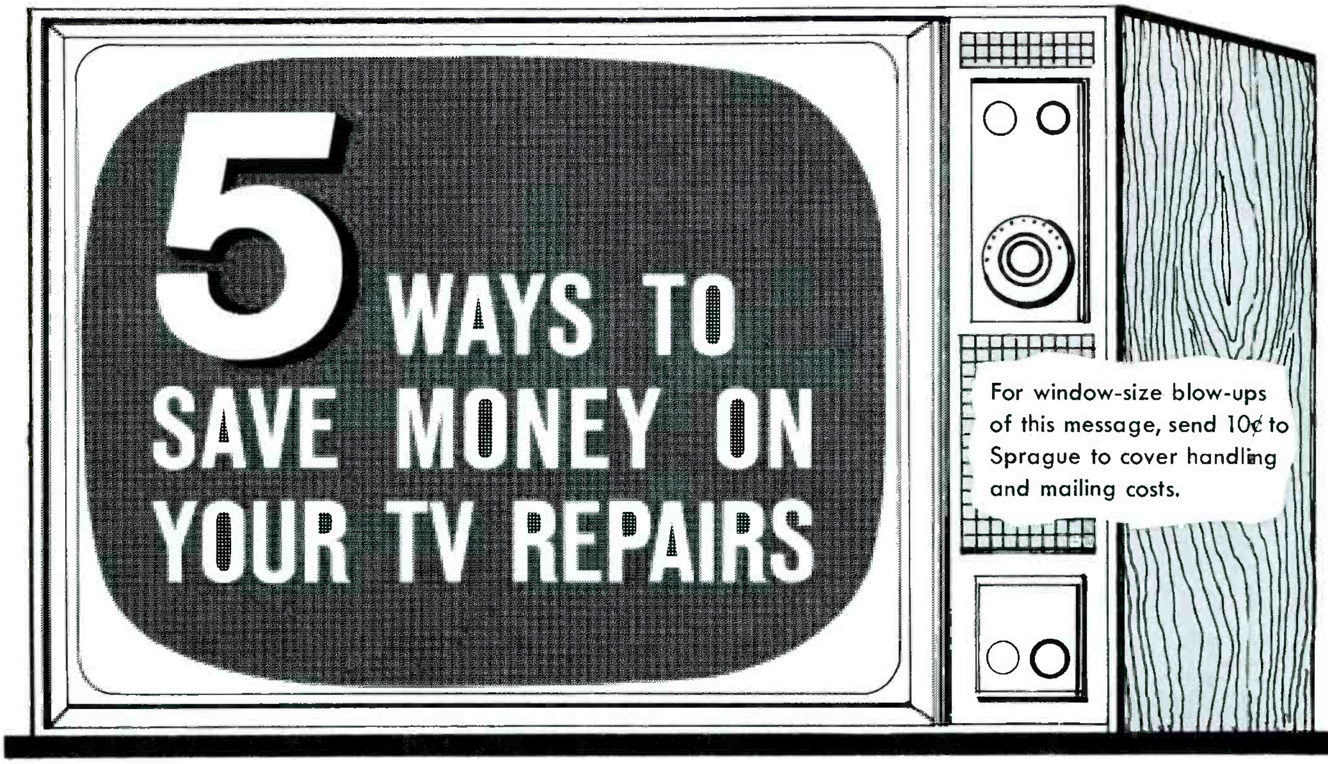
including Electronic Servicing

VOLUME 12, No. 8 — AUGUST, 1962

CONTENTS

ABOUT THE COVER

TV and FM antennas now crown more American homes than ever before. Four special articles in this issue, covering various phases of the outdoor-antenna business, reflect the continuing importance of this business to servicemen.



1 DON'T BE A "SCREWDRIVER MECHANIC."
Every year, hundreds of "do-it-yourself-ers" damage or ruin their sets, pile up needless expense, and endanger their safety by trying to make their own TV repairs. Your TV is the most intricate piece of equipment you've ever owned—far more complicated than your car! If you're tempted to tinker with it, DON'T! Guesswork is much too costly.

2 LEAVE YOUR TV REPAIRS TO A "PRO."
Years of training and experience make the TV technician an expert. He has repaired hundreds—perhaps thousands—of TV sets. He spends countless hours and hundreds of dollars on manuals, keeping up-to-the-minute on new developments, circuits, trouble-shooting techniques. He is qualified in every way to diagnose TV trouble accurately—cure it quickly and safely.

3 DON'T LOOK FOR SERVICE "BARGAINS."
There aren't any! Cut-rate prices mean cut-rate methods and cut-rate parts in your TV set. And these lead to unsatisfactory set performance, probable damage, and additional costly repairs. The expert TV technician charges a fair price for honest service. He can't afford special deals and service "bargains" any more than you can!

4 CALL YOUR TV EXPERT AT THE FIRST SIGN OF TROUBLE.
Don't wait for your set to go completely dead. Failure of one TV part sets up a chain reaction—other parts are damaged and repair costs pile up. Early attention prevents this and also makes it easier—and less expensive—to find and cure the trouble. To keep your repair costs low, call your TV technician when trouble *starts!*

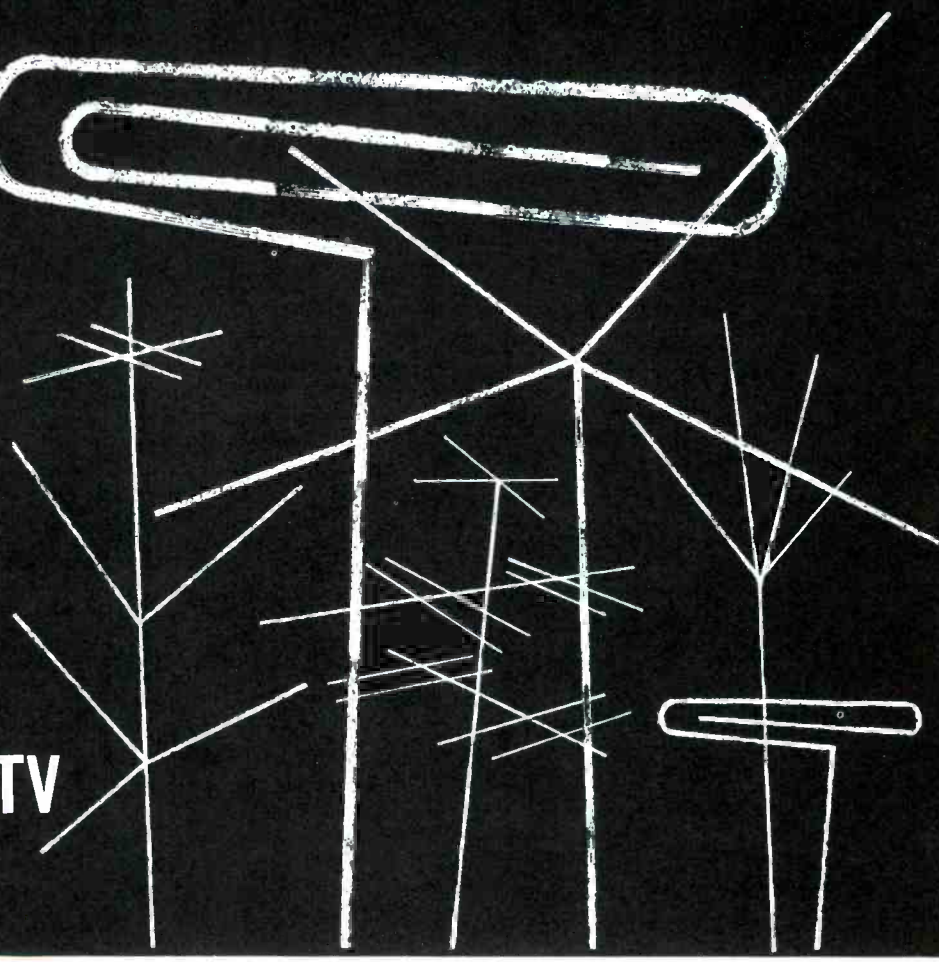
5 TRUST YOUR INDEPENDENT TV TECHNICIAN.
As a member of your community, he stakes his reputation on your continued satisfaction. His years of study and experience, his large investment in equipment, and the fact that *he's in business for himself* are your assurances of good work and honest prices. His first loyalty is to *you*—his customer.

THIS MESSAGE WAS PREPARED BY SPRAGUE PRODUCTS COMPANY,

DISTRIBUTORS' SUPPLY SUBSIDIARY OF SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASSACHUSETTS FOR . . .

YOUR NEIGHBORHOOD TV-RADIO TECHNICIAN

2 GREAT BELDEN CABLES FOR COLOR TV RECEPTION



CELLULINE* 8275

Maintains uniform electrical characteristics by eliminating all possible moisture between conductors. The thick outer wall of polyethylene protects the cable from abrasion and sun damage, and the round shape offers less resistance to wind. The result is a long lasting, efficient transmission line for clearer color and black and white TV reception.

AWG & (Stranding)	Color	Nom. O.D. (Inch)	Nom. Velocity of Propagation	Nom. Capacitance (mmf/ft)	Nom. Attenuation per 100' mc	db	Standard Package Lengths in ft
20 (7x28)	Brown	.300 x .400	80%	4.6	100	1.05	50' coils
					200	1.64	75' coils
					300	2.12	100' coils
					400	2.5	500' spools
					500	2.98	1000' spools
					700	3.62	
					900	4.3	

PERMOHM* 8285

Conductors are encapsulated in cellular polyethylene. This exclusive design provides clearer TV pictures in all areas including areas where conditions of salt spray, industrial contamination, ice, rain, or snow exist. It further improves fringe area reception as well as strengthens UHF and color TV reception.

AWG & (Stranding)	Color	Nom. O.D. (Inch)	Nom. Velocity of Propagation	Nom. Capacitance (mmf/ft)	Nom. Attenuation per 100' mc	db	Standard Package Lengths in ft
22 (7x30)	Brown	.255 x .468	73.3%	5.3	100	1.4	50' coils
					300	2.8	75' coils
					500	3.8	100' coils
					700	4.8	500' spools
					900	5.6	1000' spools

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902 — CHICAGO

Belden Cable is Packaged in Standard Lengths for Display and Handling

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

**Belden Trademark—Reg. U. S. Pat. Off.*

8-5-2

LETTERS TO THE EDITOR

Dear Editor:

The greed of some companies is fantastic. In my store I have a foreign-made recorder for which I have been trying unsuccessfully to locate parts. Finally, I phoned the consulate of the country involved, and they gave me the address of the company's local representative. When I called them, they told me if I wanted the set repaired I should bring it to them, since they do not sell parts to anyone. I feel this is a great injustice to servicemen; something should be done about it!

L & S ELECTRONICS

Brooklyn, N. Y.

As far as we know, present trade laws prohibit such action — a company such as you describe cannot legally refuse to sell parts to a bona fide service shop. Companies which engage in such unfair practices should, indeed, be "drummed out of the corps."—Ed.

Dear Editor:

Just finished reading your June special "Servicing Two-Way . . . the Right Way." The article gave a good general look at the subject, but failed to mention two important points: Simple peaking will not suffice for aligning the overcoupled IF coils found in some sets, and it is a "must" to adjust multiplier stages to the right peak and *not* to a harmonic. I suggest using the manufacturer's alignment instructions.

WILLIAM E. MURPHY

Clifton, N. J.

You're certainly right about overcoupled IF's, and it would be well for a beginner to consult the more detailed instructions furnished by the manufacturer, but you must have missed the point about multipliers—their function is to increase the frequency in multiples of the fundamental, and therefore they MUST be peaked to a harmonic.—Ed.

Dear Editor:

I have a question about freeze sprays ("Effective Use of Service Chemicals"—May, 1962 PF REPORTER). I have found, when using these sprays, I become giddy if I inhale any quantity of the vapor. This is sometimes followed by headaches. When I began suspecting the spray as being the cause, I experimented by inhaling a sizable amount of the stuff—I nearly passed out. Just how dangerous are these sprays?

BILL WHITE

Princeton, Fla.

Sure you didn't get hold of some "Scotch" spray? Seriously, since the principal ingredient in most freeze sprays is Freon—an inert substance—there should be no direct harmful effects from their use. However, direct inhalation of the vapor could possibly result in a lack of oxygen and partial suffocation. I strongly suggest, Bill, that you confine the use of freeze sprays to cooling components.—Ed.

Dear Editor:

Since drug stores take away a lot of our bread and butter by selling tubes, and since we don't sell drugs, I've worked out a way to "compete": I give each of my customers a free vitamin catalog which contains wholesale prices. The customers and the vitamin companies are both grateful! I urge all other technicians to join me, so the druggists will feel the same pinch we feel.

TV TECHNICIAN

Leavenworth, Kans.

That's the boy! Be sure the sets have B+ and the customers have B_1*—Ed.*

Dear Editor:

In the July, 1961 *Letters* column, when you printed Lee Clough's account of a customer who was trying to "put the air back in his picture tube" with a bicycle pump, you said something about having a "Believe It or Not" column for misadventures of this sort. If you ever do run such a column, I have a contribution for it.

A man brought in a TV set with the remark, "I've rebuilt it and replaced all the cartridges, but now the picture tube won't light." I took one trembling glance under the chassis, and had a nightmare in broad daylight. All resistors in sight had been changed. Investigating, I discovered he had read all the color codes *backwards*, made out a list of values he thought he needed, and found some clerk who obligingly sold him the nearest values (such as 500 ohms in place of 1 meg)! What guardian angel kept him out of the tuner, I'll never be able to guess. He was very "helpful"—handed me all the old resistors in a bag.

HAL CLARK

And there you were Hal, left holding the bag. . . Any other readers have experiences that would top yours and Mr. Clough's?—Ed.

Dear Editor:

I couldn't help noticing your remark "aligning by ear . . . just won't work where FM is concerned" (February, 1962 PF REPORTER, page 54). For about six years, I have been touching up TV and FM coils without any alignment equipment. It can be done very successfully by gradually attenuating the signal while adjusting the various coils.

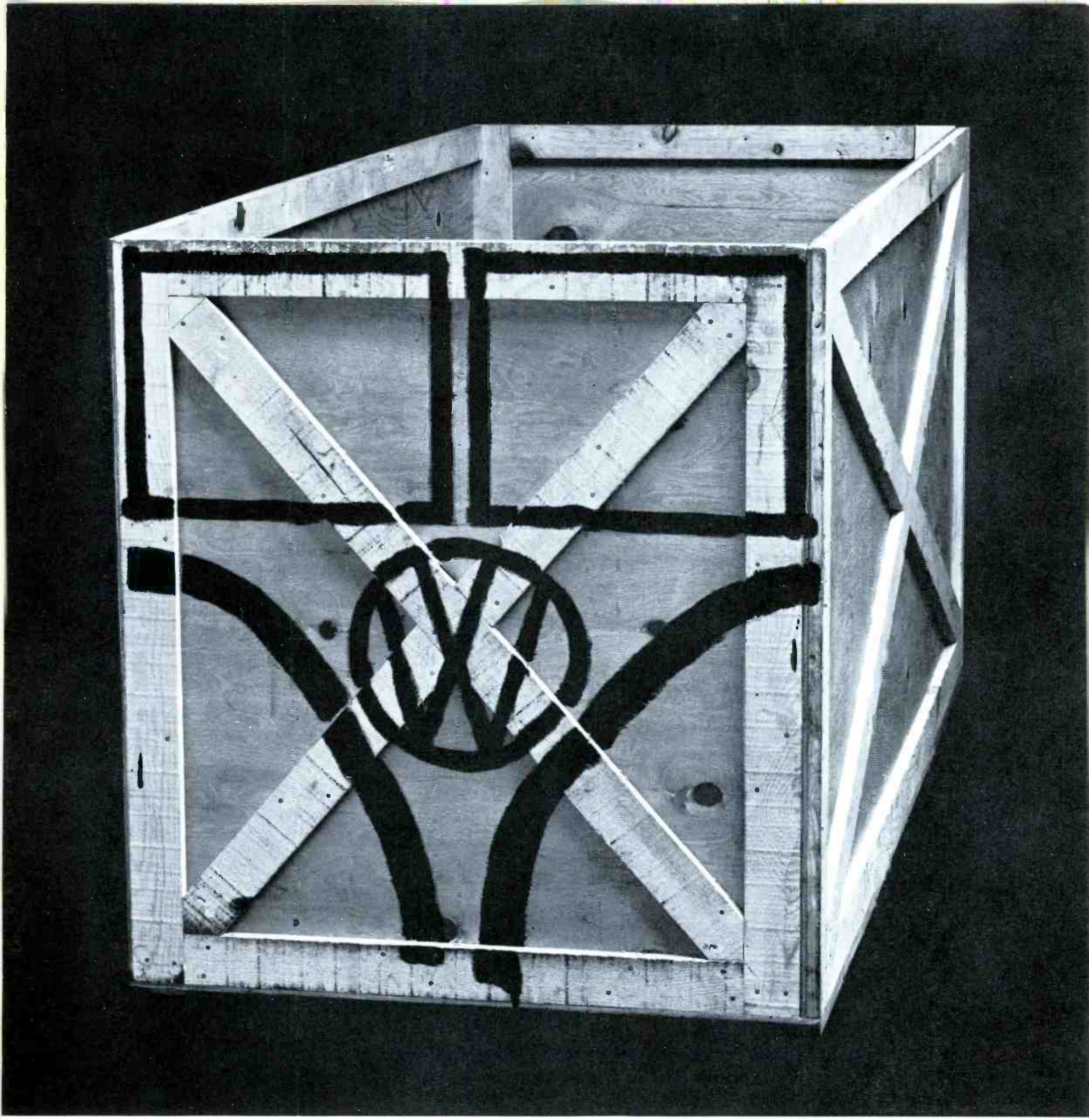
ROY R. WHITFIELD

Al's TV

Concord, Calif.

While it is undoubtedly possible to "guess at" the alignment of TV and FM

• *Please turn to page 16*



A Volkswagen truck is a big crate.

Our truck holds 170 cubic feet of stuff. Without stuffing.

(Actual capacity: 1,830 pounds. About 800 more than a half ton.)

It's our crate of a shape that does it.

Outside, you don't see a long front hood. (Our engine's in the rear. For extra traction.)

You can park our truck in 3 feet less space than a conventional truck. (It's only 9 inches longer than our VW Sedan.)

Once you're parked, you've got a doorway 4 feet wide. And double doors. Right in the side.

So you can get everything in and out from the sidewalk.

There's also a lift-up door in the rear.

For 80 bucks* more you can get another 4-foot-wide doorway. And double doors. Right in the other side.

And we haven't even mentioned the legendary VW economy. The extra tire wear. Etc.

Some crate.

receivers, the serviceman intent on doing a thorough job will seldom attempt so exacting a procedure without proper instruments. You are surely aware it is possible to align an FM set (or a TV set) for "maximum" indications, and end up with a very poor bandpass because coils are not operating at their design centers—not to mention the often-disastrous results of "touching up" stagger-tuned circuits. We stick by our guns and recommend that alignment equipment be used for these jobs.—Ed.

Dear Editor:

I would like very much to see you run an article (or even comment in your column) on tube substitution. With such a myriad of new tubes being introduced, I find many cases where a newer type may carry ratings better than an older one and appear to substitute directly. In fact, I am tempted to eliminate the older tubes completely from my overloaded caddies, and just stock the newer types.

What is your authoritative view as to how far a technician can go with substitution and still do qualified, legitimate work? I'd appreciate hearing your comments and possibly those of other readers.

CHAS. W. RUFFNER
Tucson, Ariz.

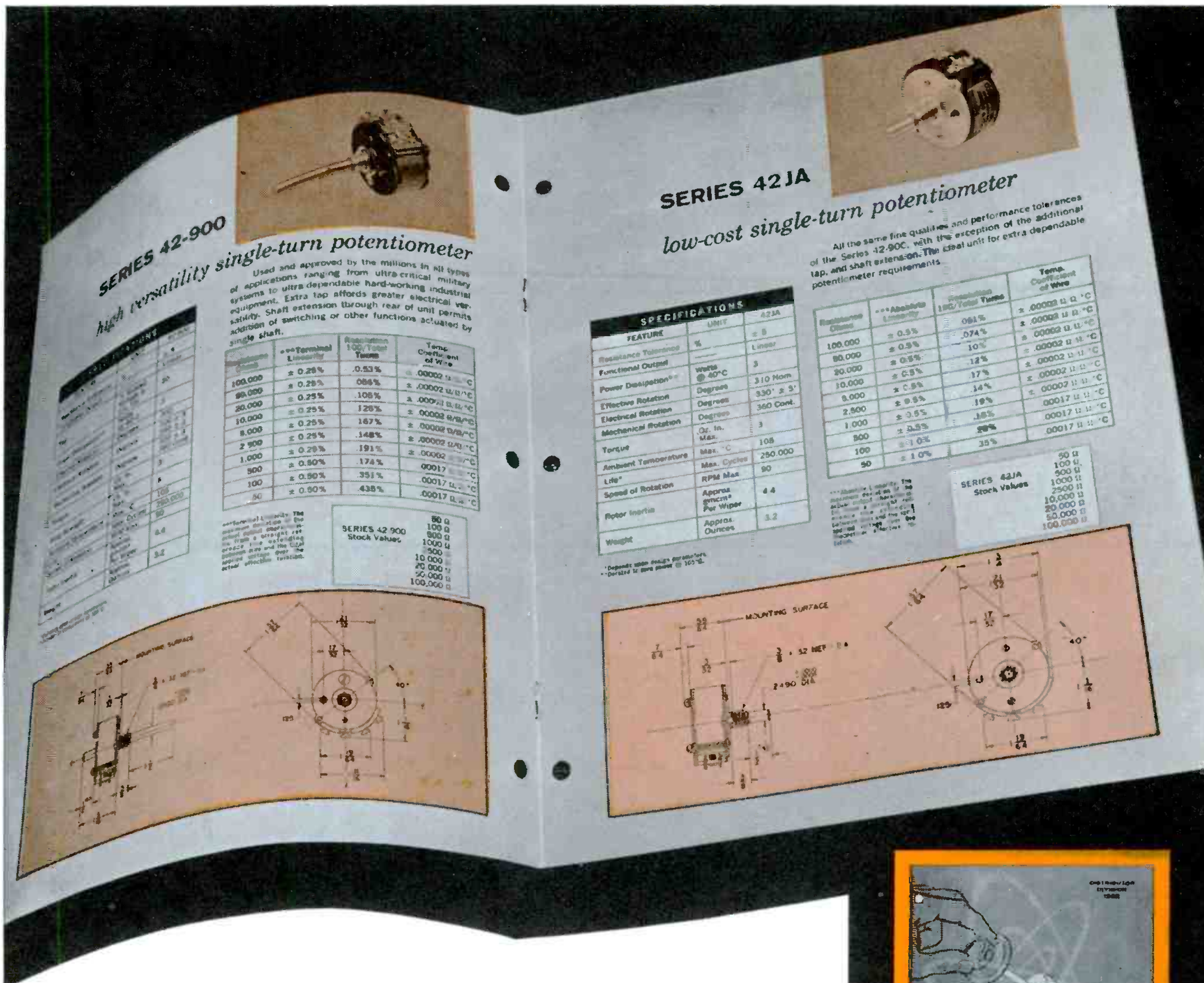
This is a common problem, and I'm sure many of our readers have their pet solutions. The Howard W. Sams book Tube Substitution Handbook *(TUB-4) is devoted primarily to answering this problem, and to serving as a guide to the "overloaded" technician. In addition, our* Stock Guide for TV Tubes *which appears in each April and October issue can help in many ways.*

However, I suspect you have something more definite in mind, such as: How can you be sure that a more recent version of a tube (having a different type number) will work satisfactorily? The answer, Mr. Ruffner, is that you can't always be sure! A specific example will show you why this is true.

Take, for instance, a commonly used substitution such as the 6EA8 in place of the older 6U8. The 6EA8 is a kissing cousin of the original general purpose triode-pentode, the 6U8. It all started when another type, the 6CL8A, was introduced as a higher-gain tube than the 6U8 for mixer use in TV tuners. Other manufacturers decided they wanted a tube like the 6CL8A, but with the basing of the 6U8; hence the 6EA8.

While the 6EA8 will interchange with the 6U8 in many instances, there are some cases where such a substitution has caused trouble. In some tuners, the capacitance tuning range is limited and the 6EA8 will not tune correctly. In others, feedback is encountered because of less shielding in the 6EA8.

Thus, you see, while a substitution is valid in some cases, in others it creates problems of its own. There is no absolute method for the serviceman to decide if a substitution will work or not, other than by trial.—Ed.



INDUSTRIAL SERVICING STARTS HERE

Get your industrial electronic servicing off to a good start. Check-out precision potentiometers, industrial-grade pots, fixed resistors, precision resistors in the Clarostat Distributor Industrial catalog. Clarostat offers the most complete line of components for prototype, limited production, and industrial servicing through distributors. Start right — get your copy of this brand-new catalog from your distributor, or write to us . . .

DISTRIBUTOR SALES DIVISION

CLAROSTAT

CLAROSTAT MFG. CO., INC. DOVER, NEW HAMPSHIRE

G-E SEPT TUNE-UP SPECTAC

*

Hugh Downs

Joe Garagiola

Mel Allen

8 G-E WORLD SERIES FEATURES

ON THE NBC TODAY SHOW

Full Lineup of 155 Local Stations Covers 95% of U. S. Audience

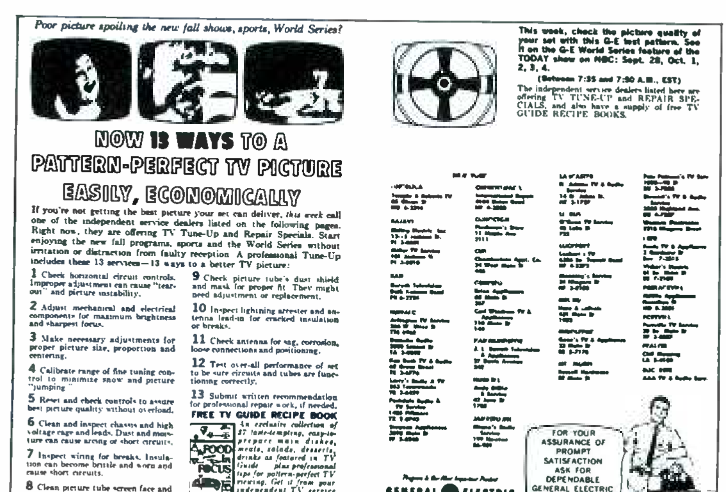
Joe Garagiola hosts sports personalities on this timely show. **Mel Allen,** with unique "Test Pattern Commercial," sells immediate need for your service to your customers through your local station. Starts Sept. 10.

These commercials direct viewers to your name, address and phone number in your local TV Guide.

SEE AD AT RIGHT ▶

*

FULL-PAGE AD PLUS YOUR NAME, ADDRESS, PHONE NUMBER IN SEPTEMBER 29 ISSUE OF YOUR LOCAL TV GUIDE



Poor picture spoiling the new fall shows, sports, World Series?

NOW 13 WAYS TO A PATTERN-PERFECT TV PICTURE EASILY, ECONOMICALLY

If you're not getting the best picture your set can deliver, *this week* call one of the independent service dealers listed on the following pages. Right now, they are offering TV Tune-Up and Repair Specials. Start enjoying the new fall programs, sports and the World Series without irritation or distraction from faulty reception. A professional Tune-Up includes these 13 services—13 ways to a better TV picture:

1 Check horizontal circuit controls. Improper adjustment can cause "tear-out" and picture instability.

2 Adjust mechanical and electrical components for maximum brightness and sharpest focus.

3 Make necessary adjustments for proper picture size, proportion and centering.

4 Calibrate range of fine tuning control to minimize snow and picture "jumping."

5 Reset and check controls to assure best picture quality without overload.

6 Clean and inspect chassis and high voltage cage and leads. Dust and moisture can cause arcing or short circuits.

7 Inspect wiring for breaks. Insulation can become brittle and worn and cause short circuits.

8 Clean picture tube screen face and safety glass.

9 Check picture tube's dust shield and mask for proper fit. They might need adjustment or replacement.

10 Inspect lightning arrester and antenna lead-in for cracked insulation or breaks.

11 Check antenna for sag, corrosion, loose connections and positioning.

12 Test over-all performance of set to be sure circuits and tubes are functioning correctly.

13 Submit written recommendation for professional repair work, if needed.

FREE TV GUIDE RECIPE BOOK

FOOD IN FOCUS

An exclusive collection of 87 taste-tempting, easy-to-prepare main dishes, meats, salads, desserts, drinks as featured in TV Guide plus professional tips for pattern-perfect TV viewing. Get it from your independent TV service dealer while the supply lasts.

This week, check the picture quality of your set with this G-E test pattern. See it on the G-E World Series feature of the TODAY show on NBC: Sept. 28, Oct. 1, 2, 3, 4.

(Between 7:35 and 7:50 A.M., EST)

The independent service dealers listed here are offering TV TUNE-UP and REPAIR SPECIALS, and also have a supply of free TV GUIDE RECIPE BOOKS.

GENERAL ELECTRIC

FOR YOUR ASSURANCE OF PROMPT SATISFACTION ASK FOR DEPENDABLE GENERAL ELECTRIC TUBES

TV GUIDE

This hard-hitting ad sells your professional repair and maintenance service . . . refers to local TV Tune-Up Commercials on TODAY show . . . directs customers to you through your name and address listing *in your local edition.*

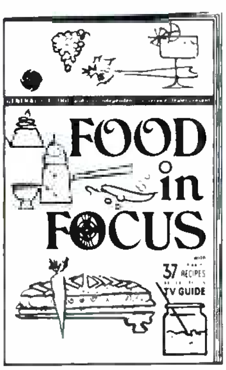
EMBER

3-part program sells immediate need for your service before & during World Series*

ULAR!!!

*

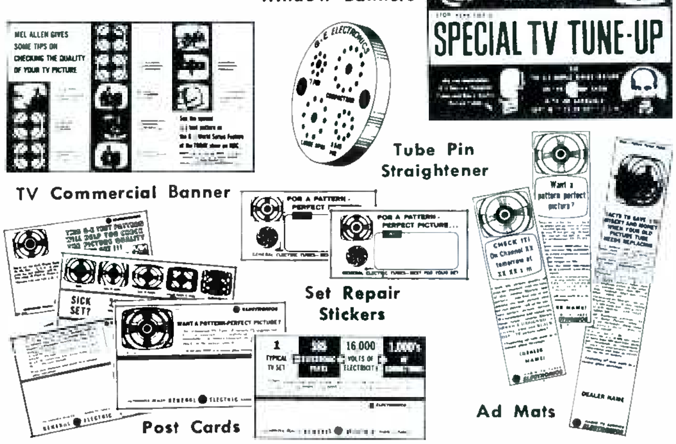
COMPLETE PROMOTION AND DISPLAY KIT



TV GUIDE RECIPE BOOK

First time available—this exclusive collection of recipes as featured in TV Guide, plus professional tips for TV viewing enjoyment. Unique new premium is yours *exclusively;* helps you build goodwill and the need for your services.

Window Banners



TV Commercial Banner

Tube Pin Straightener

Set Repair Stickers

Post Cards

Ad Mats

G-E reporter, Roland Kempton, tells how September Tune-Up Spectacular

BUILDS BUSINESS FOR YOU 3 WAYS

1. Your customers prove to themselves the need for a tune-up and repair.

2. Through local television, local TV Guide and promotion materials.

3. In your city, your neighborhood, with your customers and prospects, you cash in on this TV TUNE-UP SPECTACULAR.

SEPTEMBER TUNE-UP SPECTACULAR is your campaign. It's easy to tie in. Proven effective. No red tape. Get full details from your G-E tube distributor, now. Names of participating dealers must be in by August 27. General Electric Company, Distributor Sales, Electronic Components Division, Room 1748B, Owensboro, Ky.

