FEBRUARY, 1959 35 CENTS

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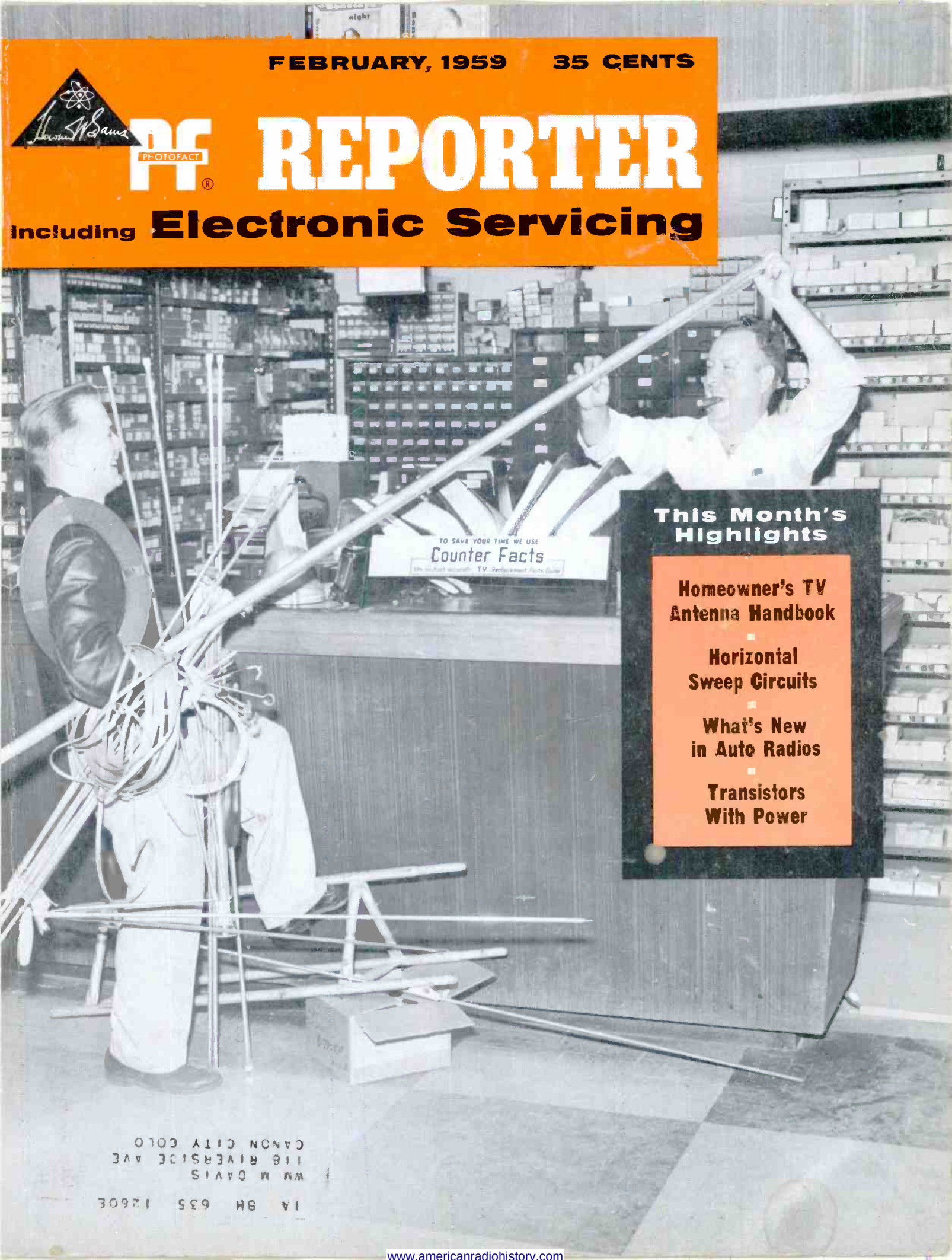

This Month's Highlights

- Homeowner's TV Antenna Handbook
- Horizontal Sweep Circuits
- What's New in Auto Radios
- Transistors With Power

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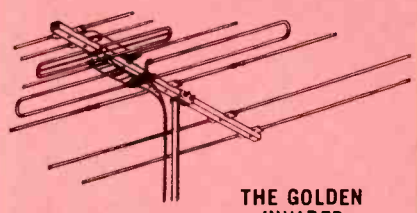

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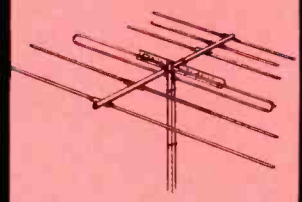

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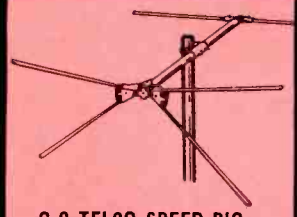

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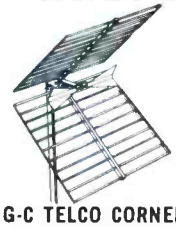

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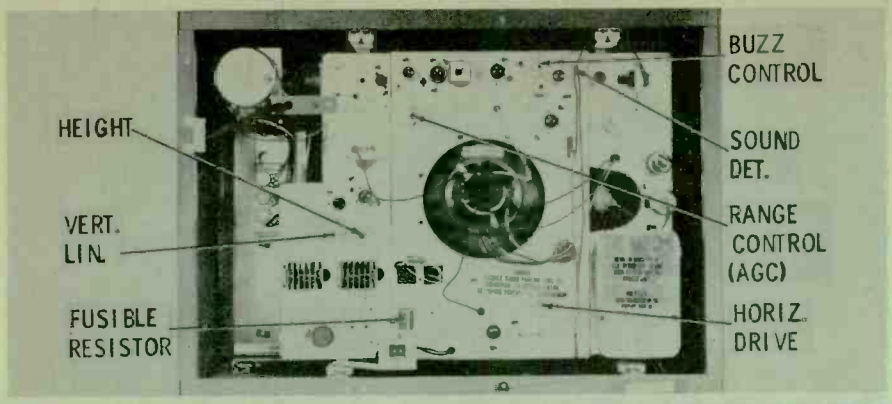
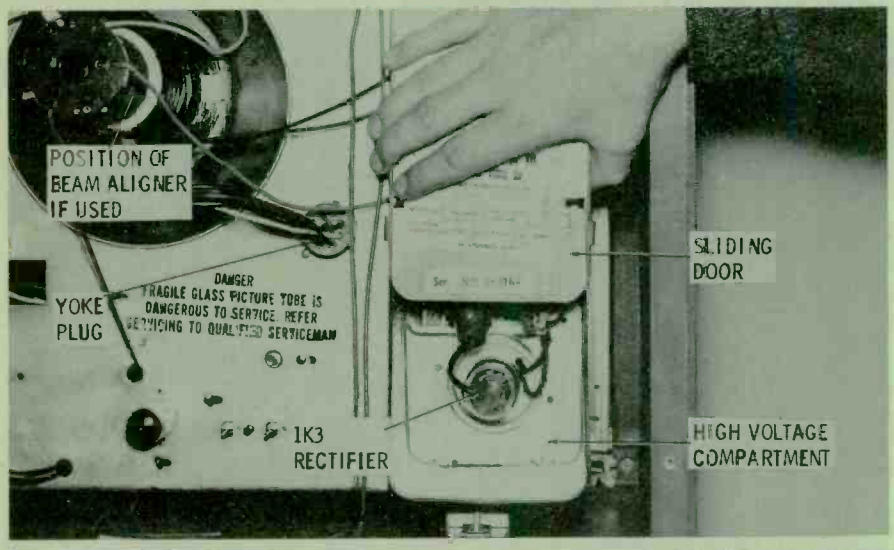
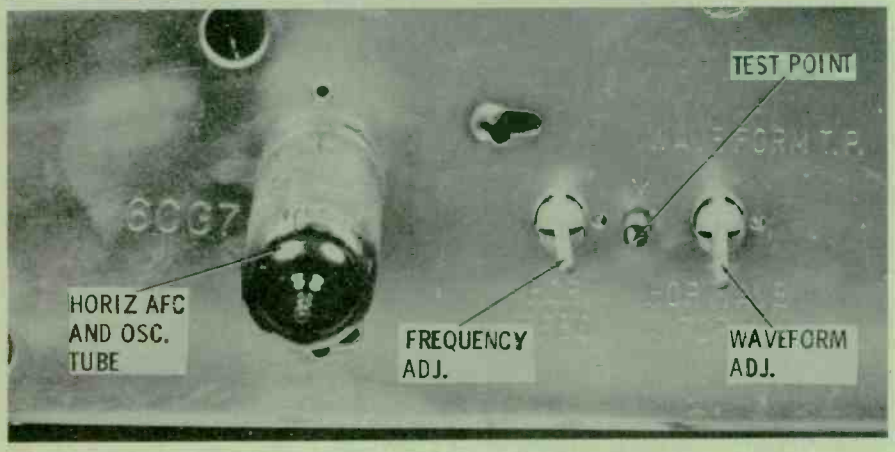
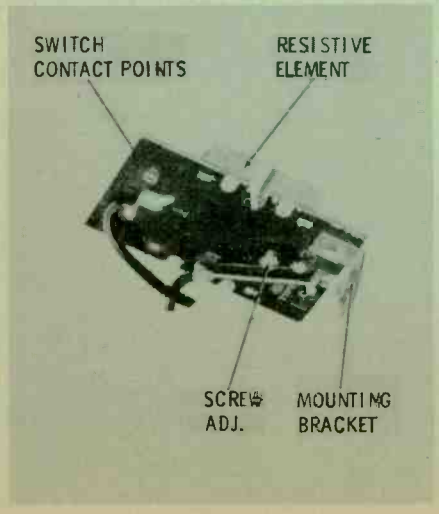
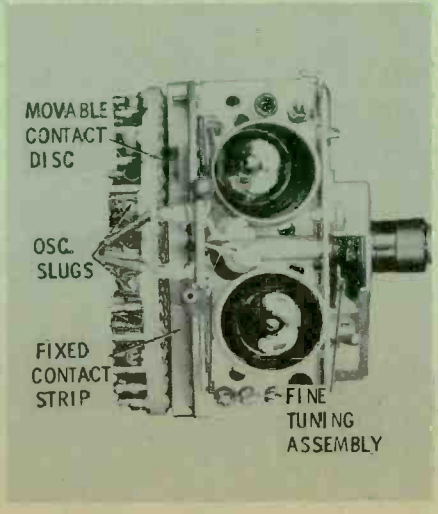
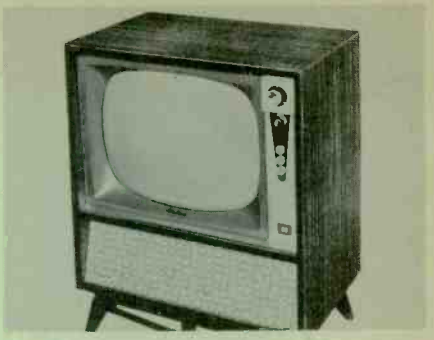












Airline Model WG-5062B

Here's a new 21" console with VHF tuning, dual front speakers, and vertically-mounted chassis. The "hot" chassis, powered by two selenium rectifiers, is well spread out and conventionally wired. All tubes of the series string are easily accessible, including the 10DE7 vertical oscillator-output. 3DK6's are found in the IF's, while the video detector stage employs a crystal diode. The plug-in fusible resistor shown has a value of 7.5 ohms, and protects components in the B+ circuit against heavy-current damage.

The 1K3 high-voltage rectifier is housed in a shielded compartment with the flyback transformer. The door of the compartment merely slides upward as shown. A 90° yoke plugs into the chassis pan just left of the high-voltage cage and is supported only by a clamp on the neck of the CRT. A *beam aligner* resembling an ion trap is used in some models of this line. This device fits over the neck of the picture tube and aids in focusing the beam.

In the lower right section of the chassis, you'll find the adjustments for the horizontal AFC system. Instead of a single coil form with adjustments at both ends, the frequency and waveform coils are mounted separately and are accessible from the back of the set. When it becomes necessary to adjust the waveform coil, an oscilloscope should be used. As standard procedure, the combination saw- and sine-wave should have peaks of equal amplitude with the picture in sync. For convenience, a scope test point is brought out through a 10K-ohm series resistor between the two coils as shown.

The strange-looking device pictured in the closeup is known as a *Tube Saver*. Located on the chassis above the fusible resistor, it controls warmup of the series string tubes and automatically times the application of B+ to the receiver. The unit is essentially a resistive element that actuates a thermal-type switch. A small screw is provided for delay adjustment of the switch, but this is set at the factory and should not be disturbed.

This receiver uses one of the relatively new *Fireball* Standard Coil tuners. Telescoping-type shields are employed on both the 2BN4 RF amplifier and 5CG8 converter tubes. To adjust the oscillator slug for each channel, the chassis must be removed from the cabinet. A single hole is provided in the tuner cover (not shown).

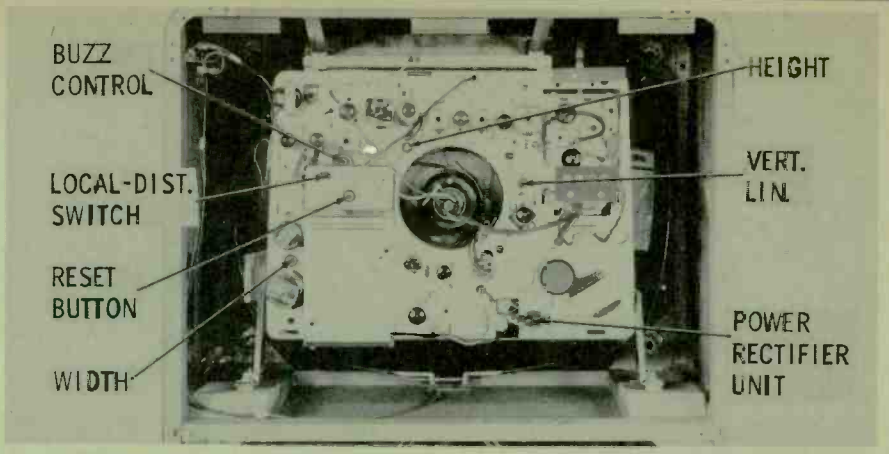
DuMont "Northfield 21" Chassis RA 502

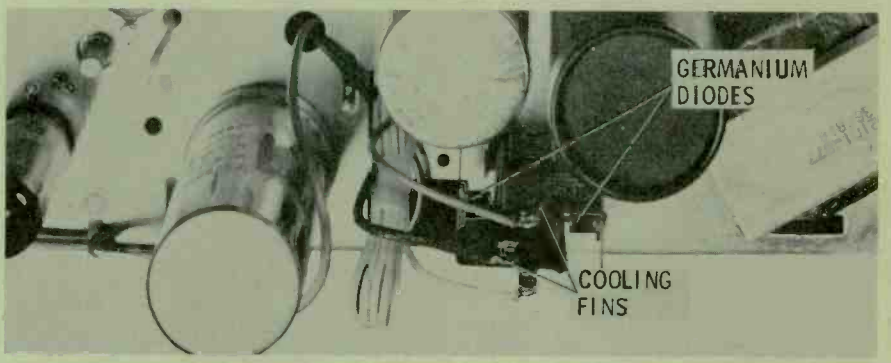
Operating controls for this 21" console are positioned on top of the wooden cabinet and extend upward from a single-pan vertical chassis. The "hot" chassis, having series-string tubes, is hand-wired and drives a 21DAP4, 110° picture tube. One of the latest tube types employed is a 5CZ5 in the vertical multivibrator-output section. Following the three-stage IF strip, you'll find a crystal diode employed in the video detector circuit. The red push button located on a small panel above the high-voltage cage is the manual reset for a circuit breaker in the power supply. This device does not protect the tube filaments, however, and all tubes will light even with the breaker open. The series filament circuit connects directly to the AC input through a 50-ohm, 25-watt resistor.

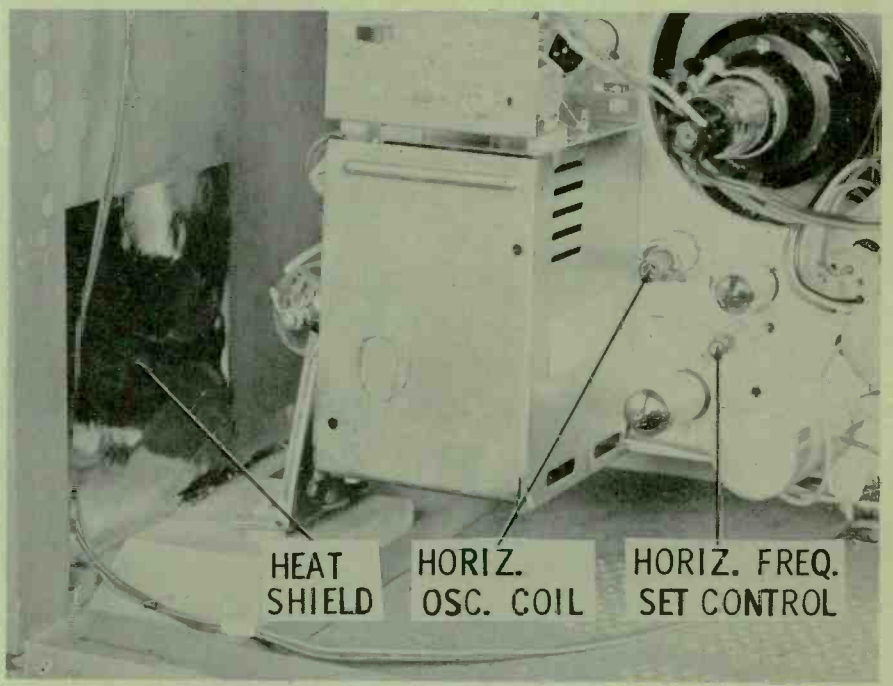
Taking a closer peek at the power rectifier unit, you'll discover that the two germanium diodes are mounted on a strip of metal for efficient heat dissipation. The unit is all one piece and snaps into two small cutouts in the chassis. For replacement, merely unsolder the three exposed leads, plug in the new unit, and reconnect in the circuit. Besides a circuit breaker, the B+ supply also has a 12-ohm, 20-watt series resistor located on the wiring side of the chassis.

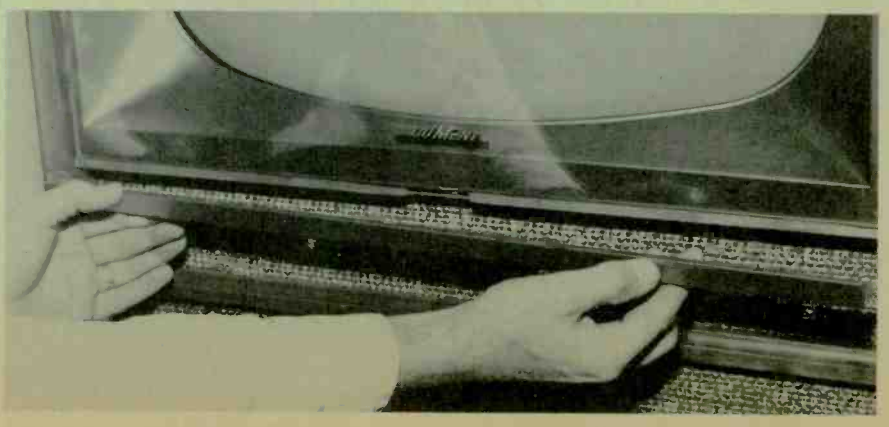
The *horizontal frequency set* is a coarse adjustment electrically in series with the hold control. The horizontal oscillator or ringing coil is beside the high-voltage cage and requires a hex-ended tool for adjustment. The piece of metal foil inside the cabinet is not part of a built-in antenna system. It shields the cabinet from heat radiated by the horizontal output tube, which is positioned fairly close to the veneer at this point.

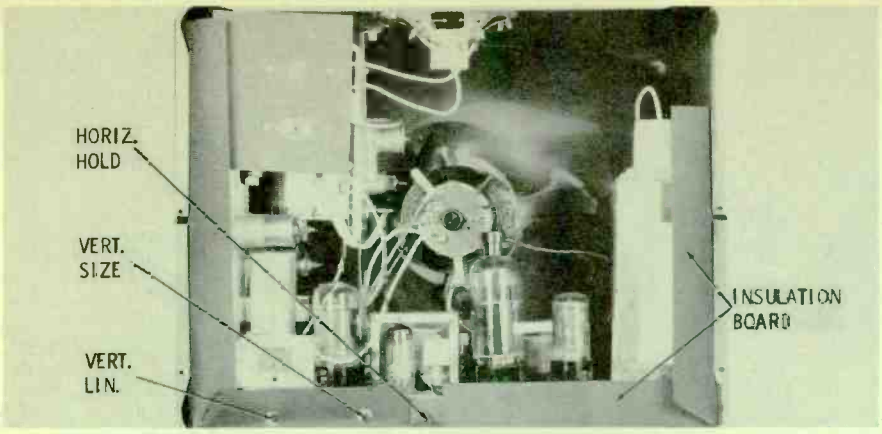
The safety glass for this model can be cleaned from the front by removing four wood screws under the bottom trim strip. The strip comes off as shown, and the glass can be pulled forward at the bottom, then down and lifted out. After removal of channel-selector and fine-tuning knobs, tuner-oscillator slugs are accessible through a hole at the front of the tuner housing. Set the fine tuning so that the flat side of its shaft faces toward the side of the cabinet. Using an insulated alignment tool, adjust each oscillator screw for best picture and sound.

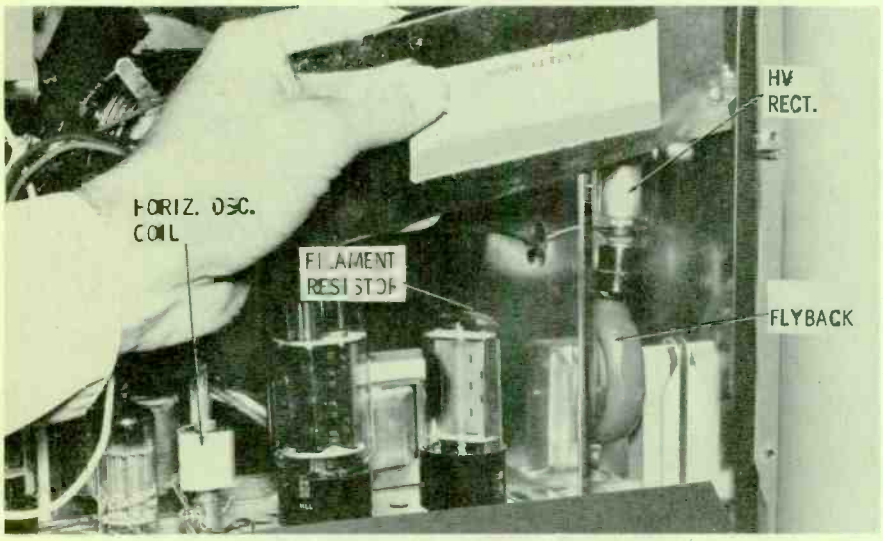


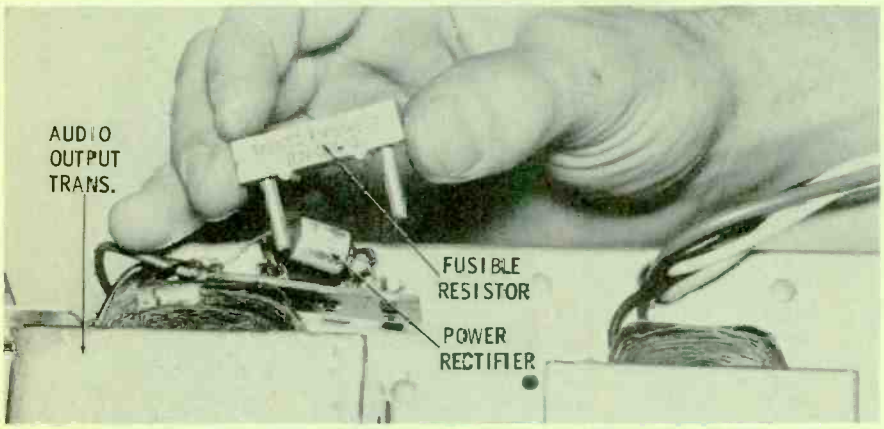












Muntz Model 17PS Chassis "J"

This new portable, clad in a three-piece metal cabinet, has all its operating controls grouped inside a large channel-selector knob. Although the chassis is a complete assembly, it has two major sections — one mounted vertically along the side of the cabinet, and the other horizontally across the bottom. Of the three service controls on the rear of the set, two are screwdriver adjustments — vertical size and linearity. Since the chassis is connected to one side of the AC line, the manufacturer has placed insulation between the chassis frame and the metal cabinet. When servicing the instrument, take care that all insulators are intact before returning it to the customer.

Opening the back door of the high voltage cage by sliding it to one side as shown, you can gain access to the 1K3 rectifier. This tube mounts upside down, and since its plate cap comes so close to the flyback, a taller tube such as a 1B3 cannot be used as a substitute. A 36-ohm, 15-watt resistor, located directly behind the high-voltage compartment, is connected in series with the filament string. If it opens, all tubes will fail to light.

A single silicon rectifier powers the 11-tube chassis, which in turn drives one of the newer short-neck, 90° picture tubes. Two crystal diodes are employed in the sound discriminator stage, and a 5BW8 serves both IF and horizontal AFC circuits. A 5-ohm fusible resistor, protecting the B+ circuitry, plugs into a terminal board on top of the chassis just behind the audio output transformer. One of the latest features in this chassis is the new Sarkes Tarzian *Hot Rod* tuner. The housing of the turret-type unit measures only 2½" x 3½" x 2", and the circuit makes use of a 2CY5 RF amplifier and 5CG8 converter.

To disassemble the receiver for bench servicing, remove four small Phillips-head screws holding the control escutcheon in the middle of the channel knob. Pull off all control knobs and remove the back of the set. Next, remove the yoke clamp and leads to picture tube and speaker. Remove the seven Phillips-head screws securing the top half of the cabinet and lift off as shown. Take out the four bottom chassis bolts and remove the chassis and yoke assembly from the rear of the cabinet. The face of the picture tube and the safety glass can be cleaned by removing the CRT from the cabinet.

V-M Model 571

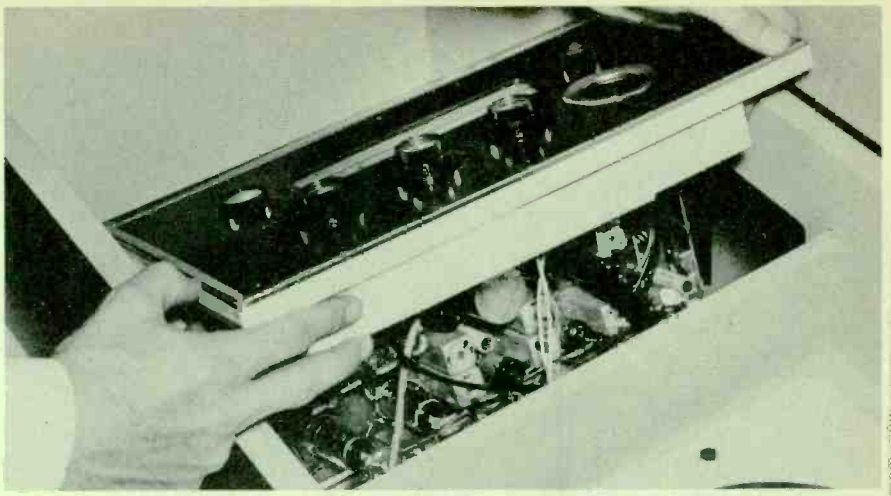
This new combination hi-fi features an AM-FM tuner, four-speed automatic record changer, separate amplifier chassis, and three permanent magnet speakers. Raising the top lid of the cabinet, you'll find a record storage compartment on the left, the tuner panel in the center, and a Model 1201 record changer on the right. On the changer baseplate under the tone arm, you'll notice a two-position slide switch marked "M" and "S." This is a monaural-stereo switch for playing either type recording. Although the instrument comes with a monaural pickup, the tone arm is equipped for a stereo cartridge and may be used in conjunction with an auxiliary amplifier and speaker system.

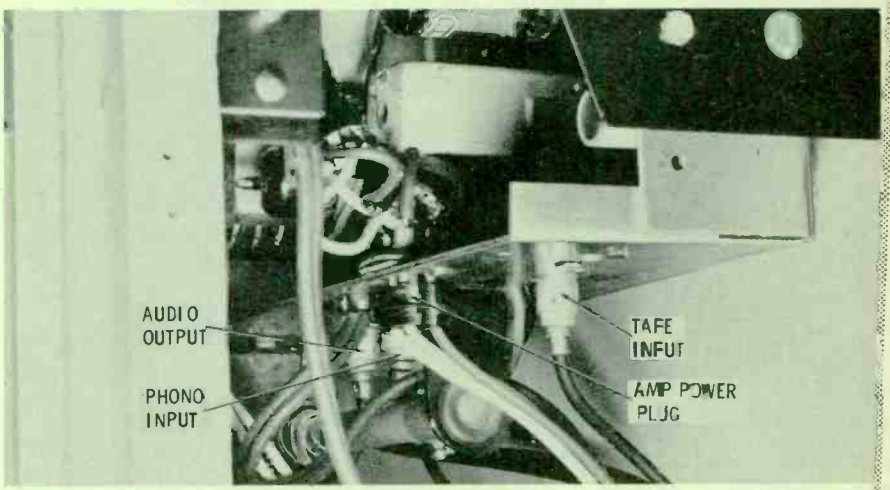
The tuner chassis, built on a single printed wiring board, incorporates seven tubes, including a ECC85/6AQ8 in the FM RF section. Powered by a selenium rectifier, yet isolated from the line, the tuner chassis is not too easily reached from the rear of the cabinet. To change tubes or work on the chassis, it must be lifted out from the top as shown. The deep recess in the control panel is for storing a 45-rpm spindle which can be used with the automatic changer.

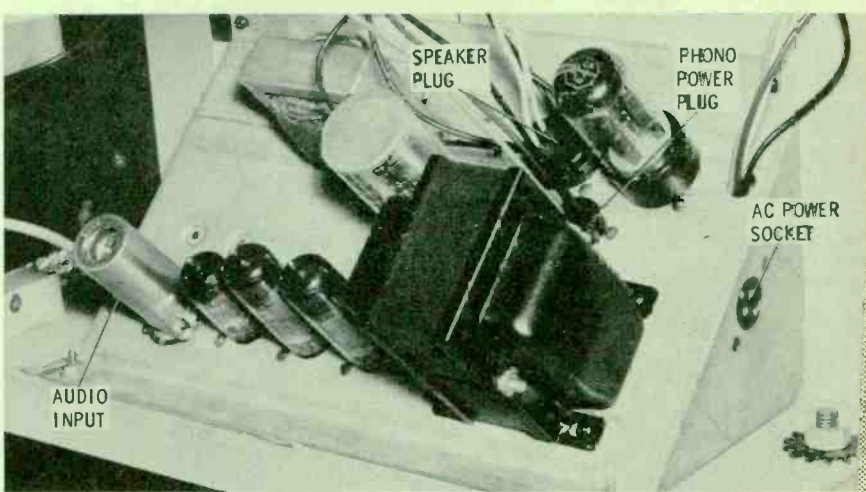
To free the chassis for removal, unplug the cables and free the other connecting leads from their cabinet retainers. The tuner is mounted in a very narrow center compartment, but leads and plugs can be reached by merely removing a small interlock panel from the back of the set. After removing two Phillips-head wood screws from each side of the control panel, the tuner chassis and panel can be lifted out from the top.

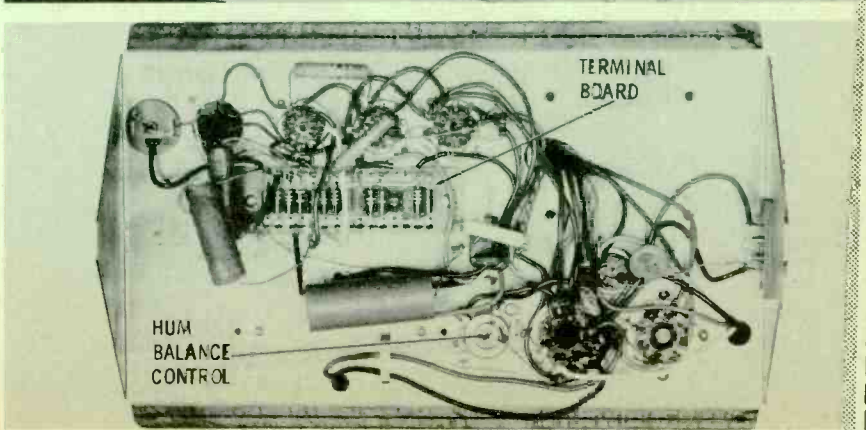
The 5-tube amplifier chassis mounts in the lower right corner of the cabinet and has a somewhat triangular shape. Transformer - powered, and using a 5Y3GT rectifier, the chassis employs a 6AU6 pre-amp, two ECC83/12AX7's, and a pair of 6BQ5's in a push-pull output circuit.

On the wiring side of the amplifier, you'll find a terminal board riveted to the chassis with a number of components neatly fastened to it. The hum-balance control is adjustable from either top or bottom of the chassis. The amplifier drives a speaker system consisting of a 12" woofer, an 8" mid-range unit, and a 3½" tweeter. Speaker connections are coded by a dot system for proper phasing.









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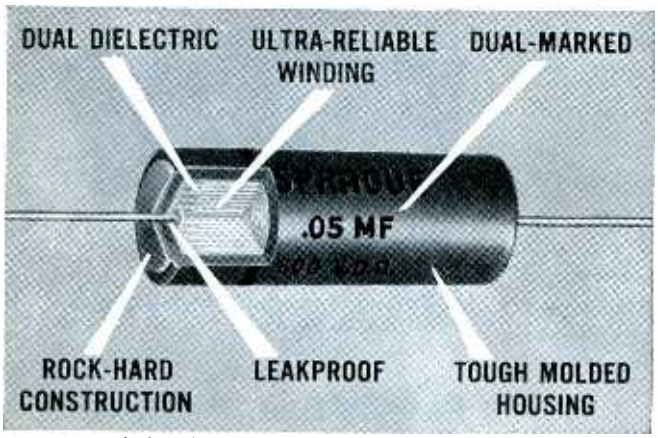

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VOLUME 9, NO. 2 FEBRUARY, 1959

CONTENTS

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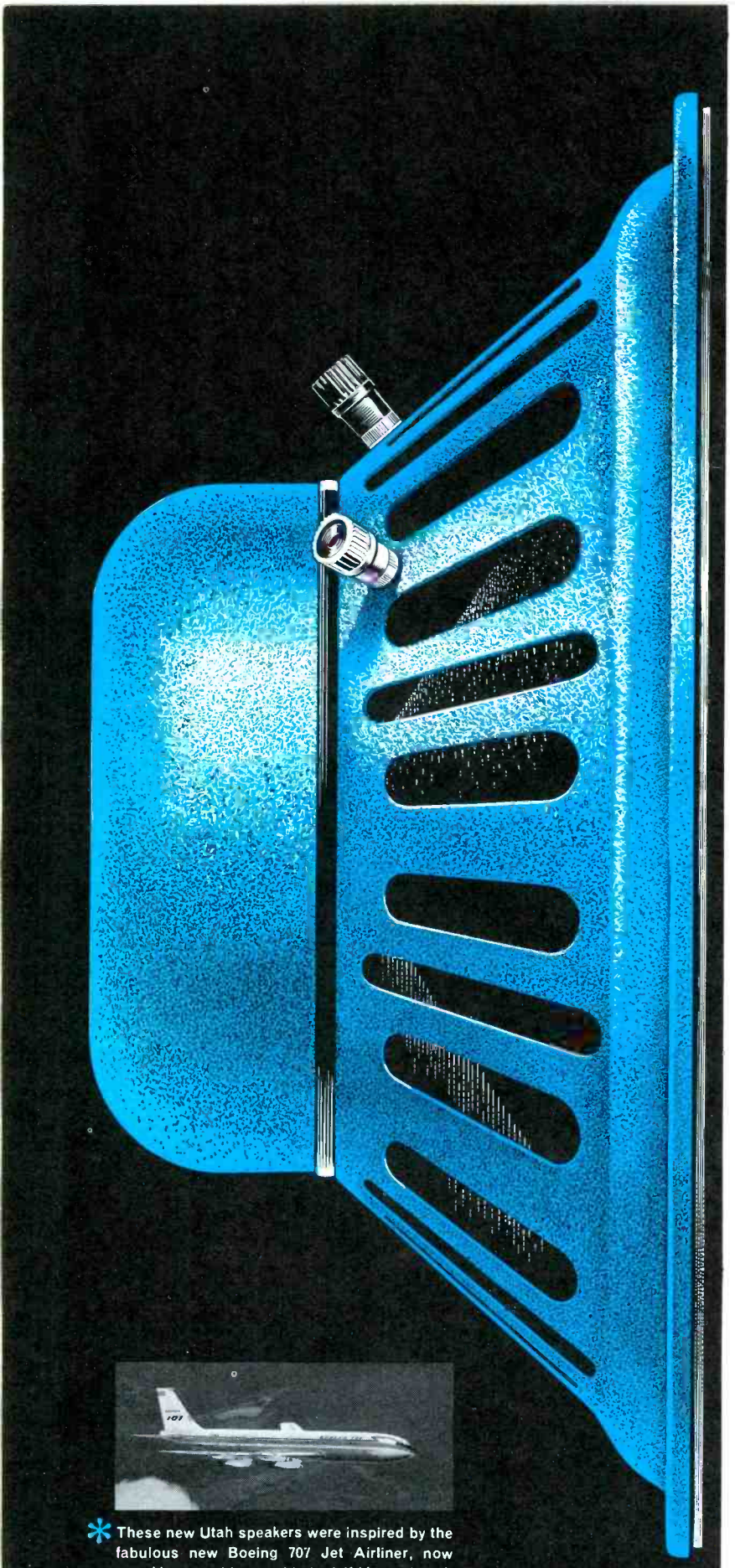