Progress Is Our Most Important Product

GENERAL ELECTRIC

The Electronic Scanner

Business-Building Plan Unveiled by G-E

A unique package plan to promote preventive television maintenance at World Series time by combining many advertising and publicity media—television, press, and direct mail—is available to service dealers. Key opportunities offered dealers in **G-E's** program are: an exclusive offer of a "Food in Focus" cookbook designed for giveaway to the housewife; listing of dealers' names in local editions of TV Guide magazine; and, during interview shows by Mel Allen, special "Test Pattern" messages to help owners evaluate the performance of their sets. An entire sales kit containing store banners, back-of-set repair stickers, post-card mailers, and other promotional material, is available to dealers at one-third its normal value. To participate in this package promotion, you should contact your G-E distributor before August 27.

All-Channel Bill Becomes Law

The All-Channel-UHF Bill, subject of much controversy in the television industry and in the halls of Congress, has been signed into law by President Kennedy. Requiring that new television sets henceforth include facilities for receiving all channels — both VHF and UHF — the Bill is intended to help overcome a major objection to UHF station assignments in certain localities. The FCC will set a date for the Bill to become effective.

Enters Second Phase of FM Stereo Promotion Program

Harman-Kardon's sponsorship of FM stereo programs on station KMLA Los Angeles is continuing with a new series of evening "Stereo Award Showcase" programs, Monday through Friday, 7:00 to 8:00 PM, Los Angeles time. These programs offer the listener a superior source of FM stereo programming and provide the dealer with the opportunity of demonstrating FM stereo during the evening hours, so his merchandise can be sold with assurance. Participating dealers are given a predominant role in the advertising messages during the course of the program.

Receives Citation

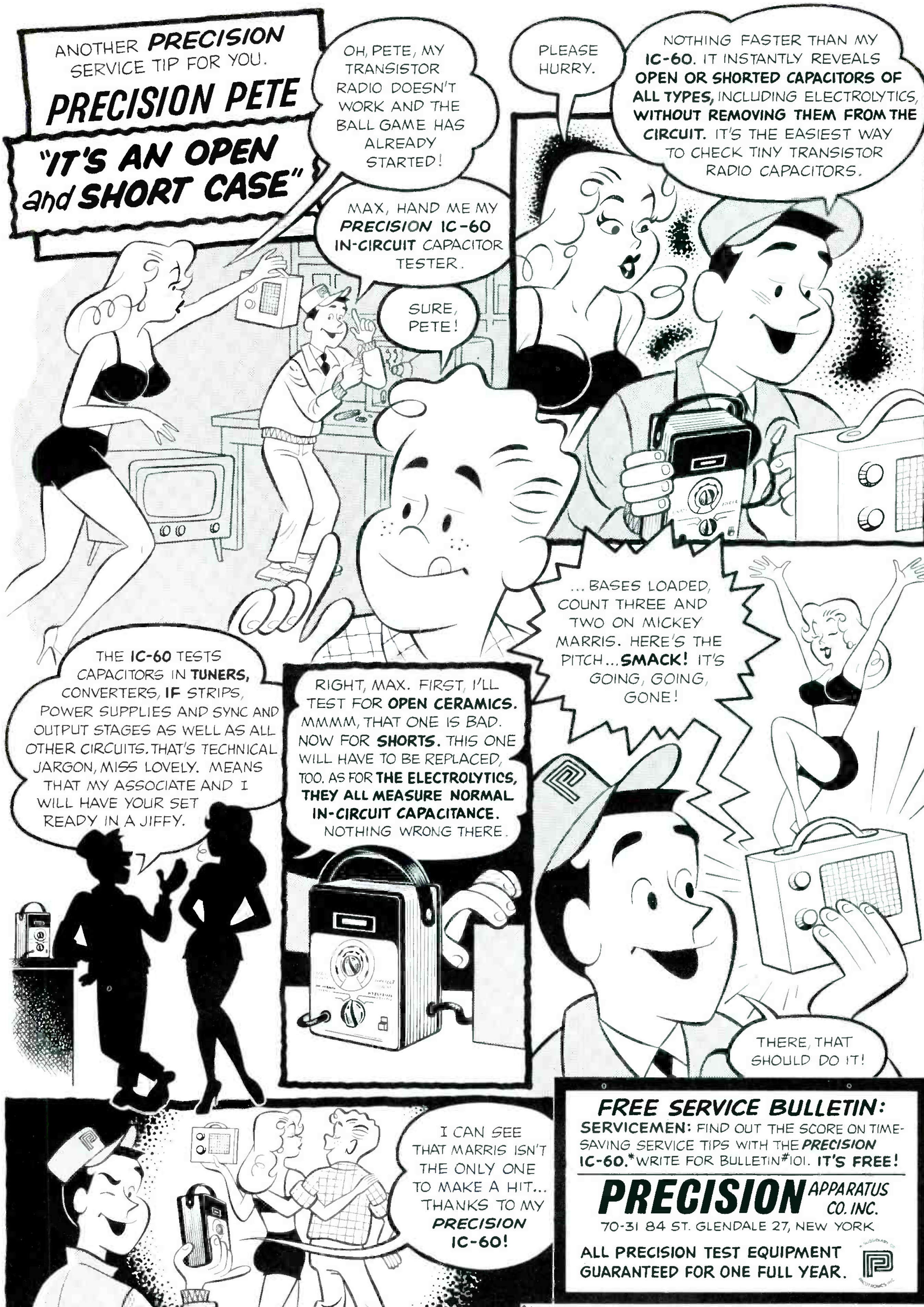
United States Secretary of Commerce, Luther H. Hodges has presented a citation to **Jackson Electrical Instruments** for "Outstanding Service to the United States." The award was given in connection with the company's participation in the 1961 New Delhi, India, International Trade Fair. Instruments manufactured by Jackson were used in demonstrations and training of Indian TV engineers.

Simulated Bumpy Ride Checks Reliability

New two-way mobile radios get a hot and bumpy ride at **RCA's** Meadow Lands, Pa. plant before they are ever bolted into a vehicle. The "ride" is simulated by factory test equipment that surpasses in severity any operating or environmental condition the equipment is likely to encounter on the road. In addition, every seventh unit that leaves the factory is removed from its carton and given operational checks even while it is awaiting shipment.

PFR Moves to New Home

Recently, PF REPORTER joined other divisions of **Howard W. Sams & Co.** in moving to a new plant in suburban Indianapolis. The vast new building, located at 4300 W. 62nd St., houses facilities needed to prepare and manufacture the numerous technical books, magazines, and technical servicing literature the company produces each month.



*$32.95. ALSO AVAILABLE IN KIT FORM AS PACO MODEL C-25: $19.95

NEW .....VALUE ENGINEERED

C-855

FOR LOWEST INSTALLED COST

8″ SPEAKERS FOR DISTRIBUTED SOUND

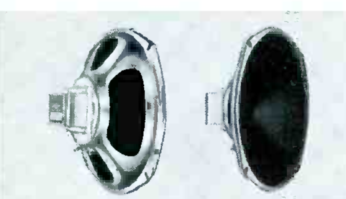
This new line of Jensen 8-inch Professional Series loudspeakers is specially designed to meet the exacting rigorous demands for commercial sound installations. The 8-inch size is ideal for the majority of all distributed sound systems giving more than adequate low frequency range without enclosure and mounting complications.

A wide selection of models to meet every need—from the lowest cost highly competitive application to the most sophisticated highest quality system.

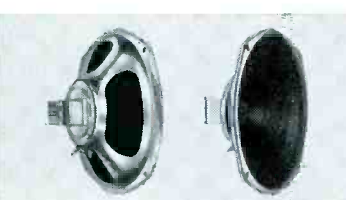
This entire line is *value engineered* for *lowest installed* cost of the entire system. Convenient 10-pack with or without preattached 70.7 or 25-volt transformers are options available. Handy KWIKON* instant connectors for input and power tap adjustment.

For full details write for individual data/specifications available on each speaker.

C-840
C-850



P-830



P-810

1. AVAILABLE IN HANDY 10-PACK

Added savings and convenience in bulk-packed carton of ten speakers, with or without preattached transformers.

2. PREATTACHED TRANSFORMERS

CHOICE OF 70 AND 25-VOLT LINE TYPES

Especially designed for use with the popular "constant voltage" distribution systems. Center-tapped primary windings for balanced-line or special circuit needs. Tapped secondary for adjustment of power to 8-ohm speaker in 3 db steps from ⅛ watt to 4 watts. Core size ⅝″ x ⅝″. Two 3/16″ dia. mounting holes on 2⅝″ centers. Prices below are for transformers only.

70CV4. For 70-volt distribution systems.

25CV4. For 25-volt distribution systems.

List Price.................. **$4.75**

Model	Power Rating Watts	Magnet Weight Ounces	Loudness Level (3)	Overall Depth	Net Weight Pounds	List Price
C-855	12	10.0 (1)	85.0	3 1/16″	2½	$13.50
C-850	12	10.0 (1)	85.5	3″	2⅜	12.95
C-840	11	6.0 (1)	84.5	2 15/16″	2	10.95
P-830	10	2.5 (2)	84.0	3¼″	1¼	7.25
P-810	9	1.47 (2)	82.0	3 5/16″	⅞	5.80

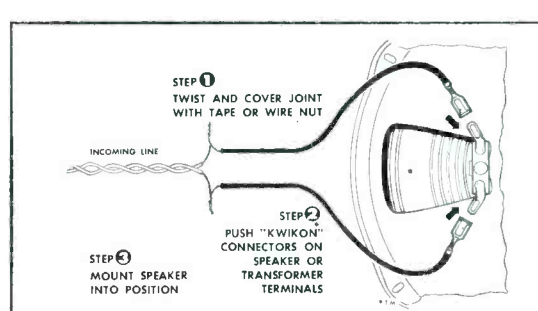
(1)—SYNTOX-6® Ceramic. (2)—DP-Alnico-5.
(3)—db above 2×10^{-4} dyncs/cm.^{2} @ 10 Ft. for input power of 1.0 watt standard 800-1250 cps warble signal.

Speakers conform to applicable EIA Standards. Max. O.D. 8⅛″; width and height 7 11/16″. Recommended baffle cutout 6¾″ dia. Nom. voice coil impedance 8 ohms. Facilities for standard 2-hole mounting transformers up to ¾ x ¾ nominal core size.

3. KWIKON* INSTANT CONNECTORS

Simply twist bare ends of two 12″ input leads supplied for each speaker to incoming signal cable leads, insulate with wire-nut or tape. Slide sleeve clips onto input terminal lugs of speaker or preattached transformer as speaker assembly is raised into place. KWIKON* instant connectors also provide simple fast power tap re-adjustment on transformer.

*T.M.



jensen MANUFACTURING COMPANY
Division of THE MUTER COMPANY
6601 S. Laramie Avenue, Chicago 38, Illinois
In Mexico: Universal De Mexico, S.A., Mexico, D.F.

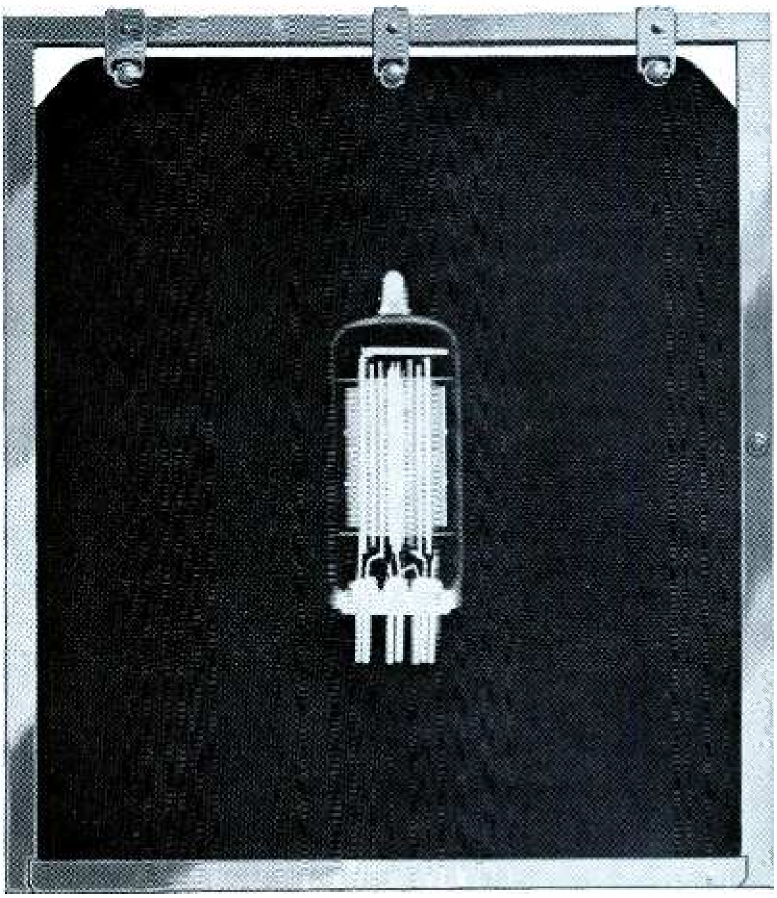
jensen LOUDSPEAKERS

ANATOMY CLASS FOR DOCTORS OF RADIO AND TV SERVICE

NEW AUDIO AMPLIFIER TUBE SUPPLIES FULL-RANGE TONE FIDELITY IN RECEIVERS

NEWEST addition to Tung-Sol's family of fine audio amplifier tubes is the type 4GZ5 pentode. Thorough exposure to realistic combinations of operating and environmental hazards during development shows this tube will lead its class in television, radio and high-fidelity service. Even after accelerated life testing, the subject remains full of pep, providing large power output with remarkably low distortion over the full audio range from loud cry to subdued chortle.

Tung-Sol takes lavish parental care of this baby during its formative stages. Internal elements are welded and brazed on hospital-clean production lines after sterilization in bakeout ovens to prevent gas, leakage and spurious emission. Rigidized construction cures low-frequency rattles and other forms of tube distress. Alclad plates spread body heat evenly for efficient cooling.

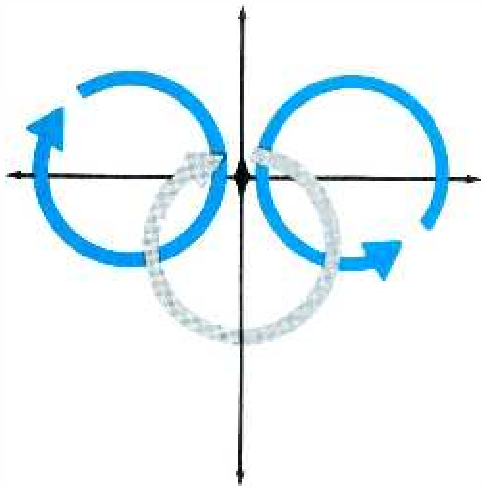


FORMULA FOR GOODWILL

Customers will love the way this model tube makes stereo, radio and tv audio come alive. Foster good customer relations by adopting the 4GZ5 as your first choice in replacement tubes. Others in Tung-Sol's family of audio amplifiers are: 6CU5, 6BQ5, 12CU5, 6AQ5A, 6GK6.

TUNG-SOL®
AUDIO AMPLIFIER TUBES

TUNG-SOL ELECTRIC INC., NEWARK 4, N. J.



Rotator Maintenance & Troubleshooting

Overhaul these devices while the weather is good . . . by George F. Corne, Jr.

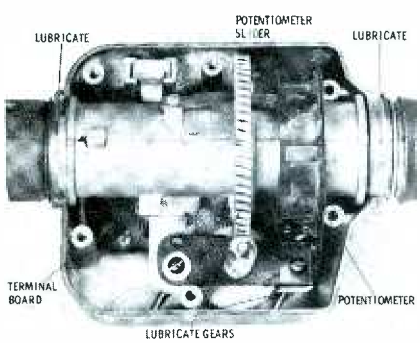


Fig. 1. This rotor mechanism has been cleaned and is ready for relubrication.

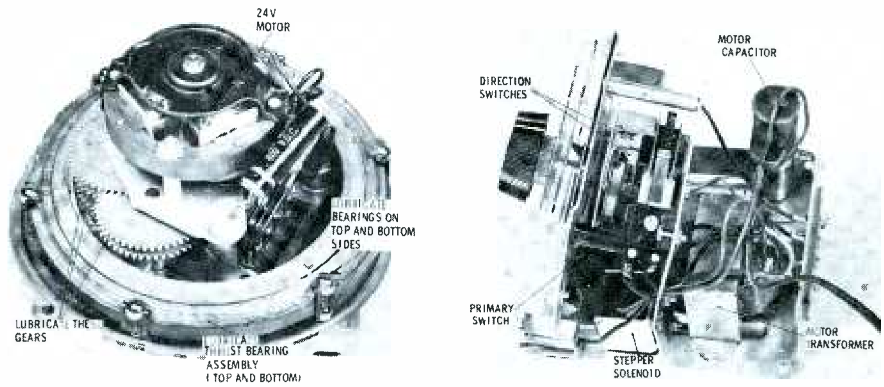


Fig. 2. Mast-top unit and control unit box for a heavy-duty *in-line* rotator.

Antenna-repair season is here, and the alert serviceman will take advantage of fair weather to put his customers' antenna systems in top shape. On every service call, it's a good idea to make a quick check of the antenna installation, in the interest of your own safety and convenience.

If you wait for antenna trouble to appear, you'll probably be called out for repairs on some cold and windy day. This stands to reason, because shaky antenna systems are most likely to reach the breaking point in the worst weather. Winter is especially hard on antennas; system components become brittle with cold, antenna elements break under the weight of accumulated ice, and the wind whips away at lead-ins and guy wires.

Rotators also take their share of punishment. The lubricant inside the rotor housing stiffens during cold weather, causing additional strain on the motor; the result may be erratic rotor operation or damage to some component.

A rotator unit which isn't "up to snuff" may not be able to withstand the rigors of another winter, but the owner usually isn't aware of this fact as long as the unit is still functioning. You, as a service technician, can generally detect slight trouble indications which the owner will usually miss or shrug off.

Telltale Signs

Here are several functional tests with which you can quickly spot rotator trouble while on a service call:

1. If the unit has a directional indicator, does it track properly, or even work at all?
2. Does the rotor start, run, and stop smoothly, or does it skip or pause? Is it sluggish in starting?
3. Does the rotor make a complete revolution in the normal time? (This takes one minute in most models.) Does it reverse its direction after making a full revolution?
4. Is the antenna mounted straight? A bent or tilted mast produces

• *Please turn to page 83*

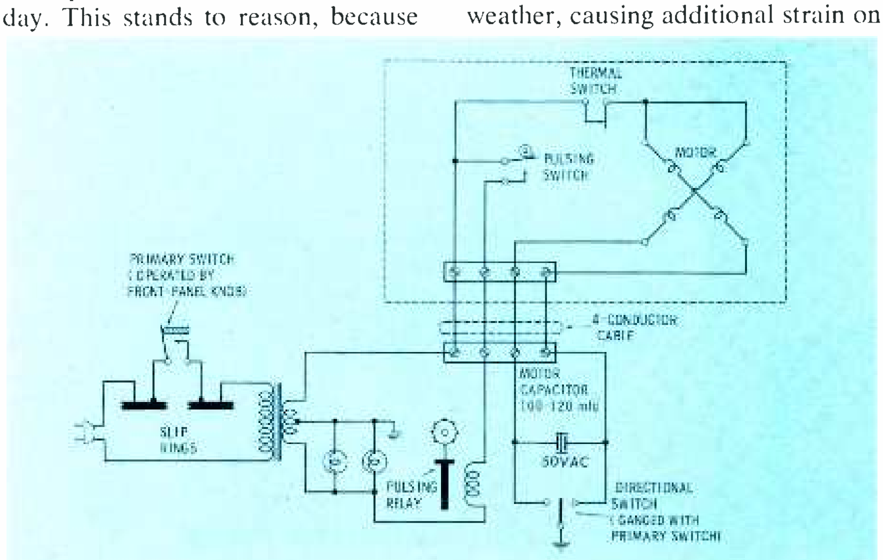


Fig. 3. Rotor automatically turns to direction selected by front-panel knob.

FINEST MONEY-MAKER FOR Professional Servicemen

Multiple-Socket Speed with Gm Accuracy

PLUS OBSOLESCENCE PROTECTION

TESTS All TV and Radio Tubes —Old and New

TESTS European Hi-Fi Tubes, Voltage Regulators, and Most Industrial Types

TESTS for True Dynamic Mutual Conductance (Gm)

TESTS Nuvistors and Novars

TESTS the New 10-Pin Tubes

TESTS New 12-Pin Compactrons

Model 700 DYNA-QUIK

DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

See your B&K Distributor or Write for Catalog AP20-R

TESTS BOTH OLD AND NEW TUBE TYPES—SELLS MORE TUBES PER CALL

All over the nation, thousands of professional servicemen rely on the "700". Once you use it, you'll be as enthusiastic as they are. *Everyday use has proved its speed . . . its accuracy . . . its efficiency.* This up-to-date, obsolescence-proof tube tester is designed for maximum use *today and tomorrow*. Provides multiple-socket section to quick-check most of the TV and radio tube types the *true dynamic mutual conductance way—plus* simplified switch section to check new tube types in Dyna-Quik emission circuit. Also includes provision for future new sockets.

Makes test under set-operating conditions. Checks each section of multi-section tubes separately. Checks for *all* shorts, grid emission, leakage and gas. Makes quick "life" test. Exclusive *adjustable* grid emission test provides *sensitivity to over 100 megohms.*

Makes complete tube test in seconds. Checks average set in a few minutes. Discovers weak tubes that need replacement. *Satisfies more customers. Sells more tubes. Saves call-backs. Insures your reputation. Pays for itself over and over again.* Net, $169.95

Time-Saving, Money-Making Instruments Used by Professional Servicemen Everywhere

Model 960 Transistor Radio Analyst

Model 360 V O Matic Automatic VOM

Model 375 Dynamatic Automatic VTVM

Model 1076 Television Analyst

Model 440 CRT Rejuvenator Tester

NEW TUBE INFORMATION SERVICE
Available every 3 months, on subscription, for all B&K Dyna-Quik Tube Testers

B&K

B & K MANUFACTURING CO.
Division of DYNASCAN CORPORATION
1801 W. BELLE PLAINE AVE. • CHICAGO 13, ILL.
Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

Horizontal Oscillator Running Wild

Off-frequency operation can have dire consequences . . . *by Thomas A. Lesh*

A TV set which displays several trouble symptoms usually has multiple defects, and requires extra time to repair. A notable exception is the following combination of symptoms: picture extremely far out of horizontal sync, insufficient raster width or height, and poor brightness or loss of focus. If you correct the horizontal-frequency trouble *first,* you'll probably find that the other troubles will disappear. These side effects often occur because an off-frequency horizontal oscillator causes inefficient operation of the horizontal flyback system. In some cases, the drive signal to the horizontal output tube is weakened. On the other hand, the drive amplitude may be normal, but the incorrect frequency makes the flyback circuit operate off resonance—with a consequent loss of performance.

Sometimes a horizontal-frequency error produces a rise in the screen or plate current of the horizontal output tube. If this current is already excessive because of misadjustments or defects in the sweep section, unnecessary strain may be placed on the flyback transformer or other output-circuit components, and damage may result from continued operation at the wrong frequency. Therefore, it's wise to develop a fast troubleshooting procedure for wild horizontal oscillators.

Less severe forms of horizontal-frequency trouble are not likely to lower the efficiency of the sweep system; they merely cause a loss of sync. However, these mild discrepancies are more difficult to define and locate, since the defect is relatively slight and can easily be concealed by readjusting the horizontal oscillator—only to appear later as a more drastic malfunction. Careful application of the same techniques used to troubleshoot serious frequency errors will also serve to nip these minor troubles in the bud.

Symptom Analysis

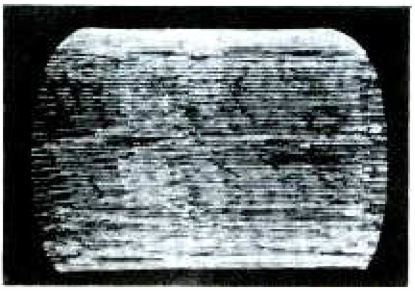
A horizontal-frequency trouble can be distinguished from a sync failure by the inability to "pull in" a picture at any setting of the hold control. This preliminary observation localizes the trouble area to the horizontal oscillator-AFC circuitry.

The oscillator frequency may shift either higher or lower than normal. Each of these two conditions has different characteristic symptoms and causes, calling for a different strategy; so it's important to recognize the direction of frequency error before proceeding to troubleshoot the horizontal section.

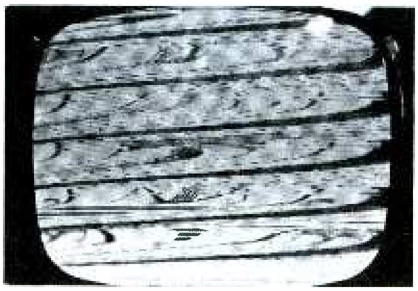
Frequency Too Low

If the oscillator can be tuned close enough to the normal frequency so that only a small number of slanting black bars appear on the screen, the bars will slant downward to the left (as in Fig. 1A) if the oscillator is running slower than 15,750 cps. In worse cases of trouble, there will be more bars, and the direction of slant won't be distinguishable; but you can rely on your ears for a clue. Even though you may not be able to hear the 15,750-cps "singing" of a normally operating flyback, you will probably have no trouble detecting this sound when the frequency is reduced by a few thousand cycles. In fact, the squeal may become loud enough to set up a painful ringing in your ears.

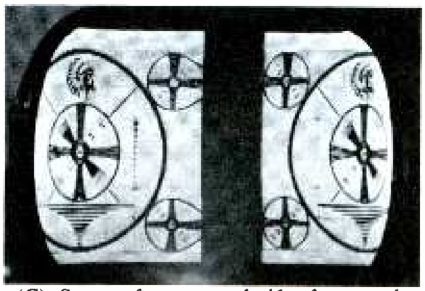
A great decrease in frequency may cause a horizontal multivibrator circuit to develop the symptom shown in Fig. 1B. The raster breaks into a jagged pattern that indicates abrupt changes in frequency. At one point in the hold-control range, the multivibrator may lock in at half the normal frequency, or 7875 cps, displaying



(A) Few cycles off frequency.



(B) Multivibrator "squegging."



(C) Sweep frequency half of normal.

Fig. 1. Indications that the horizontal-oscillator frequency is below normal.

two pictures side by side (Fig. 1C).

In the latter two photos, note the loss of height—a common side effect when horizontal frequency is too low. This symptom typically appears in sets which use boost voltage to supply the plates of the vertical oscillator and output tubes. The decrease in height is due to a reduction in boost, a normal result of the horizontal-oscillator slowdown. Normally, the boost capacitor is recharged 15,750 times per second — each time the damper conducts in response to a flyback pulse (see Fig. 2). When fewer charging cycles occur each second, without a corresponding reduction in the boost load, full boost voltage cannot be maintained. The lowered efficiency of the flyback circuit also contributes to the weakening of boost, since the amplitude of the charging pulses is lowered.

As an example of the effect described, when the symptom of Fig. 1C occurred in a General Electric Model 21C172, boost fell from 520 to 380 volts.

With the oscillator running slow, the sawtooth waveform fed to the grid of the horizontal output tube does not usually decrease in amplitude; in fact, it may increase by 5% to 10%. Even so, since the flyback circuit is not properly resonant to this off-frequency signal, the high voltage falls below normal. The width of the raster also may decrease.

Frequency Too High

Bars slanting down to the right, just the opposite of Fig. 1A, denote a rise in oscillator frequency above 15,750 cps. As the frequency goes higher, no squeal will be heard, but the raster width is likely to shrink and the brightness to fade. The reason is quickly apparent when the grid waveform of the output tube is checked; its amplitude steadily drops as the frequency departs farther from normal. The raster contains a rough pattern of dark, thin horizontal lines, and at certain frequencies, a series of picture fragments will come into view—as in Fig. 3A.

Check the comparative effect on circuit voltages when this same symptom appeared in two different

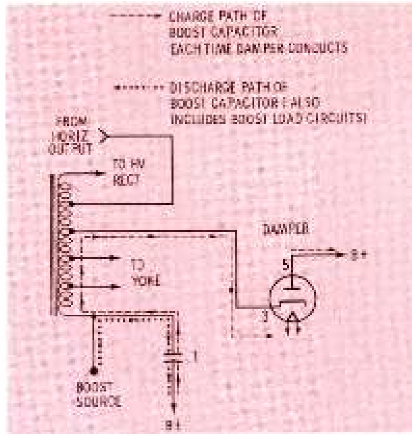


Fig. 2. Conduction of damper charges a capacitor to develop boost voltage.

sets of about the same vintage:

Westinghouse H-667T17	**Normal**	**Abnormal**
Drive (p-p)	120V	105V
Output screen	155V	130V
Boost	580V	580V
High voltage	13 kv	9 kv

Philco 51-T2132	**Normal**	**Abnormal**
Drive (p-p)	90V	65V
Output screen	110V	110V
Boost	400V	410V
High voltage	12.5 kv	8.5 kv

How great was the frequency error? The raster contains overlapping picture segments, and when a normal program is viewed, moving images appear four times. This gives the impression that the frequency has been quadrupled. Actually, only *portions* of pictures are seen (note the absence of blanking bars separating the sections), and the frequency is only one-fourth greater than usual. This figures out to 19,687.5 cps.

Why does the drive signal decrease? Part of the explanation lies in the sawtooth-forming network (including C91, R100, and R99 in Fig. 4), which charges and discharges at a rate controlled by the oscillator. If a full 1/15,750 second is taken to charge C91 on each cycle, it will charge to the prescribed voltage level. Shortening this time will reduce the charge C91 can accumulate; hence, it will reduce the peak-to-peak value of the drive waveform.

In sets using a *Synchroguide* (blocking-oscillator) horizontal circuit, the oscillator is prone to break into squegging almost as soon as the frequency rises above 15,750 cps. (For more information on this topic, see "Getting Rid of the Christmas Tree" in the January, 1962 PF REPORTER.) However, the picture may lock into a stable but distorted pattern as shown in Fig. 3B.

Troubleshooting

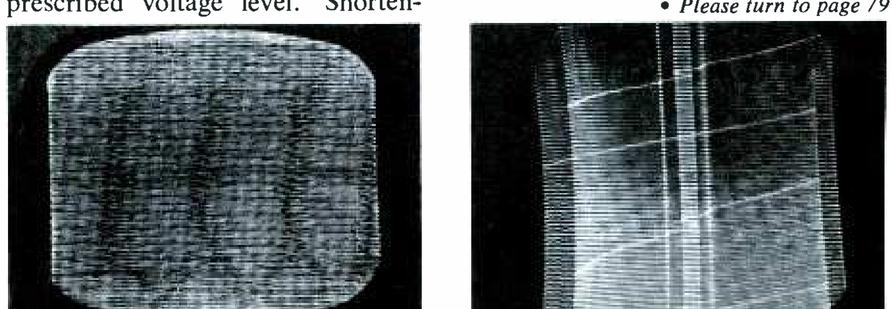
The two most popular types of horizontal AFC-oscillator systems each have their own idiosyncrasies, so each circuit will be discussed separately. Specific service hints for multivibrators are presented this month, and similar information about the *Synchroguide* circuit will appear in a forthcoming issue.

Multivibrator

The cathode-coupled multivibrators used in the majority of TV sets can typically be tuned through a wide frequency range with the front-panel horizontal hold control; therefore, a frequency-shifting trouble may exist for some time before it comes out in the open. Moderate drifting of component values, slight leakage in capacitors or tubes, and similar defects may not prompt a service call until horizontal sync becomes intermittent or the hold control reaches the end of its range.

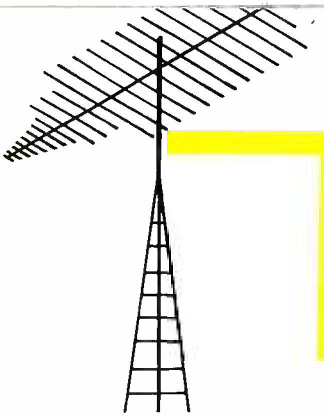
The dual-diode AFC circuits used with multivibrators also help to compensate for a great deal of frequency error. However, if very much AFC correction voltage is required to maintain operation at 15,750 cps, the multivibrator will

• *Please turn to page 79*



(A) One-fourth higher than normal. (B) Unusual *Synchroguide* symptom.

Fig. 3. Sypmtoms produced by oscillator operating above normal frequency.



INSTALLING MASTER

This specialty is if you have the

by Denis A. Gentry

The service technician who lacks experience in installing multiset TV-signal distribution systems may think this activity is too far afield for him. But this is not necessarily true; master-antenna installations are an excellent and logical addition to the business of any service shop.

The newcomer to the multiset-system business is often intimidated by the thought of designing and installing a mammoth system feeding 1000 sets, but such a large job is not typical. The backbone of the business is the relatively modest system, involving perhaps a few dozen (or fewer) receivers. This kind of arrangement usually is associated with a motel, hotel, hospital, school, motor court, trailer camp, dealer showroom, or even a private home.

The average serviceman probably has most of the tools and equipment he will need to install these systems, except for an electrician's fish line for manipulating cables in the spaces between walls, or perhaps a field-strength meter.

To make this field even more attractive, the technician will find less competition and more assistance available than he might realize. Manufacturers of the equipment he will use are convinced there are many more systems waiting to be sold and installed than there are people qualified to handle them. Accordingly, they are willing to help through the beginning stages, even laying out installations on paper and developing complete specifications and equipment lists for the job.

If you would like to get into this interesting line of work, and you choose this easy way to start your first system, there is some basic data you will have to furnish to the manufacturer. You'll have to describe the installation location, list the stations to be received and their location with respect to the receiving site, give the approximate signal strength of the stations as measured at the installation point, state the type of antennas to be used, and indicate their height and location. The number of receivers to be served must also be reported. A typical "Engineering and Layout Data" form for reporting such information is shown in Fig. 1.

ENGINEERING AND LAYOUT DATA

To furnish an accurate layout, bill of materials and installation suggestions, the following information must be supplied. (Additional notes and sketches are recommended, where helpful in designing the layout.)

1. Location of system ______
2. Stations carried; Station location; Approx. signal strength; Picture quality ______
3. Type of antennas to be used: ______
4. Height of antennas above ground: ______
5. Supply reasonably accurate plan or sketch of area to be served.
6. Number of receivers to be connected to system: ______
7. Mark most practical routes for running cable on drawing submitted. Indicate type of walls to be encountered.
8. Mark receiver locations and distances between.
9. Location is / business / residential / rural / (cross out two) ______

Fig. 1. Form for furnishing antenna-system data to equipment manufacturer.

Along with the information on this sheet, you must also provide a sketch of the installation site, showing the planned cable routes with all receiver locations and distances between them. Your own sketch may be adequate, but the best procedure is to obtain architectural or engineering plans of the structures involved, if such drawings are available. These will also indicate the type of walls to be encountered and the materials of which they are made, which will help you decide whether it is practical to route your lines through certain partitions.

If you cannot take an absolute signal-strength reading, you can at least determine whether a satisfactory signal is available—by connecting an operating receiver to the antenna you intend to use, and noting the picture on all the desired channels.

System Planning

Even if you are initially going to let the manufacturer do as much of the planning as possible, you will want to have some idea of what is going on. This will help you follow the sense of his plan and give you a big boost toward independent operation on future jobs.

There are three phases of the installation that have to be settled before you get into the actual work.

ANTENNA SYSTEMS

a good Market know-how .

First of all, you must decide how you will run the distribution lines, where you will take off signal for various outlets, and where the antenna and distribution amplifier will be located. Next, you must determine what losses will be incurred in this system—how much signal will be used up in lines, tap-offs, etc. Then, knowing what losses must be compensated for, you can choose the distribution amplifier and the other equipment needed for the system.

How this planning is handled can best be illustrated by referring to Fig. 2, a layout diagram for the 16-cabin motel we will use as an example. The antenna is located near the main office, which is also a good location for the distribution amplifier, because it is away from the prying hands of guests and is accessible for maintenance and service. This means, however, you will have to split the main output of the amplifier into two feeders, each of which will supply eight cabins. There happens to be a technical as well as physical advantage in doing this instead of using a single feed line, but we will come to that later.

The Cables

There is more than one way of running cable. In a situation like the one in Fig. 2, it may be practical to run the cables underground, through a system of weatherproof conduit. An outlet of the type shown in Fig. 3 would then bring the signal to each cabin. Each outlet would use a 72-ohm coaxial lead-in (which "weathers" better than 300-ohm line) and would need an impedance-matching transformer, which can be part of the wall-mounted receiver outlet.

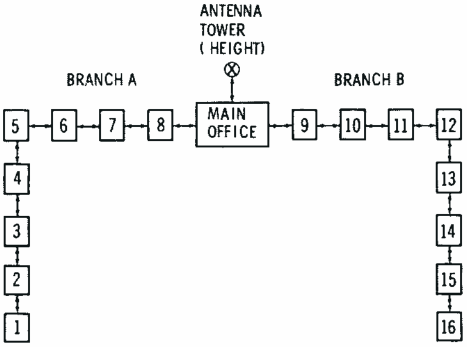


Fig. 2. Preliminary layout sketch for an antenna system in a 16-unit motel.

If the cabins are joined to each other, and a peaked roof provides some crawl space above each cabin, you may prefer to route the feeder cables as shown in Fig. 4. To reduce lead lengths and losses, note how outlets in adjoining cabins are mounted back to back. In such an installation, a network in the outlet provides an impedance match to a 300-ohm receiver, in addition to isolating each receiver from the rest of the system.

Vertical Runs

In other types of structures, particularly buildings several stories high, feed lines may run vertically rather than horizontally; but this is not strictly necessary. Suppose you are dealing with an edifice in which all the living rooms to be served are stacked directly one on top of the other; in this case, you should look for some means of running concealed vertical cables.

The walls themselves are not likely to provide satisfactory space. Even where hollow-wall construction is used, the open spaces are probably blocked at intervals by horizontal members, called fire stops. Therefore, you must look for vertical ventilating ducts, elevator shafts, closets stacked one above the other, hollow spaces meant for power lines, or the like.

Finally, cables can be run effectively outside the building, with a separate take-off to each outlet. The use of coaxial cable is recommended, although the nominal loss for this type is greater than for 300-ohm ribbon. The reason is that the latter has serious disadvantages: It provides no shielding against interference; it permits different lines in the system to radiate to each other, upsetting distribution characteristics; its losses, rather than being constant so a system with a specific gain can be designed, vary with different conditions; also, it will deteriorate more rapidly than coax. 300-ohm lead should therefore be ruled out in all cases except where a relatively small system is being planned, involving only a few outlets and with all wiring indoors.

System Calculations

The most commonly used coaxial cable is RG-59/U. Its loss per hundred feet is relatively constant, but varies on different VHF channels. Most systems are designed around channel 13, even when it is not used, since it is the frequency at which the greatest signal loss occurs. RG-59/U will lose nearly 6 db of channel-13 signal for every 100′ used, so this figure will be used in most of the system calculations.

Suppose, then, that RG-59/U wire is being used in the system laid out in Fig. 2, and that 150′ will reach from the distribution amplifier in the main office to the very last cabin at either end of the system (cabin 1 or 16). This is the point at which losses will be greatest and the least amount of signal available for the receiver. Considering one of these branches, then—say the one going out to

• *Please turn to page 76*

Fig. 3. Small outlet box is tap-off in a system that uses underground cable.

ANTENNA EQUIPMENT

Are you up to date on what's available in the way of antennas and installation accessories? You can do a better job for your customers (and, incidentally, show a greater profit) if you recognize and take advantage of the technical advances made during recent years.

To help you learn what's being offered and where to find it, we have prepared a Buyer's Guide, indicating the various categories of equipment and showing the manufacturers of these items. To enable you to procure additional information about any item of special interest, we have included the address of each manufacturer.

VHF and UHF Antennas

Most antennas of recent design are based on the yagi principle. Besides providing high gain, these new in-line types are designed to offer low wind resistance, contributing to long useful life. In addition, corrosion damage—a serious problem in the past—has been largely eliminated by coating processes called *anodizing* and *alodining*.

An operational factor which has been improved is front-to-back ratio. There are more stations now, with more power, and good directional qualities are practically a must for antennas in many areas. Unidirectional antennas that have reception angles of only a very few degrees are available.

UHF antennas are more carefully engineered than ever before, especially those designed to cover the entire band. Specially-cut units which provide exceptionally high gain over only a narrow range of UHF frequencies are used in some fringe localities — such as those where translators are located or in areas which receive MPATI airborne-TV signals.

Antenna Designs—802 Washington St., Burlington, Iowa
All Channel Products Corp.—47-39 49th St., Woodside 77, N. Y.
Channel Master Corp.—Ellenville, N. Y.
Clear Beam Antenna Corp. — 21341 Roscoe, Canoga Park, Calif.
Cornell Dubilier Electric—So. Plainfield, N. J.
Finney Co.—34 W. Interstate, Bedford, Ohio
G-C Electronics—400 S. Wyman, Rockford, Ill.
Hy-Gain Antenna Products—1135 N. 22nd St., Lincoln, Neb.
iE Mfg.—3090 W. Carroll Ave., Chicago 12, Ill.
JFD Electronics—6101 16th Ave., Brooklyn 4, N. Y.
Kay-Townes Antenna Co.—1511 Dean Ave., Rome, Ga.
Lance Antenna Mfg. Co.—1730 First, San Fernando, Calif.
Mark Products Co.—5441 W. Fargo Ave., Skokie, Ill.
RMS, Inc.—2016 Bronxdale, New York 62, N. Y.
S & A Electronics—1025 Nevada, Toledo 5, Ohio
Snyder Mfg. Co.—22nd & Ontario, Phila. 40, Pa.
Superex Electronics Corp.—4-6 Radford Pl., Yonkers, N. Y.
Technical Appliance Corp.—1 Taco St., Sherburne, N. Y.
Tenna Mfg. Co.—7580 Garfield, Cleveland 25, Ohio
Trio Mfg. Co.—101 S. Union St., Griggsville, Ill.
Ward Products Corp.—Edson St., Amsterdam, N. Y.
Winegard Co.—3000 Kirkwood St., Burlington, Iowa

Mast-Mounted Preamps and Converters

Still necessary in fringe areas and distribution systems, these units are available in a wide range of tube and transistor models with varying prices and performance characteristics. At least one maker has introduced a mast - mounted UHF preamplifier that uses frame-grid tubes.

Transistorized Antennas

Recently, a number of electronic (preamplified) antennas have appeared on the market. Offering higher gain than passive types, these units have enjoyed increased popularity, especially in fringe areas. For a complete report on transistorized preamplifiers and electronic antennas, see the April, 1962 PF REPORTER.

Blonder-Tongue Labs—9 Alling St., Newark, N. J.
Channel Master Corp.—see *Antennas*
Finney Co.—see *Antennas*
Jerrold Electronics—15th & Lehigh, Phila., Pa.
JFD—see *Antennas*
Technical Appliance Corp.—see *Antennas*
Winegard Co.—see *Antennas*

Rotators

In areas where distant stations must be received from various directions, the antenna rotator has always proved the most popular and economical means of receiving all available signals. Rotators have lately been simplified, ruggedized, and even provided with means for remote-controlling the rotator control by ultrasonic signals. For more details about rotators and controls, see "Rotator Maintenance and Troubleshooting" in this issue.

Alliance Mfg. Co.—Alliance, Ohio
Channel Master Corp.—see *Antennas*
Cornell Dubilier—see *Antennas*

Towers and Masts

Manufacturers of towers and other antenna supports have been placing emphasis on serviceability more than ever before. Recent innovations include a telescoping triangular tower with a built-in winch. This tower can be raised or lowered at will to service antennas or mast-mounted preamplifiers. Self-supporting towers and pipe masts have been improved by new anti-corrosive finishes which extend their life by several years.

In addition to the suppliers listed

REVIEW

What's available for antenna installation and replacement.

below, a number of antenna manufacturers offer towers and masts to go with their own units.

E-Z Way Towers, Inc.—5901 E. Broadway, Tampa 5, Fla.
Rohn Mfg. Co.—6718 W. Plank Rd., Peoria, Ill.
Spaulding Products Co.—550 W. Barner St., Frankfort, Ind.

Installation Accessories

Antenna installations are only as dependable as the materials used in them. For this reason, manufacturers have been stressing greater strength, longer life, and greater ease of installation for their hardware and installation devices. Some offer kits designed to include, at nominal cost, all the materials needed for a normal installation.

Installation Kits

Channel Master—see *Antennas*
Clear Beam—see *Antennas*
Columbia Wire and Supply Co.—2850 Irving Park Road, Chicago 18, Ill.
Finney Co.—see *Antennas*
G-C Electronics—see *Antennas*
Hy-Gain Antenna Products—see *Antennas*
iE Mfg.—see *Antennas*
International Wire and Cable Co.—1665 N. Milwaukee, Chicago 47, Ill.
JFD Electronics—see *Antennas*
Lance Antenna Mfg. Co.—see *Antennas*
Parker Metal Goods—85 Prescott St., Worcester, Mass.
Saxton Products—4320 Park Ave., New York 57, N. Y.
Technical Appliance Corp.—see *Antennas*
Trio Mfg. Co.—see *Antennas*
Winegard Co.—see *Antennas*

Guy Wire

Channel Master—see *Antennas*
Clear Beam Antenna Corp.—see *Antennas*
Columbia Wire and Supply Co.—see *Installation Kits*
Consolidated Wire Co.—1635 S. Clinton, Chicago, Ill.
Finney Co.—see *Antennas*
G-C Electronics—see *Antennas*
iE Mfg.—see *Antennas*
International Wire & Cable Co.—see *Installation Kits*
JFD Electronics—see *Antennas*
Tenna Mfg. Co.—see *Antennas*
Rohn Mfg. Co.—see *Towers & Masts*
RMS, Inc.—see *Antennas*
Lance Antenna Mfg. Co.—see *Antennas*
Parker Metal Goods—see *Installation Kits*
Saxton Products—see *Installation Kits*

Installation Hardware

Channel Master—see *Antennas*
Clear Beam Antenna Corp.—see *Antennas*
Finney Co.—see *Antennas*
G-C Electronics—see *Antennas*
Hy-Gain Antenna Products—see *Antennas*
iE Mfg.—see *Antennas*
JFD Electronics—see *Antennas*
Lance Antenna Mfg. Co.—see *Antennas*
Parker Metal Goods—see *Installation Kits*
RMS, Inc.—see *Antennas*
Rohn Mfg. Co.—see *Towers & Masts*
Saxton Products—see *Installation Kits*
South River Metal Products Inc.—South River, N. J.
Technical Appliance Corp.—see *Antennas*
Trio Mfg. Co.—see *Antennas*

Wire and Cable

Flat 300-ohm line is as popular as ever, and is available in a number of grades and packaging arrangements. It can now be purchased in quantities ranging from 25′ hanks to 1000′ rolls. Improved plastics have made it possible to create products which outlast older types by far, and offer fewer losses.

Transistorized antennas and mast-mounted preamps have caused more widespread use of 72-ohm lead-in systems, and as a result, a lot of RG-59/U and RG-11/U cable is being used. Educational TV and master-distribution systems have also done their bit to expand the coaxial-cable market.

Alpha Wire Corp.—200 Varick St., New York 14, N. Y.
Belden Mfg. Co.—415 S. Kilpatrick, Chicago 44, Ill.
Calcon Mfg. Co., Inc—100 Oakland, Washington, Pa.
Columbia Wire & Supply Co. see *Installation Kits*
Consolidated Wire Co.—see *Guy Wire*
Jersey Specialty Co.—Burgess Pl., Wayne, N. J.
Rego Insulated Wire Co.—830 Monroe St., Hoboken, N. J.
Tevco Insulated Wire—108 E. Prospect, Burbank, Calif.

Lightning Arresters

A necessary part of any outdoor antenna installation, the lightning arrester is available in a variety of styles. The National Electrical Code states that each conductor of a lead-in from an outdoor antenna shall be provided with a lightning arrester which has been approved by *Underwriters Laboratories.*

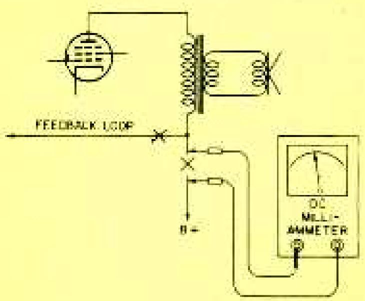
Amphenol-Borg—1830 S. 54th Ave., Chicago 50, Ill.
Channel Master Corp.—see *Antennas*
Consolidated Wire—see *Guy Wire*
Cornell Dubilier Electric—see *Antennas*
Ercona Corp.—16 W. 46th St., New York, N. Y.
Finney Co.—see *Antennas*
G-C Electronics—see *Antennas*
iE Mfg.—see *Antennas*
JFD Electronics—see *Antennas*
Parker Metal Goods—see *Installation Kits*
RMS, Inc.—see *Antennas*
Rego Insulated Wire Co.—830 Monroe St., Hoboken, N. J.
Saxton Products—see *Installation Kits*
Tenna Mfg. Co.—see *Antennas*
Technical Appliance Corp.—see *Antennas*
Winegard Co.—see *Antennas*

Distribution Accessories

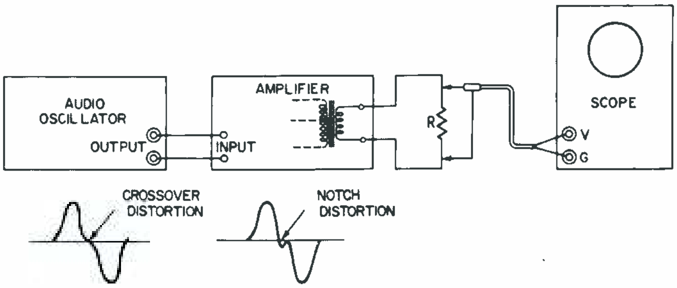
One area where many improvements have been made recently is that of indoor distribution accessories. In the old days, a lead-in wire was run through a hole in a wall and attached to a set. Now, we have items such as amplified multiset couplers, neat two-set couplers and splitters, and attractive wall plates and plugs so that the set can be moved conveniently from room to room. In 72-ohm systems, cable tap-offs and outlet boxes allow a much more attractive system than a cable which just drapes from set to set.

Antronic Corp.—2712 W. Montrose Ave., Chicago 18, Ill.
Blonder-Tongue Labs—9 Alling St., Newark 2, N. J.
Channel Master Corp.—see *Antennas*
Clear Beam Antenna Corp.—see *Antennas*
G-C Electronics—see *Antennas*
Jerrold Electronics—see *Preamps & Converters*
Mosley Electronics, Inc.—4610 N. Lindbergh, Bridgeton, Mo.
RMS, Inc.—see *Antennas*
Rego Insulated Wire Co.—see *Lead-In Wire & Cable*
Saxton Products—see *Installation Kits*
Walsco Electronics Mfg. Co.—100 W. Green St., Rockford, Ill.

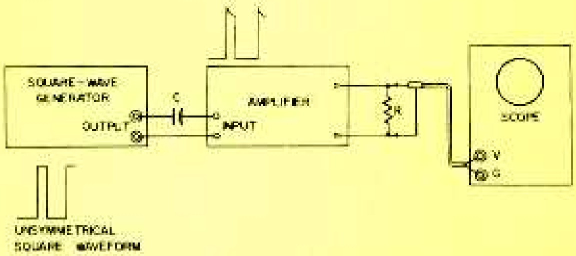
SPECIAL DISTORTION TESTS FOR HI-FI AMPLIFIERS



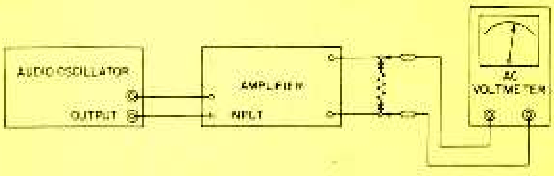
REGENERATION caused by a defective negative-feedback loop is indicated if B+ current to the output stage decreases when the feedback line is disconnected. Check the complete feedback loop for wrong component values or stray-capacitance effects which could be shifting the phase of the feedback, and thus changing it from degenerative to regenerative



CROSSOVER AND NOTCH DISTORTION are revealed by scoping the amplifier output. The audio oscillator is tuned to approximately 3000 cps and adjusted for maximum power output across R. Crossover distortion, which indicates excessive bias on push-pull output tubes, shows up as a bend which is symmetrical above and below the zero-volt line on the scope screen. On the other hand, notch distortion (caused by the leakage reactance in the output transformer resonating with the stray capacitance in the primary circuit) occurs only on the negative half-cycle of the waveform.
(Note: Resistor R, substituted for the speaker system, should have a value equal to the over-all speaker impedance.)



PEAK-OVERLOAD testing evaluates an amplifier's ability to reproduce transient, high-amplitude pulses without distortion. The generator must furnish asymmetrical square waves (pulses), and should be tuned to a frequency high enough to produce differentiation of pulse tips in the input waveform. When the generator is adjusted to provide 50% greater peak voltage across the load than for rated power output, the amplifier input and output waveshapes should be identical.

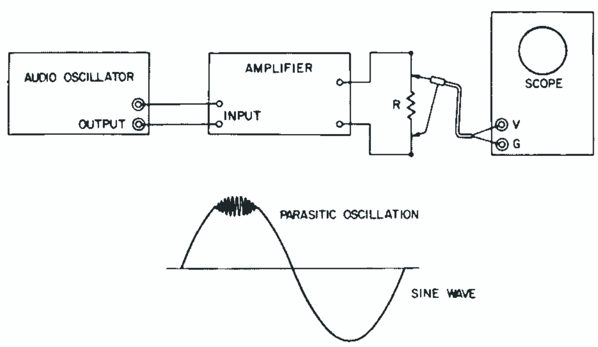


DAMPING FACTOR can be calculated by comparing the output voltage under no-load conditions with that measured under normal load. The signal from the oscillator (usually at 60 cps) is kept low in amplitude, in order to protect the circuit while the load resistor is not being used. This component is a 15-watt, wire-wound variable resistor, set to the nominal load value. The damping factor equals the full-load voltage divided by the difference between the no-load and the full-load voltages.

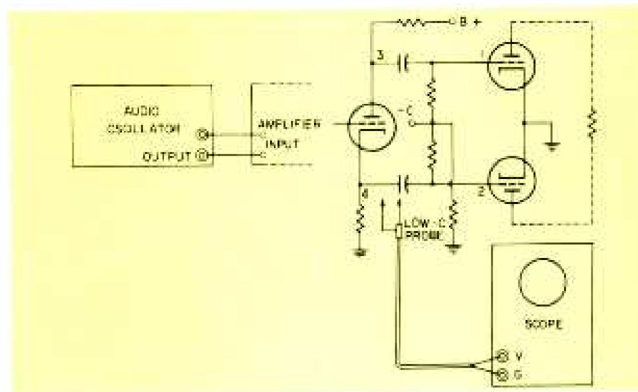
Finding the cause of distorted output from a high-fidelity audio amplifier is one of the most exacting jobs in electronics servicing. Since the performance standards of the equipment are exceptionally high, not even slight defects are likely to be tolerated by the user; furthermore, the possible causes of distortion are almost innumerable.

The "detective work" involved in catching these villians demands an extra measure of analytical skill, as well as competence in using several specialized test instruments. To do a thorough job, the technician needs to develop the ability to distinguish between various forms of distortion, and should also know how to improvise test set-ups to check his suspicions of trouble. Although voltage and resistance checks are of some benefit in finally pinpointing distortion troubles, these measurements alone do not usually provide adequate information. Some additional help can be obtained with special instruments (particularly harmonic-distortion and intermodulation analyzers), but these still do not always supply the answers.

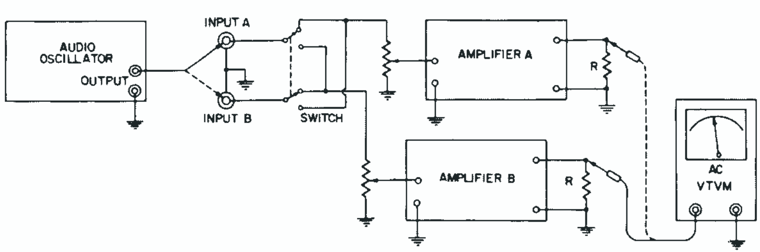
The illustrations on these pages (based on the Howard W. Sams book, "101 Ways to Use Your Audio Test Equipment," by Robert G. Middleton) demonstrate several tests which advanced audio technicians find useful. Items of equipment required include: audio VTVM, DC milliammeter, audio oscillator, oscilloscope, and square-wave generator, plus load resistors.



PARASITIC OSCILLATION, which causes "rattle" in the sound, shows up as "bulging" spots in a scope trace. Waveforms are checked with the oscillator tuned to low, medium, and high frequencies, and at several levels of output power (up to maximum rated output). If parasitic oscillation appears under any conditions, it can usually be eliminated by connecting 50- to 500-ohm resistors in series with the tube-electrode leads in the circuit where the oscillation is occurring.

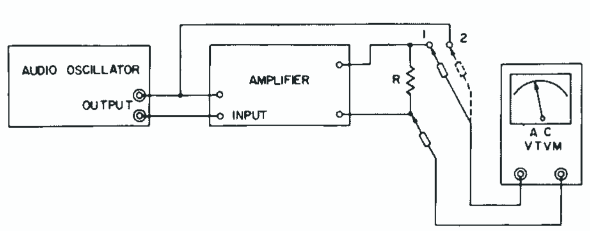


PHASE INVERTERS can be checked for distortion or unbalance by observing waveforms at points numbered 1 through 4. The sine-wave generator is adjusted to produce maximum rated output from the amplifier. The resulting waveform should be a good sine wave at all audio frequencies, and peak-to-peak voltages at all four test points should be practically the same. If distortion or unequal amplitudes are noted, components in the phase-inverter circuit should be meticulously checked.

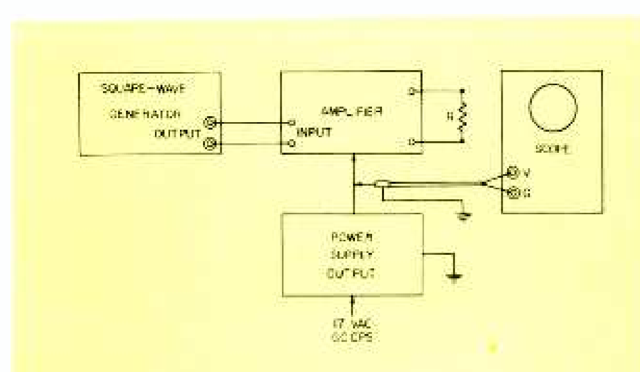


CROSS TALK between stereo amplifiers is measured by checking the frequency response of amplifier A with the meter connected to the output of this amplifier, and then repeating the procedure with the meter at the output of amplifier B. The db difference between the two VTVM readings at the frequency of maximum cross talk is termed the *cross-talk figure*. Results should be checked by repeating the test with the audio oscillator connected to the input of amplifier B, and seeing if the cross-talk figure is the same in both directions.

AMPLITUDE NONLINEARITY, or distortion that varies with the output level, can be detected with this test setup. Starting at a very low amplitude level, a 400-cps output from the oscillator is gradually increased *in equal steps* until maximum rated power is reached; at each step, the voltage ratio between the amplifier input and amplifier output is recorded. If the amplifier is free from amplitude distortion, this ratio will remain constant during the entire series of tests.



POWER-SUPPLY REGULATION is a factor in amplitude nonlinearity; if B+ voltage falls when current drain increases, amplifier tubes will receive insufficient voltage at high power levels. In this test, the load on the supply is alternately increased and decreased by applying a 20-cps square wave to the amplifier. In poorly-regulated supplies, B+ will fluctuate, producing a distorted square-wave pattern on the scope. The poorer the regulation, the higher the waveform amplitude.



ANTENNAS FOR

There's a type to overcome any reception problem . . . *by Leonard Feldman*

The FM service complaints are beginning to roll in! Not that a new strain of "electronic virus" has infected FM sets throughout the land . . . No, these complaints stem from FM listeners who have heard about the new FM stereo broadcasts and have added adapters or converters to their present equipment. As a result, what was once a respectably quiet, noise-free system begins to hiss and crackle, justifiably causing the unsuspecting customer to wonder if FM stereo is all it's cracked up to be.

There are two fundamental reasons why FM stereo reception may be poor where monophonic performance has been very satisfactory. By far the more important of these has to do with signal strength. FM stations radiate the same amount of total power on both mono and stereo transmissions. However, the stereo subcarrier is amplitude-modulated and occupies a portion of the spectrum where signal-to-noise ratios are especially low. As a result, the subcarrier would have to be transmitted at much greater power to achieve quieting conditions equal to that of monophonic FM transmission. This means that if 10 microvolts of monophonic signal was formerly enough to provide satisfactory receiver performance, as much as 100 microvolts of stereo signal may be needed to give equally satisfactory results.

Table I—Length Of Half-Wave Dipole

DESIRED FREQUENCY (mc)	LENGTH (FT) (TOTAL, 2 SIDES)
88	5.32
89	5.26
90	5.20
91	5.14
92	5.08
93	5.03
94	4.98
95	4.93
96	4.88
97	4.83
98	4.78
99	4.73
100	4.68
101	4.63
102	4.59
103	4.55
104	4.50
105	4.46
106	4.42
107	4.38
108	4.34

The second factor contributing to customer complaints about FM stereo has to do with the nature of the composite stereo signal. As you probably know, a 19-kc pilot carrier, having a relatively low amplitude compared to the rest of the signal (10% of full modulation), rides along with the audio information. This pilot carrier is used to "lock in" the local 19-kc or 38-kc oscillator in the receiver or converter.

If signal strength is low—so low that full limiting is not achieved in the receiver—the pilot carrier may be lost altogether, or be otherwise unable to positively and accurately lock or synchronize the local oscillator. In such cases, a motorboating sound may be heard, stereo separation may fade or wander, and the stereo portion of the signal may be noticeably distorted.

Speaking of distortion, one of the least recognized but most offending causes for this condition is an effect which, until now, was primarily associated with TV. In television parlance, we call it "ghosting;" in FM it's called "multipath." You can readily see that if a certain pulse of 19-kc pilot carrier is supposed to lock in with a specific group of similar sine waves in the stereo subcarrier signal (38 kc)—and its echo locks in instead — the phase and frequency stability required for good

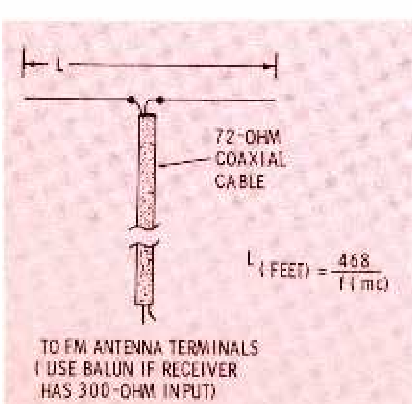


Fig. 1. Half-wave dipole with 72-ohm impedance, simplest FM antenna type.

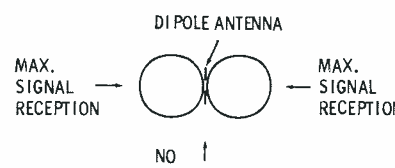


Fig. 2. Directional response of a simple half-wave dipole type of antenna.

stereo reception will be affected.

Most FM tuners and receivers should operate satisfactorily on stereo, with an appropriate adapter which has been properly installed. When they don't, chances are they simply aren't being fed a good, clean RF signal. The answer—an antenna installation to suit the particular situation.

Since FM stereo is still fairly new, you're likely to run into customer resistance. "Why do I suddenly need an outdoor antenna for stereo, when all I needed before was this two feet of wire hanging behind the set?" To help convince him, you might show him this article. If this isn't enough, you can quote from the FCC order which authorized FM-stereo broadcasting.

". . . Also, System 4-4A (*the system finally adopted*), in common with other multiplex systems, will not provide an FM stereophonic service area which is coextensive with the service area available to monophonic listeners. Accordingly, acceptable monophonic reception of a given station will not, per se, insure acceptable stereophonic reception."