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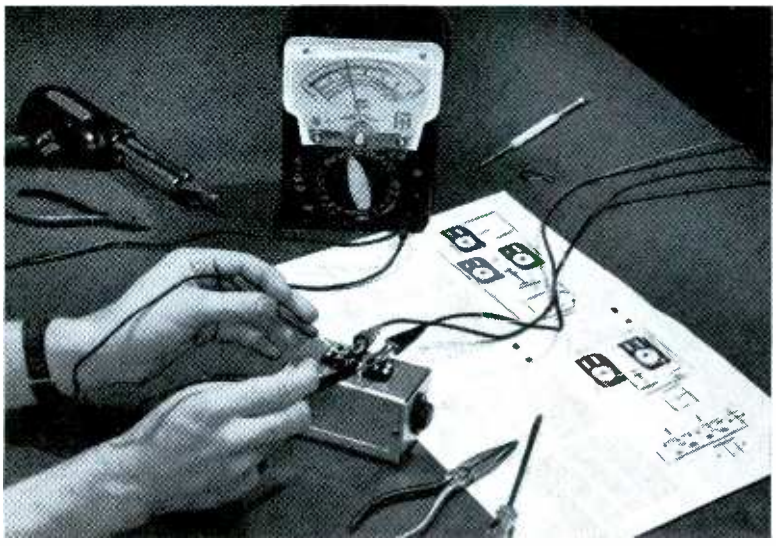

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- Ten intensive lessons (with 3-ring binder) . . . up-to-date, complete
- Simplified basic theory . . . how transistors work
- Practical experiments and servicing techniques for:

Amplifiers . . . applications in all fundamental circuits
Oscillators . . . a-f, r-f, relaxation, multivibrator, special TV
Rectifiers . . . diode and transistor rectifiers and detectors
TV deflection circuits . . . and Eccles-Jordan Trigger circuits
Practical commercial applications . . . immediate and future

HOW TO GET IT

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Advancement opportunities await service-dealers, engineers and technicians who know about basic transistor fundamentals. The newly revised and expanded edition of this popular and economical Transistor Course can help you too. A CBS-Hytron first, it was especially written and illustrated by A. C. W. Saunders, well-known educator and author, to make it easy for you to learn about transistors by *using* them. What you learn you can be sure you will remember . . . by making for yourself the practical transistor devices described. Check the expanded features. Read how easy it is to start your fast, fascinating Transistor Course.

CBS-HYTRON, Danvers, Mass.
A Division of Columbia Broadcasting System, Inc.

one of these Electro-Voice microphones will meet your needs best

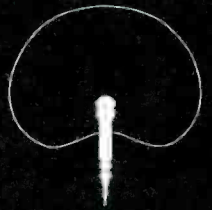
CHOOSE FROM THE WORLD'S MOST COMPLETE LINE: ELECTRO-VOICE THE CHOICE OF PROFESSIONALS

Whatever your microphone problem, Electro-Voice has the solution. Because only Electro-Voice offers you such a wide selection to choose from, and only Electro-Voice has spent years of painstaking research to bring you microphones which rate BEST in every category.

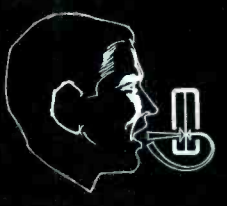
Choose from carbon, crystal, ceramic or dynamic E-V microphones; choose any pick-up pattern: non-directional, cardiod, or differential Electro-Voice has them all. Look at this chart . . . and choose the BEST. And, for detailed information regarding special applications, write

INC., BUCHANAN, MICHIGAN, DEPT. PP-2

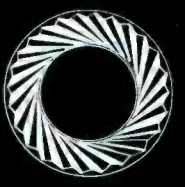
NONDIRECTIONAL MICROPHONES pick up sound equally well from all directions. In this diagram of a pick-up pattern, the omnidirectional microphone is in the center. Diagrams of pick-up patterns are often called polar patterns.



CARDIOID (UNIDIRECTIONAL) MICROPHONES, so named because their polar pattern is heart-shaped, pick up sound arriving at the front and reject sound arriving at the back. Proper placement of cardioid microphones reduces pick-up of ambient noise and echoes, minimizes risk of feedback.



DIFFERENTIAL MICROPHONES have a noise-cancelling pick-up pattern. Sound waves originating from a point more than a few inches away from the microphone enter *both* sides of the case at the same time and cancel each other. When sound source is close to microphone, the sound waves do not cancel. Differential microphones are ideal for use in areas of high surrounding noise.



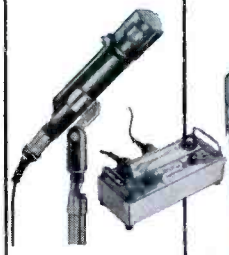
ACOUSTALLOY DIAPHRAGM IN ALL DYNAMIC MICROPHONES. Acoustalloy—the virtually indestructible diaphragm material—gives peak-free response, prevents popping as commonly experienced by explosive syllables "B" and "P" in ribbon-type microphones. Because Acoustalloy gives improved response, operators can work with confidence under rigorous program conditions.

ELECTRO-VOICE MICROPHONES FOR EVERY PURPOSE

MODEL NUMBER	667	666	665	655C	654	649A	646	635	664	636	630	647	623	611	605	615	911	926	920	715	727	924	912	951	622SKK	625SKK	606	648	600D	600TR	602	602TR	210KK	205KK	205STCKK
PICKUP PATTERN	◡	◡	◡	○	○	○	○	○	◡	○	○	○	○	○	○	○	○	○	○	○	○	○	○	◡	○	D	D	○	○	○	D	D	○	D	D
BROADCAST—TV																																			
Telecast	●	●	●	●	●	●	●																												
Studio	●	●	●	●	●	●	●	●	●			●																							
Remote		●	●	●	●	●	●	●	●	●	●	●	●															●							
PUBLIC ADDRESS																																			
Auditorium	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●		●											
Outdoor		●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	●		●					●		●				
High noise																										●	●									
Mobile																●														●	●					
Broad Coverage—Stage	●	●	●	●	●				●	●	●													●											
Localized—Stage	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●											
Paging									●	●	●		●	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●				
Church Pulpit		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●				●							
COMMUNICATIONS																																			
Railroad																																			
Emergency—Fixed									●	●	●		●	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●	●		
Emergency—Mobile																				●					●	●	●		●	●	●	●	●		
Marine															●	●					●				●	●	●	●	●	●	●	●	●	●	●
Aircraft—Ground Station									●	●	●		●		●										●	●	●	●	●	●					
Aircraft—Airborne																															●	●			
Bus, taxi—Mobile																																	●	●	●
Inter-Communication										●	●		●	●	●	●	●	●	●	●	●			●	●	●		●		●	●	●	●		
Amateur—Fixed									●	●	●		●	●	●	●	●	●	●	●	●		●	●	●			●		●					
Amateur—Mobile																●				●	●								●		●	●	●	●	●
RECORDING																									●	●									
Studio Recording	●	●	●	●	●			●	●																										
Disc—Professional	●	●	●	●	●			●	●																										
Tape—Professional	●	●	●	●	●			●	●																										
Tape—Home									●	●	●		●	●	●	●	●	●	●	●	●		●	●											
DICTATING MACHINES																●				●	●		●												
SOUND LEVEL MEASUREMENT				●	●			●		●	●														●				●						
GENERATING ELEMENT																																			
Dynamic	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●									●	●	●	●	●	●	●	●			
Crystal																	●	●	●			●	●	●											
Ceramic																				●	●														
Carbon																																	●	●	●

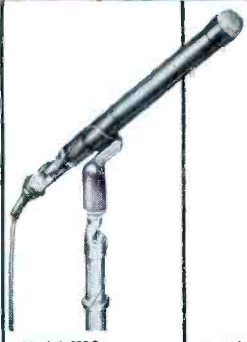
BROADCAST AND TV MICROPHONES

Model 666
Dynamic, Cardioid
Rejects unwanted sound—doubles the working distance—wide range. Floor or desk stand and boom mount available.



Model 667
Dynamic, Cardioid
Variable response—low noise—transistorized—shockproof. Controls compensate for varied acoustic conditions found in TV, broadcast, recording.

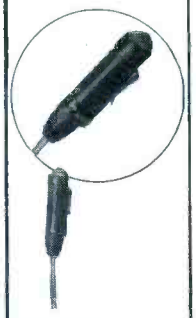
Model 665
Dynamic, Cardioid
Economical—high value—top performance. Similar to 666 but designed for less exacting conditions.



Model 655C
Dynamic, Nondirectional
Widest range—to 22KC for TV, broadcast and recording. Can be hand-held or mounted on floor or desk stand.

Model 654
Dynamic, Nondirectional
Similar to 655C except designed for all-around use; economical.

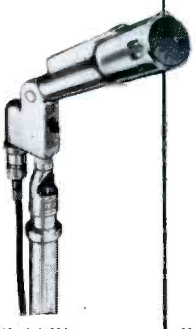
Model 646
Dynamic, Nondirectional
Compact lavalier for chest, desk or hand use. Designed for broadcast, TV or PA use.



Model 649A
Dynamic, Nondirectional
Exceptionally small highest quality lavalier that can be easily concealed anywhere for chest or hand use.

Model 635
Dynamic, Nondirectional
For TV, broadcast, recording; ideal for remote use—rugged. May be hand held or mounted on desk or floor stand.

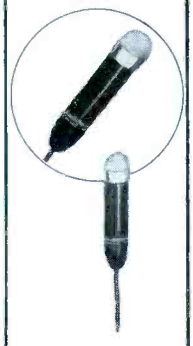
PUBLIC ADDRESS, RECORDING AND GENERAL PURPOSE MICROPHONES



Model 664
Dynamic, Cardioid
Designed for rugged use in any PA, recording or communications situation. Doubles working distance—minimizes feedback.

Model 636
Dynamic, Nondirectional
World's finest for wide range PA, recording and general purpose. Slim style does not hide entertainer.

Model 630
Dynamic, Nondirectional
Favorite for years in PA, with recording, amateurs and broadcast applications.

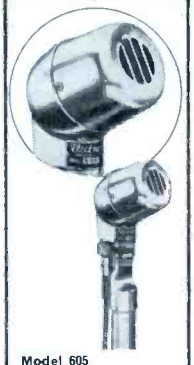


Model 647
Dynamic, Nondirectional
A versatile PA lavalier for chest, desk or hand use, indoors or outdoors.

Model 623
Dynamic, Nondirectional
Handsome modern styling. Designed for PA general use or recording.

Model 611
Dynamic, Nondirectional
Offers fine performance for general sound pick-up, PA, recording and amateur uses.

Model 911
Crystal, Nondirectional
For economical PA, home recorders, amateur uses. Desk or floor stand mounting.



Model 605
Dynamic, Nondirectional
A small, convenient microphone for PA, general purpose, or paging. Desk or floor stand mount.

Model 615
Dynamic, Nondirectional
An inexpensive, PA and general purpose microphone for hand, desk or stand mounting.

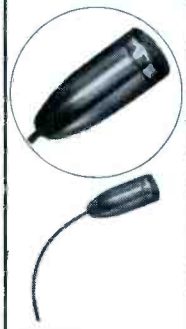
Model 715
Ceramic, Nondirectional
An inexpensive microphone for general PA, home recording and amateur uses. Hand held, or mounted on desk or floor stand.

Model 951
Crystal, Cardioid
For widest variety of PA, general purpose and amateur uses. Increases working distance—retards feedback.

Model 926
Crystal, Nondirectional
Excellent for PA, general purpose, paging, home recording and amateur use.

Model 920
Crystal, Nondirectional
All direction pickup for conferences, discussions, home recording and PA.

Model 727
Ceramic, Nondirectional
Designed for PA, paging, recording and amateur uses. Hand held, desk or stand mounted.

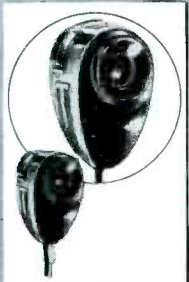


Model 924
Crystal, Nondirectional
Small lavalier for chest or hand use, home recording, PA and amateur applications.

Model 912
Crystal, Nondirectional
An inexpensive microphone for general PA, home recording and amateur uses. Hand held.

Model 718
Ceramic, Nondirectional
Suitable for paging, home recording and amateur use. Can be hand held or desk mounted.

COMMUNICATION MICROPHONES



Model 210KK
Carbon, Nondirectional
Single button microphone for general replacement and amateurs.

Model 600D
Dynamic, Nondirectional
A rugged mobile microphone. Offers flat response and light weight.

Model 205KK
Carbon, Differential
Noise cancelling close talking microphone for Private Aircraft or any noisy vehicle. Discriminates against all noise from any direction.

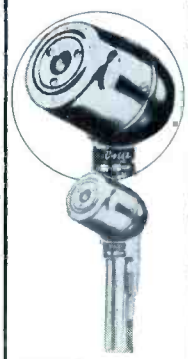
Model 205STCKK
Carbon, Differential
A noise cancelling microphone for commercial aircraft. Has CAA type certificate 1040.

Model 602
Dynamic, Differential
Noise cancelling, hand held, microphone for mobile or fixed station use.

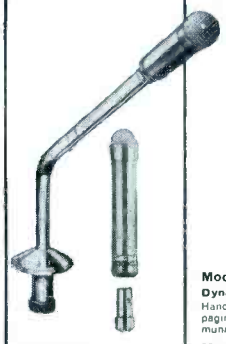
Model 600TR
Dynamic, Nondirectional
Same as 600D but has built-in transistor amplifier. Works in carbon microphone input to give high quality sound.

Model 602TR
Dynamic, Nondirectional
Same as 602 but has built-in transistor amplifier. Works in carbon microphone input.

SPECIAL PURPOSE MICROPHONES



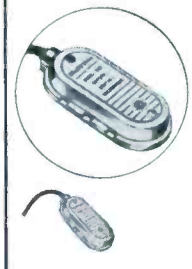
Model 606
Dynamic, Differential
Noise cancelling microphone for stand use under high ambient noise.



Model 648
Dynamic, Nondirectional
For intercom, paging or PA. Mount on stand, boom, goosenecker Model 448 boom.

Model 622SKK
Dynamic, Nondirectional
Handset type microphone for paging, intercom and communications uses.

Model 625SKK
Dynamic, Differential
Noise cancelling handset for use under high noise conditions.



Model 805
Crystal, Contact
Mounts directly on body of guitar, banjo, mandolin, violin or any vibrating musical instrument.

Independent TV-Radio Service Dealers:

Here are a few of the reasons why the Raytheon Senior Tube Case is tops:

- 226 Tube Capacity — Perfect for Everyday Servicing
- Removable Tool Box Unit
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- Cover for Miniature Tube Section
- Solid Wood, Locked Corner Construction
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- Reinforced Stress Points
- Modern Airplane-Luggage Styling

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RAYTHEON TUBE CASE COMBINATIONS!

Your choice of any two of the Raytheon home servicing items shown, *plus a genuine Raytheon Senior Tube Case* (SP-Q-7645) — that's the special home servicing combination offered to you by your Raytheon Tube Distributor. And he's making it very easy for you to obtain these useful kits.

Take advantage of this excellent opportunity to equip your technicians and improve your home servicing efficiency: Call your Raytheon Tube Distributor and make arrangements to outfit every man in your shop. There'll never be a better time than now.

TV CUSHION (SP-Q-7639)

A foam plastic cushion faced with flexible Vinyl for longer life. Won't slip, ideal safeguard against marring TV case, floor, furniture.

DROP CLOTH (SP-Q-7542)

Protect your customers' floors and furniture when repairing TV sets in their homes.

SCREW DRIVER SET (SP-Q-7518)

Four-in-one Screw Driver Set. 4 blades — two sizes of standard heads, 1 Phillips head and 1 Punch. Interchangeable in quick adjusting, firm grasping chuck.

TRUCK DECAL (SP-Q-7587)

A heavy duty, outdoor type decal ideal for trucks, doors or panels.

BALL POINT PEN AND PENCIL SET (SP-Q-7634)

A slim-line-styled pen with new push-top retractable action and a matching mechanical pencil.

TV SCREEN POLISHING CLOTH (SP-Q-7617)

Chemically treated to clean dust and dirt with a quick swipe over face of TV screen.

Letters to the EDITOR

Dear Editor:

If you plan to make reprints of the chart on page 28 of the December issue, I would appreciate a copy for my tube caddy.

FRANK J. BELLONE

New York, N. Y.

Dear Editor:

Will extra copies of the *Cross Reference Guide on Fusible Resistors* (December issue) be available? This chart would be handy to have in my caddy, but I don't like to cut up my copy of PF REPORTER.

W. J. TIERNEY, JR.

Pawtucket, R. I.

Can do! If you'd like a free copy of this handy guide to fusible resistors, printed on card stock, just drop us a line. —Ed.

Dear Editor:

Enclosed is one of my business cards. Like Mr. Bond's in the December *Letters* column, it carries the wording, "Have Tubes—Will Travel." I've been using this slogan for quite some time.

ORVILLE TAFT

Morgantown, W. Va.

Dear Editor:

I have had business cards imprinted with "Have Tools—Will Travel" for over a year, and have also run an ad in the local paper with the same wording.

A. T. BESWICK

West Haven, Conn.

We decline to referee any disputes as to who's fastest on the "draw!"—Ed.

Dear Editor:

I thoroughly enjoyed Stan Prentiss' interesting and enlightening article on the RCA KCS47 chassis, and also the one on the split-chassis Philco set. However, I noticed that a certain peculiarity of the KCS47 design wasn't mentioned. Nearly all sets of this breed reaching our bench for the first time need repairs to the long, long damper filament wiring. These wires are the source of much intermittent horizontal instability, flashing or arcing interference in the picture, and miscellaneous nuisance-type troubles. Defects are seldom serious enough to cause complete failure of the set, but as the insulation deteriorates with age, arcing usually occurs at points where the wire is tucked under hold-down clamps, or where it passes through holes in the chassis.

We have observed many crude attempts at taping and patching ragged places on these wires. Damper wiring trouble apparently is often recognized but seldom correctly fixed. In most cases, a simple and trouble-free solution is to slip flexible vinyl plastic tubing (¼" inside diameter) over the wires. Unsolder all leads in the damper filament circuit (this is most

• *Please turn to page 22*

SAVE 1/2 THE TIME

in TV Trouble-Shooting

Make Twice The Profit!

THIS EASY
SIGNAL INJECTION
POINT-TO-POINT
DIRECT VIEWING
WAY—

MODEL 1075

B&K TELEVISION ANALYST

New Technique Makes TV Servicing Easier, Faster, More Profitable

Thousands of service technicians already save thousands of hours every day with the amazing B&K TELEVISION ANALYST. Enables you to inject your own TV signal at any point and watch the resulting test pattern on the picture tube itself. Makes it quick and easy to isolate, pin-point, and correct TV trouble in any stage throughout the video, audio, r.f., i.f., sync, and sweep sections of black & white and color television sets—*including intermittents.* Makes external scope or wave-form interpretation unnecessary. Enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, and make more money.

MODEL 1075 TELEVISION ANALYST. Complete with standard test pattern, white dot, and white line crosshatch pattern slide transparencies, and one clear acetate. Net, **$259.95**

See your B&K Distributor or Write for Bulletin ST21-R

R.F. AMPLIFIER
Complete r.f. signal at all VHF channels. Isolates tuner trouble to the r.f. amplifier, converter, or to the r.f. oscillator stage.

4.5 MC AUDIO I.F.
Provides FM modulated 4.5 mc sound channel. This audio carrier is modulated from the built-in 400 cycle tone generator.

AUDIO AMPLIFIER AND AUDIO OUTPUT
Injection of 400 cycle tone signal simplifies trouble-shooting this section. Isolates the defect instantly.

CONVERTER

1st, 2nd, 3rd I.F.
Signals available at 20 mc and 40 mc i.f. Checks A.G.C. action. Isolates trouble to individual defective stage, i.f. transformer, or other component.

VIDEO DET.
VIDEO AMP.
Reproduces test pattern on picture tube. Injects signals into video detector or video amplifier stage of TV receiver for fast, visual trouble-shooting and correction. Makes it easy to check bandwidth, resolution, shading and contrast.

R.F. OSC.

SYNC
Composite sync signals available for checking of these stages.

VERTICAL — Provides separate driving pulse to isolate defect between vertical oscillator and vertical output stage.

HORIZONTAL — Driving pulse applied to output stage produces full sweep and high voltage if output system is working. Eliminates uncertainty of B+ boost affecting horizontal oscillator operation.

B & K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois
Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 458 Broadway, New York 13, U.S.A.

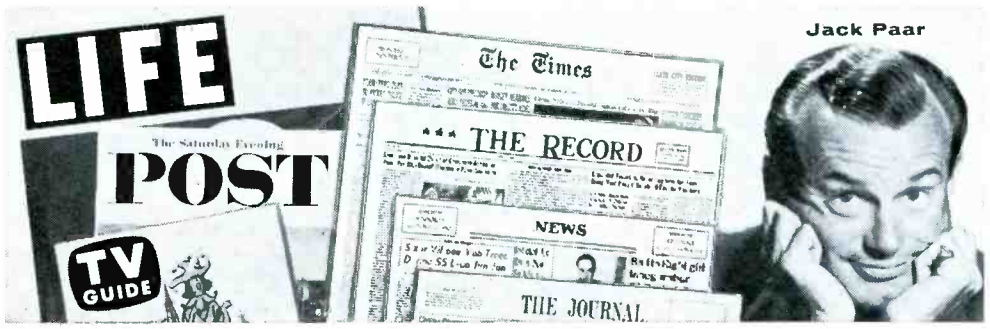
B&K

NOW FROM RCA...TWO

ALL-NEW

RCA Silverama®

SILVERAMA is RCA's premium tube—and that means tops in the industry! Manufactured with all-new glass and parts, it's the finest picture tube made—for the customer who prefers top-quality. RCA SILVERAMA—a premium tube that merits a premium price—and commands premium profits for you!



RCA is telling every TV owner the facts about RCA's BIG 21 IN PICTURE TUBES in the most informative and hard-hitting advertising campaign ever undertaken in the tube industry—directing all sales to you, the independent TV service technician.

GET THE PRICE AND PROFIT STORY

LINES OF PICTURE TUBES

RCA Monogram

RCA MONOGRAM is the finest rebuilt picture tube made. Factory-rebuilt by RCA to high quality standards, this tube assures dependable performance and fewer call-backs. It is backed by a brand name *you sell* with confidence—a brand name *they buy* with confidence. RCA MONOGRAM is economy-priced for the economy-minded buyer.

NOW you will be able to offer your customers a choice between an ALL-NEW, PREMIUM RCA SILVERAMA TUBE, the finest tube in the business, and an RCA MONOGRAM, the best REBUILT made. Yes, RCA manufactures both—and *warrants both for a full year*. Satisfy the needs of every customer with the right tube for virtually every set on the market.

Now, *you* call the signals. Now, *you* supply the very best tube in both price ranges—all-new or factory-rebuilt! Both lines of tubes now available from your RCA Distributor.

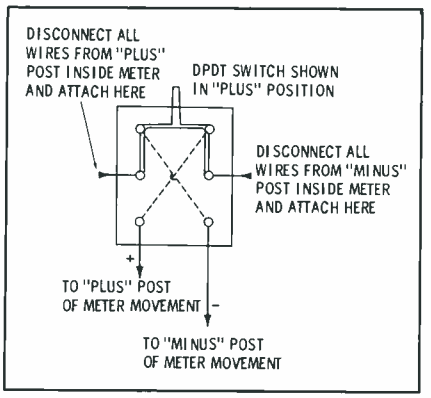
FROM YOUR RCA DISTRIBUTOR TODAY

RADIO CORPORATION OF AMERICA
Electron Tube Division *Harrison, N. J.*

conveniently done at a terminal strip under the chassis), and slide the tubing onto the wires leading to the power transformer as well as those going to the damper tube. Redress the leads to their original positions and resolder to the terminal strip. The whole job can be done in about 20 minutes, requires about 2' of tubing, and will fix a lot of existing and potential troubles. In rare cases, arcing will occur inside the power transformer; then the only cure is a separate isolation-type filament transformer with high-voltage insulation.

CHARLES H. MASTON, JR.
Indianapolis, Ind.

Glad you like our new "Across the Bench" series, and thanks for the KCS47 "kink." A simpler cure, however, would be to wire the damper into the regular filament circuit, isolate it from boost, and install a tube type with a high cathode-to-filament voltage rating—such as the 6AX4.—Ed.



For those readers who are tired of switching leads on a multimeter or VTVM to change polarity, here is an idea: Install a simple DPDT toggle switch as shown. Dotted lines represent two criss-cross wires to be connected on the switch to accomplish polarity reversal.

Use the smallest available toggle switch. To mount it, drill a hole in the meter case at any convenient spot; the top of the instrument is an especially handy location.

JOHN ZOLIKOFF
Erie, Pa.

Besides making a VTVM more convenient to use, a polarity-reversal switch prevents errors that can creep into meter readings when the test leads are simply reversed in order to measure negative voltages. If you install one of these switches, be sure that it is connected directly to the terminal posts of the meter movement itself—not just in series with the test leads.—Ed.

Dear Editor:

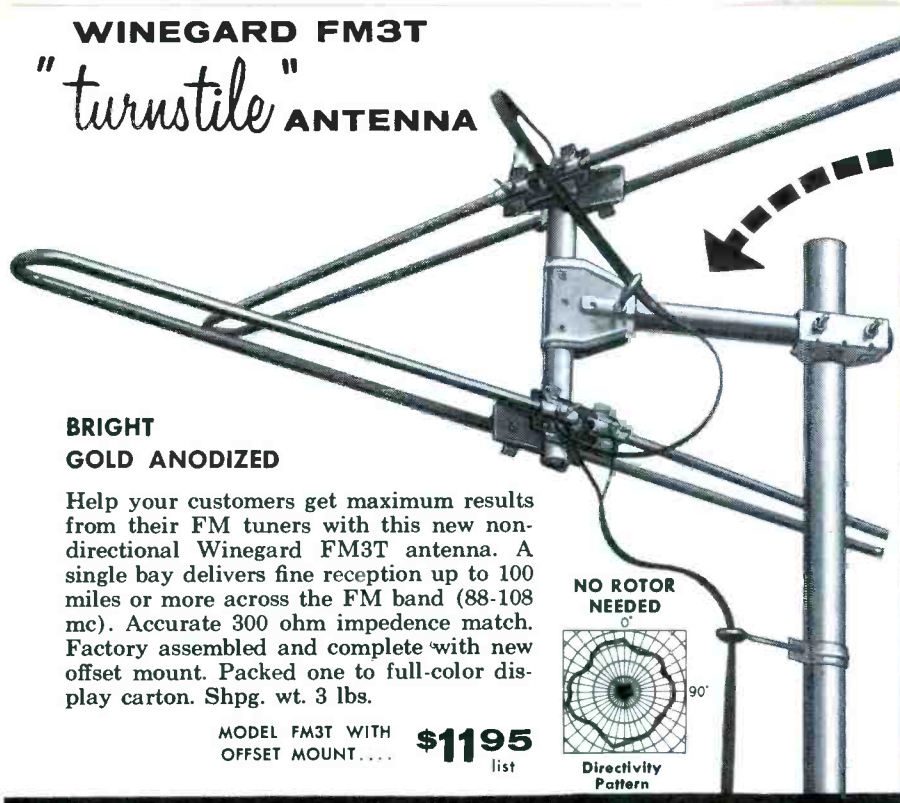
On page 19 of your December issue, the captions for the second and third sets of photographs must have been accidentally interchanged. Except for this point, congratulations to Mr. Martynec for a fine article on an oft-abused facet of servicing.

V. P. RODGERS
Culver City, Calif.

• *Please turn to page 28*

WINEGARD FM3T "turnstile" ANTENNA

WITH EXCLUSIVE "offset" MOUNT



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Help your customers get maximum results from their FM tuners with this new non-directional Winegard FM3T antenna. A single bay delivers fine reception up to 100 miles or more across the FM band (88-108 mc). Accurate 300 ohm impedence match. Factory assembled and complete with new offset mount. Packed one to full-color display carton. Shpg. wt. 3 lbs.

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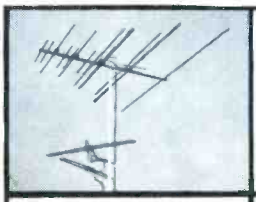

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Easiest antenna you ever installed. Factory assembled. Mounts quickly on any mast. No extra mounting parts needed.

STACKS EASILY IN 2, 3 OR 4 BAYS

Unique Winegard offset mount allows you to stack up to 4 bays for greater power and distance, using regular 300 ohm line.

WRAP-AROUND MAST CLAMP CAN'T TILT

New, super-strong "wrap around" mast clamp aligns antenna automatically. Can't crush boom no matter how much you tighten it.

Winegard

Shows you how to cash-in on the FM Market with the

MOST COMPLETE LINE OF FM ANTENNAS

Did you know that high gain TV antennas are worthless for good FM radio reception? This is true because the gain is purposely reduced across the FM radio band on most TV antennas to eliminate possible FM interference on TV.

Thousands of people who own precision FM tuning equipment don't know this and as a result are ruining their reception and picking up only a few of the stations they should be getting.

A well engineered tuner with a modern Winegard FM antenna can consistently bring in excellent reception on stations from close in, up to 100, even 300 miles away. Add to your profits by displaying and selling Gold Anodized Winegard FM antennas. Choose from 7 different models and kits.

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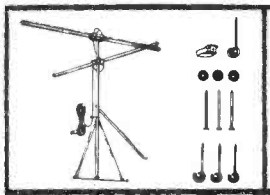
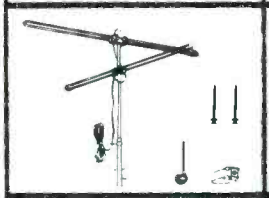


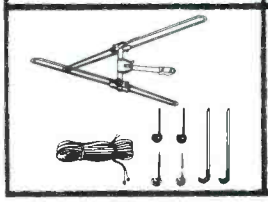
MODEL FM3A

Same antenna head as FM3T, but with Winegard's universal tripod mount. Complete with all mounting parts and 50-ft lead-in. Model FM3A, list.... **$17.95**



MODEL FM3S

Same antenna head as FM3T, but includes mast with sleeve mount. Complete with all mounting parts and 50-ft. lead-in. Model FM3S, list **$16.95**



MODEL FM3K

Same as Model FM3T, but includes 50-ft. lead-in, 2 mast stand-offs and 2 wood screw stand-offs. FM3K, list..... **$14.95**

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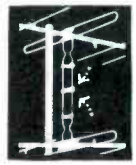
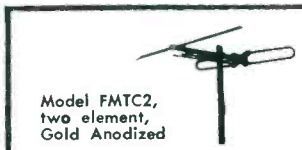
For Long Distance Reception . . . 200 Miles and More!

Choose from three directional, high gain FM Yagis With Exclusive New TransCoupler

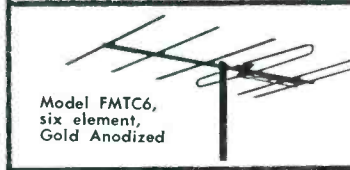
Three new FM yagis, the ultimate in FM antennas. Bright gold anodized heavy-duty aluminum. Flat frequency response across entire FM band. Extremely high gain and sharp directivity.



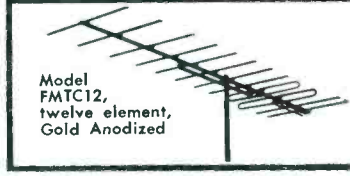
Winegard's exclusive TransCoupler bars fold down for easiest and most accurate stacking ever devised • Perfect 300 ohm match on single bay or when stacked. No extra bars needed.



Model FMTC2, two element, Gold Anodized



Model FMTC6, six element, Gold Anodized



Model FMTC12, twelve element, Gold Anodized

Winegard Co.

3009-2 Scotten, Burlington, Iowa

Write Today for Technical Bulletins on Winegard FM Antennas

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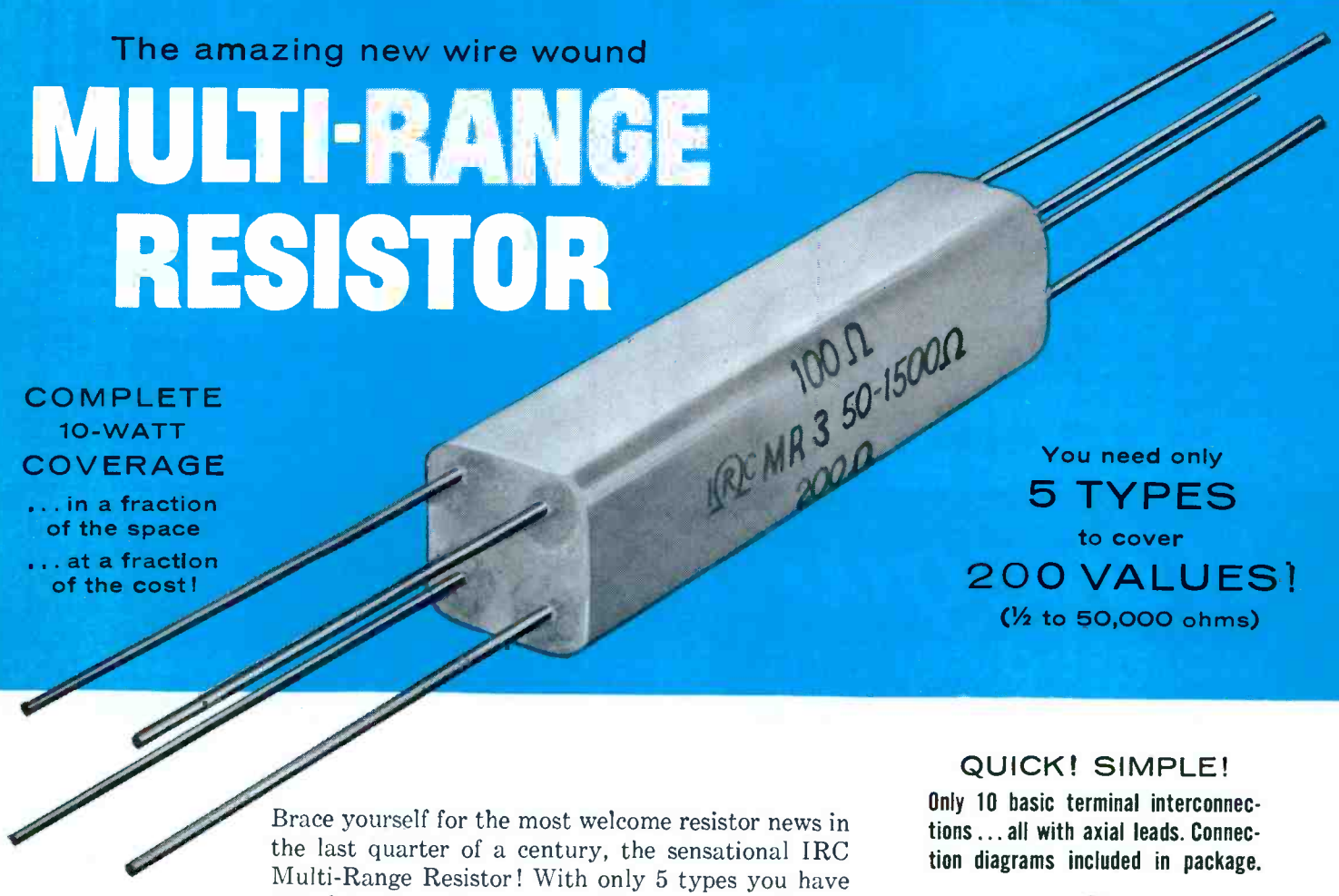
The amazing new wire wound

MULTI-RANGE RESISTOR



COMPLETE 10-WATT COVERAGE
. . . in a fraction of the space
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You need only
5 TYPES
to cover
200 VALUES!
(½ to 50,000 ohms)

Brace yourself for the most welcome resistor news in the last quarter of a century, the sensational IRC Multi-Range Resistor! With only 5 types you have complete 10-watt coverage. Never again will you need to delay set servicing to order an odd resistance value. Neither will you have to tie up inventory dollars on slow-moving types. Just 5 Multi-Range resistors cover all your 10-watt needs.

In addition to their amazing convenience IRC Multi-Range resistors are setting new standards of performance and reliability for power resistors.