The City Dweller

Once you've passed the selling hurdle, you must carefully decide what type of antenna will best do the job. If the customer's location is not too far removed from the station site, the simple half-wave dipole shown in Fig. 1 may be enough to do the trick. Since the FM band extends from 88 to 108 mc, most FM antenna manufacturers choose a length which is resonant at about 98 mc, the middle of the band. The total length is nearly five feet (half for each leg of the dipole), if you care to make one yourself. For best results, a 72-ohm coaxial lead-in should be employed for proper matching to the impedance of the dipole. For critical areas where every last db is important, antenna length should be cut precisely to the frequency of the desired station, according to Table I.

FM antennas require careful attention to orientation—in fact, just as much as you would devote to a TV antenna. The directional response of a simple dipole is shown in Fig. 2. You can see that signals are best received from either of the two broadside directions and most poorly received at the dipole ends. Orientation should be performed while actually listening to a stereo broadcast, as signal strength alone is not the only criterion. Often, a slight offset from the optimum-signal position will result in reduced distortion because of a reduction in the multipath effects discussed earlier.

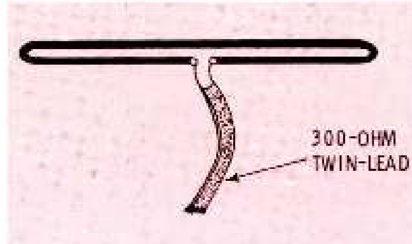


Fig. 3. Folded dipole has higher directivity, impedance than simple type.

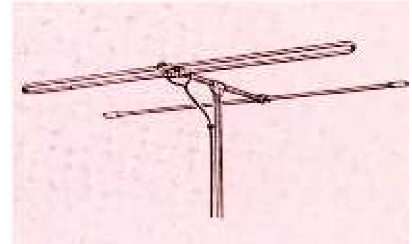


Fig. 4. Adding a reflector element increases effective gain in one direction.

An Improved Dipole

Fig. 3 depicts an antenna type with which you should be familiar, for it is one of the basic elements in many TV installations. A folded dipole can be described as two dipole antennas connected in parallel, the two dipoles being separated by about 3". The bi-directional and unidirectional characteristics of the folded dipole are similar to those of its simple-dipole counterparts; however, directivity is somewhat sharper, and this, of course, results in greater gain. In addition, the higher impedance of the folded dipole permits making a direct connection to a standard 300-ohm FM-receiver input.

The Near-Suburbanite

This stereo customer, concerned primarily with receiving all stations from one general direction, will do somewhat better with the type of antenna shown in Fig. 4—a half-wave folded dipole with reflector. The action of the reflector is twofold. First, because of its relative position, it reinforces signals reaching the dipole section. Second, it cuts down reception of signals arriving from the rear. The signal voltage developed by this antenna is about 5 db greater than that developed from a dipole alone—in marginal cases, enough to make the difference between "barely acceptable" and "fully acceptable" stereo reception. The response characteristic of this type of antenna is shown in Fig. 5.

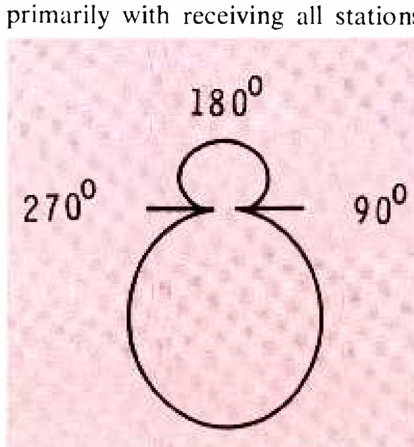


Fig. 5. Directional response of dipole antenna when one reflector is added.

For More Stations

The antenna type shown in Fig. 6 is recommended when stations are to be received from widely separated directions. This unit, known as a cross-dipole (or turnstile) antenna, consists basically of two folded dipoles at right angles to each other, interconnected by a piece of 300-ohm transmission line one-quarter wavelength long. Other designs utilize simple dipoles following the same mechanical arrangement.

For FM stereo reception, such antennas are successful only under ideal circumstances; while they

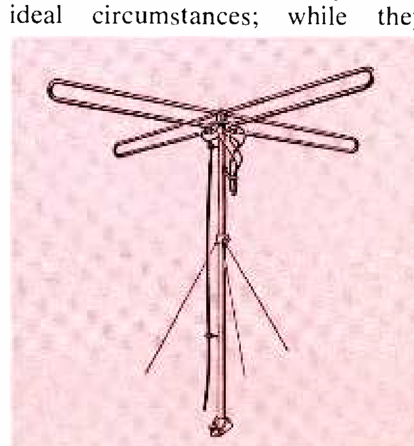


Fig. 6. Cross-dipole antenna is able to receive signals from all directions.

have an advantage in providing multidirectional reception, they will more than likely intensify any multipath effects which may be present.

Out-of-Towner

A conical array, illustrated in Fig. 7, consists of two or three dipoles, with one or more sets of reflecting elements. Use of different dipole lengths (the center elements usually shorter than the others) tends to broaden frequency response. Also, the dipole elements are angled forward about 10°, which increases directivity. Thus, a conical antenna system is ideally suited for outlying districts where several stations are to be received from the same general direction but at diverse frequencies across the FM band. For added gain, a *stacked* conical array may be utilized.

'Way Out

An example of the so-called yagi antenna, a high-gain type useful for fringe-area reception, is shown in Fig. 8. This particular array uses two folded dipoles, one rear reflector, and three directors;

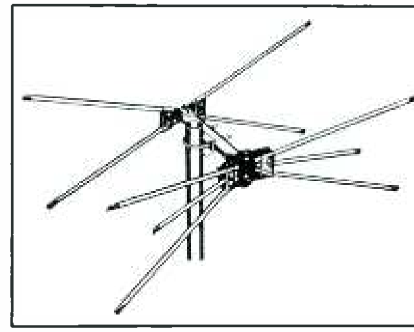


Fig. 7. Conical antenna has broad frequency response and fair directivity.

however, there are many variations in design. All provide considerably more gain than the types previously described and have very narrow directivity patterns. Some are designed for maximum response to a specific narrow band of frequencies, but most of them are planned to provide fairly flat response over the entire FM band.

The yagi antenna, because of its narrow directivity, is ideally suited for eliminating multipath problems. In cases where signals must be received from more than one direction, however, it may be necessary to install two yagis, or perhaps even a rotator, whichever seems most suitable for the particular situation.

There are, by latest count, some 17 million FM receivers in this country. Only a small fraction of these are equipped to receive FM stereo. As more and more stations begin transmitting "two-channel sound," you may be certain that thousands and ultimately millions of FM listeners will attempt to convert their existing equipment. Many are sure to be disappointed at first, and you can often come to their rescue by installing a suitable antenna system. ▲

ED. NOTE: The article "Antenna and Accessories Review" in this issue contains a guide to the manufacturers of various TV-FM antennas, including many for FM stereo.

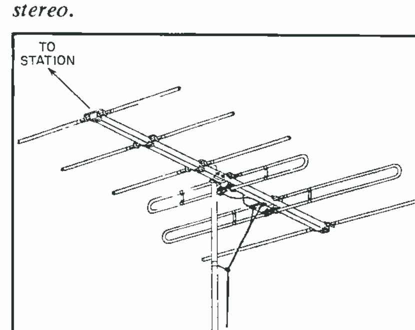


Fig. 8. This array is typical of high-gain yagi types for fringe reception.

New TRANSISTOR RADIO ANALYST

makes it Easy and Profitable to Service all Transistor Radios

B&K Model 960

TRANSISTOR RADIO ANALYST

with Exclusive DYNA-TRACE Single-Point Probe—and Built-in Metered Power Supply and VTVM

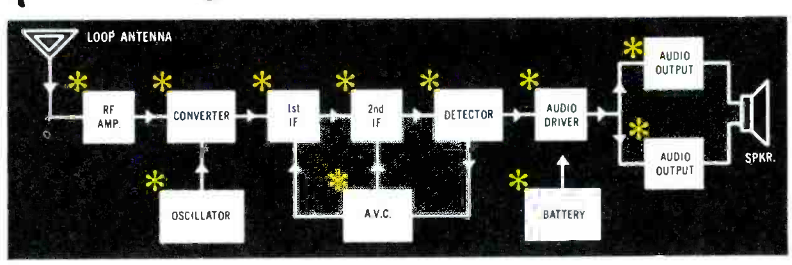
Complete Transistor Radio Service Shop in One Instrument

Signal-Generator, Power Supply, Milliammeter, VTVM, Battery Tester, Ohmmeter, and Both In-Circuit and Out-of-Circuit Transistor Tester—All in One

Also Speeds Servicing of Tube-Type Radios

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

Now you *can profit* from transistor radio servicing! This amazing new B&K "960" ANALYST gives you *everything* in *one* complete easy-to-use instrument. Makes transistor radio servicing *quick and easy*. Nothing else is needed except the transistor radios themselves waiting to be serviced. Brings you new customers for service, parts, and batteries. Makes this new business *yours*.



EASILY TROUBLE-SHOOT ANY STAGE BY UNIQUE POINT-TO-POINT SIGNAL INJECTION

The ANALYST gives you a complete signal-generating source for point-to-point signal injection. Easily enables you to trouble-shoot any transistor radio—check all circuits stage-by-stage—isolate and pinpoint the exact trouble in minutes.

Supplies modulated signals, with adjustable control, to check r.f., i.f., converter, and detector. Supplies audio signal to check audio driver and audio output. Provides unmodulated signal to test local oscillator. Provides separate audio low-impedance output for signal injection into loudspeaker voice coils to check speaker performance.

BUILT-IN METERED POWER SUPPLY FOR EASY SERVICING

Makes it easy to operate radio under test, while you inject your own signals. Provides from 1 to 12 volts in 1½ volt steps. Supplies all bias taps that may be required.

SIMPLIFIES IN-CIRCUIT TRANSISTOR TEST WITH NEW DYNA-TRACE SINGLE-POINT PROBE

Unique single-point probe needs only the one contact to transistor under test. No longer are three wires required to connect to emitter, base, and collector. Gives fast, positive meter indication. Saves time. Makes trouble-shooting simple and easy.

BUILT-IN VTVM

Includes high-input-impedance vacuum-tube voltmeter, which is so necessary for transistor radio servicing.

TESTS ALL TRANSISTORS OUT-OF-CIRCUIT

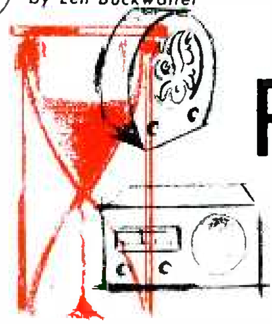
Meter has "Good-Bad" scale for *both* leakage and beta. Also has direct-reading Beta scale, calibrated 0-150. Assures quick, accurate test. Also automatically determines whether transistor is NPN or PNP. Meter is protected against accidental overload and burn-out.

Model 960. Net, $99.95

Solve Every Service Problem and Profit with a Modern B&K Service Shop. See Your B&K Distributor or Write for Catalog AP20-R

B&K MANUFACTURING CO.
Division of Dynascan Corporation
1801 W. BELLE PLAINE AVE. • CHICAGO 13, ILL.
Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
Export: Empire Exporters, 277 Broadway, N.Y. 7, U.S.A.

by Len Buckwalter



Repair SUPERHETS IN MINUTES

Repairing the "lowly" AC/DC table-model radio — ungraciously dubbed the *superhet* — is the most dependable sideline of well organized service shops, and represents an income not to be ignored. On the other hand, all is not so simple that the matter can be easily dismissed. Many servicemen, however competent they may be at TV repairs, have failed to develop a quick logical approach to servicing these small "enigmas." This article is devoted to describing how superhets *can* be repaired profitably.

The techniques described here were developed during many years' experience with "flat-fee" radio repair. No matter how high the stack of ailing superhets became, the pay rate remained in the vicinity of $2 per cure—whether the repair was a fast squirt of solvent in a noisy volume control or a lengthy session with an intermittent. Needless to say, *speed* was the key to survival.

The system boils down to this: Subject a circuit to a fast series of easily performed checks which will isolate the defective stage or possibly even a single component. "Nothing new here," you may think; but there is—the nature of these tests. They are characterized by their basic simplicity and a minimum use of special bench facilities.

As many possible avenues exist for troubleshooting a superhet as there are servicemen, but the most-favored approach is a general path from the power supply to the audio section, and on to the IF and RF stages. Several symptoms can be serviced by shorter routes; many of these shortcuts are listed in the troubleshooting chart accompanying this article.

Fig. 1. Quick test for power switch.

Dead Set

First, let's assume that you're confronted by a totally dead set. Since tube failures cause a major percentage of troubles, the tubes are checked at the very start. After this, the set is placed on the bench with the chassis removed from the cabinet.

Power Section

If the tubes will not light when supplied with AC power, the switch may be at fault. A fast method for detecting this is to short across the two switch contacts on the back of the volume control with the shank of a metal screwdriver, as illustrated in Fig. 1. If the tubes light, the defect is obvious; if not, the line cord is the next suspect. Grasp it three or four inches from the plug and gently wiggle it in every direction.

Beyond these steps, a conventional ohmmeter test is in order; the probes across the prongs of the AC plug (power switch closed) should indicate resistance ranging up to a few hundred ohms. If the initial test reveals an open circuit, one probe can be left at one side of the plug (point A in Fig. 2) while the other is moved consecutively through points 1 to 8 in the filament-circuit path. In this example, a break in the line is pinpointed by a continuity reading at point 4, with no continuity reading at point 5.

The next step is to make a quick search for obvious signs like charred components, the giveaway

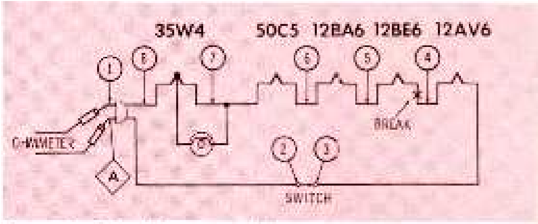


Fig. 2. Step-by-step ohmmeter tests will locate filament-string defects.

sounds of sizzling or frying, or the tell-tale odor of a burnt resistor. If nothing provokes suspicion, listen carefully to the speaker; hold your ear close and listen for the soft hum which arises from 60-cps ripple in the power supply. If it is present, this is fair evidence that the power supply is operating, as well as at least a part of the audio section. It also proves that the audio output transformer and speaker voice coil are functioning.

An unusual amount of hum (with volume control turned down) is a good indication of rectifier or filter trouble—usually the latter. A quick test by bridging with a good electrolytic will tell for sure. Many shops have a filter capacitor, with clips attached, on hand for just this purpose.

Audio Stages

A quick, conclusive check of the audio section can be made at the volume control by inducing hum at the "high" end as shown in Fig. 3. Although the metal tip of a screwdriver is sometimes used, a more dependable probe can be

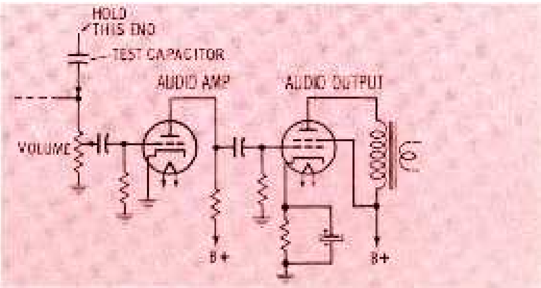


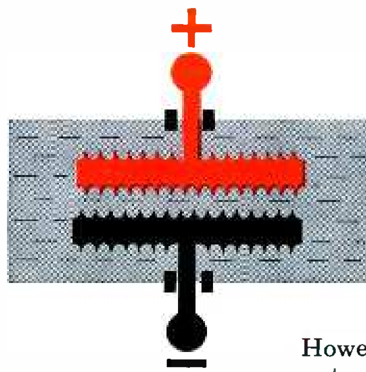
Fig. 3. Using "test-probe" capacitor for isolating audio - circuit faults.

MALLORY
P. R. MALLORY & CO. Inc.

Tips for Technicians

Distributor Division, P. R. Mallory & Co. Inc.
P. O. Box 1558, Indianapolis 6, Indiana

Why some filter capacitors develop hum... and some don't



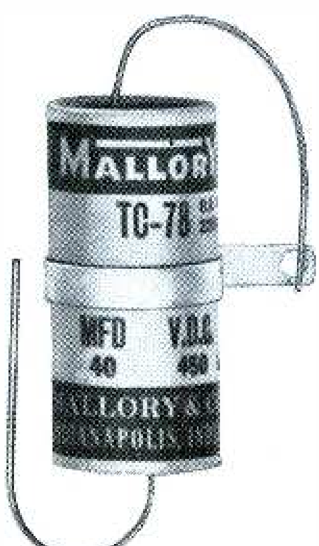
Aluminum electrolytic capacitors are widely used as filters in DC Power Supplies. This is because of their large capacitance in relatively small size. All in all, they do an efficient job of reducing ripple (hum) to acceptable levels.

However, all electrolytic capacitors are not alike. This is often why some types seem to allow hum to rise to objectionable levels more quickly than do others. In order to understand why, we must investigate actual construction methods.

As you know, electrolytics are basically made by depositing a film of aluminum oxide on aluminum foil to form the positive anode. The oxide is the dielectric. A semi-liquid electrolyte surrounds the anode and is actually the negative cathode. In order to connect this semi-liquid cathode to a terminal, a second piece of aluminum foil is used. This is often *called* the cathode, but it is not. It is actually only the *cathodic connection*. (The preceding describes a "polarized" electrolytic capacitor.)

When high ripple currents are applied to polarized electrolytics, a thin oxide film forms on the so-called "cathode". It begins to assume the characteristics of a second anode. This in turn, has the same effect as placing two capacitors in series. Consequently, overall capacitance is reduced. Inevitably hum increases.

This action is especially noticeable in electrolytics which use plain foil as the "cathode". This is simply because the oxide builds up over a relatively small area.



Mallory avoids this problem by etching the "cathode" on electrolytics. As a result, oxide build-up is spread over a vastly increased area. Therefore, ripple currents are maintained at very low levels for very long time periods.

Of course etched "cathodes" cost a lot more to make. But you get them from Mallory at *no extra cost.* There's much more to the Mallory capacitor story, but we'll leave that to another TIP.

Meanwhile, see your local Franchised Mallory Distributor for capacitors, resistors, controls, switches, semiconductors, and batteries. In fact, he's the man to see for *all* of your electronic component requirements.

A Sylvania exclusive from your participating Distributor

Big news for dealers who appreciate Sylvania quality and what it means to bigger service profits. Now you can profit and save at the same time through the many Distributors participating in Sylvania's big receiving tube stamp plan.

Start saving America's most valuable stamps for the things you and your family have been meaning to buy. Get them free. Get them faster, if you're one of the millions of families already saving S&H Green Stamps.

Select your gifts from the big new 144-page S&H catalog that's chock-full of America's most valued merchandise. Everything from home furnishings to fabulous furs.

Select S&H Gifts from this big new catalog—available from participating Sylvania Distributors.

SYLVANIA

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

made from a .1 mfd 600-volt capacitor.

To make this test, turn the volume control fully clockwise and touch one lead of the capacitor to each of the three lugs of the control, while holding the other lead between your fingers. A loud hum should be heard in the speaker when the capacitor lead contacts either of the two ungrounded lugs —the quiet one is the ground return.

RF and IF Circuits

If the power supply and audio stages are okay, you can continue with further tests, still using the .1-mfd capacitor as a probe. With it, you can short, shock and otherwise disturb signal circuits, while running no risk of burning any components due to DC overload.

Specifically, the IF and RF stages should be subjected to what could be termed the "click" test. One lead of the capacitor is touched to the control grids of each of these tubes (see Fig. 4) with the volume full up. A click should be heard in the speaker; failure to hear it singles out the stage for closer inspection. As suggested by the schematic in Fig. 4, the process should follow a logical order—from IF to RF. It starts at the input to the detector and ends at the oscillator grid of the converter tube.

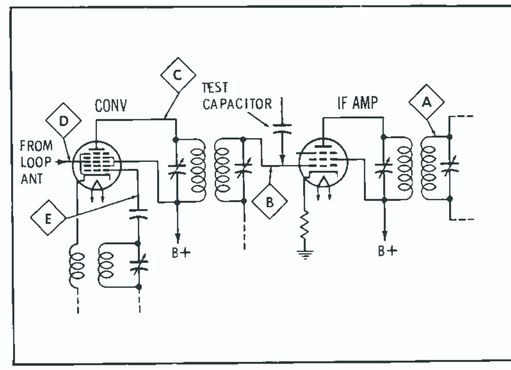


Fig. 4. "Click" test is efficient way to pinpoint trouble in RF-IF section.

Though the click test can reveal that each stage is capable of passing a signal, it gives no clue to the condition of the local oscillator. The first sign of a disabled oscillator: No stations are received, but sometimes the hiss and crackle of atmospherics will be audible (though much weaker than usual). In some cases of trouble—usually those caused by a defective oscillator coil—the click test will shock the oscillator into temporary operation.

Determining for sure whether the local oscillator is functioning takes very little time. Two quick methods are commonly used. In the first, a nearby set is tuned to approximately 1400 kc. The set in question is then dialed from the low to the high end of the broadcast band. If the oscillator is working, a whistle will be heard in the nearby set as the tuning dial passes through approximately 1000 kc.

The second method of verifying oscillator action is by measuring the bias developed at the grid of the oscillator tube (point E in Fig. 4), preferably with a VTVM. This voltage should be from −3 to −10 volts DC, depending on the tube being used.

Other Tests

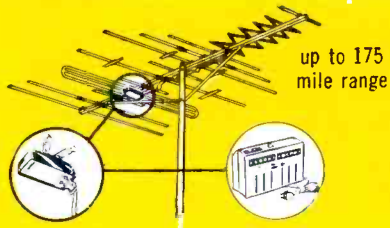
The steps just described deal principally with a dead set. Other symptoms—like squeals or distortion — can also be localized with the aid of the .1-mfd capacitor. In the case of self-oscillation (squeals), one capacitor lead is touched to the radio chassis (or other B− point) while the free end is used as a probe on successive

JFD transis-tenna the brand that puts you in command of your market—

brings you the *total* line of TV and FM electronic antennas and antenna amplifiers that is *ahead* in models, *ahead* in features, *ahead* in sell.

Why settle for less? Rely on JFD, the Antenna America knows best—and profit best!

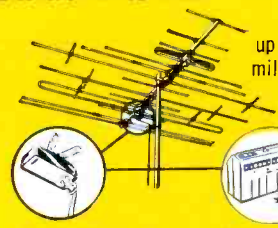
JFD TRANSIS-TENNA ELECTRONIC TV ANTENNA-AMPLIFIER-DISTRIBUTION SYSTEM



up to 175 mile range

No. TNT1111G-AC $76.95, list

100 MILE YAGI-SHARP RECEPTION FROM EVERY DIRECTION—WITHOUT A ROTATOR!



up to 150 mile range

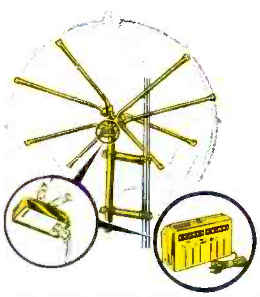
No. TNT520G-AC $66.95, list

200 MILE DEEP-FRINGE HIGH FIDELITY RECEPTION

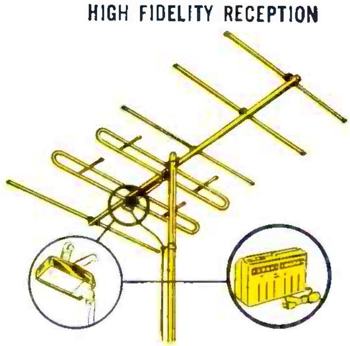
ASSURE **MAXIMUM** GAIN AND **HIGHEST** SIGNAL-TO-NOISE RATIO—IN BLACK AND WHITE OR COLOR Super-gain PADT transistor circuit delivers up to 18 db gain on low-band, and 15 db gain on high band . . . exclusive direct-to-terminal mounting—the point of highest S/N ratio . . . a few of many reasons why you get **more clean** useable gain with Transis-tennas. Only JFD provides you with the broadest selection of electronic Transis-tenna systems—**15** models—for **every** location and budget. Priced from $39.95 to $76.95, retail (antenna, amplifier and power supply included). Each antenna gleamingly AAA* gold bond alodized.

*Attractive, Anti-corrosive, Alodine-treated

JFD TRANSIS-TENNA ELECTRONIC FM ANTENNA-AMPLIFIER-DISTRIBUTION SYSTEMS



FM Stereo-Cone Transis-tenna
No. TNTFM175G-AC $47.95, list

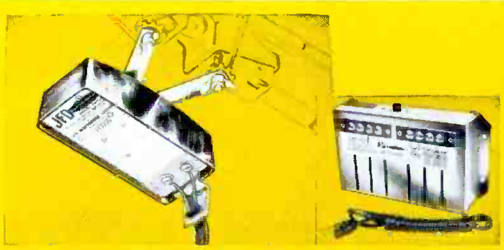


FM Stereo Yagi Transis-tenna
No. TNTFM350G-AC $54.95, list

HIGH FIDELITY FM STEREO RECEPTION STARTS WITH A JFD FM STEREO-ENGINEERED ANTENNA. Whether you select an ultra-powerful JFD FM Stereo transistorized Transis-tenna or one of the 8 other quality-built JFD FM antenna kits, you step up to bright new profit opportunities in the growing FM market. You also get the extra sales boost of knowing that each JFD FM antenna is designed to overcome the power loss and range limitations of multiplexed FM stereo . . . receive distant stations crisply and clearly . . . add high fidelity quality to even budget-priced FM systems. Each antenna in lustrous AAA* gold bond alodized aluminum.

*Attractive, Anti-corrosive, Alodine-treated

JFD TRANSIS-TENNA TV/FM AMPLIFIER



No. TNT103 AC-POWERED (shown above) $36.95, list
No. TNT100 BATTERY-POWERED $34.95, list

THE ONLY "ADD-ON" TV/FM ANTENNA AMPLIFIER THAT MOUNTS ON EVERY TV ANTENNA AT THE RIGHT PLACE—DIRECTLY ON ANTENNA TERMINALS—THE POINT OF HIGHEST SIGNAL-TO-NOISE RATIO.

Only the JFD Transis-tenna mounts **directly** on the terminals of any antenna, regardless of its design—for maximum signal transfer Exclusive PADT transistor circuitry provides superior gain—up to 18 db on low, 15 db on high band. Interference-proof circuit design rejects spurious amateur, CB, aircraft, fire, police and other interfering frequencies. Available with AC powered (TNT103) or battery-powered (TNT100) supply.

JFD "ALL-IN-ONE" HOME TRANSIS-TENNA TV AMPLIFIER

DEMONSTRATION SHUNT SWITCH

OPTIONAL 72-300 OHM CONNECTION

ADJUSTABLE GAIN CONTROL

No. TNT105
AC-POWERED
$29.95, list

COMBINES AMPLIFIER AND AC-POWERED SUPPLY IN ONE HANDY UNIT that installs conveniently anywhere in home—yet operates 1, 2, 3 or 4 sets with amplified signal power Average gain: low band, 18 db; high band, 15 db. Adjustable gain control . . . demonstrator shunt switch . . . optional 72 or 300 ohm connectors . . . courtesy AC outlet . . . AC-powered supply . . . 4-set coupler . . . all in one compact housing.

JFD TRANSIS-TENNA FM AMPLIFIER

No. TNT106FM
AC-POWERED
$36.95, list

FOR THE ULTIMATE IN FM STEREO POWER, ADD THE NEW JFD FM TRANSIS-TENNA—THE ONLY FM ANTENNA AMPLIFIER THAT MOUNTS DIRECTLY ON THE TERMINALS OF ANY FM ANTENNA.

The best place for an amplifier is at the antenna terminals—and that's exactly where the JFD FM Transis-tenna goes . . . regardless of the antenna type. Increases gain of any FM antenna by 25 db Complete with AC-powered supply—4 set distribution unit, 300 ohm connectors, and transistorized amplifier

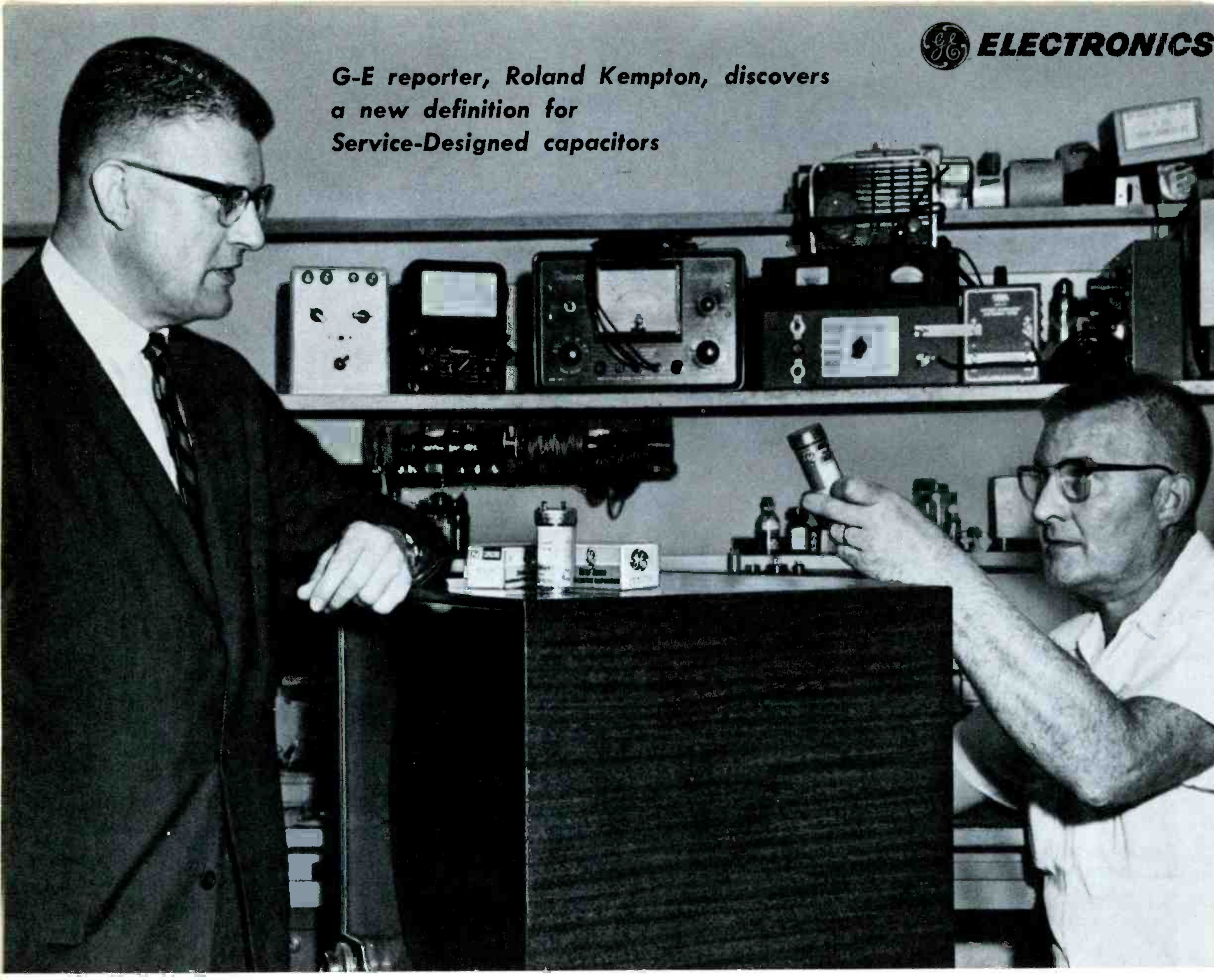
MAKE JFD—THE TOTAL TV/FM ANTENNA LINE—YOUR MAIN LINE TO PROFITS! CALL YOUR JFD DISTRIBUTOR NOW.