- Revolutionary design—4 separate 10 watt elements are sealed in a single steatite housing.
- All types are one size—for easier handling.
- Axial leads speed servicing.
- Special steatite housing provides superior insulation.
- Conservatively rated—10 watts or more.

QUICK! SIMPLE!

Only 10 basic terminal interconnections . . . all with axial leads. Connection diagrams included in package.

FOR REQUIRED RESISTANCE VALUE, SIMPLY SOLDER DESIRED INTERCONNECTION AND CUT OFF UNWANTED TERMINALS

HERE'S IRC's SOLUTION

Type	Watts	Resistance	# of Values	Dealer Net
MR-1	10	½ to 15 ohms	47	60c
MR-2	10	5 to 150 ohms	47	60c
MR-3	10	50 to 1,500 ohms	47	60c
MR-4	10	500 to 15,000	47	60c
MR-5	10	3,000 to 50,000	12	90c

all types 10% tolerance

Another Multi-Range Feature! Supplied in exclusive IRC

HANDY-PAKS

For greater convenience and ease of stocking and handling, MR Resistors are supplied in Handy-Paks only . . . 2 of a type to a Pak.

HANDY-PAK PRICES	
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$1.20 dealer net	$1.80 dealer net
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approach to Power Resistors in 25 years

LOOK!
A complete 10-watt resistor inventory in the palm of your hand.

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New! Compact! Efficient!

MULTI-RANGE RESISTOR KIT!

Now you can have complete 10-watt power resistor coverage at your fingertips . . . in a stock so compact it occupies no more space than 2 packs of cigarettes. Your entire stock is always visible. Identification of type, value, etc. shows through the plastic case. You always know what you have, and have what you need with an IRC Multi-Range Resistor Kit.

- Kit gives complete 10-watt coverage of 200 values.
- Contains 5 Handy-Paks—2 of each Type MR resistor . . . 10 Multi-Range units.
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FULL 10-WATT POWER RESISTOR COVERAGE IN STURDY PLASTIC KIT!

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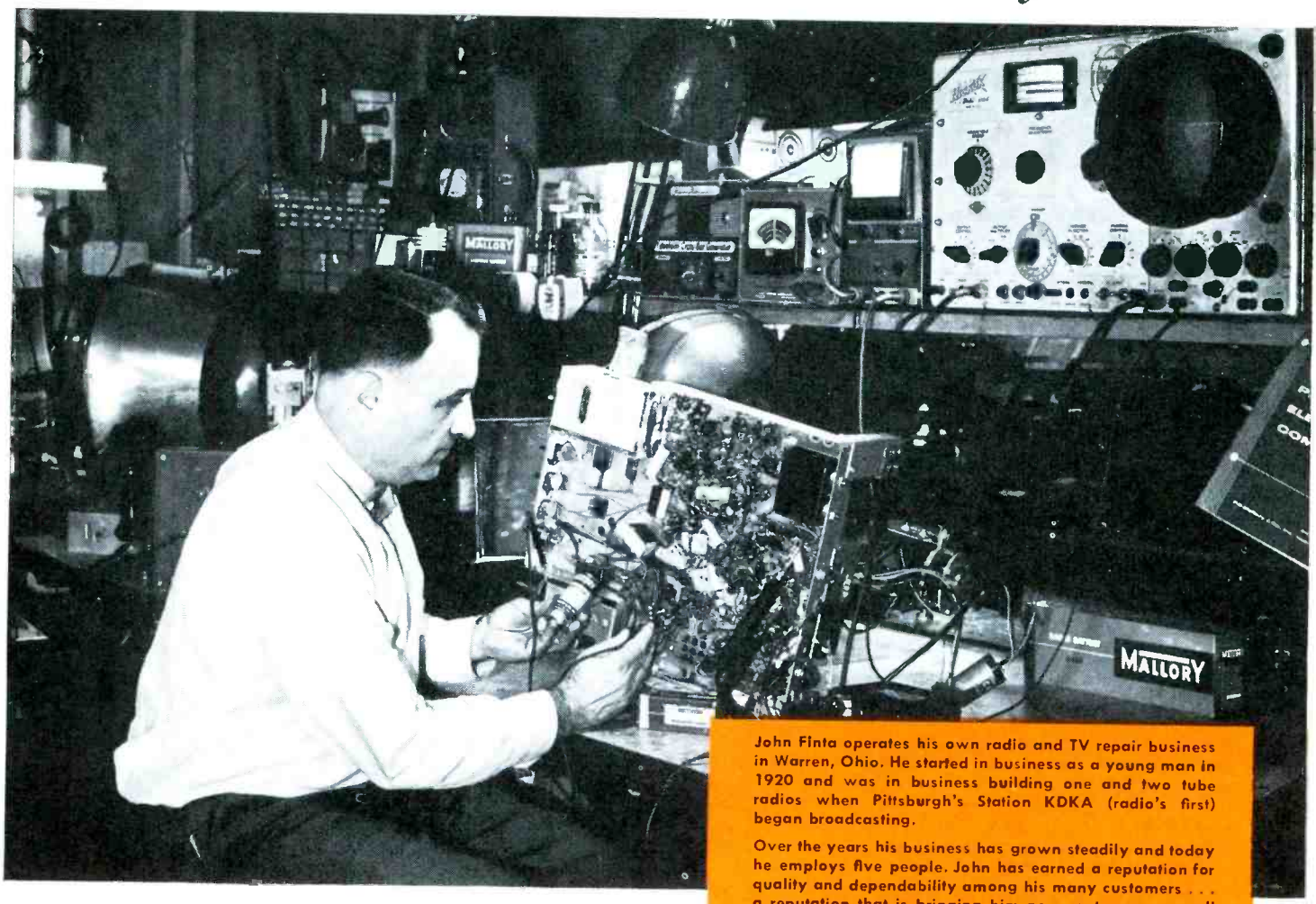
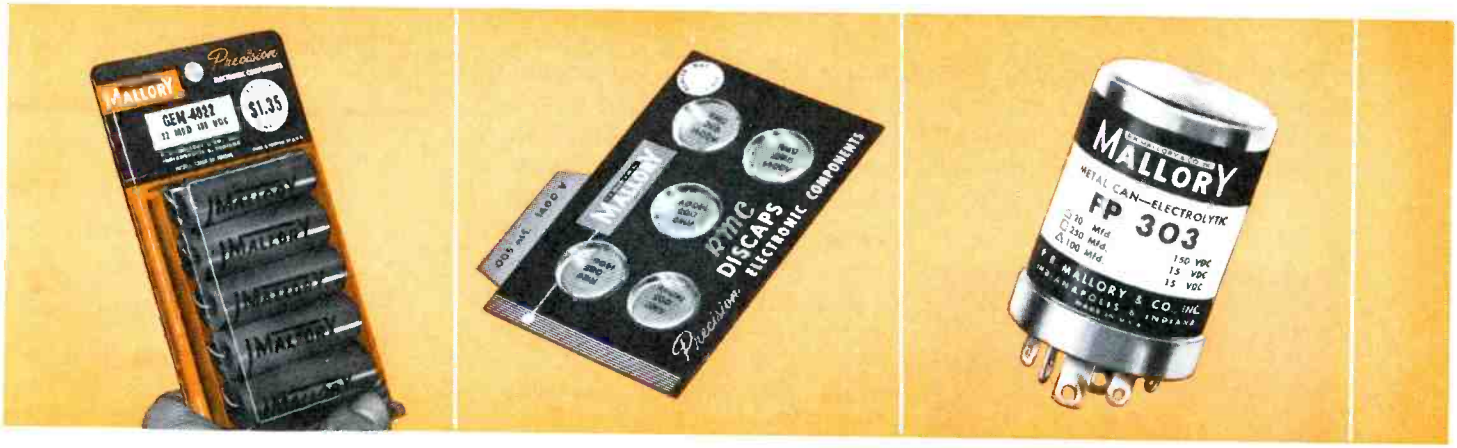
Service Technician John Finta Says...



John Finta operates his own radio and TV repair business in Warren, Ohio. He started in business as a young man in 1920 and was in business building one and two tube radios when Pittsburgh's Station KDKA (radio's first) began broadcasting.

Over the years his business has grown steadily and today he employs five people. John has earned a reputation for quality and dependability among his many customers . . . a reputation that is bringing him new customers as well as making fast friends of the old.

Cut Call-Backs with These Quality Mallory



Gems—5 rugged, moistureproof, Mallory "Gem" tubular capacitors in an easy-to-use dispenser that keeps your stock fresh and clean—easy to find—no more kinks in lead wires. They're your best bet for outstanding service in buffer, by-pass or coupling applications.

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....“Mallory Components Make Every Job a ‘Sure Thing’”

“Nothing gets under your skin more—or eats into your profits deeper—than time consuming, expensive call-backs. But, there’s one sure way to stop them: use only quality replacements.

“You know you’re getting the best when you ask for Mallory . . . and you don’t pay premium prices, either. You see, Mallory components are service-engineered to give long, trouble-free life. They’ve been thoroughly tested and ‘punished’ in the Mallory lab, far beyond any beating they’ll ever get in actual service.

“This is the kind of quality you get across the entire line of Mallory components . . . capacitors, controls, resistors, vibrators, rectifiers and batteries.”

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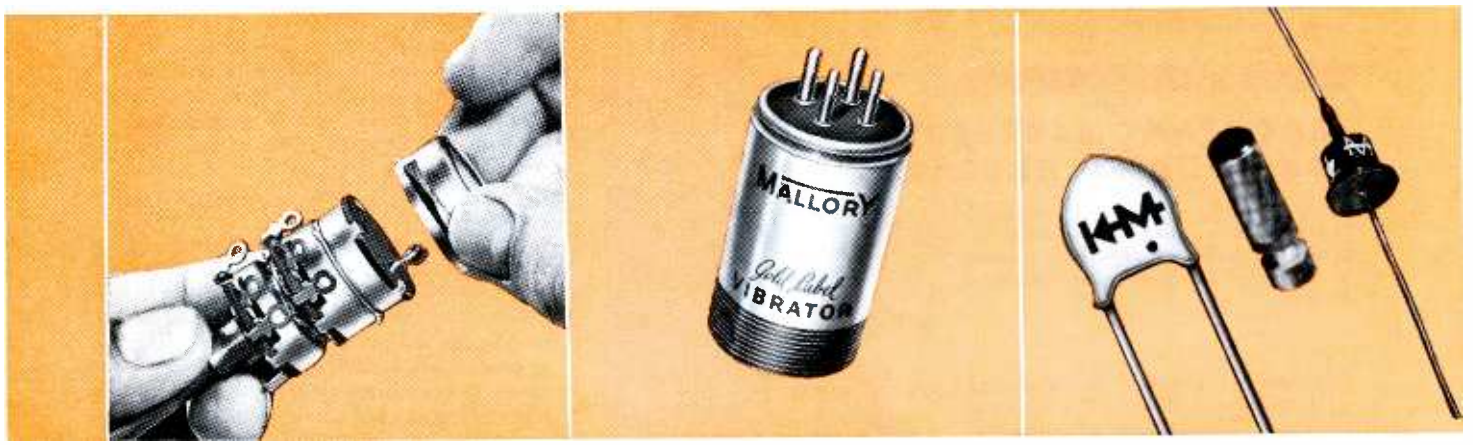

Sta-Loc* Controls—New Sta-Loc design enables your distributor to custom build, in just 30 seconds, over 38,000 combinations—eliminates waiting for out-of-stock controls. You can replace the line switch by itself, without unsoldering control connections.

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**Trade Mark*

Letters *(Continued from page 22)*

Dear Editor:

Thought you and your readers might be interested in the enclosed "historic" photograph taken at the signing of Service Intrument Co.'s 72-ad PF REPORTER contract, which I understand is the largest in terms of frequency you've ever had from one company. You can tell by the smiles that we are all quite happy with this agreement.

SANDER RODKIN
Sander Rodkin Advg., Ltd.
Chicago, Ill.

Without any pressure from the sales department, we're happy to introduce (l. to r.) Sander Rodkin; Ed Flaxman, Sencore sales veep; Herb Bowden, Sencore president; and Robert Baum, the firm's v-p of engineering.

Incidentally, Sandy, wish my desk was as clean as yours. What's the formula? —Ed.

Dear Editor:

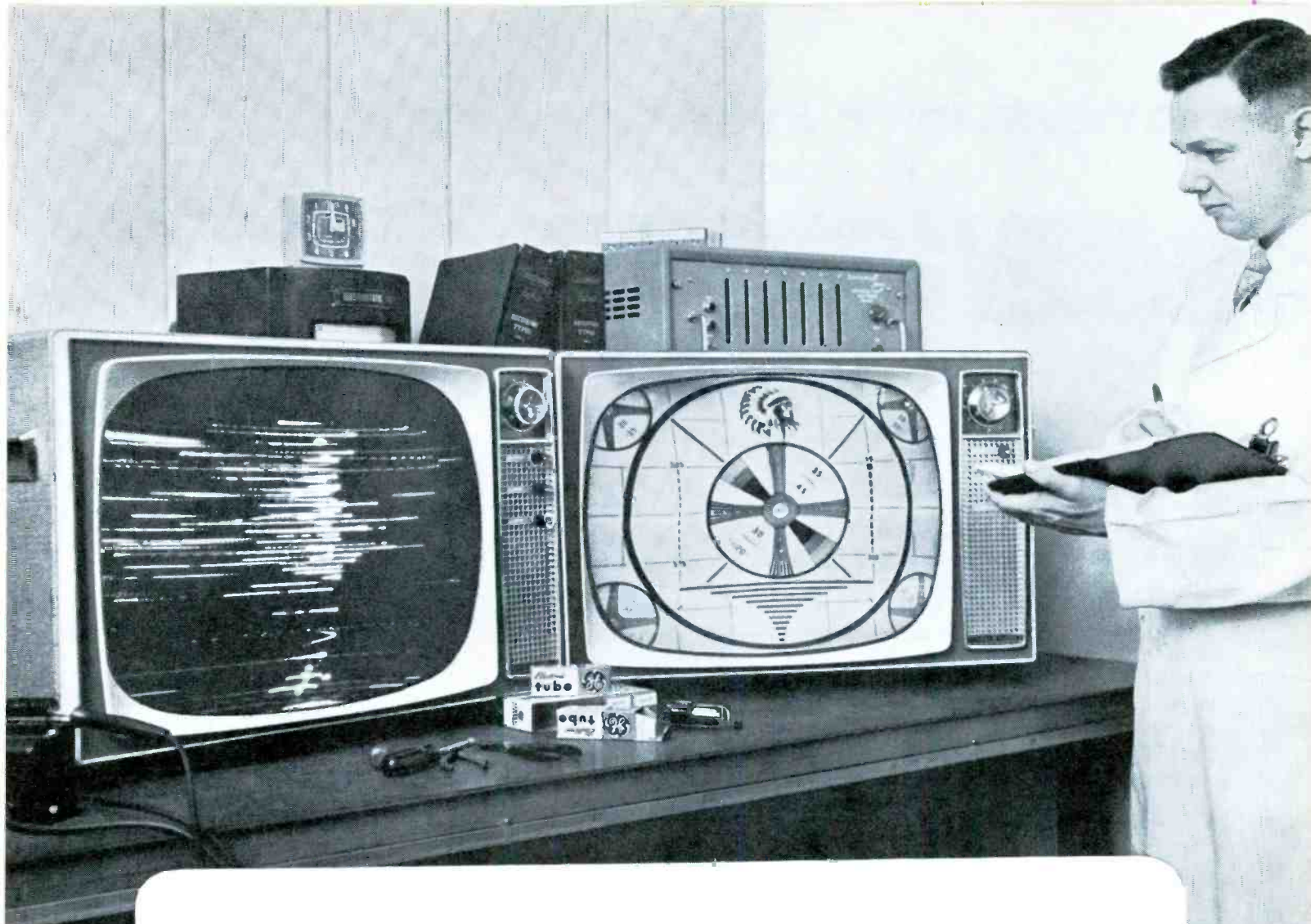
I have an old Thomas A. Edison disc phonograph, Model A100. It has a mechanical reproduction system, but I would like to use an electronic system to reproduce the audio.

What type of crystal would be needed, and what type of phono needle would be required for the records that were used with this phonograph?

The records I have are about ¼" thick, and I am unfamiliar with the type of grooves they have. I have tried a couple of different kinds of needles, but they do not reproduce the sound with sufficient output.

JAMES L. KIRKWOOD
Macon, Ga.

Any high-output crystal or ceramic cartridge should be suitable for playback, but it will have to be slightly modified in order to follow the vertical modulation on the old Edison records. In this type of modulation, sound is reproduced by an up-and-down motion of the needle in the groove, rather than lateral motion as in more modern records. You might install a cartridge sideways in a tone arm (with the needle pointing out to the side), and replace the regular needle with a 2.5-mil type having a right-angle bend. Then, vertical motion of the needle tip will be converted to lateral motion at the stylus. This system ought to work OK, especially since it won't be subjected to the strain of playing rock-'n'-roll records.—Ed.



CUT DAMPER-TUBE ARCING!

Have steady, dependable pictures with the new Service-Designed General Electric 6AX4-GTA (right)!

Side-by-side receiver tests show how prototype horizontal-damper tube occasionally will arc, cathode-to-plate (screen at left), whereas the new General Electric 6AX4-GTA continues to do its job reliably. The reason: a new, 15% larger cathode, with more emission area, consequently a lower operating temperature requirement.

New 6AX4-GTA also has faster warm-up, tapered pins, other improvements. Install this advanced tube to promote customer satisfaction, reduce call-backs. Service-Designed quality through and through! See your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Co., Owensboro, Ky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

2-111-202

across the BENCH

by Stan Prentiss

This is the story of the CX-33 series Capehart chassis made during 1950 and 1951. Tuners in these sets are either a 3-tube Sarkes Tarzian or a 2-tube Standard Coil, while the IF strips used straight 6AG5's in early versions, a mixture of 6AG5's and 6CB6's in intermediate models, and straight 6CB6's in the CX-33DX. The audio, vertical, and horizontal deflection sections of the three chassis, however, are substantially the same.

Automatic Gain Control

The single video amplifier stage employs a 6AH6 pentode, sound take-off trap, sync supply point, and DC coupling to the CRT. Video is coupled to the grids of AGC Det. and Pre-Sync Sep. (V13 in Fig. 1) through R58. In one half of V13, detection for development of AGC voltage takes place; the resultant potential is coupled from the cathode of this tube through a voltage divider that includes the 500K AGC potentiometer R3 to the grid of the AGC voltage amplifier, one half of V14. Capacitor C7 filters the AC component from this amplified signal, and the DC voltage is applied to a divider consisting of R28 and R29, and fed through resistors R27 and R26 to the grid of the RF amplifier. The output of the voltage divider is fed to the grids of the 1st and 2nd video amplifiers.