JFD

THE BRAND THAT PUTS YOU IN COMMAND OF THE MARKET

JFD ELECTRONICS CORPORATION

6101 Sixteenth Avenue, Brooklyn 4, N Y
JFD Electronics-Southern, Inc., Oxford, North Carolina
JFD International, 15 Moore Street, New York, N Y
JFD Canada, Ltd 51 McCormack Street, Toronto, Ontario Canada
557 Richards Street, Vancouver 2, British Columbia



"Gas Savers". . . that's what John Crocker calls G-E *SERVICE-DESIGNED* capacitors, because he can fill 70% of his replacement needs with just 20 types

Here's how John Crocker, owner of CROCKER TELEVISION AND RADIO SERVICE, Fort Wayne, Ind., figures the day-to-day advantages of G-E Service-Designed capacitors:

"In these days of watching each leak in overhead, we have calculated that G-E Service-Designed capacitors save us gas and time whenever we can just reach over to the rack and pull out the capacitor for the job. We call them gas savers. Our edge-of-town location means one hour of a man's time, plus the wear and tear on equipment, whenever we have to rush to the distributor for an exact replacement. Over a period of months this can run into a lot of unnecessary expense."

It pays to stock G-E Service-Designed capacitors. Save gas. Save time. Reduce costs and inventory requirements. Speed customer service.

Get all of the facts, including the most complete capacitor catalog and replacement guide ever published, from your G-E capacitor distributor. Ask for ETR-2600, or write to: General Electric Company, Distributor Sales, Electronic Components Division, Room 1754A, Owensboro, Kentucky.

Progress Is Our Most Important Product

GENERAL ELECTRIC

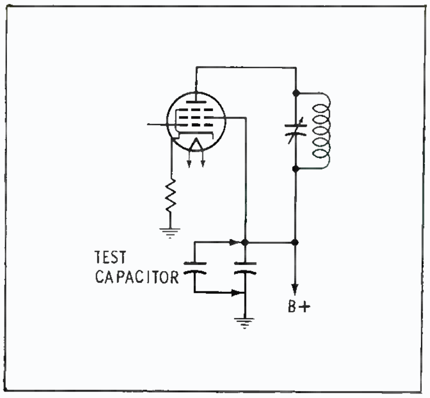


Fig. 5. Curing oscillations by bridging.

control grids. The offending circuit ceases to oscillate when the capacitor shunts the feedback signal to ground.

When the defective stage is pinpointed, bridging with the capacitor is often helpful. If, for example, an open screen bypass is responsible for setting up the feedback path, the test capacitor should stop the squeal when its leads bridge the defective component—see Fig. 5.

The bridging technique is pretty much restricted to spotting *open* bypass or coupling capacitors; the .1-mfd unit will not help if the suspected component is shorted or leaky. In the case of filter capacitors, the .1-mfd value will not provide enough capacitance to indicate an open condition; an electrolytic comparable to the original filter should be tried.

Transistor Sets

How valid are these techniques on transistorized superheterodyne receivers? To a significant extent, they are useful if certain limitations are recognized. Introducing hum to a transistor audio section with .1-mfd capacitor and fingers is not generally too successful; the impedances encountered are simply too low to respond with ample hum levels. But, the circuit-disturbance (click) test can be applied, in most cases. (Sudden transients introduced by the lead of a capacitor might damage certain high-frequency, low-signal transistors, but these are not generally used in broadcast receivers.)

Chart of Common Troubles (other than tubes)

SYMPTOM	CHECK
Dead set	Power switch, line cord and plug, tube-socket contacts. Incorrect power-supply voltages.
Steady hum	Defective filter capacitor, open audio-grid resistor, open cathode-bypass capacitor in audio output, open volume control, shorted filter resistor.
Tunable hum	Defect in RF (converter) stage, faulty antenna loop and ground connections, lead dress, line-filter capacitor.
Oscillation	Microphonic tube, defect in bypass or couling capacitor, improper grid bias, faulty lead dress, defective filter capacitor, poor wiper contacts on tuning capacitor, incorrect alignment, excessive line voltage, open decoupling capacitor.
Distorted sound	Leaky coupling capacitor, incorrect grid bias, incorrect supply voltages, defective AVC filter capacitor, rubbing voice coil, torn speaker cone, oscillation (see above).
Poor sensitivity	Misalignment, poor antenna loop or ground connections, dirty tuning capacitor, shorted coils or IF transformers.
Intermittents	Defective paper and electrolytic capacitor, cracked resistor, insufficient tension on tube-socket contacts, worn volume control, short between tuning capacitor plates, critical oscillation of local oscillator tube (replace), defective IF coil, faulty solder joints, cracked printed board conductors.

In a transistor set, the bridging system of checking capacitors requires the serviceman to stock a few miniature electrolytic capacitors, since values are important in these sets. Care must be used that the test unit is inserted into the circuit with correct polarity.

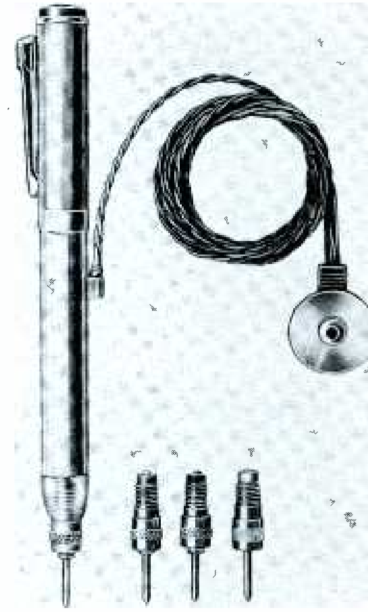
If it is desired to check the local oscillator signal by using a nearby radio, the transistor set must be held within an inch or two of the antenna loop of the test receiver. Radiation from the transistor oscillator is limited and might possibly be missed at a greater distance.

Conclusion

Other shortcuts for fast servicing of superhets are shown in the accompanying chart. Each is intended to trim the time between customer complaint and completed repair. All the steps here take more time to describe than to actually perform on the bench. Once they become a part of your standard techniques, your service time on superhets can be measured in minutes.

Little But Loud

An unusually small signal tracer is contained within a fountain-pen sized unit known as the *Stethotracer.*



Manufactured by Don Bosco Electronics, Inc., the instrument is transistorized and operates from a penlight cell.

The *Stethotracer* has an audio gain of approximately 1000 — enough, we found, to use in almost any stage of a transistor radio. The signal path can be traced from the output of the mixer all the way to the speaker. The instrument was usable in the RF stage, but the audible sound in the tiny earplug was at a low level. Of course, for troubleshooting in RF and IF stages, a demodulator tip (furnished with the unit) must be attached.

One suggested use for the *Stethotracer* is as a preamplifier for other instruments, such as a scope or VTVM. We used it in this manner in our lab, and found we could increase the sensitivity of one of our scopes—normally 30 millivolts per inch—to beyond 100 microvolts per inch. If the impedance match between the tracer and our scope had been better, we would probably have realized an even greater increase. Somewhat less favorable results were found with the VTVM, but the impedance mismatch between the unit and our VTVM was even greater than with the scope.

When used with the demodulator tip, the *Stethotracer* served well as a scope demodulator probe, and made possible the measurement of modulated RF signals having very low intensity.

Priced at $29.95, the Don Bosco *Stethotracer* can be a very useful little instrument for any technician.

FRIEND?...OR FOE?

TIME . . . your most valuable asset! The people at Philco and at the Philco Distributor nearby know this all too well! For 30 years we've made it our business to understand your business . . . and to know your problems as well as our own.

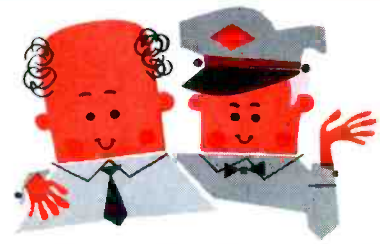
TIME means money to you . . . and the TIME saved or wasted on a service call can mean a big difference in your earnings. To help you save TIME, we sponsor the Philco Factory-Supervised Service Association; the industry's finest, most complete program of technical information. Your membership in "PFSS" helps you service Philco products faster, easier . . . and at a greater profit. ■ We know that callbacks cost you TIME—and reputation . . . that's why we confidently recommend the use of Philco parts, tubes and accessories. All of them have passed the most rigorous tests of quality and performance. Products repaired with Philco parts stay repaired. ■ Yes, indeed—TIME can be Friend or Foe. We can help you call it "Friend."

We can save you buying-time, too. **Your Philco Distributor** has a complete selection of Philco tubes, Philco and Universal parts, capacitors, batteries and accessories . . . for easy, one-stop buying.

PARTS & SERVICE OPERATIONS

PHILCO®

A SUBSIDIARY OF Ford Motor Company



WANT TECHNICAL INFORMATION TO HELP SAVE MORE TIME?

MAIL THIS COUPON TODAY

PHILCO Factory-Supervised Service

Philco Parts & Service Operations, Dept. C-8
"C" and Westmoreland Sts., Phila. 34, Pa.

Please send me the latest Free technical information and my complimentary copy of the Philco Service-Businessman magazine.

Name__________

Address__________

City__________ State__________

☐ Service Only ☐ Retailer with Service Dept.

DOLLAR & SENSE *Servicing*

your investment in COLOR TV

Color TV was slow in getting started, but the number of homes that now have color sets has become quite impressive and is steadily increasing. As a result, the day is near when color-service requests will be as frequent as black-and-white service calls are today. The up-to-date shop should be equipped for servicing color TV, and the technician should become familiar with color servicing and its attendant problems as soon as he possibly can. By preparing now, he will have an easier time when color-service demands become heavy.

If sales of color television in your town have increased significantly in the last year or two, you had best start getting set up for service; otherwise, you may be "left behind" when the real need arises. Gather as much information as you can on color, and begin acquiring the test equipment you'll need. Then when the business starts coming in, you'll not be faced suddenly with a lack of facilities or abilities. It is not difficult to learn to service color sets, and color test equipment can be purchased over a period of time to spread the cost.

Your Investment In Equipment

Before purchasing test equipment, you will want to consider two important factors: what equipment you will need in addition to present items, and what characteristics you should look for in the different brands of equipment now on the market. Naturally, certain models of equipment have advantages over others, and the prices vary accordingly.

The first question for you to answer is: What equipment will I need? The answer depends on whether you intend to buy a complete line of color test equipment or purchase only the essential items. Since the majority of shops will want to stick to essentials, especially while starting out, we will list the basic test-equipment needs first. More elaborate equipment will be described as we go along.

Basic Items

For servicing color television sets thoroughly and intelligently, a serviceman will need a degaussing coil, a dot-bar-color generator, the usual television sweep-alignment instruments, a wide-band oscilloscope, and a small assortment of special tools.

The degaussing coil is important enough to color servicing that no shop should expect to do consistent high-quality work without one. While some servicemen have "rolled their own," this item is not too expensive — even when purchased commercially. A good degaussing coil can be bought for as little as $3.00 and up to $20.00.

The dot-bar-color generator is probably the most expensive single unit you will have to buy—assuming, of course, yours is one of the progressive shops which is already equipped with a good scope and alignment generators. The dot generator is needed for static convergence adjustments, while the vertical and horizontal bars make dynamic convergence easier. Some technicians prefer just the one or the other, but the most successful color-TV servicemen find the most practical instrument to be one which furnishes dots, vertical and horizontal bars, *and* a crosshatch pattern. Commercially-built generators which provide all these outputs can be found ranging in price from $100 to $300. The prices vary because of increased stability in some instruments, ease of connection (some can be connected directly to the antenna terminals of the set), and quality of the outputs.

Included in some dot-bar generators is a color-signal output for checking the chroma circuits in color receivers. The color signal will be in one of three forms: rainbow, keyed rainbow, or NTSC. Of these, the plain rainbow generator is least expensive. However, the keyed-rainbow generator is decidedly more accurate for most chroma-adjustment work, and is considered by many technicians to be sufficient for all chroma testing. Other servicemen prefer the NTSC color signal, since it is actually a replica of the color-station signal, complete with burst signal and all. Dot-bar-keyed-rainbow generators can be had for up to $350, while an NTSC generator (including dots and bars) will cost $500 or more.

Sweep-alignment equipment which has been used for black-and-white TV servicing can also be used for color; the only special requirement is that the marker-generator calibration be quite accurate. If you don't own a sweep generator, it is recommended that one be available, because IF-bandpass alignment is much more important in color receivers than in monochrome sets. Good alignment generators cost between $125 and $275, with marker generators (unless included in the sweep generator) costing from $100 to $200 extra.

The serviceman who "got by" without a scope for television serv-

GET YOUR First Class Commercial F.C.C. LICENSE IN 12 WEEKS!

Is the course proven?

A high percentage of our fulltime resident students get their 1st class licenses within 12 weeks from the time they start the course. Intensive FCC license training is our specialty – not just a sideline.

Is the course complete?

The Grantham course covers all the required subject matter completely. Even though it is planned primarily to lead directly to a first class FCC license, it does this by TEACHING you electronics.

Is the course "padded"?

The streamlined Grantham course is designed specifically to prepare you to pass certain FCC examinations. All of the instruction is presented with the FCC examinations in mind. If your main objective is an FCC license and a thorough understanding of basic electronics, you want a course that is right to the point – not a course which is "padded" to extend the length of time you're in school. The study of higher mathematics or receiver repair work is fine if your plans for the future include them, but they are not necessary to obtain an FCC license.

Is it a "coaching service"?

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

Is the school accredited?

Accreditation by the National Home Study Council is your assurance of quality and high standards. Grantham is accredited.

Is it a "memory course"?

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

THE GRANTHAM *FCC License Course in Communications Electronics is available by CORRESPONDENCE or in RESIDENT classes.*

For further details concerning F C.C. licenses and our training, send for our FREE booklet

Grantham Schools

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

FIRST CLASS F.C.C. LICENSE IN 12 WEEKS

Grantham resident schools are located in four major cities – classes in F. C. C. license preparation are offered at all locations. New day classes begin every three months, and new evening classes begin four times a year.

MAIL COUPON NOW—NO SALESMAN WILL CALL →

Accredited by the National Home Study Council

(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS
NATIONAL HEADQUARTERS OFFICE
1505 N. Western Ave., Hollywood 27, Calif.

Gentlemen:

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

Name ____________________ Age ______

Address ____________________

City ______________ State ______________

I am interested in:

☐ Home Study, ☐ Resident Classes 29-M

icing will find himself at a loss if he tries to service much color TV without one. You will need a wide-band scope, capable of showing a good, clean trace at the burst frequency—3.58 mc. This requires a sensitivity of about 25 millivolts per inch of deflection, with a flat response (within ±1 db) to at least 4 mc. Scopes with this capability range in price from $125 to $400, depending on certain other features.

Special devices which you will find helpful, if not absolutely necessary, are items such as: high-voltage interlock cheater (for certain chassis), special tool for adjusting dual controls, gun-killer device for use during convergence, high-voltage probe for your VTVM, and jumper cables to permit servicing chassis outside of their cabinets. This entire group of service aids rarely costs more than $25.

Totalling the above information, it is obvious you can have a well-equipped color-television service shop for around $475, if you buy economical commercially-built equipment. Buying more elaborate models, you can spend as high as $1400 for test instruments. In either case, however, if you already own a good scope and high-quality alignment equipment your expenditure will be barely half this amount.

Kits

Most of the instruments listed above are available in kit form. Dot-bar-color generator kits suitable for color servicing are available at prices ranging from $60 to over $100. Sweep generators can be purchased for $50 and up, as can marker generators in kit form. The only precaution is that the builder be sure to calibrate such generators as accurately as possible. Good scope kits are available for about $75 and up.

As in many other undertakings, the quality of the finished product is only as good as the workmanship which goes into it. With this in mind, the careful technician can build kit-type instruments which will furnish him with many hours of faithful service, and at reasonable cost. Using these instruments, the serviceman can equip his shop quite well for about $250 or $300 plus his assembly time.

Other Equipment

In addition to the basic equipment for color servicing, other items are available to make high-volume color-service work much easier. For example, if a large number of sets are being serviced, the shop could use a setup whereby it is necessary for the home-service technician to pull only the chassis of a defective set. A color CRT and a yoke assembly facilitate "mocking up" the set for service right in the shop. This can save countless hours of lugging large cabinets to the shop and trim delivery time by eliminating most of the necessity for reconvergence. Such a setup can be built from commercially-available parts priced at approximately $250, complete with cabinet, CRT convergence and yoke assemblies, cables, and the necessary brackets and hardware.

Several cable arrangements can be made up as needed by the time-conscious technician who will use them to save minutes in preparing a chassis for servicing. The cost of such cables is minimal — usually

Can you afford to guess

AT SWEEP, SYNC OR HIGH VOLTAGE TROUBLES?

WHEN IT'S SO EASY TO WALK THE TROUBLE RIGHT OUT OF THESE TIME CONSUMING CIRCUITS..... STEP BY STEP.....

SYNC. CIR. & H. SYNC. DISCRIM.	VERT. OSC.	VERT. OUTPUT	VERT. OUTPUT XFORMER	VERT. DEFLEC. YOKE
HORIZ. OSC.	HORIZ. OUTPUT	HORIZ. FLYBACK XFORMER	2nd ANODE VOLTAGE CIRCUIT	HORIZ. DEFLEC. YOKE

NEW, IMPROVED SENCORE

SWEEP CIRCUIT ANALYZER

MODEL SS117

PUSH BUTTON TESTING . . . for Color and Black and White

How many times do you ask, "Why do I take so long finding that sweep trouble?" How often have you wondered whether weak horizontal sync was caused by defective sync circuit, horizontal oscillator, or sync discriminator? Can you quickly isolate inadequate width or low 2nd anode voltage to the oscillator, output, flyback transformer, or yoke? How many times have you changed a good yoke by mistake?

The SS117 will pinpoint troubles like these in minutes with tried and proven signal injection, plus yoke substitution for dynamic in-circuit tests. Error proof push button testing enables you to make all tests from the top of the chassis without removal from cabinet for maximum speed and profit on every job.

Here are the checks the SS117 makes . . .

- Horizontal Oscillator: Checked by substituting 15,750 variable output universal oscillator from SS117. Signal can be injected at any spot from horizontal output grid to horizontal oscillator to determine defective component.
- Horizontal Output Stage: Checked by reliable cathode current and screen voltage checks made with adapter socket and two push buttons,
- Horizontal Output Transformer: Checked for power transfer in circuit and read as good or bad on meter.
- Horizontal Deflection Yoke: Checked by direct substitution with adjustable universal yoke on SS117.
- Vertical Oscillator: Checked by substituting 60 cycle synchronized oscillator.
- Vertical Output Transformer: By simple signal injection for full height on picture tube.
- Vertical Deflection Yoke: By signal substitution for full height on picture tube.
- Sync Stages: Checked by synchronizing triggered horizontal SS117 oscillator from any stage. If oscillator synchronizes, sync is O.K.
- 2nd Anode Voltage: A new dynamic check using simulated picture tube load. C.R.T. does not need to be operating for current tests. No interpretations—read direct from 0 to 30 KV.
- External Circuit Measurements: By applying from 0 to 1000 volts AC or DC to external meter jacks. Meter will read DC or peak-to-peak volts. 0 to 300 milliamp scale also provided for measuring horizontal fuse current.
- New features include: Large 0 to 300 microamp meter for minimum circuit loading; all-steel carrying case with full mirror in adjustable cover; two 115 volt AC outlets in cable compartment.

Size: 10¼" x 9¼" x 3½". Wt. 10 lbs.

Model SS117 Dealer Net $89⁵⁰

Sencore Sam says . . . How can you miss . . .

EACH PACKAGED UNIT CONTAINS:

- An Easy to Follow Instruction Book Especially Prepared and Edited by H. W. Sams.
- A complete 33 RPM, 10 inch Permanent Record on "How to Simplify Sweep Circuit Trouble Shooting."

SEE YOUR AUTHORIZED SENCORE DISTRIBUTOR

SENCORE

ADDISON, ILLINOIS

only the time required to make them, and a few cents' worth of wire.

Color-CRT testers, elaborate gun-killer devices for convergence and testing, and numerous other special test instruments are available to the technician who contemplates a large volume of color servicing. Each is designed to do a specific job quicker and easier than usual. As the work load increases, it will become necessary for you to make use of more of these time-savers—meanwhile, you will probably want to enter the field as modestly as possible.

Your Investment in Parts

Instruments are not the only addition you will make to your shop when you enter the color-servicing field, although they will likely be the most expensive one. Less costly, but every bit as important, will be your investment in tubes and parts not used in monochrome sets.

Most color sets on the market use from three or four to a half-dozen tube types not found in black-and-white receivers. The high-voltage section will usually have at least three special types, and certain other circuits also use specially-designed tubes in their sockets. Among the tubes you'll want to add to your stock are: 2V2, 3A2, 3A3, 5AU4, 6AS6, 6AR8, 6BC7, 6BD4, 6BJ7, 6BK4, 6CB5, 6HB6, 6HS8, and 6JH8. The total cost for two of each type will be about $60.

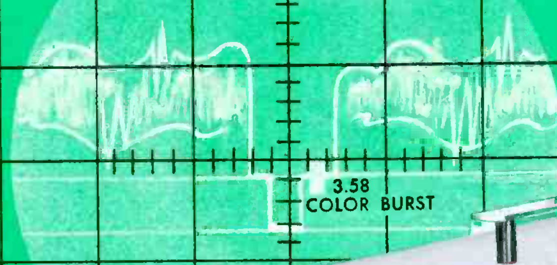
Few other parts are used often enough to warrant stocking them unless a large volume of work is expected. The exceptions to this are special fuses which may be needed for some chassis, a number of 5% resistors for critical circuits, and a 3.58-mc crystal or two. The cost of all these items should not be over $10 or $15.

Your Investment in You

Once you have accumulated the necessary test equipment, tube stock and small-parts inventory, there still remains one important ingredient in your color-servicing investment—your ability to service the sets. The greatest expenditure here will be your time and talent;

NEW, MODERN, PORTABLE . . . FOR THE MAN ON THE GO . . .

as easy to use as a voltmeter



- A new 3 inch Extended View Portable Scope with New Features and Performance Unmatched by even the most Costly 5 inch Oscilloscopes

NEW

SENCORE PS120 PROFESSIONAL WIDE BAND OSCILLOSCOPE

Lowest priced Wide Band 3 inch Scope anywhere. All hand wired.

Only 124⁵⁰ net

Here it is, the scope that technicians, engineers and servicemen from coast to coast have been demanding. A portable wide band scope that can be used on the job anywhere, yet has the highest laboratory specifications for shop or lab. Cumbersome color TV sets, remote audio and organ installations and computers are just a few of the jobs that make owning a scope of this type so essential. Why consider a narrow band scope, when for only a few dollars more, this professional wide band sensitive scope equips you for any job. • The PS120 provides features never before offered. Only two major controls make the PS120 as easy to use as a voltmeter. Even its smart good looks were designed for functional efficiency. New forward thrust design, creating its own shadow mask, and full width calibrated graph increase sharpness of wave form patterns. A permanent chromed steel carrying handle instead of untidy leather strap and a concealed compartment under panel for leads, jacks and AC line cord make the PS120 the first truly portable scope combining neatness with top efficiency.

• Electrical specifications and operational ease will surpass your fondest expectations. Imagine a wide band scope that accurately reproduces any waveform from 20 cycles to 12 megacycles. And the PS120 is as sensitive as narrow band scopes . . all the way. Vertical amplifier sensitivity is .035 volts RMS. The PS120 has no narrow band positions which cause other scopes to register erroneous waveforms unexpectedly. Another Sencore first is the Automatic Range Indication on Vertical Input Control which enables the direct reading of peak-to-peak voltages. Simply adjust to one inch height and read P-to-P volts present. Standby position on power switch, another first, adds hours of life to CRT and other tubes. A sensitive wide band oscilloscope like the PS120 has become an absolute necessity for trouble shooting Color TV and other modern circuits and no other scope is as fast or easy to use.

SPECIFICATIONS

WIDE FREQUENCY RESPONSE:
Vertical Amplifier—flat within ½ DB from 20 cycles to 5.5 MC, down —3 DB at 7.5 MC, usable up to 12 MC.
Horizontal Amplifier—flat within —3 DB from 45 cycles to 330 KC, flat within —6 DB from 20 cycles to 500 KC.

HIGH DEFLECTION SENSITIVITY:

		RMS	P/P
Vertical Amplifier—	Vert. input cable	.035V/IN.	0.1V/IN.
	Aux. vert. jack	.035V/IN.	0.1V/IN.
	Through Lo-Cap probe	.35V/IN.	1.0V/IN.
Horizontal Amplifier—		.51V/IN.	1.44V/IN.

HIGH INPUT RESISTANCE AND LOW CAPACITY:

Vert. input cable	2.7 Meg. shunted by approx. 85 MMF
Aux. vert. input jack	2.7 Meg. shunted by approx. 20 MMF
Through Lo-Cap probe	27 Meg. shunted by 8.6 MMF
Horiz. input jack	330 K to 4 Meg.

HORIZONTAL SWEEP OSCILLATOR:

Frequency range—	4 ranges, 15 cycles—150 KC
Sync Range—	15 cycles to 8 MC-usable to 12 MC

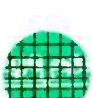
MAXIMUM AC INPUT VOLTAGE:

Vertical input cable— / Aux. vert. jack— / Lo-Cap probe—	1000 VPP (in presence of 600 VDC)
Horiz. input jack—	approx. 15 VPP (in presence of 400 VDC)

POWER REQUIREMENTS:

Voltage—	105-125 volts, 50-60 cycle
Power consumption—	On pos. 82 watts Stby. pos. 10 watts

SIZE: 7" wide x 9" high x 11¼" deep—weight 12 lbs.



The PS120 is a must for color TV servicing. For example, with its extended vertical amplifier frequency response, 3.58 MC signals can be seen individually.

SENCORE
ADDISON 2, ILLINOIS

the dollar investment can be comparatively small.

To become a successful color-TV technician, you must first learn how the sets work. Many good books are available which can lead you from the fundamentals of colorimetry through the most complicated color-matrixing systems, explaining every detail of color-set operation. In addition, numerous articles in PF REPORTER have explored the mysteries of color-TV receivers, showing how they function and describing troubleshooting techniques. Much can be learned from such books and magazine articles.

Besides these, a number of correspondence and resident courses are available from schools of electronics, at various prices. Along with the theoretical material, some of these courses include practical troubleshooting information which can be of great help to the beginning color serviceman.

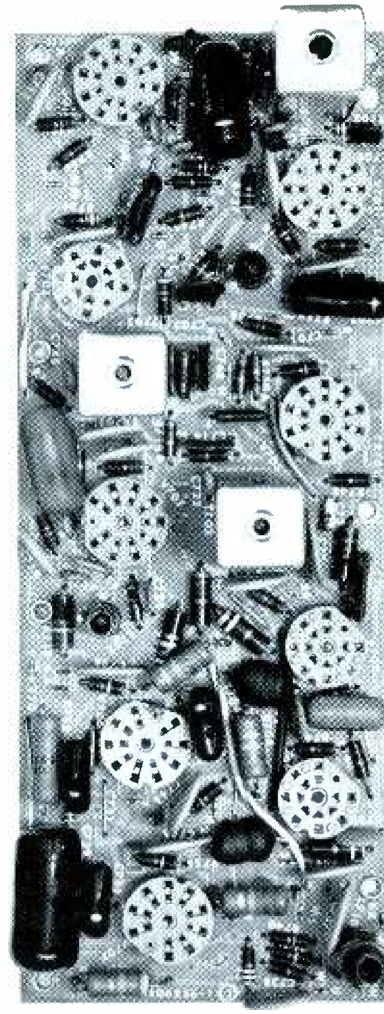
Last, but probably most important, are the extensive color-training seminars and information clinics conducted by manufacturers in the industry. These training sessions are, almost without exception, given at no cost to the service technician.

Conclusion

So, your investment in color-TV servicing is primarily up to you. You can spend as little or as much as you like on test equipment. You can stock a bare minimum of parts, or you can prepare for a large volume of work. These matters are not nearly so important as your choice of training.

Learn to understand color-television receivers, and you have the key to success in servicing them. If you arm yourself with this understanding, at whatever cost, you can do an excellent job of servicing color—even though you spend a bare minimum for test equipment and spare parts. Without this understanding, a $2000 investment will not suffice to make you a competent serviceman for color television. Your future in color TV is in your hands, and your return will be in proportion to your investment. ▲

Old



New

Now, RCA VICTOR takes the tangle out of TV's toughest circuitry

The advantages of the new RCA Security Sealed Chroma Circuits are plain to see. The simple fact that they're Precision Crafted Security Sealed boards tells you most of the good news . . . clean; easy to get at; "road-map" tracking, and just generally a cinch compared to their old, hand-wired counterparts.

This newly developed RCA chroma board sets many more benchmarks. For example, the color bandpass amplifier circuit operates near Class "A," providing linear amplification of chroma signals. Color video amplifier outputs are 100% DC coupled to reduce drift in color temperature set-up.

The chroma circuit also features two new multi-grid pentode color demodulators to improve color with better matrixing. No "short cuts"—this is full-function circuitry...demodulators *plus* amplifiers for extra color brilliance and stability! This circuit is very stable, and tube change has almost no effect on performance of matrixing.

The new Precision Crafted Security Sealed Chroma Circuit board is part of RCA's continuing program for faster, easier servicing of today's fastest-growing home entertainment medium . . . Color TV.

See Walt Disney's "Wonderful World of Color" Sunday's, NBC-TV Network.

RCA The Most Trusted Name in Television

Tmk(s)®

ShopTalk

by Allan F. Kinckiner

IRONING OUT VERTICAL SWEEP DISTORTION

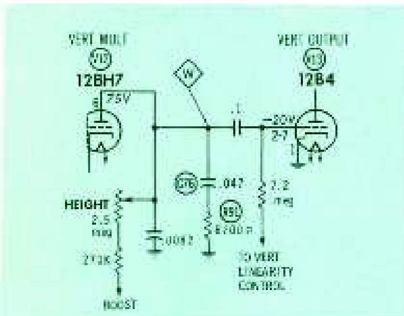
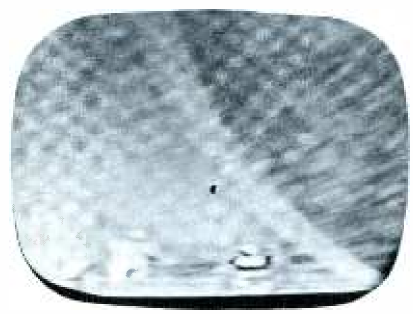
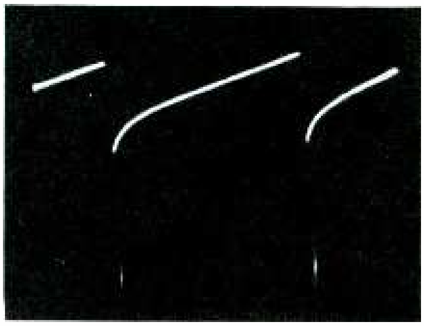


Fig. 1. Philco D-181 has simple type of vertical sawtooth-forming network.



(A) Top stretched, bottom compressed.



(B) Nonlinear drive "sawform."

Fig. 2. Poor linearity—Philco D-181.

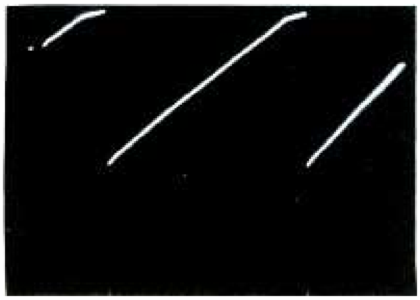
Poor vertical linearity presents one of the strange paradoxes of the TV servicing business. The fault is very common, but set owners frequently choose to live with the condition until their receivers develop other trouble. Alas, sometimes they become so used to nonlinearity that they complain of figures being "out of proportion" when some conscientious serviceman sets the linearity right.

Probably every serviceman has had experiences similar to two typical cases I recently encountered. The first set—an RCA portable—was brought in with a blank screen. This condition was easily remedied by replacing a shorted damper tube and a blown fuse; however, the restored raster had a foldover of more than 1½″ at the bottom of the 17″ picture tube. Set two—a Philco table model—was brought in to have an audio buzz cured. Turning this set on, I was surprised when the raster failed to fill the picture-tube screen. The lower half was badly compressed, and the bottom edge was a good two inches from the bottom of the 21″ CRT used in this set. The point is—in neither instance did the customer even mention the obvious vertical distortion.

After finding that neither case of poor linearity was curable by adjusting the vertical linearity and size controls—nor by replacing the vertical sweep tubes—I suggested that the customer leave the set so I could correct the vertical trouble. In spite of the severity of the defects, both customers were reluctant to have this work done. Only after it was pointed out that the defect could (and probably would) lead to more costly repairs in the future, did they agree to having the vertical trouble corrected.

Analyzing linearity problems in a vertical sweep system presents certain technical difficulties. The majority of signals in the circuit are nonlinear, and the major components — the output transformer, tubes, charging and filtering capacitors—all have nonlinear characteristics. The yoke current necessary for linear raster deflection is the result of combining the various nonlinear factors in such a way that they augment one another. The normal result: a linear vertical sweep.

In spite of the various nonlinear circuits and components in vertical systems, troubleshooting conditions of poor linearity can be comparatively simple. To locate trouble, we must check signals at various points in a defective vertical sweep circuit and compare them with signals shown in service literature, found in similar receivers, or seen in previous experiences. Inasmuch as the shape of the signals is most important, the oscilloscope is the only instrument with which such checks or comparisons can be made effectively.



(A) Curve in sawform straightened.

(B) Controls not yet readjusted.

Fig. 3. Results of replacing C76.

Scope Test Points

While the oscilloscope's ability to reveal waveshapes make that instrument the logical choice for troubleshooting vertical-linearity faults, the circuit points to be checked are not so obvious.

The input grid of the deflection

COLOR-APPROVED and NTSC for $200 less!

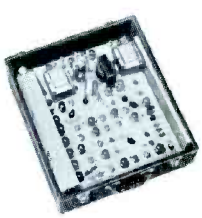
Model 661—NTSC Bar-Dot Generator—$349.50

Based on the same designs as Hickok's famous Model 656XC NTSC color bar generator, the NEW Model 661 is literally the answer for progressive service technicians who recognize the opportunities in color TV service but have been stopped by the cost of equipment. *The 661 is not a compromise—there are no short cuts—it's not "NTSC-like"; it is a complete instrument generating correct, 100% saturated, NTSC color signals complete with sync, blanking and burst at the right pedestal position and of the correct amplitude and phase, as well as demodulator alignment signals (R-Y, B-Y, —G-Y, G-Y 90°), plus dots and crosshatch.* In short, you can expect the same kind of performance standards from the new 661 that have established Hickok's reputation with leading Color TV manufacturers as COLOR-APPROVED.

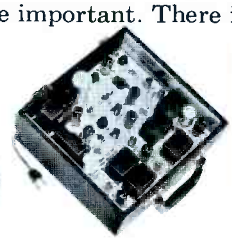
Compact, weighing just nine pounds, ideal for installation, convergence and in-the-home servicing, the new Model 661 provides everything needed for complete color service.

Ask your Hickok distributor to demonstrate the Model 661 for you . . . Write for our free booklet, "Why NTSC?" which explains why the NTSC standard tests are important. There is no obligation.

Equip your shop with these other Hickok Color-Approved *instruments to provide your customers with complete color TV service:*



656XC
NTSC Color
Bar Generator

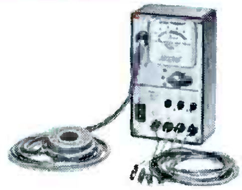


660
White Dot-
Bar Generator

675A
Wide-Band
Oscilloscope

691
Marker
Adder

615
Sweep &
Marker
Generator



CR33
Color
Picture Tube
Tester

THE HICKOK ELECTRICAL INSTRUMENT CO.
10566 Dupont Avenue • Cleveland 8, Ohio

amplifier is usually a good point to begin tracing in most sets, but inclusion of components between this point and the sawtooth-generating circuit can sometimes result in distortions—misleading the technician into believing the original sawform is incorrect. Because of this possibility, it is suggested that the first scope trace be taken from the "top" of the sawform network (for example, point W in Fig. 1). Experience has recommended this spot as an excellent place to begin looking for the causes of vertical distortion.

Getting Down To Cases

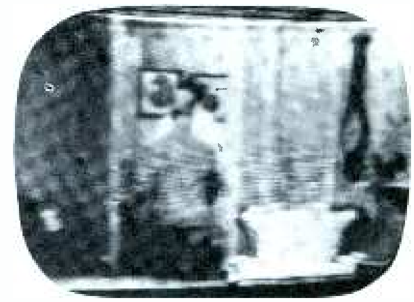
Instead of dwelling at length on explanations of vertical-circuit theory (which was explained extensively in an eight-page special section of the January, 1962 issue), let's look at several specific cases of vertical distortion. In this way, I can show you quickly and easily how to *apply* your knowledge of vertical circuits, and move right to the source of trouble. For the technician who wishes to delve into the theory more deeply, references to coverages in earlier issues are included.

One set, a Philco D-181—using the vertical circuit shown in Fig. 1—presented the nonlinear picture shown in Fig. 2A. This was about the most linear vertical deflection obtainable, even with the height control set for full spread and the linearity control advanced to the threshold of foldover. The scope trace in Fig. 2B was obtained at point W of Fig. 1—the top of sawform network C76-R91. Obviously, a defective sawform was being produced, and this was its point of origin.

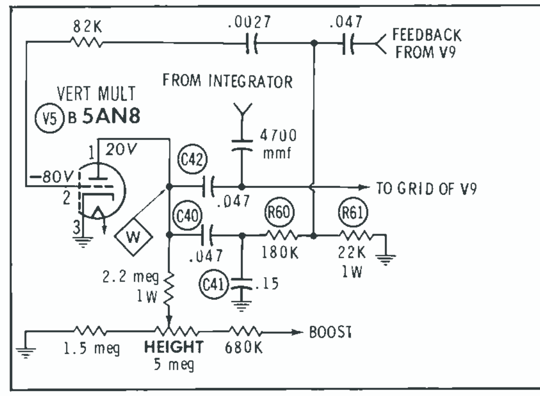
Replacing C76, the sawforming capacitor, resulted in the larger and more linear trace seen in Fig. 3A, and the over-scanned picture in Fig. 3B. A slight readjustment of the vertical controls provided normal deflection linearity, and also removed the flattened tip seen in the Fig. 3A trace. (For an explanation of why the flat spot disappeared, refer to page 70 of the April, 1960 issue.)

"Middle" Spread

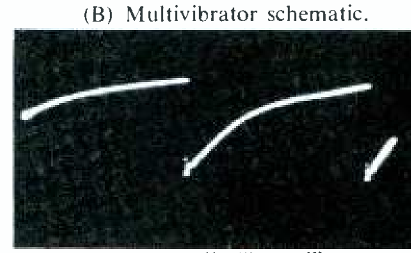
The unusual distortion shown in



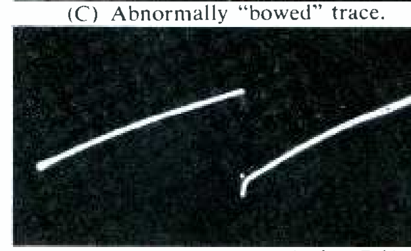
(A) Top and bottom compression.



(B) Multivibrator schematic.



(C) Abnormally "bowed" trace.

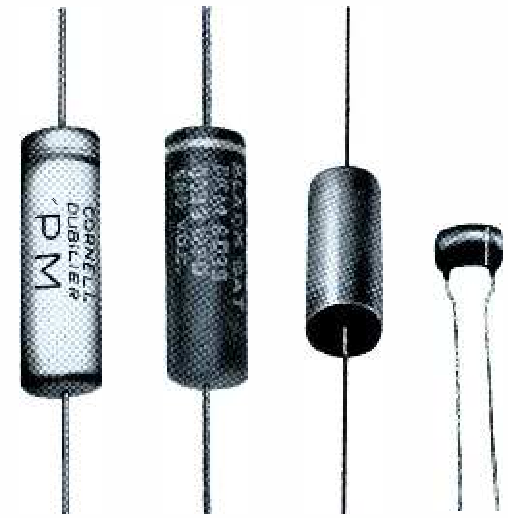


(D) Waveform after replacing R61.

Fig. 4. Westinghouse V-2376 case.

Fig. 4A—compressed at top and at bottom, but with the center spread out—caused a brief departure from usual procedures. Because this type of distortion had been found previously to be caused by a defective filter at the B+ end of the vertical output transformer, I scoped that point first; I was surprised, however, to find that filter to be okay. Next, I moved the probe to my previously-suggested primary scope point marked W in Fig. 4B. There, I obtained the trace seen in Fig. 4C. The curvature in the center of the sawform explains the spread seen in Fig. 4A. The raster size evident in this photo was all that could be obtained with the linearity and height controls both adjusted for

Type PM Molded Mylar*/Type PKM Molded Paper-Mylar/Type WMF Mylar Wrap/Type DPMS Dipped Paper-Mylar



In your lifetime, you'll probably never use all the 284 tubular bypass capacitors we make.

PM KIT

List Price $25.90
Dealer Net **$15.54**

DPMS KIT

List Price $26 40
Dealer Net **$15.84**

But you'll use these 2 kits every day.

Need a bypass capacitor? You know where to find it —in our 40-page Service Selector or under "Cornell-Dubilier" in the Radio-Electronics Master. You know where to get it, too—off the shelf, at your CDE Distributor. And you know that the price is right—we haven't been a leader in this industry for more than a half century without good reason.

But for your day-to-day needs, you're better off with these two kits. Each contains 80 units, all 600 WVDC and ± 10% tolerance. The large plastic case comes equipped with hinged cover, separate compartments and a durable selector chart. You pay only for the capacitors...the case is free. Your CDE Distributor has them in stock, too.

When it comes to bypass capacitors, you can afford to bypass all names except:

CORNELL-DUBILIER ELECTRONICS, DIVISION OF FEDERAL PACIFIC ELECTRIC COMPANY, 50 PARIS ST., NEWARK 1, N. J.

*DuPont TM

CDE CORNELL-DUBILIER

the only Company that makes them all

maximum deflection. The small amount of ringing at the start of the trace in Fig. 4C, and the lack of a sharp negative spike at this point, led me again to expect trouble within the sawforming network. Checking C40, C41, R60, and R61 revealed that R61 was open. Replacing this 22-ohm resistor restored full size with good linearity.

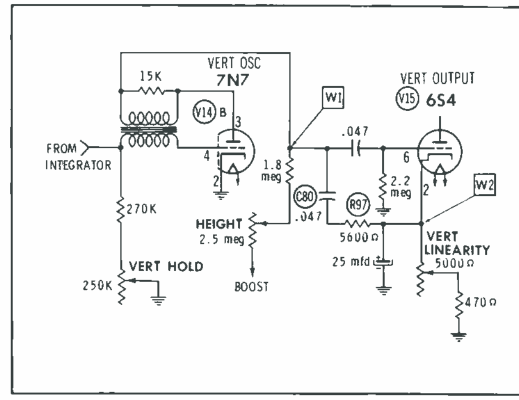
What's In A Trace?

That generated sawforms come in assorted shapes and sizes can be seen by comparing Figs. 3A and 4D—normal for their individual vertical-system designs. The actual shape in any system depends on the amplifier-tube characteristics and the yoke inductance, as explained in the article, "Vertical Nonlinearity and Foldover", on page 35 of the April, 1955 PF REPORTER; however, specific types of circuits do not always run true to form.

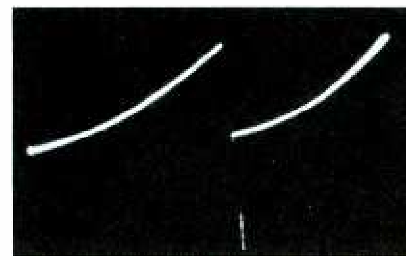
Ordinarily, I expect to find a trace somewhat similar to Fig. 3A whenever I service a set using the blocking-oscillator design. Recently, however, I had reason to scope the vertical drive signal in a Philco 52T1810—Fig. 5A. The curved drive sawform in Fig. 5B was taken with the receiver displaying normal vertical linearity. A look at the circuit revealed the reason for the slightly unexpected trace shown in Fig. 5C; the sagging is due to peaking resistor R97 being returned to the output-tube cathode. Being thus interconnected, the two signals necessarily have to mix, producing the waveform shown.

Amplifier Faults

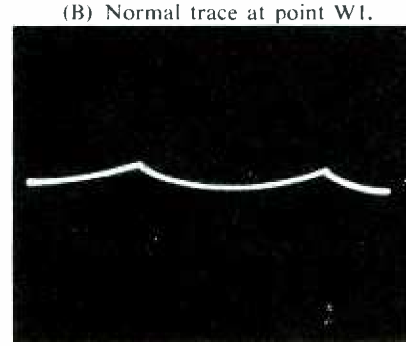
Poor linearity associated with a defective sawform is not usually accompanied by insufficient raster size, because the amplifier has enough gain to overcome the slightly lower amplitude found in defective sawforms. Vertical distortion due to amplifier defects, however, is generally accompanied by insufficient height; in most cases, the shrunken raster is more evident than the lack of linearity. Amplifier defects are usually traceable to the amplifier tube, filter capacitors bypassing the tube cathode or the B+ terminal of the output



(A) Philco circuit concerned.



(B) Normal trace at point W1.



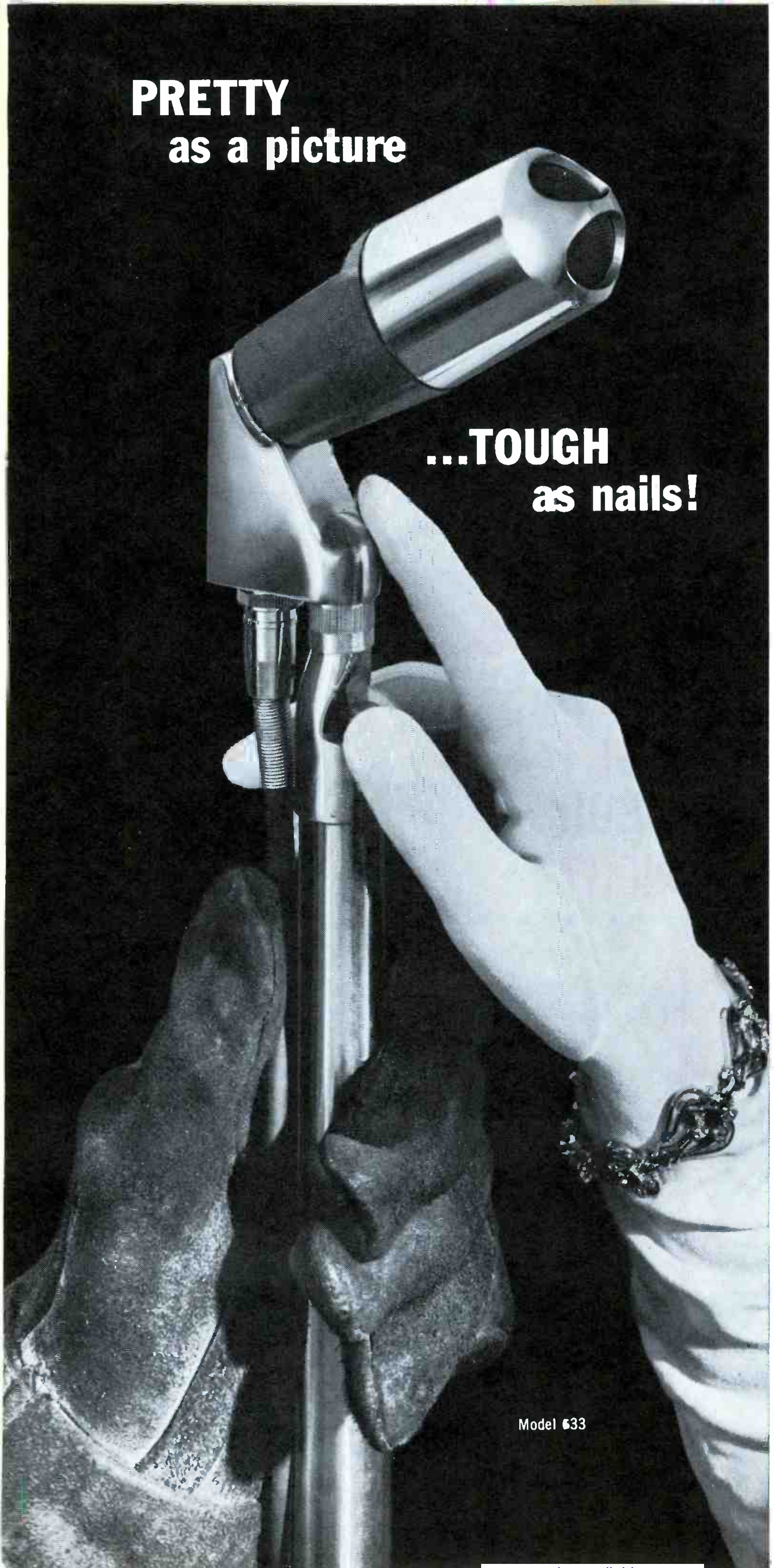
(C) Trace present at point W2.

Fig. 5. Unusual "drooping" waveform.

transformer, the vertical output transformer itself, resistors within the output stage, or (very infrequently) the yoke.

Amplifier-caused distortion is generally easier to troubleshoot than that due to abnormal drive sawforms. If the scope indicates a normal drive sawform, the defective component can usually be found by checking amplifier-stage parts, either with component checkers or by substitution. The substitution procedure has the advantage that improvements are immediately apparent. While resistors or capacitors are easily substituted, however, the same cannot be said of the output transformer or yoke; isolation techniques are needed for these.

In one recent case in an RCA 6T53, the vertical deflection was bunched at the top, and the raster was only about two-thirds of full size. A scope check indicated a normal shape and size of drive sawform, so further testing was



SETTING NEW STANDARDS IN SOUND

THE NEW ELECTRO-VOICE MODEL 633 AND 634 UTILITY MICROPHONES

Now! An exciting new answer to your most demanding microphone needs! The Electro-Voice Model 633 and 634 utility microphones. Handsome new style wedded to rugged, dependable performance. Looks good anywhere...sounds great everywhere!

Specify the Model 633 for floor or desk stand use in school sound systems, tape recorders or industrial applications. Choose the Model 634 for custom mounting on boom or gooseneck in language laboratories, paging systems or wherever semi-permanent mounting is required.

Identical except for mounting, the 633 and 634 both feature a precision dynamic element with remarkable E-V Acoustalloy® diaphragm for smooth, peak-free response and unparalleled reliability despite high shock, moisture or heat. The generous diameter plus a high-energy magnetic structure offers excellent sensitivity for every application.

The precision dynamic element is carefully "packaged" in modern, unbreakable Cycolac* plastic combined with a satin-chromium finished, high-density die casting that soaks up abuse yet stays attractive for years. Handy on-off switch is included. Choice of high- or balanced low-impedance models.

In every way these fresh new dynamics set new standards of appearance and performance . . . yet the price is surprisingly low! The result of advanced engineering plus the most modern and efficient production facilities in the industry! Make the Electro-Voice Models 633 and 634 your new standards of utility microphone excellence, today!

*T. M. Borg-Warner

Model 634

SPECIFICATIONS: Response 70-10,000 cps. Omni-directional. Sensitivity -57 db (Hi-Z, ref. 0 db = 1 volt/dyne/cm^2). Available Hi-Z or balanced 150 ohms. 633: 5/8"-27 mounting, 6-foot cable with connector at microphone. $35.00 List. 634: 5/8"-27 thread at back, 6-foot cable coaxial with mounting thread. $31.50 List. (Normal trade discounts apply).

Electro-Voice®

ELECTRO-VOICE, INC.
Commercial Products Div., Dept. 822R
Buchanan, Michigan

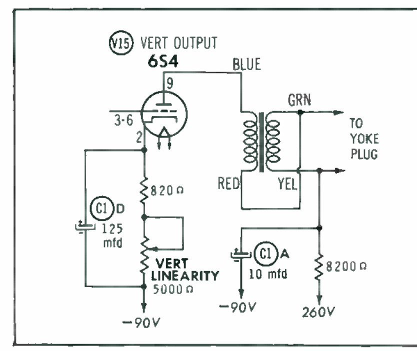
centered in the amplifier stage. The tube and supply voltages were normal, all resistor values were correct, and substituting the electrolytic filters had no effect. Next, I removed the yoke plug and tested the output transformer, by means of an inductance "ringing" check. (A future *Shop Talk* column will cover the full particulars of this technique). The ringing check disclosed shorted turns in the output transformer, and when that component was replaced, the trouble was remedied.

A more stubborn case of linearity trouble was found in a Tele-Tone TAO chassis. This receiver presented the distorted picture shown in Fig. 6A.

The drive sawform was scoped and found to be just about perfect, so once again troubleshooting was concentrated in the amplifier stage. Voltages and resistances measured correctly, as did the output transformer and yoke when tested with a ringing check. The filter C1A was presumed to be okay because of the small signal across it, but scoping across C1D revealed the trace in Fig. 6B.

(A) Compressed lines—bright bar.

(B) 120-cps ripple at V15 cathode.



(C) Vertical-sweep filter circuits.

Fig. 6. Odd trouble—Tele-Tone TAO.

Since Fig. 6B was taken at a scope-sweep frequency of 30 cps, the four humps indicated a 120-cps ripple in this signal. Disconnecting C1D from the circuit resulted in a small but linear raster, so the distortion was evidently due to coupling within this filter. The condition was verified when the disconnected C1D presented the trace in Fig. 6C.

Normally a multisection filter that has one bad section is better replaced in its entirety. An exception is occasionally made if the bad section is the low-voltage bypass—in which case the defective section can be replaced with a separate unit. In this particular case, C1B and C1C were slightly deficient, so the entire can was replaced. The result was a full, linear raster.

If the serviceman will immediately use his scope to check the drive sawform, he can quickly ascertain if vertical distortion troubles are caused by sawforming defects or by amplifier troubles. Once the location of the problem is determined, it is a simple matter to isolate the defective component — even by parts-testing methods. ▲

FAST, ACCURATE TESTERS FOR C/B INSTALLATION AND ALIGNMENT BY SECO

TRANSMITTER TESTER

Designed especially for citizens band (C/B) and other low power transmitters up to 160 MC. Calibrated for direct percentage reading of amplitude modulation; 0-5 watts RF output; 0-400 ma. RF output. Connection provided for headphones or scope.

MODEL 510—complete with all necessary cables and adapters
$46.95 NET

2-WAY RADIO TEST SET

Combination Crystal Checker, RF Signal and Field Strength meter—ideal for C/B. 0-50 ma. meter for final amplifier tuning. Use as RF output indicator. Checks activity on third overtone transmitter crystals—checks fundamental and high overtone crystals at fundamental frequency. Powered by two 1.5 c. "C" cells.

MODEL 500—wired and factory tested
$29.95 NET

ANTENNA TESTER

For 50 ohm coaxial transmission line applications. 1000 watt maximum dual air cylinder coupler inserts no error up to 160 MC. Simplified direct reading scales give quick GOOD-POOR results as well as percent. Direct reading of FORWARD POWER and REFLECTED POWER. 0-10, 0-100 and 0-1000 watt ranges

MODEL 520—complete with instructions
$42.95 NET

ATTENU-LOAD

Ten db "T" pad attenuator for reducing power levels by ratio of 10 to 1 . . . fully shielded 50 ohm termination for coaxial cable applications.

Model 511A—
$15.95 NET

SIGNAL FILTER

Noise limiter and controllable squelch electronically cleans signal. Clips noise pulses—increases reception range—filters ignition noises. Rugged encapsulated circuit.

Model 530
$15.88 NET

"S" METER

Self powered, transistorized. Indicates signal strength accurately with no loading on AVC. Illuminated "zero to 30 db over 9" meter. Zero set and sensitivity controls.

Model 540
$13.88 NET

See Seco Two Way Radio Test Equipment at your electronic supply dealer or send coupon for literature.

SECO ELECTRONICS, INC.
1221 S. Clover Drive, Minneapolis 20, Minn.
Please send information on MODELS . . .
☐ 510 ☐ 500 ☐ 520 ☐ 511-A ☐ 530 ☐ 540

NAME____________________

ADDRESS____________________

CITY__________ STATE__________

ONLY **$74.50** NET
Model 250 B (battery powered)

NEW MODEL 250 TRANSISTOR *and tunnel diode analyzer

THE MOST RAPID, COMPLETE AND ACCURATE SEMI-CONDUCTOR TEST SET IN THE MEDIUM PRICED FIELD

You'd expect to pay much more for a semi-conductor test set that:

- Requires no setup data
- Includes a "Speed Test Socket"
- Reads BOTH collector-to-base (Icbo) and collector-to-emitter (Iceo) leakage currents
- Cancels Iceo leakage to give a TRUE gain reading
- Tests signal type tunnel diodes
- Also tests signal, power and zener diodes
- Includes a very complete circuit analyzer

Just look at all the semi-conductor tests you can perform on the new Seco Model 250 TRANSISTOR AND TUNNEL DIODE ANALYZER—many circuit analyzing features, too!

- Tests transistors in or out of circuit
- Tests signal and power transistors, also tunnel and zener diodes
- Indicates transistor leakage and gain
- Indicates tunnel diode negative resistance characteristics
- Indicates diode forward conductance and reverse leakage current
- Identifies NPN and PNP transistors immediately
- Matches transistors of similar types by AC dynamic test or DC analysis
- Operates as a sine wave and harmonic signal generator
- V-O-M meter with appropriate ranges

THE NEW MODEL 250 IS IDEAL FOR INCOMING TRANSISTOR AND DIODE STOCK INSPECTION—AND FOR SERVICING TRANSISTORIZED EQUIPMENT

Model 250A—AC powered $86.50 Model 250 B—battery powered $74.50
Includes 24" test leads with slim line test prods.

See the new Model 250 Transistor and Tunnel Diode Analyzer at your electronic supply dealer or send in the coupon for literature.

SECO ELECTRONICS, INC. 1221 South Clover Drive Minneapolis 20, Minnesota

Please rush information on the Model 250 Transistor and Tunnel Diode Analyzer, including full line folder describing complete range of Seco test equipment.

NAME____________________

ADDRESS____________________

CITY__________ STATE__________

NOTES ON TEST EQUIPMENT

by Forest H. Belt

Reviving Old CRT's

Quite often, television picture tubes which are condemned and replaced could possibly have been revived and used, at least for a while longer. Recognizing this fact, the Anchor Division of Antronic Corp. of Chicago has recently introduced their Model T-475 *Reacto Tester,* a combination CRT tester and rejuvenator (Fig. 1).

Specifications are:

1. *Power Required — 117 volts AC; 60 cps.*
2. *Tests Performed—shorts between various elements; cathode emission; quality; gas.*
3. *Tubes Tested—all television picture-tube types, including color CRT's.*
4. *Other Features—repairs shorts between elements; reactivates cathodes of low-emission CRT's.*
5. *Panel Meter—face size 4½"; sensitivity 1 ma; 100-ohm movement;* GOOD-REPLACE *scale.*
6. *Controls and Terminals—two rotary switches:* SELECTOR *and* HEATER VOLTAGE*;* QUALITY *potentiometer; three momentary-contact push-type switches:* ELECTRON BEAM, READ METER, *and* GAS TEST*; neon shorts indicator; separate test cables for color and black-and-white CRT's; adapters for testing 110° tubes.*
7. *Size, Weight, Price—10" x 9¾" x 4½"; 6½" lbs.; $64.95.*

We used the Model T-475 in our lab to test a number of CRT's with various known conditions. In each instance, the instrument provided us with concrete evidence of the actual condition of the tube. Here is the procedure we found most logical in operating the tester:

Fig. 1. New unit reactivates weak CRT's and, in some, even eliminates shorts.

Activate the unit by rotating the QUALITY control to the SET position, which applies AC to the transformer and also calibrates the testing circuit. Next, make sure the SELECTOR switch is in the HEATER-CATHODE SHORT position and the heater-voltage control is correctly set for the tube to be tested. This presetting procedure eliminates the likelihood of accidental damage when the test socket is plugged onto the end of a tube.

Once the tube is connected, its filament will light—if that element is not open. If it is open, the usual repair techniques (such as resoldering the pins) may fix it. If not—nothing further can be done with that CRT!

If the filament is normal, next observe the shorts indicator on the panel of the T-475. If the neon lamp is glowing, a heater-cathode short is indicated. If not, move the selector switch to the next SHORTS position. This position causes the lamp to register any short which exists between the first grid and either of the adjacent elements (the cathode or the second grid).

If a short is indicated in either SHORTS position of the switch, there is always the possibility that it can be cleared with the *Reacto Tester*. To make this repair, turn the selector switch to SHORT REPAIR. This connects the test cable into a circuit which, when the ELECTRON BEAM button is depressed, will connect approximately 850 volts DC to the grid of the CRT via pin 2 of the test socket; the remaining elements are, of course, grounded. If the short is caused by only a small particle or flake between the elements, the arc which this high potential develops will burn it out. If this fails to eliminate the short, you can consider the tube nonrepairable.

The 850 volts DC for the shorts-repair function and the 250 volts DC used in the shorts test are supplied by a selenium-rectifier power supply contained within the T-475 (see Fig. 2). Six selenium rectifiers are connected in series to attain the voltage rating needed to withstand the

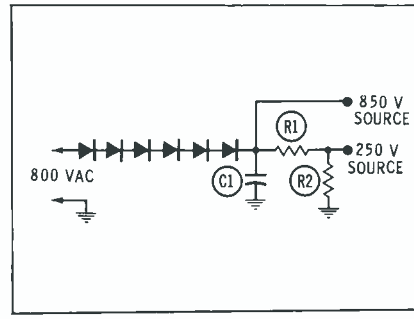


Fig. 2. Power supply of Antronic T-475.

800 volts AC which is applied to the half-wave rectifier circuit. The input capacitor (C1) serves to smooth the pulsating DC. The 850 volts DC is taken directly from the cathode end of the rectifier bank, while the 250 volts DC is taken from the voltage divider consisting of R1 and R2.

Once any shorts within the tube undergoing test have been eliminated, the emission of the CRT can be tested by placing the selector switch in the EMISSION test position. The QUALITY control must be pointing to the SET marking on its dial; this calibrates the circuit to indicate the correct emission value. Pressing the READ METER button will now cause the panel meter to evaluate the condition of the CRT cathode.

While the CRT depends primarily on cathode emission for its brightness, its contrast range depends mainly on the *control* which certain elements exert on the beam current. In order to test this quality of the CRT, hold the READ METER button down while rotating the QUALITY control through its full range, attempting to bring the meter needle to the "Check Point" mark on the scale. When the needle rests as near as possible to this point, the quality of the CRT can be read from the dial surrounding the control.

Having reached this point in the test procedure, suppose we found the tube to be weak in emission or quality. The next step is to attempt rejuvenation with the *Reacto Tester*. This is done by switching the selector to REACTO-LO or REACTO-HI.

The low position (which you'll use first) applies extra voltage to the filament of the CRT — about 50% more than normal. About 15 seconds is usually enough of this process, which is designed to "cook" the cathode so it will more readily emit surface electrons.

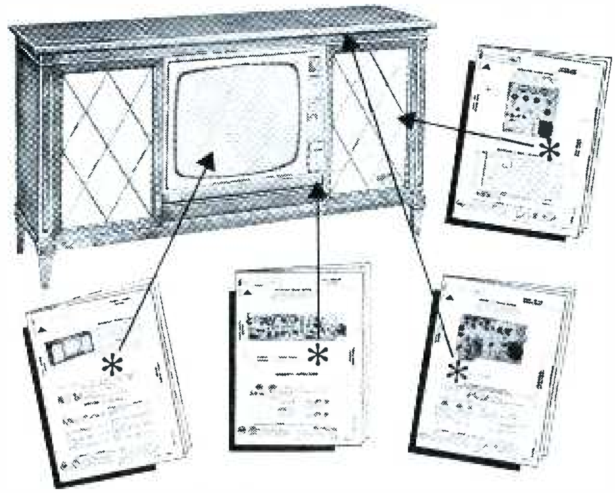
In very severe cases, when the CRT is unusable anyway, a "brute-force" tactic may be employed — the use of the REACTO-HI position of the selector switch. In this position, the switch applies over two times the normal voltage to the CRT filament. If there is any emitting ability at all left in the cathode, this will bring it out; however, the chances are considerable that the filament will burn out. Thus, it is usually advisable to attempt this drastic repair only as a last resort before completely discarding the tube.