In this circuit, notice particularly that electrolytic capacitor C7 has its plus terminal to ground, R25, R27, and R28 are 5% tolerance resistors, and the AGC and sync tubes (except in the CX-33DX) are a pair of 12AU7's. If you're looking for a precise AGC setting, turn the chassis over or plug V5, the second video IF amplifier, in a test adapter and adjust R3 for exactly —3 volts at the control grid.

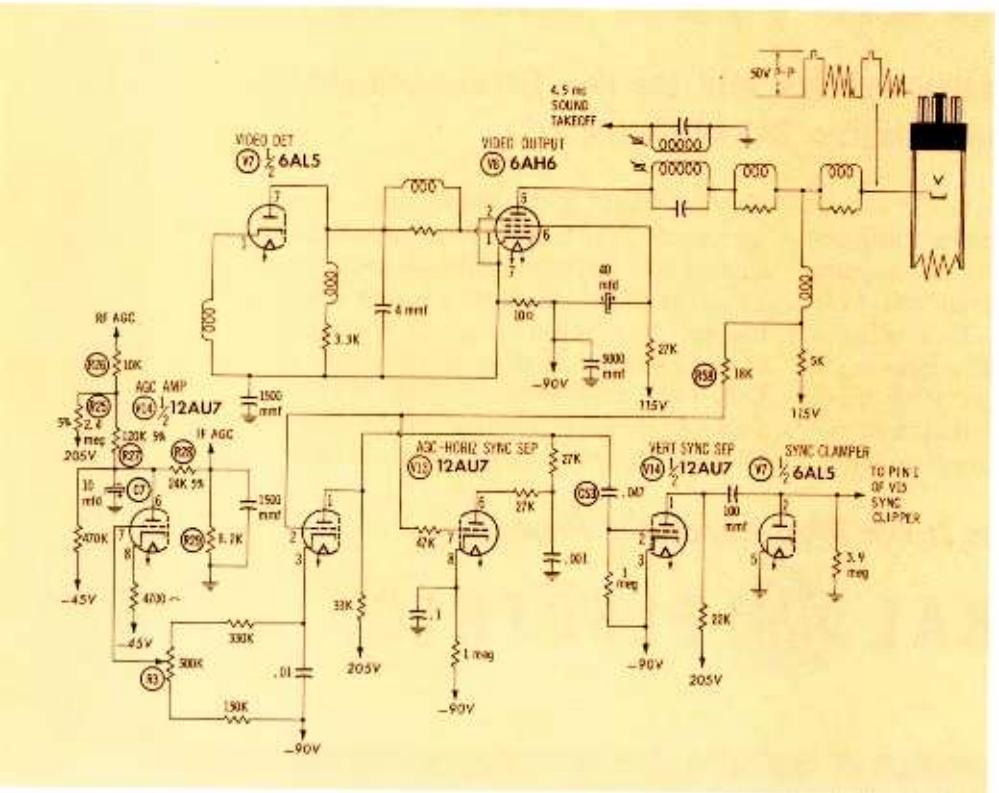


Fig. 1. Video, sync, and AGC circuits in Capehart CX-33 chassis.

Video

As you trace from the plate of video detector toward the CRT, note that direct coupling is employed all the way and that the signal applied to the picture tube is positive-going, with an amplitude of about 50V. Since no coupling capacitors are employed in the video detector or amplifier circuits, DC restoration is not necessary to maintain the proper black level. Neither is vertical retrace blanking necessary. When the brightness and contrast controls are properly adjusted, the vertical retrace lines are automatically blanked. However, if it is desired to operate these chassis at higher than normal brightness levels, a retrace blanking circuit can be added.

Sync

The operational theory for the sync circuits in these Capeharts gets a little "hairy," but is relatively straightforward, nevertheless. The second section of triode V13 accepts and amplifies sync pulses, while the first section amplifies horizontal sync pulses and develops AGC voltage proportional to pulse amplitude. The vertical and horizontal sync pulses are then combined in the plate circuit of V13 and fed to a grid-leak biased sync amplifier-limiter through coupling capacitor C53. The signal is now negative-going and will virtually drive the sync amplifier to cutoff if its amplitude is excessive — a condition that can well be true if a large pulse of noise is riding on the signal. When the sync amplifier is conducting, the amplified positive signal at its plate charges the 100-mmf capacitor C54. When this capacitor discharges through the 3.9-megohm grid-leak resistor R69, it biases the sync clipper to cutoff during active line scanning time. Therefore, only the actual sync pulses appear across the 6800-ohm load in the cathode circuit of the sync clipper.

CX-33DX Sync

In the CX-33DX chassis, sync is picked off at the video detector load and coupled to the grid of the 6CB6 1st sync amplifier (see Fig. 2). Here it is amplified to about 70 volts p-p and inverted to positive polarity. The sync pulses are DC coupled to the cathode (pin 8) of V12 where they are first rectified by one side of the tube, removing the video portion of the signal, and then amplified by the other side. The sync is then capacitively coupled to the grid of the 2nd sync amplifier. This 12AU7 tube increases the signal level from 100 volts to 200 volts. As with the CX-33, the 100-mmf coupling capacitor to the sync clipper stage is charged with a positive signal, biasing the sync clipper to cutoff by discharging through the 3.9-megohm grid resistor during active line-scanning time. Thereafter, vertical sync, at approximately 75 volts p-p, is taken from the plate of the sync clipper, and horizontal pulses at 50 volts p-p from its cathode.

General Troubleshooting

The most difficult circuits to service in these receivers are not those already described but, strangely enough, those that are generally common to *all three* chassis, i.e., sound, horizontal sweep, and power supplies. Since troubles in the power supply can affect operation of the entire receiver, let's discuss them first.

Outputs from the supplies range from +310 volts to —90 volts. Both filters and voltage-dropping resistors are of excellent quality and do not often require replacing. However, defects in load circuits supplied from these power sources can be misleading, and send you on a wild, time-consuming hunt through the power circuits. In dealing with negative and positive supplies such as these, remember that when the positive supply voltage decreases due to a change in the load, the negative supply voltage will increase. Therefore, if you suspect any circuit of upsetting the balance between the positive and negative supplies, you might well make a disconnection or two to see if the plus and minus voltages return to normal.

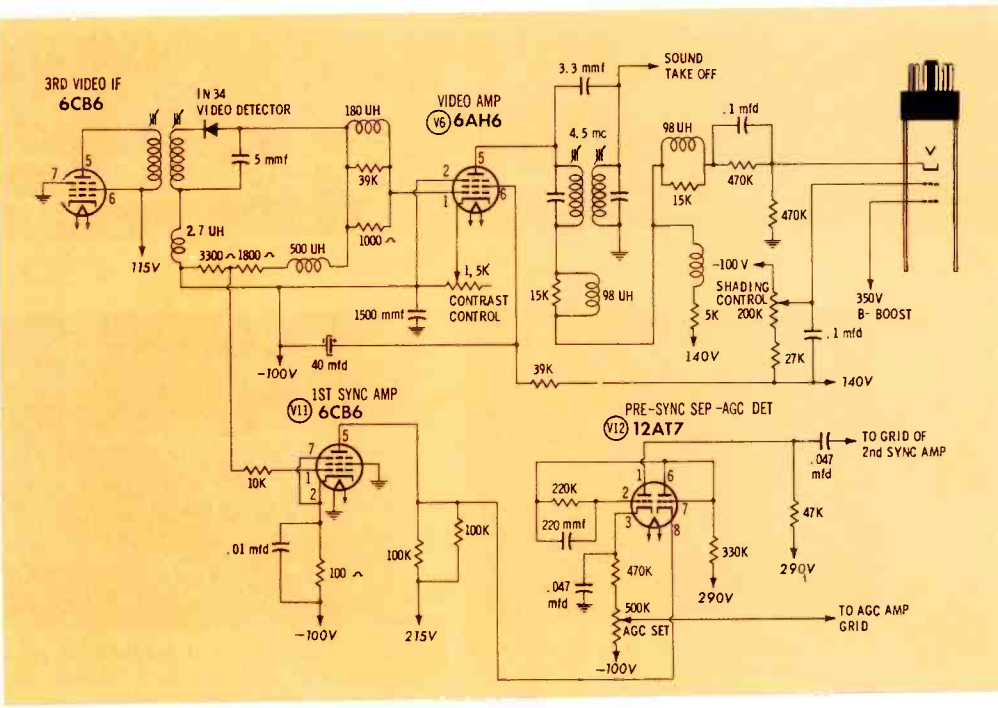


Fig. 2. Circuit variation used in CX-33DX series chassis.

I recently was called on to repair a CX-33DX that had no picture and no sound. I immediately measured the power supply voltages with a small 20,000 ohms/volt multimeter I carry. The —90 volt bus read —110, and the high B+ supply was more than 10% low. Immediately, I suspected there was high leakage or a short somewhere along the path between the tuner and video amplifier. Further checks revealed that all plate and screen voltages in this section were down considerably, so I began disconnecting circuits the easy way — by pulling tubes. When I removed the 6CB6 3rd video IF, B+ returned to normal. It so happens that in this "super" version, the IF's are all 6CB6's with suppressor grids tied

• *Please turn to page 84*

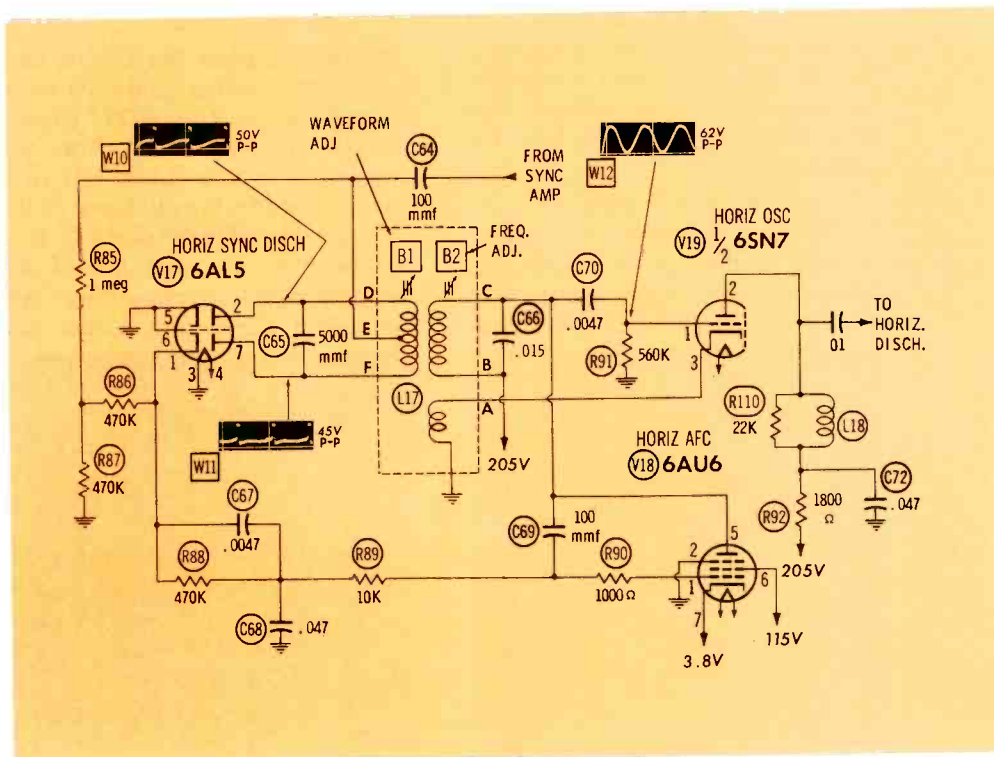


Fig. 3. Horizontal AFC and oscillator circuit with key waveforms.

Here's the real low-down straight . . . . HORIZONTAL

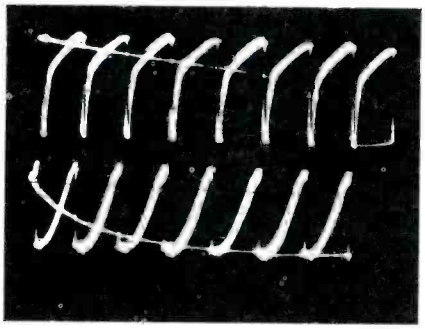


Fig. 1. Comparison of output-tube grid-drive and cathode-current waveforms shows affect of voltage on conduction.

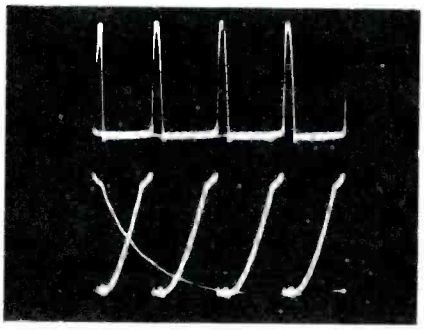


Fig. 4. Comparison of output-tube plate signal with drive signal shows that inductive kick occurs during retrace.

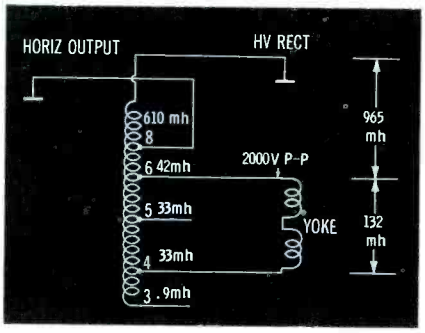


Fig. 5. Basic horizontal output transformer circuit showing inductance values for portions of the transformer.

Horizontal sweep circuits have followed a trend toward greater simplification at a faster rate than other TV circuits. This increased simplicity, while somewhat easing service problems, has not eliminated them entirely. In analyzing letters from the field, we find that horizontal sweep problems still "dog" the nation's servicemen.

This article commences with a brief discussion of circuit operation and then proceeds with adjustment setup procedures, data on normal voltages and signals, and effects on operation when various components fail. It concludes with symptoms denoting failures in circuits that draw power or use signals from the output stage.

How It Works

The chain of events that lead up to the production of horizontal sweep and high voltage starts with the application of the familiar modified sawtooth signal (Fig. 1) to the grid of the horizontal output tube. This tube is biased (by grid-leak or a combination of grid-leak and cathode bias) so that it conducts only when the grid signal reaches a certain level. A comparison of grid voltage and cathode current waveforms (Fig. 1) illustrates this point. Notice that once the tube starts conducting, its plate current increases rapidly to the saturation level, remains there momentarily, and is then cut off by the negative excursion of the drive signal.

During the time the output tube is conducting at the saturation level, the grid capacitor (Fig. 2) is being charged by grid current. After the tube is driven into cutoff, this state is maintained by the discharge of the grid capacitor through the grid load resistor until the next rise of the sawtooth signal drives the stage into conduction. Conduction of the output tube produces only the last half of horizontal sweep. This point will be dealt with in more detail a little later.

At this point, let's consider circuit operation during horizontal retrace (see Fig. 3). At the instant the scan interval ends, the magnetic field produced by the gradually increasing current through the yoke and flyback system collapses. This causes an inductive kick and produces a voltage (first half cycle positive) with a shape as shown in Fig. 4. This pulse voltage is stepped up via transformer action of the horizontal output transformer before being applied to the plate of the high-voltage rectifier tube.

Consider an example where the circuit is connected as shown in Fig. 5. The voltage measurement at pin 6 and the various inductance values were taken from an operating circuit. As you will note, the yoke is connected across two sections of the transformer, each rated at 33 millihenries. Since these windings are wound series aiding, however, the total equivalent inductance Lt is greater than the sum of the individual sections—132 millihenries in this case. The formula for inductors in a series-aiding configuration is as follows:

$$Lt = L1 + L2 + 2\sqrt{L1 \times L2}.$$

The same condition exists between the top of the yoke and the plate of the high-voltage rectifier, where 610 mh and 42 mh aid in producing a

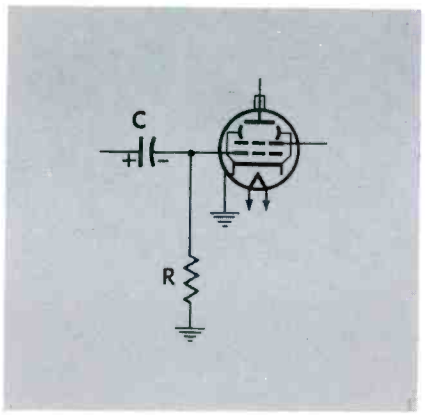


Fig. 2. Coupling capacitor charges as shown when tube draws grid current.

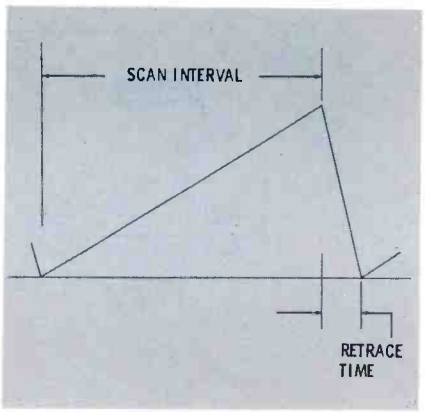


Fig. 3. Sawtooth signal is key to development of high voltage and boost B+.

from our own labs — by Calvin C. Young, Jr.

SWEEP CIRCUITS

total of 965 mh. These inductance figures were obtained using a precision inductance bridge.

By comparing these equivalent inductances, we can determine the step-up ratio of the high-voltage-producing segment of the transformer. Simply divide 965 by 132 to get the step-up ratio, which we find is 7.3. This means the 2,000-volt kickback pulse will be stepped up to about 14,600 volts by the transformer. When rectified, the resultant DC voltage will be about 14 kv at no load, and on the order of 12 to 13 kv at normal brightness settings.

If you thought the output transformer produced high voltage by simply stepping up the signal voltage from the output tube, consider the following explanation of why this signal is inadequate for developing high voltage unless a kickback pulse is included. If this point is already clear in your mind, skip to the next paragraph. If the boost voltage is 700 volts, and we consider the portion of the transformer between terminals 4 and 8 as the primary, we have a set of conditions whereby we can determine the maximum high voltage that can be produced by a direct step-up of the horizontal output tube signal. First of all, let's consider just how much signal amplitude we can get from the horizontal output amplifier. Since boost B+ is our DC supply, and its value is 700 volts, we know at once that our signal cannot exceed 700 volts p-p. Since the equivalent inductance of the primary is on the order of 350 mh, and the inductance of the secondary is about 610 mh, we can calculate the step-up ratio to be about 1.74. However, the yoke is connected in parallel with the 132-mh portion of the primary, and it actually reduces the equivalent primary inductance to about 120 mh. Using this value, we then arrive at a maximum step-up of about 5.1 (610 divided by 120). Using this figure and a theoretical signal value of 700 volts p-p, we find we can get only a 3,570-volt pulse at the plate of the rectifier — not enough to produce high voltage at a usable level.

The balance of this discussion will be based on the circuit (Fig. 6) used in a current Admiral receiver. Boost is produced when capacitor C100 is charged by damper conduction. The damper conducts after the first half cycle of the kickback pulse to prevent current oscillation, which would cause ringing in the picture. The damper doesn't conduct on the first half-cycle because this pulse is positive-going; it takes a negative pulse to cause the damper to con-

• *Please turn to page 87*

CHART I—Typical Voltages and Currents in Horizontal Output Stages Compared With Maximum Ratings

TUBE	GRID DRIVE p-p	SCREEN VOLTAGE Max.	SCREEN VOLTAGE Typical	CATHODE CURRENT Max.	CATHODE CURRENT Typical	BOOST	DEFLECTION ANGLE
BG6	60-90	350	325	110	90-100	450-550	70
BQ6	75-90	175	135	110	75-100	450-550	70
BQ6GB	75-90	200	130-150	110	90-105	450-600	70
CU6	75-90	200	150	110	90-105	450-600	70
DQ6	95	175	130-145	120	100-125	500-600	90
DQ6A	100	175	130-145	140	100-140	500-640	90-110
DN6	75-150	175	130-150	240	128-140	450-600	90-110
CD6	75-150	175	150	200	135-150	450-650	70-90-110
* CB5	125-200	200	150-180	200	200-225	750-850	21AXP22
* CB5A	125-200	200	150-180	220	215-240	750-850	21AXP22
*†DQ5	200	175	145	285	170	820	21CYP22

*Color sets

†New tube; all figures based on one set.

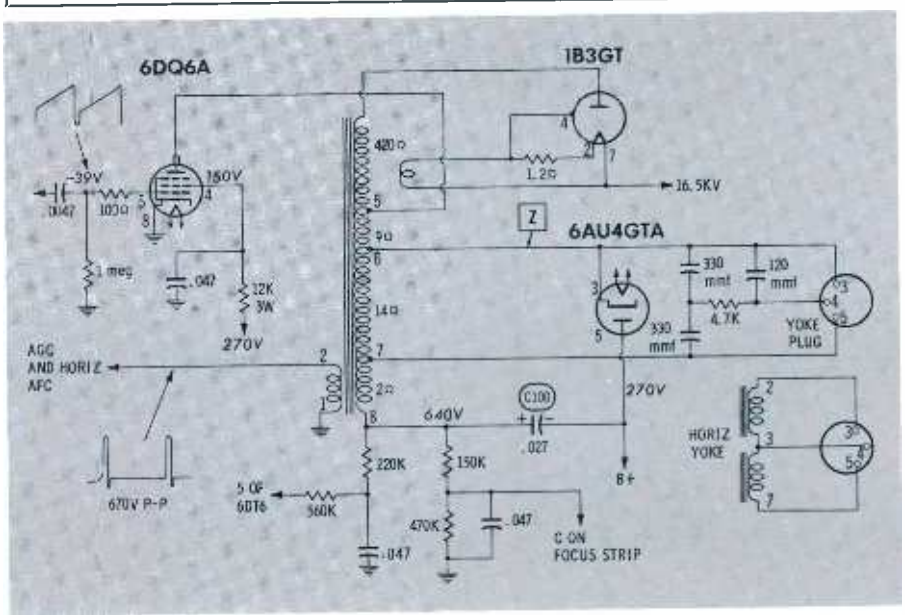


Fig. 6. Autotransformer circuit in Admiral 18A6C illustrates current trend.

transistors with POWER

. . . transistorized power services and how they work

by Allan Lytel

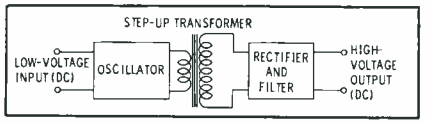


Fig. 1. Elements of DC-to-AC converter.

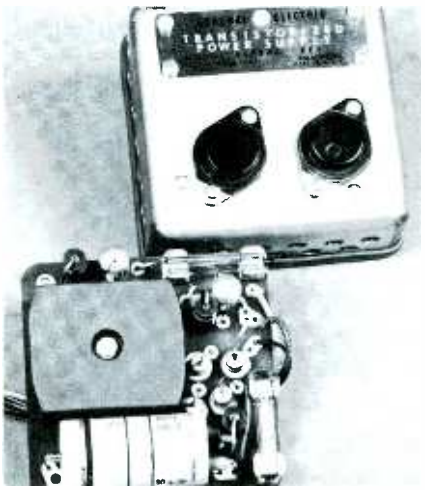


Fig. 2. External and internal views of General Electric Model EP8A converter.

DC-to-DC Power Converters

Transistors, operating either as amplifiers or as switches, are beginning to replace electromechanical devices in power conversion systems such as DC-to-DC converters and DC-to-AC inverters.

A converter is a power supply that steps up low-voltage DC for use with mobile radios, aircraft equipment and guided missiles. Less weight, longer life, greater efficiency, and fewer breakdowns are made possible by transistorizing this device.

What is a transistorized power converter? Basically, it is an oscillator (such as the one shown in Fig. 1) fed by a battery source. The oscillator, which is often a multivibrator, generates an AC signal by positive feedback. After being stepped up by a transformer, the AC is rectified and filtered to pure DC. Since frequencies in the range of several kilocycles are used, the filtering problem is much simpler than it is at 60 cps. Besides having smaller filter elements, the power supply can use a lighter and more compact transformer.

An important use of a DC-to-DC converter is as a source of plate voltage for a mobile radio, as shown in Fig. 2. Transistors outlast vibrators and produce no "hash" or radio-frequency interference. This power-supply unit can be added to existing radios.

Fig. 3 is a schematic of a transistor power supply for GE mobile radios. This unit is shown in Fig. 4 as it appears when mounted on the front panel of a radio (underneath a louvered cover). Locating the power supply outside the case of the radio has the advantage of providing cool surroundings for transistor operation. As a rule, this permits an increase in the power ratings of the transistors.

The DC input is applied to two power transistors which operate as a flip-flop oscillator (a type of square-wave generator) at a frequency of approximately 3500 cps. A small step-up transformer, weighing only a few ounces, is adequate for service at this frequency. The stepped-up voltage at the transformer secondary is rectified by a bridge circuit with four silicon diodes. Ripple is filtered out by an ordinary RC network following the rectifiers. The power output of the transistor supply is approximately 195 volts at 100 ma, which is sufficient to power a 15-tube FM communications receiver. Over-all efficiency of the supply (DC output divided by DC input) is

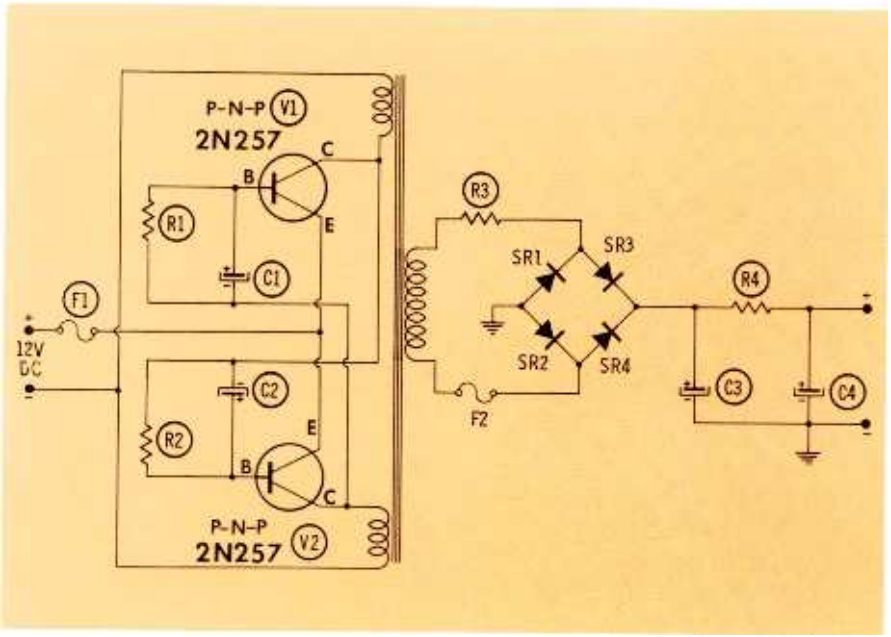


Fig. 3. Output of transistor oscillator is rectified by silicon diode bridge.

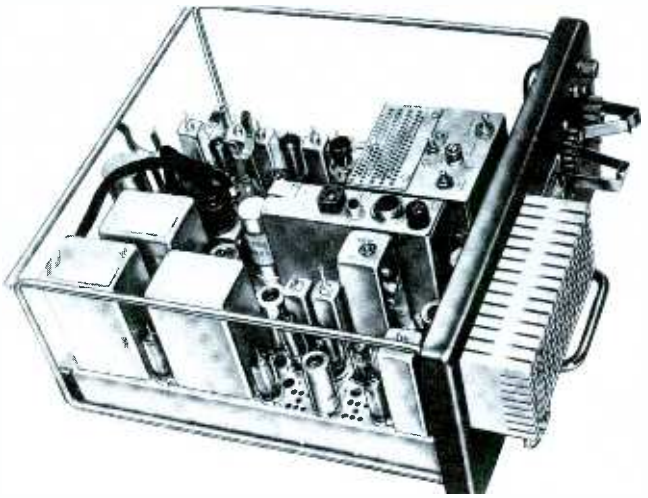


Fig. 4. Transistorized DC-to-DC converter mounted on front panel of radio set.

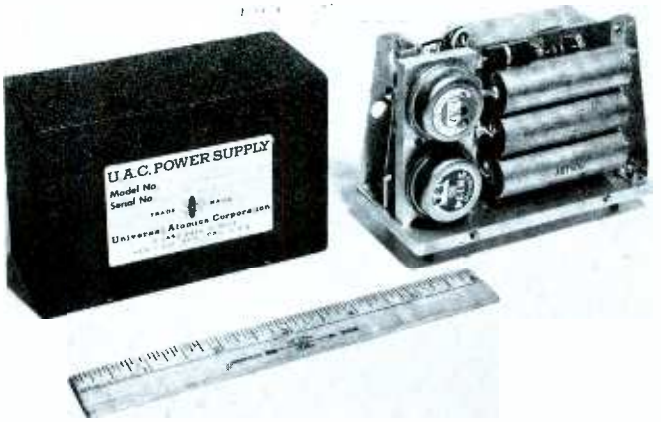


Fig. 5. Two 2N174 transistors provide 130-ma output current at 240 volts DC.

about 70% — approximately the same as for a power supply using a nonsynchronous vibrator and selenium rectifier.

All components except the transistors are mounted on a small printed circuit board. To dissipate heat, the transistors are mounted directly on the surface of the cover, which acts as a heat sink. The louvers in the cover permit free air circulation around the heat sink to help keep the transistors within recommended operating temperature ranges.

Since current switching is done electronically by the transistors, there is no arcing or "hash" such as is produced by mechanical switch contacts. Consequently, the transistorized power supply needs relatively little filtering or shielding. This factor, when considered along with the small size of the step-up transformer, largely accounts for the compactness and light weight of transistorized converters.

DC-to-DC power converters have other uses and cover a wide range of supply voltages. Some typical units have inputs of 6, 12, or 28 volts DC and outputs from 125 to 2,100 volts DC. Output currents vary from 40 ma to 1 amp. Available power outputs range from 1 to more than 500 watts. Fig. 5 shows a 30-watt unit using a pair of 2N174 power transistors. Special converters with outputs up to 100,000 volts DC are available for high-voltage, low-current applications such as in radiation detectors.

Power converters can be bought as complete "package" units, such as the one shown in Fig. 6, or the special transformers may be purchased separately and a power supply custom-built. The 12-volt Model 12-D transformer made by Sunair Electronics, Ft. Lauderdale, Fla., can be used in the circuit shown schematically in Fig. 7. This unit provides up to 40 watts of output at 200, 250, or 300 volts with current drains up to 125 ma. Two power transistors (Delco 2N441) are cross-coupled to form an oscillator that operates at about 2 kc. After voltage step-up, the output of the oscillator is rectified by a voltage doubler and filtered by an RC filter. Note that the filter capacitors are only 10 mfd.

Another packaged unit, Fig. 8, is made by Arnold Magnetics Corp. of Los Angeles. Depending on the model, this type of supply operates from either a 6- or 12-volt battery and delivers up to 265 ma with output voltages ranging from 150 to 400 VDC. Compactness is illustrated by its size, 4¾" x 1¾" x 3¼", and weight, 24 ounces.

DC to AC Inverters

Power transistors are also used in DC-to-AC inverters, which are precision oscillators for powering AC equipment. In a transistorized inverter, a DC source feeds a transistor circuit that acts as a typical generator. It consists of an oscillator stage feeding an output stage which is either a push-pull circuit (in which the power transistors are class-B amplifiers,) or an arrangement in which

• *Please turn to page 81*

Fig. 6. Complete transistorized DC-to-DC converter fits into a small package.

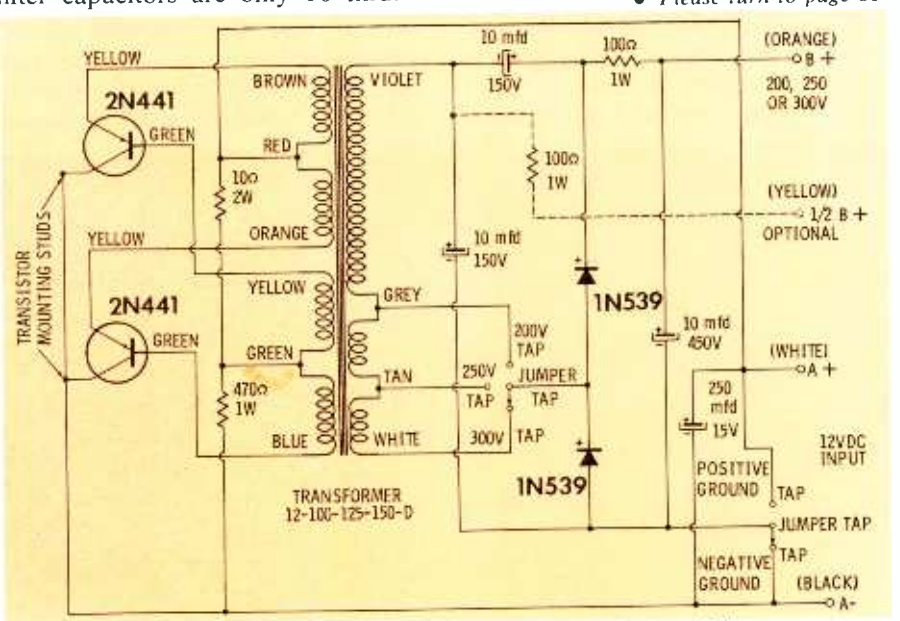


Fig. 7. Three taps on step-up transformer provide choice of three outputs.

RF amplifier. Signal input to pin 7; AVC to both pins 1 & 7.

High-gm RF amplifiers. 12DZ6 is unusual remote-cutoff type.

Dual diode/space charge tetrode for detector - AVC - audio driver.

Pentode specially designed for IF stage not controlled by AVC.

what's new in . . .

The majority of radios in late-model automobiles are of the hybrid type, with a transistor in the output stage and tubes in all other circuits. Judging from an over-all inspection of 1959 models, it appears evident that further transistorization of car radios is going to be a gradual process, although there has been a slight increase in the use of transistors this year. For instance, the stage ahead of the audio output circuit has been transistorized in several of the latest designs, and a limited number of fully transistorized sets have been produced. By and large, however, it appears that hybrid radios will not be completely replaced by all-transistor designs for some time to come.

Plenty of engineering talent has been applied to the job of improving hybrid tubes and circuits for more efficient operation. Before we examine this streamlining process in detail, let's refresh our memory on some of the special problems that had to be solved in order to make hybrid radios practical in the first place. When the transistorized audio output stage was adopted, it seemed feasible that receivers without vibrators could be built—provided that tubes could be made to operate with plate and screen potentials between 10 and 16 volts. These tubes also had to be able to withstand road shocks and wide fluctuations in supply voltage. To meet such stiff requirements, design features like low plate current were adopted for early types of hybrid RF-IF tubes. This meant low gm and low gain per stage; therefore, most earlier-vintage hybrid radios had to have at least one more stage than comparable all-tube radios. The circuit added was an audio-frequency "driver" — a power amplifier especially designed to supply a suitable signal to the low-impedance, high-current input circuit of the output transistor.

In 1957, when hybrid radios first came into widespread use, audio tube circuits were generally of the type shown in Fig. 1. The 12K5 in the driver stage is a space-charge tetrode that employs a unique means of obtaining high plate current at a low plate potential. Note that the No. 1 or *space-charge* grid is returned directly to the 12-volt source. The positive potential on this grid tends to prevent electrons from straying back toward the cathode after they are emitted; as a result, a dense cloud of electrons (space charge) collects in the vicinity of the No. 1 grid and forms a ready source of plate current. The value of this current during normal operation is about 40 ma, much more than could be obtained with a conventional tube at a plate potential of only 12 volts. The No. 2 grid of the 12K5 functions like the control grid of an ordinary triode amplifier tube.

Some hybrid radios have utilized a 12J8 (a non-space-charge tetrode) as a driver tube. Just as in an ordinary tetrode, the No. 1 grid receives an input signal and the No. 2 grid serves as a screen. Plate current is lower than in a space-charge tube, and plate resistance is many times higher; but, if a driver transformer with a relatively great step-down turns ratio is used, a 12J8 can develop sufficient power at 12 volts to drive an output transistor.

Still another variation of the driver circuit is found in certain Philco radios which utilize a 12AE7 dual triode in place of a single tetrode.

Earlier models of hybrid radios included an audio voltage amplifier between the detector and driver. As can be seen in Fig. 1, this stage bears a close resemblance to the first audio amplifier stage of a conventional all-tube radio. A 12AJ6 triode or 12F8 pentode is sometimes used instead of a 12AE6.

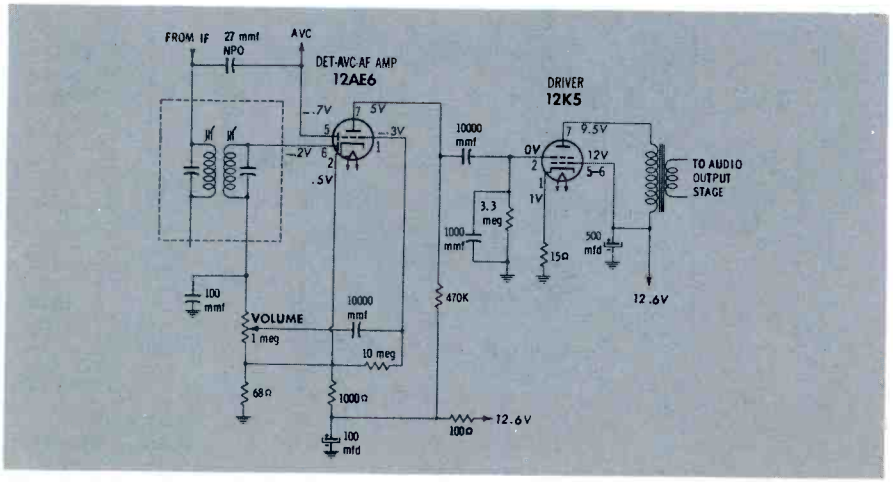


Fig. 1. Tube circuits following second detector in Mopar Model 624 car radio.