Testing for gas in the CRT's proved to be a very simple procedure. While holding the button down for the emission test, you merely push the GAS TEST button

new in PHOTOFACT® the world's finest electronic service data

2 great firsts to save you valuable servicing time!

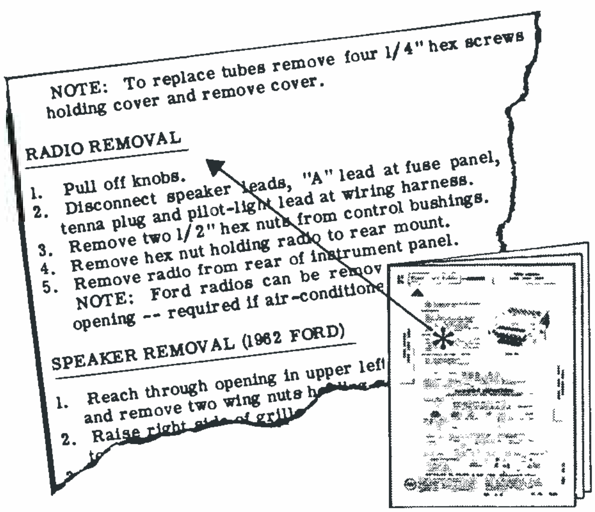
SEPARATE FOLDERS FOR SUB-CHASSIS



now it's far easier for you to service Home Entertainment Combinations

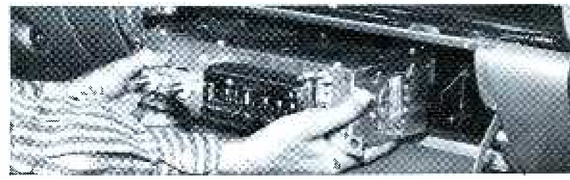
Yes, PHOTOFACT now provides separate Folders (within each master TV Folder) on each of the sub-chassis which require servicing. Whether it's the TV section, Stereo amplifier, FM-AM tuner, or remote tuning device, you now conveniently select only the Folder required for the specific sub-chassis needing repair. There's no more searching; the separate Folders for each sub-chassis are easily identified and keyed within the master Folder. This ideal new system gives you more complete, handier coverage than ever—instantly locates detailed, separate data on all additional units used with the basic TV chassis. It's another great PHOTOFACT advance!

AUTO RADIO REMOVAL INSTRUCTIONS



a wonderful time-saving, effort-saving feature

Complete auto radio removal instructions are now included in all PHOTOFACT auto radio Folders! New step-by-step procedure tells you whether tubes are accessible without removing receiver; points out obstacles you may encounter; spells out tool requirements; gives wiring connections, etc. Data is based on actual unit removal research by the Sams Photofact engineering staff. Here's another tremendous time-saver that puts an end to the tough job of removing auto radios—another great PHOTOFACT feature!



These new advances are just a few of the dozens of great features in PHOTOFACT for fastest, easiest, most profitable servicing. See your Sams Distributor for full details on an Easy Buy Library or Standing Order Subscription!

ONLY $10 DOWN

puts the *complete* PHOTOFACT Library in your shop—and you have up to 30 months to pay! And *right now*—to keep up with the industry—sign up for a standing order subscription to PHOTOFACT! See your Sams Distributor for full details on a Complete Library or Standing Order purchase.

FREE PHOTOFACT INDEX

Your invaluable guide to over 53,000 TV, Radio, Electronic listings, covering virtually every model produced since 1946. Helps you locate the proper PHOTOFACT Folder you need to solve any service problem in any model. Send coupon today for your FREE copy of the latest PHOTOFACT Index!

HOWARD W. SAMS & CO., INC.

Howard W. Sams & Co., Inc., Dept. 7-H2
4300 W. 62nd St., Indianapolis 6, Indiana

Send full information on:
☐ Easy Buy Plan ☐ Standing Order Subscription
☐ Send Free Photofact Cumulative Index

Shop Name__________

Attn.__________

Address__________

City______ Zone______ State______

and watch the meter needle slowly return to its resting position. If the meter reading declines rapidly, the tube is gassy. For the tubes we tested, the needle fell rather slowly, so they were apparently free of excessive gas. Even with the Model T-475, a gassy CRT cannot be repaired, and the gas means its useful life is somewhat limited.

To find out how well the instrument worked on color CRT's, we tested a color tube which we knew to have a weak red gun and a very strong green gun. We rotated the filament selector to the COLOR gun section and made emission tests on each gun, using the same procedure as for black-and-white tubes. Sure enough, the red gun caused a very weak indication on the panel meter, while the green gun showed a much higher reading. The blue gun checked about normal.

To eliminate the guesswork from servicing the video end of a television receiver, the Model T-475 can be very helpful. Add to this the possibility of repairing a percentage of defunct CRT's, and you have a combination which can be rather profitable.

Clean-Sweep Generator

The new PACO Model G-32W *TV-FM Sweep Generator and Marker Adder* (pictured in Fig. 3) incorporates features which eliminate the response distortion normally encountered when sweep-aligning television and FM receivers.

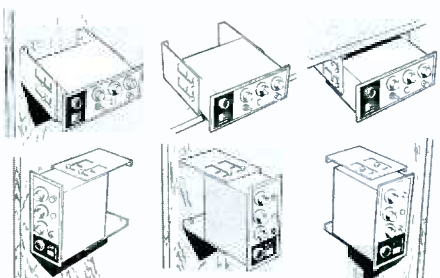
Specifications are:

1. *Power Required—117 volts AC; 50-60 cps.*
2. *Frequency Range—five bands, overlapping, from 3 mc to 213 mc.*
3. *Sweep Width—from ±1.5 mc maximum at 3 mc to ±30 mc maximum at 85 mc; ±16 mc at frequencies above 85 mc.*
4. *Output Impedance—50 ohms, terminated.*
5. *Other Features—marker-adder section which permits adding external marker without causing distortion that usually accompanies internal mixing; automatic blanking; automatic gain control which maintains constant RF output throughout each band; internal crystal marker.*
6. *Controls and Terminals—five coaxial*

Fig. 3. Sweep generator includes self-contained marker adder for versatility.

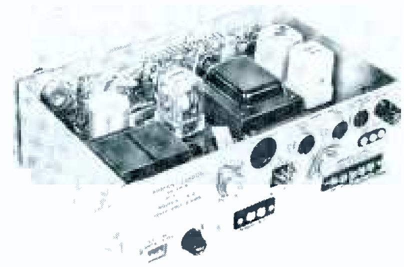
TR-1 **15 watt mobile transistorized p.a. amplifier**

Plug-in-accessories



Universal mounting

TR-2 **30 watt portable transistorized DC or AC/DC p.a. amplifier**



Plug-in-accessories

with LC-5 Carrying Cover

Harman-Kardon offers more operating features, more application versatility, more value than any other mobile or portable public address amplifier ever made . . . and they're transistorized!

With the new Troubador Series, Harman-Kardon introduces exciting new potentials for mobile and portable p.a. amplifiers. Never before has there been equipment offering the extra value, the operating facilities and the flexibility of these advanced new units. For rentals, for regular and unusual applications, the TR-1 and TR-2 provide dramatic performance and economy benefits. The TR-1 will find use in police, fire, marine, military, construction and other mobile commercial applications where battery or ignition power is available but AC is not. The TR-2, in addition, includes on-chassis provision for optional AC-to-DC converter to give it limitless applications in schools, hospitals, stores . . . anywhere an amplifier is needed regardless of power source. Automatic switch-over to DC in event of AC power failure makes this the only amplifier to offer uninterrupted service. It is also the long-awaited answer for emergency control work.

TR-1 • Simultaneous 2-channel operation: 1 mic, 1 music • Plug-In preamplifier module with equalization for tape head and mag phono • Universal mounting—TR-1 is free standing, also mounts flush on dashboards, panels, etc. Mounting brackets permit installation on all surfaces in all positions. Removable without disturbing brackets • Provision to turn amplifier on or off from remote location or microphone • Constant voltage output in addition to voice coil impedances • Can't damage amplifier by grounding chassis or incorrect polarity • 4-position filter for maximum tone and acoustical control • And many other flexible operating features.

TR-2 • Simultaneous 4 channel operation—2 mic, 2 music • Provision for on-chassis AC-to-DC solid state converter • On-chassis facilities for operation from AC with optional plug-in converter • Plug-in accessory provides automatic switchover to DC in event of AC power failure • Plug-in preamplifier module with built-in equalization for tape head and mag phono • Facility to turn amplifier on or off from microphone or remote location • Master Volume Control • Separate Bass and Treble Controls • Constant voltage output (25v & 70v balanced & unbalanced) and variety of voice coil impedances • Can't damage amplifier by grounding chassis or incorrect polarity • De Luxe Carrying Cover • Many other valuable operating and installation features.

Built *by* Sound Men *for* Sound-Men

For full details, write: Commercial Sound Div. **harman kardon** Desk H-8, Plainview, L. I., New York.

HK-74

connectors: MARKER GENERATOR, RECEIVER RESPONSE, SCOPE VERTICAL, SCOPE HORIZONTAL, OUTPUT; *coarse and fine* OUTPUT *level controls; band-selector switch; sweep-width control; three marker-added controls:* MARKER WIDTH, MARKER SIZE, PATTERN SIZE; *crystal socket;* ON-OFF *slide switch; 5" tuning dial; pilot lamp.*

7. *Size and Weight—13" x 8½" x 7"; approximately 15 lbs.*

Fig. 4 shows, in block form, the internal workings of the Model G-32W. The RF oscillator is one half of a 6BQ7A, connected in a Colpitts configuration; the other half of the tube is used as a cathode follower to isolate the output circuits from the oscillator tuned circuits, preventing load conditions from affecting the oscillator frequency.

The method of sweeping the oscillator frequency is one which is becoming rather popular in sweep generators—an *incredutor* system is used. An increductor (often called a saturable inductor) is a device whose inductance is governed by current flowing in a control winding or windings. To understand its operation more clearly, let's assume we have an increductor whose normal (no control current) inductance is 10 microhenries. When a control current of 5 ma flows in the control winding, the inductance lowers to—let us say—7 microhenries. Therefore, the frequency of any tuned circuit which might use this increductor would increase.

If this control current is in the form of a 60-cps sine wave, a frequency-sweeping action will take place at the same 60-cps rate. Thus, the increductor can be used to sweep the frequency of an RF oscillator.

This system has the advantage of containing no moving parts; its functioning is entirely electronic. However, it has one drawback: The sweep width varies with the frequency of the RF oscillator. This means that at low frequencies—say 4 mc—the maximum possible sweep width is limited—in this case, to 1.5 mc each way (a total of 3 mc). At higher frequencies, of course, the sweep width is correspondingly greater; at 60 mc, for example, it can reach a 50-mc width (25 mc each way). This will seldom affect the use of the instrument, since wide bandwidths are encountered only in high-frequency receivers (such as television and FM sets), anyway. Only in certain types of lab work or other special applications would limited bandwidth cause any problem.

Probably the most unusual feature of the Model G-32W is its built-in marker adder—a device which has been around for quite some time but has been mostly ignored by servicemen. The reason for this avoidance may be that it formerly was necessary to interconnect several instruments—sweep generator, marker generator, marker adder, scope, and the receiver being tested. The Model G-32W makes it easy to use a marker adder by simplifying the connections—since the marker adder is right in the instrument.

The principle of the marker is such that it completely eliminates the distortion which often results when the marker signal and the sweep signal are mixed within the receiver being aligned. Much has been written on how to mix these signals without distorting the resulting response curve, but in many situations it is not an easy job. The marker adder gets around this trouble by adding the marker to the response curve itself—not to the sweep signal, at all! Referring again to Fig. 4, here is how the marker adder works:

From the oscillator, the swept RF signal is fed to the cathode follower and also to a sweep-sampling amplifier. The sweep-sampling amplifier serves two purposes: It isolates the RF oscillator from the marker adder circuits, and it passes along a sample of the sweep signal as a reference for the adder.

The marker signal is fed into the G-32W from an external marker generator and mixed with the aforementioned sample of the sweep signal. Thus, these two signals mix in the marker adder much the same as they would have done if combined within a receiver, except that their mixing is not influenced in any way by the receiver circuits.

Meanwhile, the main RF sweep signal is coupled into the receiver and demodulated at the output of the RF (or IF) amplifiers, the same as with any other sweep-alignment procedure. The resulting response curve is fed first to the G-32W and then, via internal connec-

simply say Delco

You've *always* been able to install Delco auto radio speakers with complete confidence in their quality. *Now* you can sell this popular line at competitive prices as well!

And Delco hasn't sacrificed a single one of these outstanding features: Highest sensitivity for greater range of distortion-free sound from precision-engineered magnetic circuits • Extra-efficient, premium grade Alnico-V magnets • Continuous life testing program to assure dependable performance under the most severe climatic conditions.

There's news in Delco *packaging*, too. Your choice 6 x 9's in new bulk-packs, 20 speakers to a carton, or individually boxed speakers if you like. Now that you can sell top quality Delco Auto Radio Speakers at new, competitive prices, better stock up and start cashing in! Call your supplier and—simply say Delco. **Delco Radio** Service Parts are distributed nationally through **United Delco.**

DELCO RADIO, Division of General Motors, Kokomo, Indiana

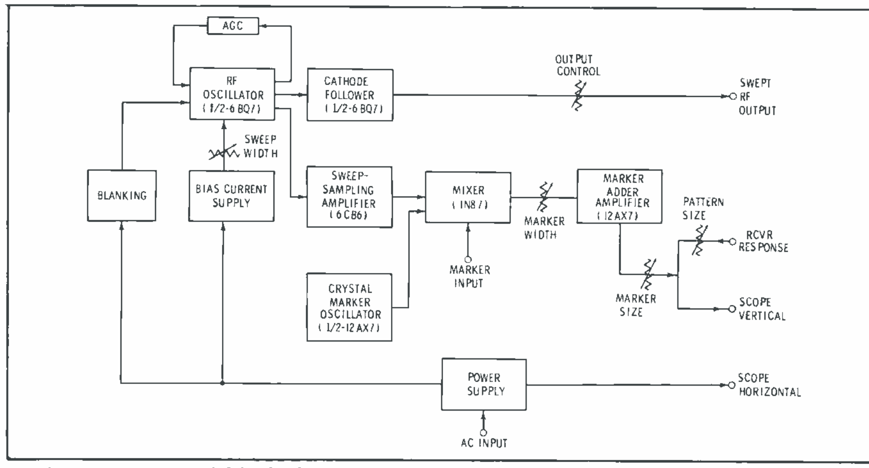


Fig. 4. Functional block diagram of Model G-32W shows internal connections.

tions, to the oscilloscope. Simultaneously, the marked "sample" signal is also coupled to the oscilloscope, via the same internal connection. The result is a scope display of the response curve with well-defined markers.

We used the instrument in the lab to align a television receiver, a communications receiver, and an FM receiver. In every case, the marker proved itself the most remarkable feature of the G-32W. We found the marker adder simplified two normally tough jobs—checking the exact frequency of trap notches and finding the true crossover point of the S-curve in an FM-discriminator alignment.

With normal marker-mixing procedures, the marker would have been attenuated in the notches, right along with the sweep signal; with the G-32W, the marker is *inserted* after the signal has already gone through the notch, so a nice, large pip is observable. This was unusually helpful, since it is otherwise difficult to see if the traps (or S-curves) fall at just the correct frequencies. We liked this simplification of a once-difficult task.

Sensitive Tube Tester

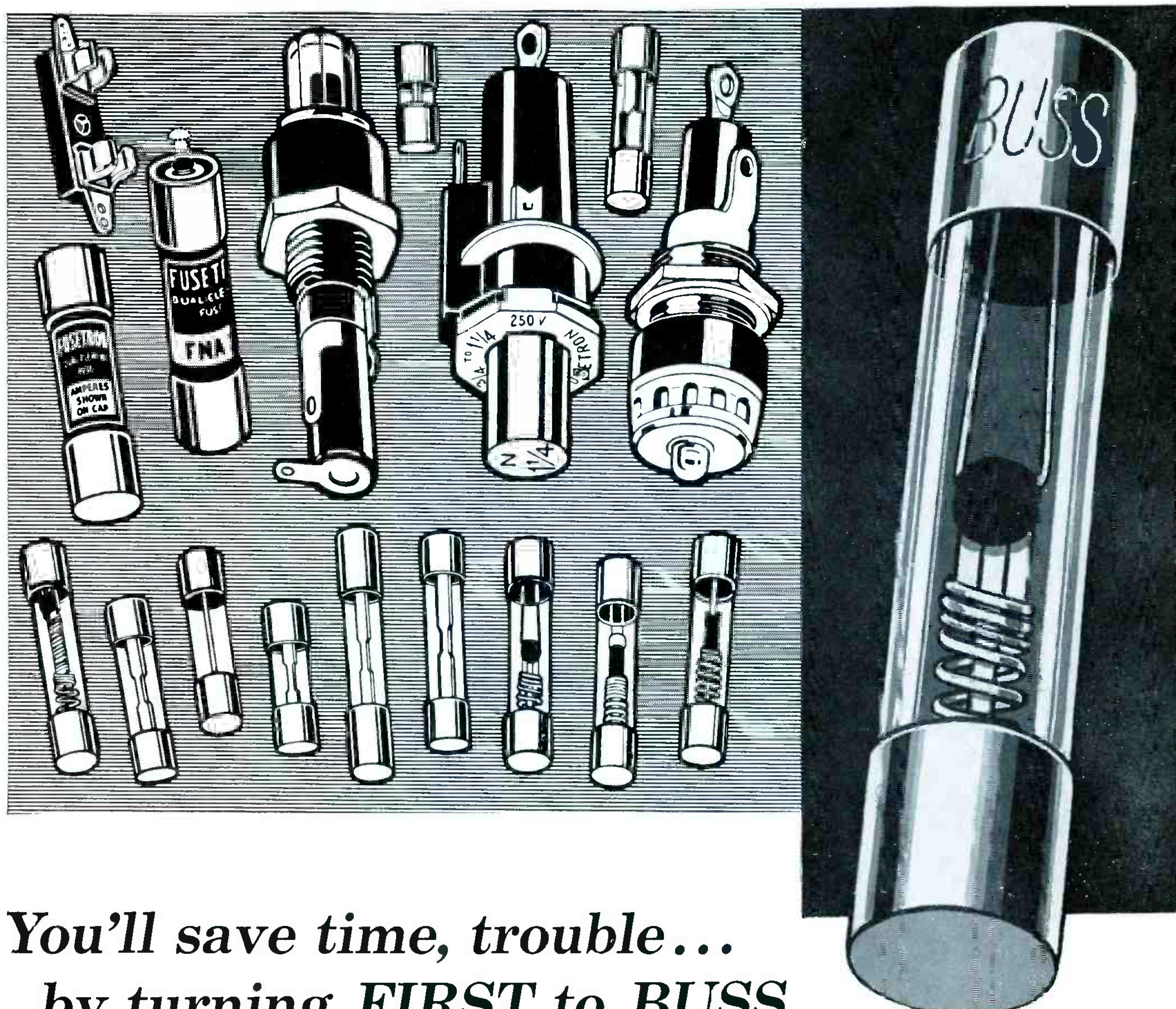
To test mutual conductance, cathode emission, and/or grid emission in tubes, Mercury Electronics Corp. has provided the Model 1000 *Mutual Conductance Tube Tester* shown in Fig. 5.

Specifications are:

1. *Power Required—117 volts AC; 60 cps.*
2. *Tests Performed—mutual conductance; cathode emission in diodes and CRT's; grid emission and gas, sensitivity up to 150 megohms; shorts.*
3. *Tubes Tested—all receiving types, including novars, compactrons, 10-pin novals, and 5-pin nuvistors; CRT's; separate tests for multisection tubes.*
4. *Panel Meter—face size 4½"; sensitivity 1 ma; mutual conductance and* GOOD-?-BAD *scales.*
5. *Controls and Terminals —* FUNCTION *selector switch; filament selector switch; thirteen lever-action switches for setting tests and selecting elements;* LOAD *potentiometer; 13 tube sockets for various tubes; 7- and 9-pin straighteners, neon* SHORTS *indicator; red* POWER *indicator; CRT test cable with dual socket.*
6. *Size, Weight, Price—14" x 9½" x 4¾"; 8¼" lbs; $79.50*

The Model 1000 utilizes a bridge circuit to measure the mutual conductance of any amplifier tube being tested. An extraordinary arrangement is used to supply DC plate voltage for the tube under test, making use of the same rectifiers to monitor the plate signal developed in the test tube. Fig. 6 shows, in greatly simplified form, the circuit arrangement.

Taken as a power supply, windings A and B of T1 apply 60 cps voltage to the diodes of V1, a 6BJ8. The ground return for the T1 windings is through resistors R1 and R2 and control R3. V1A and



You'll save time, trouble... by turning FIRST to BUSS

for fuses of unquestioned high quality

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

BUSS fuses are made to protect— not to blow needlessly

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

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

Capitalize on the BUSS trademark

The universal trade and consumer acceptance of BUSS fuses is based on the millions upon millions of BUSS fuses used in homes, on farms and in industry for over half a century. Handling BUSS fuses—and other KNOWN items—helps safeguard your reputation for service and quality.

For more information on BUSS and FUSETRON Small Dimension Fuses and Fuseholders . . . Write for bulletin SFB.

BUSS: The complete line of fuses and fuse mountings of unquestioned high quality.

FUSETRON — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — BUSS — McGRAW EDISON

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

862

Fig. 5. Model 1000 has very sensitive test for gas within tubes and CRT's.

V1B act as a full-wave rectifier, supplying pulsating DC voltage to filter capacitor C1. The capacitor smooths the ripple, resulting in a DC voltage which is applied through R4 to terminal P of the tube-test socket.

The "bias-and-signal circuits" furnish operating voltages for terminal G of the test socket. These voltages consist of a DC grid bias upon which is superimposed a 60-cps test signal. The test signal is taken from a winding on T1, but is specially processed in a phase-shift bridge so it is out of phase with the signals appearing in secondary windings T1A and T1B.

Within the bridge circuit, meter M1 is connected to read zero when the bridge is perfectly balanced—that is, when current flow is equal in each leg of the bridge. In this state, the voltage between points Y and Z is zero. Control R3 is provided to permit precise balance of the circuit, since slight differences might

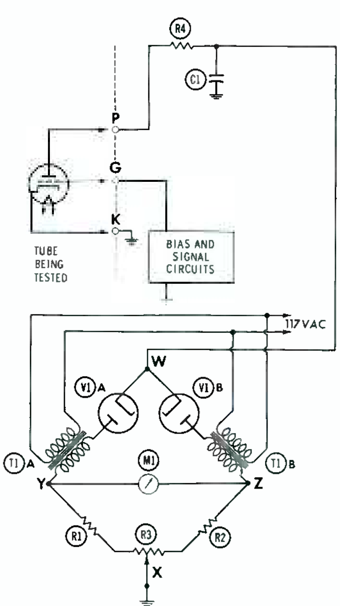


Fig. 6. Simplified schematic shows unusual power-supply and test circuits.

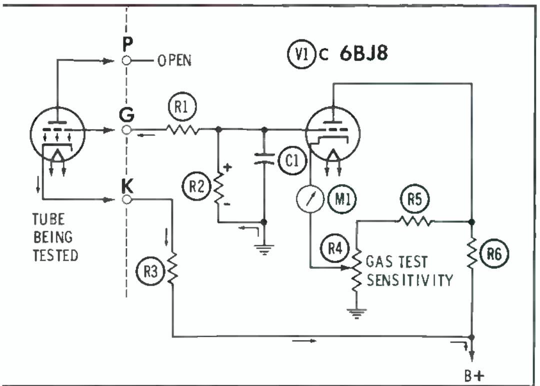


Fig. 7. Diagram of gas-test circuit.

exist between the two diodes or the two transformer windings.

The mutual conductance test is not the only significant feature of the Model 1000; there is also an unusually sensitive gas test. Fig. 7 shows how it works.

The test voltage is applied between the grid and cathode of the tube being checked. The cathode is connected to a source of B+, while the grid is returned to ground through R1 and R2. If there is gas in the tube, or if the grid itself is emitting electrons, the applied voltage shown will cause reverse current to flow from the grid to the cathode. If current does flow, it develops a positive voltage across grid resistor R2, which in turn causes V1C to conduct, indicating on the meter that reverse current *is* flowing in the test tube.

The gas-test circuit in the Model 1000 is unusually sensitive, being capable of measuring grid emission in the order of 150 megohms. R4 adjusts the sensitivity of the test circuit by controlling the conduction point of V1C; it can be set for any desired sensitivity. This adjustment is factory-set, however, and normally should not be altered.

We used the instrument in our lab and found that the gas test was, indeed, very sensitive. Among our "library" of defective tubes are several with varying amounts of gas and grid leakage, and the Model 1000 showed gas in all of them — some, in fact, that certain other testers have failed to discover. The sensitivity is so high that a number of tubes which operate normally in sets were rejected by the instrument as gassy. If a tube is to be operated in a very critical circuit, however, it is well to learn whether or not it contains *any* gas, since the gas content usually increases with age.

The instrument proved itself capable of everything we expected of it. ▲

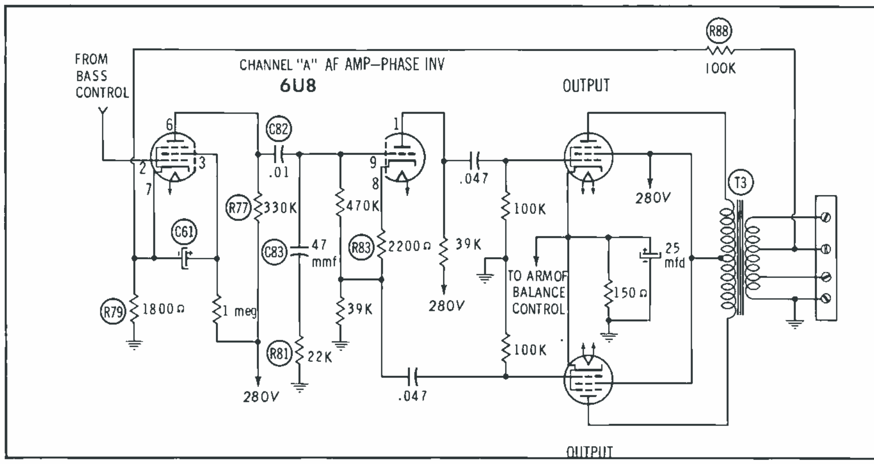
now in our lab . . .

The latest test instruments being analyzed for future "Notes" columns:

EICO Model 955 Capacitor Checker
Hickok Model 656 XC Color Generator
Paco Model G-34 Sine-Square Generator
RCA Model WO-91A Oscilloscope
Sencore Model PS-120 Oscilloscope

THE TROUBLESHOOTER

answers your service problems



Feedbacks Three

One: I have a Stromberg-Carlson Model ASR-433 Stereo Amplifier in my shop for service. The trouble is a high-frequency whistle on Channel A only. This oscillation seems to be generated in (or around) the 6U8 amplifier and phase-inverter stage. All voltages are correct except for that on pin 6, which reads 50 volts while the schematic (PHOTOFACT Folder 487-14) calls for 75 volts. I've checked most of the components in this circuit and could find none off-value, and there is no noticeable difference in lead dress between Channels A and B. What would you suggest?

Two: I have a Magnavox Model V72AA TV set which makes a peculiar squealing sound when it is tuned off-channel. I think this is due to a change which I made in the tuner; do you think this is possible?

Three: My own 8-transistor radio oscillates at times. This "put-put" noise changes as the volume control and tuning dial are adjusted. What causes this?

R. VAN CAMP

Westchester, Calif.

One: Regeneration apparently is your problem in the amplifier. Judging from the

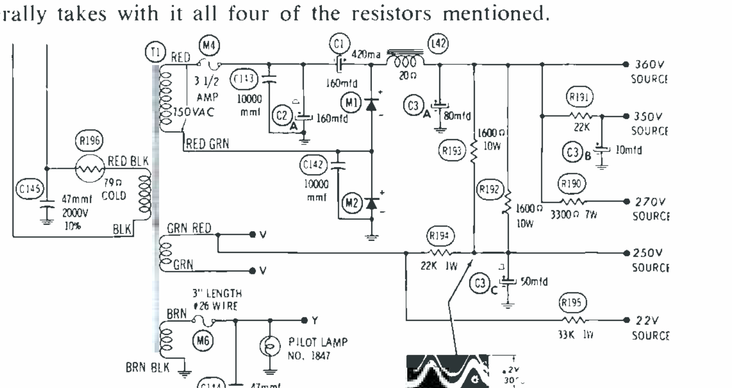
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: RCA CTC10

Symptoms: No sound, no video, odor of burnt components.

Tip: Look for damage to R192 and R193—the two 1600-ohm, 10-watt B+ dropping resistors which are wired in parallel and located on the underside of the chassis in the lower left corner. If these resistors are ruined completely (normally recognizable by their having popped open), remove the "doghouse" shield that covers the chroma section, and look at the 3900-ohm demodulator-plate resistors (R160 and R161). You'll probably find them to be damaged also, due to a shorted 12AZ7A demodulator tube (V21). When this tube shorts, it generally takes with it all four of the resistors mentioned.



voltage readings in the circuit, it seems possible that C82 is leaky or R77 has changed in value. Either fault would lower the voltage at pin 6 of the 6U8; however, a leaky C82 would also alter the bias on pin 9 of the phase-inverter section, perhaps causing excessive gain and unwanted feedback. I would, in addition, check the bias resistors in both cathode circuits—especially R79—to be sure they are of the correct value. It is possible that trouble in the C83-R81 network might contribute to the problem. Of course C61—the screen bypass—is also a prime suspect.

Turning to another possible source of positive feedback in this amplifier, be sure R88 in the feedback network is okay, and the connections to T3 have not somehow become reversed.

Sometimes the cause of oscillations of this nature can be pinpointed by the simple means of bringing a finger (or a metal screwdriver blade) near various components in the suspected feedback path; when the offending part is approached, the pitch of the oscillation should change.

Two: Your description of the off-channel noise in this TV set leads me to suspect you might have a very short high-voltage arc somewhere, and the energy is being radiated to the sound or other circuits. To identify this unusual symptom, you might disable the high voltage by pulling the sweep fuse temporarily. If the unwanted sound persists, perhaps it does stem from feedback. You could systematically try locating such a feedback path by disabling the RF, IF, and sound stages, in turn, until one is discovered that is part of the undesired feedback loop. Then troubleshoot the fault as any other feedback problem: checking bypass capacitors, component values, and lead dress.

Three: Your transistor radio is motorboating, probably because of unwanted coupling among the various circuits—a not-uncommon malady in these sets. The cause can usually be traced to a defective battery-bypass capacitor or a battery which has developed high internal resistance. Naturally, try a new battery first.

Misleading Reading

An RCA Chassis KCS81B (covered in PHOTOFACT Folder 208-8) has insufficient height, and the peak-to-peak voltage of the yoke-input waveform is half of normal. The output-tube grid waveform has the correct amplitude, but I read −10 volts on the grid. The schematic calls for zero volts. I think this difference may be the key to the trouble, but can't find the cause.

RUSSELL V. COATNEY
San Diego, Calif.

If you measured the −10 volts with a VTVM, this is probably correct. The grid voltage on the schematic was taken with a VOM (standard shop equipment when this old set was built); it loaded the high-impedance grid circuit and failed to give a true reading. The waveform indications point strongly to trouble in the output stage or yoke.

Master Antenna Systems

(Continued from page 29)

cabin 1—we already have a signal loss of 9 db.

Now, there is going to be a tap-off for each receiver (or cabin), and each tap involves one type of loss—the *isolation* loss—which is peculiar to the individual receiver rather than to the system as a whole. The tap-off is designed to reduce signal at least 10 db below the line level at the point of take-off, providing at least 20 db of isolation between any two receivers in the system. This prevents any interaction (radiated oscillator signal, noise signals caused by tuner switching, and the like) between sets.

In addition, each tap-off will produce some loss in the line—*feed-through* loss — which will affect signal availability to other receivers. Fortunately, this loss is usually small compared to other system losses; it may be, for example, only .5 db. Thus, the accumulated feed-through loss for the eight cabins in branch A would be 4 db.

Totaling the losses at cabin 1, there is a total of 4 db feed-through loss plus 9 db line loss—an accumulated total of 13 db. Also, we must add the isolation loss for the tap-off *in cabin* 1 *only* to determine the signal loss at this weakest point. Adding this 10 db, we arrive at a total drop of 23 db between the antenna and the receiver.

If the system used a single line to feed all receivers, the loss problem would end here. However, we have two branches, which must be fed from a common distribution amplifier. This will be done through a symmetrical line splitter, which introduces a loss of perhaps 3 db to each branch. Thus, assuming there is plenty of signal voltage from the antenna, we need a total boost of 26 db in the amplifier to make sure the signal is not deteriorated, even at the weakest points in the chain—cabins 1 and 16. In a symmetrical system like this, the calculation for one branch will give us the gain requirement for both branches; a 26-db amplifier will maintain good signal to the ends of both lines.

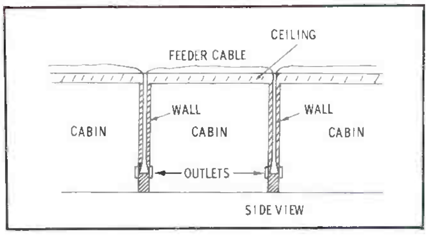


Fig. 4. Enclosed space above ceiling in row of cabins is handy cable route.

Splitters and Tap-Offs

The splitter is generally a resistive divider (not frequency-sensitive) that will divide signal voltages equally between two branches while maintaining the line impedance. The splitter has several advantages: For one thing, using branch lines permits more versatility in system layout; also, the splitter helps keep feed lines short. (Since long lines require high gain, receivers connected near the amplifier on such lines may be overloaded.) Furthermore, odd as it may sound, a splitter can actually *reduce* system losses. In the system of Fig. 2, accumulated wire losses at the very last receiver would be 18 db if a single line (300′) were used; but splitting the load into two 150′ runs involves a wire loss of only 9 db and a splitter loss of 3 db. Since this comes to 12 db altogether, there is a considerable saving of signal.

As to tap-offs, there is a wide variety. The manufacturers' catalogs are your best reference here. Some match 72-ohm lines directly to 300-ohm receiver connections; others merely maintain the 72-ohm match for short branches, such as the line to a TV set. Some are rugged outdoor types; others are for indoor use. Among the latter are flush-mounting wall units such as shown, ready for use, in Fig. 5.

In addition, certain tap-offs are

Fig. 5. Individual sets are most easily connected to system via wall plug.

designed to be frequency-sensitive, so they will introduce more isolation loss on one channel than on another. This would help in case one channel developed excessive signal (and resultant overload) while other, weaker channels were in good condition.

Amplifiers

Let's return to our sample system (Fig. 2). We have said that the distribution amplifier will have to provide a gain of 26 db. However, let's play safe: The system and its components will age, and tubes will get tired, so a margin of several db against such contingencies will avoid future dissatisfaction and reduce maintenance problems. Give the system 10 or 12 db to spare—search the manufacturer's catalog for a unit that will provide at least 38 db of gain.

The unit will be rated not only in db gain, but also as to the maximum signal—in microvolts—that can be applied without producing overload. Some amplifiers have gain controls, so you can match input and output signal requirements.

Other amplifiers have *tilt* controls, in addition. These controls shape the amplifier response so you can boost high-frequency output over low-frequency output, as with a treble control in a hi-fi system. Applying a little tilt helps to counteract increased line losses at the upper-channel frequencies without causing excessive gain on the lower ones.

Conclusion

If you run into trouble, don't hesitate to contact the manufacturer of the equipment you are using—generally, through his distributor who is nearest you. After all, fundamentals are all anyone can give you. The rest you will learn by doing—with the confidence of having a helping hand nearby in case of trouble.

So, if someone ever wanders into your shop saying he can't find anyone to install the system he wants, and asking if you can do it (this does happen), don't kick away a golden opportunity. Everyone's in your corner, so go ahead —and good luck! ▲

Horizontal Oscillators

(Continued from page 27)

be "straining at the leash" and will be likely to fall out of sync on camera changes or when a different channel is tuned in. To eliminate the annoyance of frequent hold-control adjustment, and to catch troubles before they develop into callbacks, it's good "preventive medicine" to check horizontal circuits for positive, solid sync with minimum AFC correction.

One simple test serves either to check the AFC action of a nearly normal circuit or to isolate the cause of off-frequency operation. The connection between the AFC and oscillator stages is effectively broken by grounding the input grid of the multivibrator (pin 2 of V12 in Fig. 4). In most circuits, the DC voltage at this point is normally only a few tenths of a volt above or below ground potential; thus, the test merely simulates a normal condition without permitting AFC action.

If the multivibrator was originally in sync, but drops out of sync when the grid is grounded, you should suspect that its natural frequency is incorrect—though still within the correction range of the AFC circuit. See if it can be synchronized at some point within the middle third of the hold-control range; if not, it would be advisable to see if any trouble is developing in the multivibrator.

If the multivibrator was out of sync to begin with, and grounding the grid makes no difference, this indicates that the multivibrator has a frequency error which is too great for the AFC to correct. If an out-of-sync condition is altered by grounding the grid, and can be temporarily removed by adjusting the hold control, this indicates an unbalance of the AFC stage—resulting in an incorrect AFC-output voltage which is detuning the multivibrator. (For proof, see if the input-grid stage voltage is several volts more positive or negative than the value stated in service data.)

Once you've decided whether the cause of off-frequency operation is in the multivibrator or in its control stage, you can proceed to close in on the faulty component. At this time, note again if the symptoms indicate operation *above* or *below* normal frequency; completely different techniques will be called for.

Analyzing the multivibrator itself, note that it's made up almost entirely of resistors and capacitors, and that their RC time constants are the main frequency-determining factor. Increasing the functional resistance of the hold control will slow down the operating frequency. So will an increase in the value of cathode resistor R101 or plate resistor R96, such as might be caused by a short in the tube. In R99, the second-stage plate resistor, an appreciable increase in value would place more resistance in series with the sawtooth-forming circuit which develops the drive signal—and the decrease in drive would probably produce more serious results than any accompanying change in frequency.

Coupling capacitor C89 might possibly increase in value and reduce the operating frequency, but this trouble is less likely than a resistor fault. Likewise, the ringing coil (horizontal frequency slug) normally has a rather limited effect on multivibrator frequency, and isn't likely to throw the circuit far out of line. If you have any doubt about the ringing coil, just connect a jumper temporarily across it; this will have very little influence on multivibrator stability during tests.

Now, what about AFC faults? Remembering basic multivibrator theory, a positive shift in DC voltage on the input grid is needed to pull the multivibrator down to a lower frequency. The rise in grid voltage makes it more difficult to cut off the first section of the multivibrator at the end of the "trace" portion of the cycle; hence, it lengthens the cycle. When the multivibrator frequency is obviously too low because of an AFC malfunction, the problem is to find out where the excessive positive voltage is coming from.

Filter components C86, C87, C88, R84, and R95 (Fig. 4) are an unlikely source of this particular trouble; they merely tend to "bleed off" the existing AFC voltage if shorted, or to increase ripple and cause erratic sync if open.

A more likely cause of trouble is the AFC diodes. If only one of these becomes defective, the circuit will become unbalanced and will produce an erroneous output. In the circuit of Fig. 4, for example, leakage in the upper diode section will cause insufficient negative voltage to be developed, while a normal amount of positive voltage will be generated by conduction of the lower diode. Thus, the net AFC output will be positive, and the multivibrator frequency will drop. Usually, the shift in frequency due to unbalanced diodes is not too great; a considerable amount of leakage, or even an open diode section, is needed to cause great errors in operating frequency. The older type of dual-diode AFC system, using sync pulses of two polarities (see "Troubleshooting Diode AFC Systems," December, 1961 PF REPORTER) is even less troubled by diode unbalance than the common-cathode system in Fig. 4.

The most serious frequency-shift problems involving dual-diode AFC stages are due to leakage in the input capacitors which feed the sync and the sawtooth signals to the AFC circuit (C82 and C85 in Fig. 4). The former unit is connected to a point of high positive potential; the latter also may be, if it is returned to a tap on the main flyback winding instead of going to an isolated winding. If any of this positive voltage leaks through the coupling capacitors, it mixes with the correction voltage generated by the AFC circuit. Since the net change in voltage is always in a positive direction, a lowering of multivibrator frequency is a characteristic symptom.

Strange behavior often results from this type of coupling-capacitor defect. The multivibrator may refuse to begin operating when the set is first turned on, but may be jogged into normal action by manipulating the channel selector or other controls. In other cases, the complaint may be an intermittent but severe loss of sync. This erratic operation makes it difficult to locate the trouble by routine checking of components; outright replacement of the coupling capacitors is a good idea in stubborn cases of horizontal AFC trouble.

Probing the AFC circuit with a VTVM lead may bring back normal operation; but if the trouble persists, you will note unusually high positive voltages in the circuit. In one set, for example, very slight leakage in C82 (Fig. 4) raised the voltage at pin 2 of the multivibrator to over 6 volts—placing virtually zero bias on the first section of the multivibrator. The reading at the common cathode terminal of the AFC diode, normally less than 10 volts, rose to 18 volts.

Some defects speed up the multivibrator instead of slowing it down; however, the chances of this happening are relatively slim. The interstage capacitor C89 or the second section of the multivibrator tube could develop leakage, reducing the bias on the second tube section and shortening the "trace" period; in addition, the AFC diode circuit could become unbalanced in such a way as to produce a negative DC output voltage.

Final Checks

By paying close attention to the symptoms as a guide in finding trouble, and following instructions in service data for horizontal-oscillator alignment, you should not have unreasonable difficulty in curing horizontal-frequency errors. But before the set goes back to the owner, take a few seconds to check a few points of performance that will assure you of an oscillator that will stay "on the button."

1. Are the horizontal hold and frequency adjustments reasonably close to the middle of their range?
2. When you change channels, is the picture already in sync when it first appears? Noticeable effort in "pulling into sync" may mean a latent frequency trouble.
3. Is the AFC output voltage close to the nominal value given in service data? If not, the AFC may have to be working overtime to keep the oscillator on frequency, and the picture may fall out of sync when the station signal is interrupted.
4. Is the set reasonably prompt in establishing horizontal sync when first turned on, and does it stay in sync during a "cooking" test after repairs? Thermal frequency-drift problems, although tougher to diagnose and cure than ordinary frequency errors, must be corrected as part of a thorough repair job.

If the set passes this "final exam," you can return it to your customer with confidence that you have taken care of the horizontal-frequency trouble as completely as possible. ▲

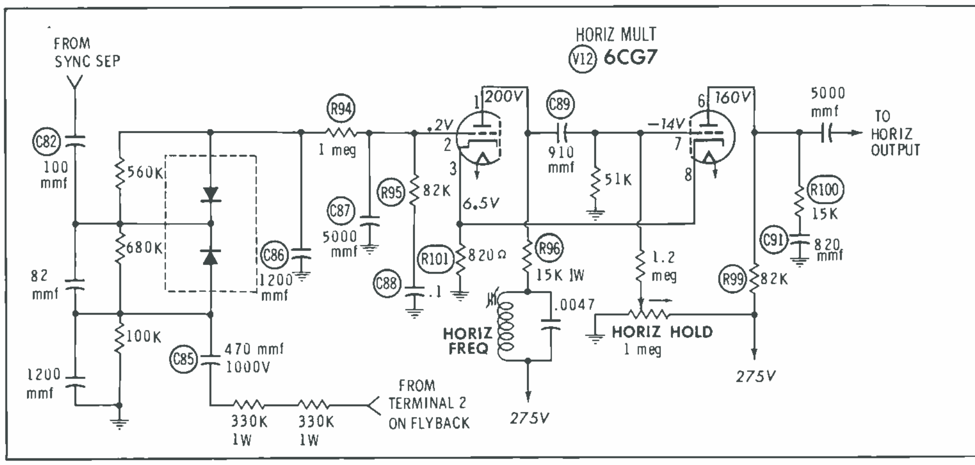


Fig. 4. Typical horizontal multivibrator using common-cathode AFC circuit.

Rotator Maintenance

(*Continued from page 24*)

off-center weight distribution — which, in turn, places undue strain on the rotor. Binding of the mechanism, stripping of gears, or damage to the motor may result.

5. Does the rotor mechanism sound as if it is straining? Is it unduly noisy?

It's also advisable to ask your customer whether the system seems to have been working normally during the past few months.

If any of the above checks indicate trouble, or if the rotator has been in operation a number of years, it should be removed, inspected, and any needed repairs made.

Repair and Maintenance

Rotators seldom require servicing, as they are quite rugged in construction. The gears and all contact surfaces are fully lubricated during production, and a sealed housing protects this lubrication for quite a few years. But eventually, a certain amount of moisture penetrates the seal and collects inside the housing. Over a period of time, it washes some of the lubricant away; this, in turn, may result in worn parts. Therefore, during rotor overhauls, or when you remove the housing for any other reason, correct cleaning and lubrication is important before reassembly and testing of the unit.

First clean all the gears and contact points with the aid of a small brush and a solution of mineral spirits. Once these parts are clean, inspect them for excessive wear or cracks. Any item having borderline defects should be replaced. However, you'll usually find that a typical rotor is in as good a shape as the unit shown in Fig. 1. Despite the age of this unit, the gears and riding sleeves are still almost as good as new, indicating the rotor has been serviced well and still has a lot of operational hours left. If you find no defective parts, the rotor is ready for final lubrication of the gears and bearings, and oiling of the motor.

A heavy grease, such as *Lubriplate*, should be placed on each of the important lubrication points shown in the photo. Put just *one drop* of oil on the motor bearings (not visible in Fig. 1)—don't oil them excessively.

Before finally sealing up the housing, check to make sure no foreign objects have found their way inside the rotor assembly. If you give those gears something to chew on, the rotor may become jammed or damaged sometime later—leading to an expensive callback.

The rotor in Fig. 1 is an *offset* type which does not sit directly on top of the supporting mast, but is mounted slightly off to one side. A different style of rotor, which mounts directly in line with the mast, is shown disassembled in Fig. 2. This unit is one of the newer models on the market.

Lubrication points for this rotor are indicated in the illustration, and the same servicing procedures mentioned above are valid for this unit.

On heavy-duty *in-line* rotors such as this, antennas weighing up to 150 lbs. can be mounted without additional support. Offset models generally require the addition of an external *thrust bracket* to support the weight of unusually heavy antennas.

Fig. 2 also shows the control box for one type of in-line rotator unit. The control box—via switches and a solenoid-operated stepper unit—supplies power to the motor. The direction of rotation, and the point at which the unit will stop, are selected by a front-panel knob. The *primary switch* (see schematic, Fig. 3) closes when the knob is moved, and opens again when it strikes a direction-indicating tab on the knob. Thus, the operation of this rotator is fully automatic once the knob is set to the desired position.

Trouble Isolation

There are many different types of

Troubleshooting Check List

ROTOR INOPERATIVE
(motor does not run)

- ✓ AC input line
- ✓ Primary winding and contacts
- ✓ Secondary windings
- ✓ Directional contacts
- ✓ Motor connections
- ✓ Motor capacitor
- ✓ Motor
- ✓ Thermal switch (in some rotators)
- ✓ Connections in control box
- ✓ Guy wires attached to rotor housing (not too taut)
- ✓ Potentiometers in rotor housing (if used)

ROTOR INOPERATIVE
(motor runs)

- ✓ Gear train—for improper meshing or indications of slippage

ROTOR OPERATIVE
(one direction only)

- ✓ Directional contacts
- ✓ Motor (for open winding)
- ✓ Control-box connections

ROTOR OPERATES SLOWLY

- ✓ Wiring connections to terminal strip
- ✓ Motor capacitor (change)
- ✓ Size of connecting wires
- ✓ Gear train (for binding or slippage)

rotators on the market, with many mechanical as well as electrical variations. The potential trouble spots in these systems are numerous—relays, contact points, switches, open or shorted transformers and motors, and stripped, broken, or binding gears, to mention a few. For easier trouble localization in rotator systems, this article includes a troubleshooting check list which will be generally useful for servicing most models. Of course, you will run across some odd cases of rotator trouble, but if you take the time to stop and figure out how the unit should operate, or what section is not functioning, your repair job will take less time and trouble to cure—and rotator servicing will be easy. ▲

PRODUCT report

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

Service Form for Two-Way (42Q)

Spaces are provided to show all important technical characteristics, measurements, and deviations for both transmitter and receiver, in **Oelrich Publications'** new Form 51. This form is a triplicate, one-time-carbon service order for writing up complete details of each mobile-radio service job. Price is $4.95 per 100 forms.

Capacitor Assortment (43Q)

A 15-drawer "Elmenco" capacitor assortment consisting of the most popular *dp*-dipped "Mylar"-paper types, VCM high-voltage silvered-mica types, and CCD disc ceramic types, is available from **Arco.** The kit, which contains 44 capacitors in 44 different values, carries a net price of $29.95. The 15-drawer cabinet is included free of charge when the complete kit is purchased. Each value of capacitor is stocked in its own section of the cabinet.

UHF Radiotelephones (44Q)

Kaar's TR505 and TR506 radiotelephones are available with power supplies for either 6 volts DC or 117 volts AC. The TR505 unit is self contained for either base-station or dash-mounted mobile use. The TR506 control head and speaker are dash-mounted and function with a trunk-mounted transceiver. List price is in the $500 range.

Receiving Tube (45Q)

Westinghouse has recently introduced a new nine-pin miniature triode-tetrode receiving tube. Type 6/10JA8 is designed for dual-purpose use as a sync separator and video output tube. The tetrode section is rated at 5 watts maximum plate power and 1.5 watts screen dissipation. The triode section features high mu and is designed for a maximum plate dissipation of 1 watt.

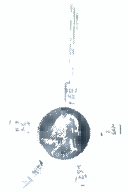
Compact Speaker (46Q)

Overall length of this 25-watt speaker from **Atlas Sound** is only 6⅛". A protective screen over the bell opening adds structural rigidity while preventing foreign materials from entering the horn. Impedance of the unit is 8 ohms, and its frequency response is from 300 to 10,000 cps. Shipping weight of the SPF-2 is only 5 lbs. and it carries a list price of $47.50.

CB Antenna (47Q)

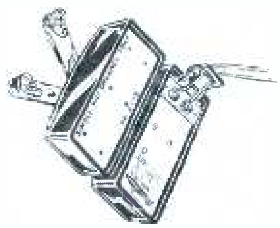
No bumper clips or springs are necessary with the "C-Bee" power-driven antenna by **Tenna Mfg. Co.** This pushbutton operated unit extends to 55" and collapses to 9½". The retraction feature reduces problems of low garage doors, washracks, and vandalism. Any 12-volt ignition system will power the "C-Bee" which is top loaded and mounts in most conventional locations on the vehicle.

Universal Transistors (48Q)



The first five models of a line of universal audio-frequency transistors are available now from **Amperex.** These types — 2N2428, 2N2429, 2N2430, 2N-2431, and AC132 — exhibit extremely flat beta characteristics over their entire operating range. Designed specifically for audio applications, all five are in standard TO-1 cases.

Antenna Traps (49Q)

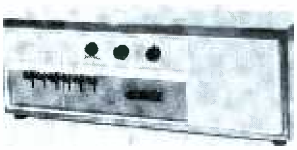


Wave traps for any one channel from 2 to 13, to be used in conjunction with their "Transis-Tenna," have been introduced recently by **JFD.** For use in areas where strong local signals interfere with reception of desired weaker channels, these traps provide approximately 35 db attenuation. Catalog numbers of the traps range from TR-2 through TR-13. TRFM is the designation for the trap which screens out FM signals. These units can be used with any antenna amplifier to prevent its being overdriven by strong local signals.

Crank-Up Tower (50Q)

The **Rohn** No. 6 tower is now available in a "crank-up" model with heights from 18' to 54'. Primarily intended for hams, the unit features a winch with cables which lift the various sections easily and safely. The tower is hot-dipped galvanized and comes in heights of 18', 26', 37', or 54'. In other respects, this unit is identical with their regular No. 6 tower.

Background Music (51Q)



Designed primarily for industrial use, **Fisher Berkeley's** new Page-Reply-Background-Music system provides music from either tape-playback devices or FM tuners. Music periods are scheduled by a printed-circuit electronic clock which also provides a signal tone to announce work start-and-stop times. Available amplifiers range from 10 to 50 watts of power output.

1963 Hi-Fi Line (52Q)

A "new look" characterizes **V-M's** 1963 line of hi-fi equipment. Featuring "certified-styling" cabinets, stereo and monaural portable phonographs, and a new series of hi-fi components, the entire line is new in appearance. Pictured here is the Model 1465 AM/FM/Stereo self-powered tuner. Other models include French Provincial and Classic Period consoles, as well as contemporary styles.

INDEX TO ADVERTISERS

August, 1962

Latest Jackson Tube Test Data

MODEL 648

Tube Type	Fil.	D	E	Plate Test
6BA3*	6.3	126	5	14 W
6KA8	6.3	A1239	678	44 YZ
	"	A123	A45	60 YZ
7HG8	7.5	A1234	B567	40 YZ
	"	123	AC89	15 XZ
12AY3*	12.6	126	5	14 W
15HB6	15.	A1234	B579	20 WZ

SUPPLEMENTS LATEST ROLL CHART 648 25

MODEL 598

Tube Type	A	B	C	Fil Cont	D	E.	F	G.
6BA3*								
6KA8	6.3	4Y		5	9	6Z	8	59
	"	4Y			1	2Z		70
7HG8	7.5	4YZ		5	8	2	9	68
	"	4Z			7	6		35
12AY3*								
15HB6	15	4Y	6	5	7	2	8	19

SUPPLEMENTS LATEST ROLL CHART 598 1

MODEL 658

Tube Type	Sec	Heater	Circuit H-K	Circuit P-G	Plate	Grid Test	Heater Current
6BA3*	D	6.4N	126	5	19U	V	
6KA8	P	6.4K	1239	678	52R	10WY•	
	T	"	123	a45	35Q	10WY•	A13 6M Z600
7HG8	P	8.5F	1234	b567	30R	10WY•	
	T	"	123	ac89	16S	15WY•	
12AY3*	D	13.6H	126	5	18U	V	A22.E Z600
15HB6	P	18.6D	1234	b579	26Q	15VY•	A18 6M Z300

SUPPLEMENTS LATEST ROLL CHART 658 5

"For further information, see Tube Test Data in PHOTOFACT Folder No 592."

CATALOG AND LITERATURE SERVICE

ANTENNAS & ACCESSORIES

1Q. *BLONDER-TONGUE* — 15-page technician's guide "Quick Reference Manual of Master TV Systems" containing diagrams for home, TV shop, apartment house, and motel systems. *See ad page 54.*

2Q. *CORNELL-DUBILIER* — Literature on new ultrasonic Model AK-122 remote-control antenna rotator. *See ad page 59.*

3Q. *CUSH CRAFT*—8-page catalog (No. 62) describing complete line of amateur communications antennas; both UHF and VHF types included. *See ad page 78.*

4Q. *GAM* — Catalog sheet giving specifications on miniaturized TG-2-R VHF mobile antenna that is designed to mount on top of vehicle or in other restricted spaces. *See ad page 70.*

5Q. *JFD*—Descriptive and promotional literature plus sales aids for new *Transis-Tennas;* also complete set of specifications for outdoor and indoor TV antennas and accessories, including exact-replacement antenna data. *See ad page 43.*

6Q. *WINEGARD*—New Factfinder bulletins on FM antennas, UHF antennas, and yagi couplers. *See ad page 66.*

AUDIO & HI-FI

7Q. *ATLAS SOUND*—Catalog No. 562 listing specifications on microphones and loudspeakers for public address, commercial and industrial use.

8Q. *DUOTONE* — 1962 wall chart listing data on replacement phonograph needles.

9Q. *EICO*—New 32-page catalog of kits and wired equipment for stereo and monophonic hi-fi, test equipment, Citizens-band transceivers, ham gear, and transistor radios. Also "Stereo Hi-Fi Guide" and "Short Course for Novice License." *See ad page 81.*

10Q. *RMS ELECTRONICS*—Sheets describing new line of wood wall baffles and speaker enclosures; also available in speaker and baffle combinations with speakers premounted. *See ad page 80.*

11Q. *ROBINS*—Catalog No. 16 listing audio accessories, audio accessory kits, replacement parts, industrial products, and air filters.

12Q. *SONOTONE*—Sheet SAH-54 describing new ceramic stereo cartridge Model 916-TA. *See ad page 52.*

13Q. *SWITCHCRAFT* — Bulletin E-508 describing new line of audio connectors with exclusive ground lug and *captive design* insert screw.

COMPONENTS

14Q. *ASTRON*—Illustrated catalog listing all types of capacitors for commercial and industrial use.

15Q. *BUSSMANN*—24-page booklet SFB giving detailed information on complete line of BUSS and FUSETRON Small Dimension fuses and fuseholders; used for protecting electronic equipment. *See ad page 71.*

16Q. *COMPONENTS SPECIALTIES* — 4-page catalog No. 62A "Universal Replacement Parts for Transistor Radios and Phonos," on complete line of replacement speakers, controls, earphones, subminiature electrolytics, ¼- and ½-watt resistors, etc.

17Q. *LITTELFUSE*—Fuse Guide No. FG-62, gives up-to-date information and cross-reference data for auto-radio fuses. *See ad 4th cover.*

18Q. *PERMA-POWER*—Latest *Britener* selector guide, showing the correct brightener to use with every type of picture tube in general use. *See ad page 62.*

19Q. *SPRAGUE*—Chart C-457 (designed to hang on wall) showing all popular TV-radio-hi-fi replacement components. *See ads pages 11, 12.*

20Q. *TEXAS CRYSTALS* — Catalog No. 962 listing Citizens-band, amateur, low-frequency, and radio-control crystals and sockets.

SERVICE AIDS

21Q. *BERNS*—Data on 3-in-1 picture-tube repair tools, on *Audio Pin-Plug Crimper* that lets you make pin-plug and ground connections for shielded cable without soldering, and on *ION* adjustable beam bender. *See ad page 85.*

22Q. *CASTLE*—Leaflet describing fast overhaul service on television tuners of all makes and models; also illustrated lists describing universal and original-equipment tuners. *See ad page 42.*

23Q. *ELECTRONIC CHEMICAL CORP.* — Catalog sheet describing *No Noise* line of servicing chemicals; gives specifications and prices. *See ad page 82.*

24Q. *PRECISION TUNER* — Information on repair and alignment service available for any TV tuner. *See ad page 84.*

25Q. *SWING LAMP CORP.*—Brochure and catalog sheets listing information and specifications for complete line of portable lamps for servicing and office use.

SPECIAL EQUIPMENT & SERVICES

26Q. *ACME*—Illustrated catalog sheet 24-BO1 giving specifications and listing applications for magnetic amplifiers for control uses requiring capacities from 5 to 1000 watts and voltage ranges from 24 to 160 volts. *See ad page 20.*

27Q. *ACTION SYSTEMS CO.*—Information describing complete line of intercommunication phones and systems; also complete line of paging systems.

28Q. *HARMAN-KARDON* — Information on *Troubador* all-transistor portable and mobile PA amplifiers; latest catalog on *Commander* series general-purpose amplifiers. *See ad page 67.*

29Q. *TERADO*—Catalog sheet describing line of converters, battery chargers, and relays. *See ad page 85.*

30Q. *VOCALINE* — Sheets giving specifications on various products, including intercoms, multiple-plug electrical outlets, and Citizens-band transceivers.

TECHNICAL PUBLICATIONS

31.Q *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics, including 1962 Book Catalog and descriptive flyer on 1962 Test Equipment Annual. *See ads pages 60, 65, 80.*

32Q. *RIDER* — 1962 Spring-Summer catalog describing over 200 books, nearly all of which are of interest to the service technician.

TEST EQUIPMENT

33Q. *B & K*—Catalog AP20-R, giving data and information on Model 850 *Color Analyst*, Model 960 *Transistor Radio Analyst*, Model 1076 *Television Analyst, Dynamatic 375 VTVM, V O Matic 360*, new Model 625 3-in-1 *Dyna-Tester*, Models 600 and 700 *Dyna-Quik* tube testers, Models 440 and 420 CRT Tester-Reactivators, and Model 1070 Dyna-Sweep Circuit Analyzer. *See ads pages 25, 36, 37.*

34Q. *HICKOK*—Form TT-627 describing new Model 661 *Chrom-Aligner* Generator for color TV. *See ad page 57.*

35Q. *RCA (PARTS & ACCESSORIES DIV.)* —Form TK-303 "Instructions for Color Test Jig", descriptive flyer on Color Test Jig TK-306, information on Color Accessories and Color Parts Rack TK-310, and Color Cross-Reference TK-331.

36Q. *SECO*—Catalog sheet and instruction manual detailing specifications and operational procedure of Model 520 Antenna Analyzer. *See ad page 63.*

37Q. *SENCORE*—New booklet, "How to Use the SS117 Sweep Circuit Troubleshooter," plus brochure on complete line of *Time-saver* instruments. *See ads pages 51, 53.*

TOOLS

38Q. *ENTERPRISE DEVELOPMENT CORP.*—Literature from Endeco on improved desoldering and resoldering techniques for use on PC boards. *See ad page 76.*

39Q. *EVERSOLE INDUSTRIES* — Sheets describing and listing prices on *DeSod* desoldering tools for removing and replacing parts on printed-circuit boards.

40Q. *XCELITE* — Bulletin N752 describing new compact Nut Driver set that contains 10 sizes with torque-amplifier handle. *See ad page 58.*

TUBES

41Q. *SYLVANIA*—Wall chart showing construction of typical color-TV picture tubes, utilizing cutaway diagrams in color. Principles described are applicable to color tubes being manufactured today. *See ad pages 40-41.*

This many picture tubes from one box?

YES!

Because RCA Universal Silverama® Picture Tubes Make Possible Multiple Replacements!

78 Universal Silveramas replace virtually every type on the market

Every time you open an RCA Universal Silverama Picture Tube carton, you get the equivalent of *many replacements*—not just one!

RCA—pioneer of the Universal Picture Tube concept—has today achieved the greatest simplification of picture tube types.

First in the RCA Universal series—the 21CBP4A that replaces 19 industry types . . . or just about 25% of your replacement needs.

Next in the series, a family of four Universal Picture Tubes (the 21CBP4A, 21AMP4A, 21ZP4B, and 21YP4A) to replace 33 industry types—about half your replacement needs.

Every RCA Universal Silverama Picture Tube is made with an all-new electron gun, the finest parts and materials, and a glass envelope which, prior to reuse, has been thoroughly inspected, cleaned, and rescreened.

Now, 78 Universal Silveramas to replace 291 industry types—covering nearly any picture tube need. This makes for an inventory simple enough that your RCA Distributor can easily keep a full stock. For you this means no more lost time hunting high and low for special, unusual, or infrequently-used types.

The whole story is conveniently set out for you in a handy slide-guide. Simply look up the Universal Silverama type you want and the guide shows you all the standard types it replaces. In addition, look up the industry type you find in your customer's set, and the guide shows you its RCA Universal counterpart. Be sure to get a Silverama slide-guide from your Authorized RCA Silverama Distributor.

RCA ELECTRON TUBE DIVISION, HARRISON, N. J.

RCA® **The Most Trusted Name in Television**

FASTER THAN A SHORT CIRCUIT

SUB-MINIATURE MICROFUSES

and microfuse holders
for internal connection
and panel mounting.

1/500 AMP. thru 5 AMPS.
@ 125 volts. Will
interrupt 10,000 AMPS.
DC short circuit.

8AG INSTRUMENT FUSES

1/500 AMP. thru 5 AMPS.

For instrument and meter protection, Littelfuse pioneered the design and development of reliable fast-acting fuses.

LITTELFUSE

Des Plaines, Illinois