12EL6

Dual diode/triode for use as detector - AVC - audio amplifier.

For detector - AVC - audio stage ahead of transistorized driver.

12FK6 12FM6

12AE7

Dual triode used as two-stage driver for output transistor.

Triode with non-space-charge tetrode for search-tuning use.

12DY8

. . . HYBRID auto radios

by Thomas A. Lesh

The efficiency of hybrid designs has already been increased to the point where one stage can be omitted from many of the newer radios, and the audio voltage amplifier has been the first circuit dropped. New tube types, incorporating two diodes in the same envelope with a space-charge tetrode, have been developed so that the functions of detector, AVC rectifier, and transistor driver can all be performed by a single tube. Perhaps the most popular tube in this category is the 12DL8, an electrical equivalent to a 12K5 plus two diodes. Other space-charge designs have also been introduced; for example, some of the newer Chevrolet radios use a 12DV8 (Fig. 2).

The first audio amplifier stage has not been eliminated from *all* the new hybrid receivers; it is still required in various sets, including 1959 models with transistorized driver stages. The latest versions utilize either an "A" revision of the 12AE6 or a newly-developed 12FK6 or 12FM6. Logically, we might expect the next development in hybrid design to be the transistorization or removal of this stage, and adoption of an all-transistor audio section.

RF-IF Stages

Initial 12-volt RF-IF tube types were modifications of conventional radio tubes such as the 12BA6, with grids specially wound to allow maximum gain with low plate voltage. Results still left something to be desired; for instance, the 12AC6 (one of the original hybrid types) has a transconductance of only 730. Further research has led to completely new designs with greater cathode area, closer interelectrode spacing, and considerably higher transconductance. Some recent Chevrolet radios employ a 12DZ6 RF amplifier, a pentode with a gm of 3600. Among other "hot" pentodes are the 12EK6 (gm = 4200) used in 1959 Bendix-built radios, and the 12CX6 (gm = 3100) found in a number of '58 and later models. Use of these high-gain tube types has been a big factor in the production of hybrid radios with fewer stages.

Another way of obtaining more efficient receivers is to squeeze all possible gain from the RF-IF section by paying careful attention to the layout of the AVC system. This circuit is somewhat difficult to adapt to hybrid operation, since most hybrid RF-IF tubes cannot tolerate variations of more than one or two volts in grid bias and still maintain linear operation.

One workable solution to this problem is the use of a delayed AVC system of the type found in many TV sets. The negative voltage output of the AVC rectifier and filter is opposed by a positive bucking voltage, usually obtained by connecting the AVC bus to the 12-volt source through a high resistance (R1 in Fig. 3). Under weak-signal conditions, the delay circuit holds the grid bias of controlled stages to a minimum — usually a fraction of a volt. An increase in signal strength causes a gradual buildup of bias, but the controlled stages never receive the full output of the AVC rectifier. If the latter were –4 volts during reception of a moderately strong signal, the voltage actually applied to the RF amplifier would be on the order of —1.5 volts.

For more precise control of this stage, bias is usually applied to both the control and suppressor grids (see Figs. 3 and 4). In addition, a small proportion of the AVC voltage is usually fed to the grid of the converter through a voltage divider. The IF may also receive all or part of the AVC voltage, but AVC may be omitted if linear operation of the IF can be obtained without it.

Although an AVC delay network is frequently used in hybrid radios,

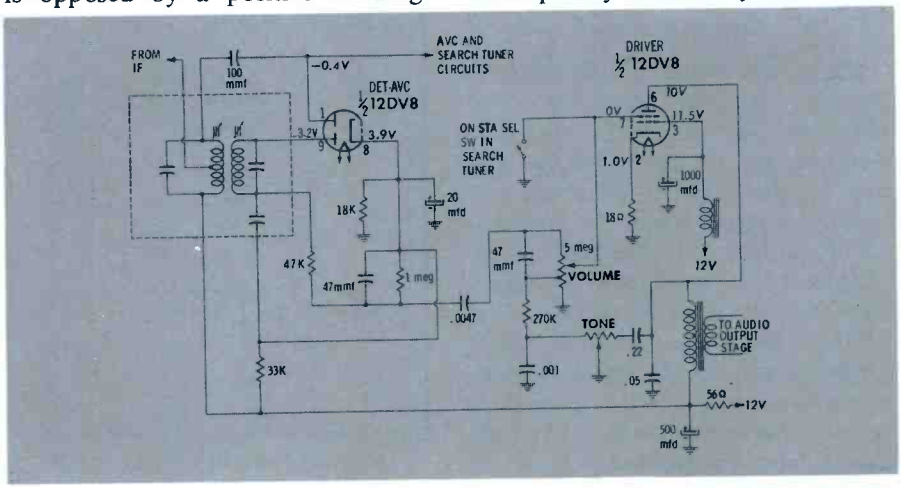


Fig. 2. Output of detector is applied to driver tube in Chevrolet Model 987730.

it is not found in *every* receiver of this type; in fact, quite a few hybrid sets have been built without this feature. When a simpler AVC system of the type shown in Fig. 4A is used, the RF amplifier tube may actually become cut off during strong-signal reception; however, a signal is still passed on to the converter by coupling through the grid-to-plate capacitance of the tube. Certain RF tubes used with undelayed AVC systems have a remote-cutoff characteristic, and even the strongest input signals are insufficient to bring tube conduction to a complete halt. (One such tube is the 12DZ6.)

The circuit of Fig. 4A is found in a five-tube 1957 Ford radio, Model 75MF. During the model year, this receiver was superseded by a simplified set (Model 74MF) with only four tubes. The AVC system of the newer radio is diagrammed in Fig. 4B. Note that a delay network was reintroduced into the RF section of the AVC line in order to provide higher gain ahead of the detector for weak signals. A portion of the AVC voltage was also fed to the IF stage, which was redesigned for better linearity of operation over a wide range of signal strengths.

In many of its current models, Motorola is using a 12EG6 heptode as an RF amplifier. AVC bias is applied to grid Nos. 1 and 3, just as in hybrid-type RF pentodes; but the heptode circuit differs from a pentode circuit in having its signal input fed into grid No. 3 instead of No. 1. This arrangement helps the AVC system to exert more precise control over RF gain.

Search Tuning

Some hybrid radios are "signal-seeking" models, equipped with motorized or solenoid - operated search-tuning devices. Control circuits for the search mechanisms are based on those found in conventional car radios. In the first hybrid versions of these circuits, a trigger tube (usually a triode section of a 12AE6) fed its output to a 12K5 space-charge tetrode which served as a control tube for the relay that actuated the tuning device. A space-charge tube was needed to provide enough current for relay operation.

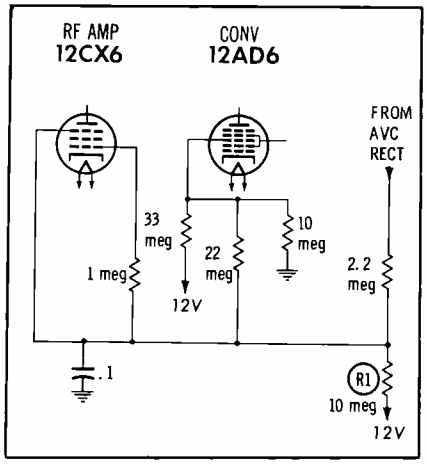
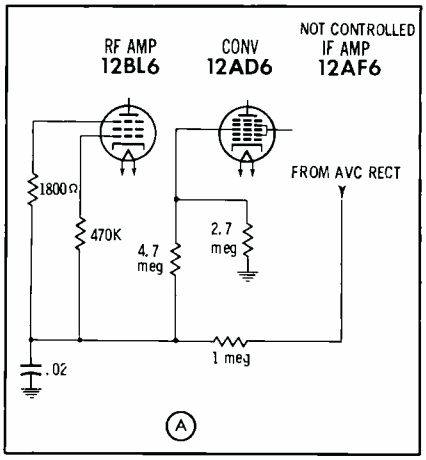


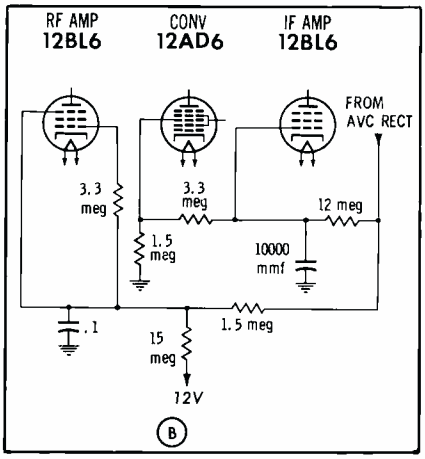
Fig. 3. Delay circuit reduces strength of AVC voltage in typical hybrid set.

It was not long before a dual-section tube (the 12AL8 triode/tetrode) was designed especially for use in the search circuits of hybrid radios. Electrically, the 12AL8 is equivalent to a combination of a 12AE6 triode section and a 12K5.

Fig. 5 is a simplified schematic of a typical 12AL8 circuit. The search-control stages used in different receiver models are generally very



(A) Early-production Model 75MF.



(B) Late-production Model 74MF.

Fig. 4. AVC networks in '57 Ford sets.

similar, in spite of the fact that considerable differences exist in the mechanical sections.

When the tuning mechanism is at rest, the relay-control tube is non-conducting, and the relay in its plate circuit is de-energized. Closing the search switch (usually a push bar or foot-operated button) grounds one side of the relay and closes a series of contacts. One set applies power to the search motor or solenoid, another mutes the sound, and still another places a shunt across the cathode resistor R6 of the control tube. Shorting out the cathode resistor lowers the bias on the tube, causing it to continue conducting heavily enough to keep the relay energized.

When the search tuner picks up a station, a signal appears at the output of the IF stage and is coupled through C1 to the grid of the trigger tube. Arrival of a signal causes the tube to conduct more heavily; as a result, a drop in plate voltage is produced. This negative-going swing of voltage is coupled through C2 to the grid of the relay-control tube, thus cutting off the tube and de-energizing the relay.

The contacts must be disengaged just in time to bring the tuning mechanism to a stop exactly at the center frequency of the desired station. This requirement is met by adjusting the system so that a predetermined level of input signal at the grid of the trigger tube will serve to cut off the relay-control tube. AVC is usually applied to the trigger-tube grid to compensate for variations in the strengths of different input signals. Some kind of "local-distant" or "town-country" sensitivity control (not shown in Fig. 5) also may be tied in with the search-tuning circuitry. When this is adjusted for local reception, the sensitivity of the RF-IF stages is cut down during operation of the search system. The tuner then skips over weak stations and seeks out the strongest signals being received in the area.

Testing Hybrid Tubes

Tubes in hybrid radios can be tested most accurately by trying substitutes of known good quality and observing the effect on performance. Just as in the TV field, this tech-

• *Please turn to page 95*

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_____
City Zone State

☐ Please imprint (maximum 4 lines) my copies as follows. Allow at least 1 week for processing.

to the tech...

Even though the Antenna Handbook is written for your customer, it will pay you well to look it over carefully. Make sure you know how to recognize and repair the defects shown. The check chart given for the customer to rate his system will also be helpful to you. Using it will enable you to accurately estimate your time in making needed repairs. Comparing your chart with the customer's before the job begins will also help to establish an agreeable price for doing the work.

The following handy reference tables list major brands of antenna components to help you calculate material costs. Since their costs are incidental, miscellaneous items such as mounting hardware, stand-off insulators, guy wire, ground wire, ground rods and entrance hardware aren't shown. To account for them in your estimate, add roughly 10% of the total material expense figure. The prices shown are those prevailing at the time of publication, and may vary at a later date.

ANTENNAS

Manufacturer	Urban 0 to 15 miles	Suburban 15 to 30 miles	Rural over 30 miles	UHF
Amphenol	114-101 11.95 / 6.45	114-005* 19.50 / 11.70	114-314 29.00 / 17.40	114-093 7.95 / 4.77
Antenna Designs		SX-55 9.95 / 5.98		
Clear Beam	A13 4.64 / 2.78	C64 5.39 / 3.23	CV90 22.10 / 13.26	KWS4 9.37 / 5.62
CDR	180SW 6.15 / 3.69	280SW 12.64 / 7.58		
Finney	B3 13.50 / 7.94	B4 17.50 / 10.29	B66A 39.80 / 23.40	
JFD	RX511 19.25 / 11.55	SX711 27.50 / 16.50	VXIIII 47.50 / 28.50	UHF410 8.20 / 4.92
Philco	30 9.95 / 4 98	50 13.75 / 6.88	70 26.95 / 13.48	
RMS	CY-IPA 17.00 / 10.20	1005 31.40 / 18.84	1007 44.30 / 26 58	UHC-1 5.00 / 3.00
TACO	1101 6.95 / 3.75	2540 14.75 / 7.96	2570 36.75 / 19.84	3044 8.75 / 4.73
Telco	A8141 19.50 / 11.70	A8111 24 95 / 14.97	A8122 59.95 / 35.97	A8128 7.50 / 4 50
Winegard	501 6.95 / 4.17	202-K* 14.95 / 8.97	CL-4 29.95 / 17.97	GG-1 7.95 / 4.77

*Complete kit

This antenna chart lists the most appropriate model in each category. First price shown in each column is list; second is dealer net. All kits listed include mast, mounting hardware, stand-off insulators, and 50' of twin lead. Lightning arrestor, ground rod and ground wire must be purchased separately. When signals must be received from more than one direction, suggest the use of either a rotator or multiple antenna setup for best performance on all channels.

LEAD-IN WIRE

Manufacturer	Standard	Heavy-Duty	Tubular	Cellulose-filled	Coaxial	Open
Amphenol-Borg	214-056 3.20 / 1.73	214-100 4.03 / 2.18	214-271 5.05 / 2.73		RG 59/U 8.38 / 5.03	
Belden	8225 3.15 / 1.84	8230 3.40 / 1.99	8235 7.00 / 4.12	8275 6.90 / 4.07		
Columbia Wire	5150C 4.79 / 2.39	5050C 5.95 / 2.98	5556 4.55 / 2.72	5650 8 15 / 4.90	RG 59/U 9.30 / 5.56	
Consolidated	4503 2.25 / 1.50	4523 8.40 / 5.60	4527 3.35 / 2.25		RG 59/U 8.40 / 5.60	

Lead-in wire is rated as standard or heavy duty, according to the number of strands, wire gauge and thickness of the dielectric material. Use heavy-duty wire in all outside applications. Tubular and cellulose-filled types are designed for low line loss. Open-wire line has the lowest loss, while coaxial cable is lowest in noise pickup. When using coaxial cable in TV antenna installations, install 72 to 300-ohm matching transformers at both ends of the cable. All prices in the chart are for 100' lengths.

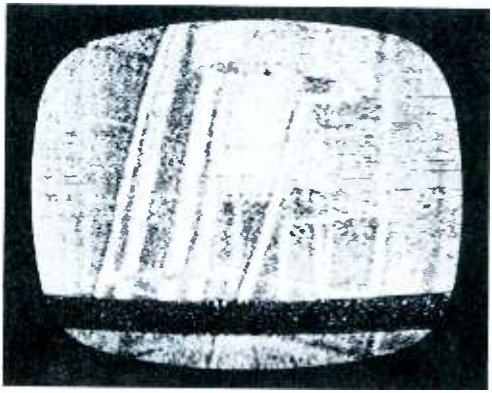
homeowner's

ANTENNA HANDBOOK

the facts behind your TV picture

A This is the type of picture quality you can expect to receive in the better signal areas.

B. Streaks are due to a broken wire in the antenna lead or to a loose terminal connection.



C. Flashes or specks are caused by auto ignition systems or electrical appliance motors.

Look for These Defects In Your Antenna System.

A television receiver, no matter how well designed and constructed, cannot produce top quality picture and sound unless its antenna system delivers a clear, strong signal. In turn, the system will provide such a signal only if properly installed and periodically maintained.

As a set owner, you should know that your antenna system must also meet certain safety standards. For example, even though reception is entirely satisfactory, your antenna system may not include necessary protection against the effects of static electrical charges and lightning, both of which present a very real hazard to life and property.

If your antenna system is more than two years old, or if it was not installed by a qualified serviceman, it may be inefficient, unsafe, or both. The following information will help you evaluate your own system and determine if and where it needs improvement.

Because the antenna can affect TV performance for one or more live channels, the first step is to check reception on each channel. Compare your own picture with those shown here. Photo A is an example of a good picture. Photos B through F indicate troubles caused by certain defects in the antenna system. Inspect your system for the defects illustrated on the following pages. After you have examined your system, use the check chart on the last page to determine the *ap-*

proximate cost of having it repaired by a qualified serviceman.

In some cases you may be unable to locate obvious defects, yet the appearance of your picture indicates the antenna system is at fault. You will recognize this condition if your picture is similar to any one of the five shown. In such instances, have your qualified serviceman test your system.

Multiple Outlets

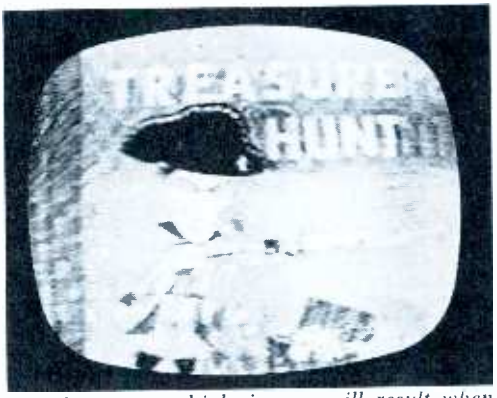
If you have more than one TV set, they can be connected to the same antenna system with excellent results. In a primary signal area (up to 15 miles from the station), multi-set couplers are very effective. For more distant locations, a signal amplifier may be necessary. Your serviceman is familiar with local conditions and can best advise you regarding multi-set installations.

About UHF

If you live in a UHF area, you are already acquainted with the fact that an outside antenna is best for consistently good results. Because UHF utilizes such high frequencies, it warrants special treatment. This involves the type and amount of lead-in wire used, and the technique with which it is installed.

Regardless of your antenna problems — VHF or UHF — look to your own serviceman for the most effective solutions at the least possible cost, and enjoy *all* the pleasure afforded by your TV set.

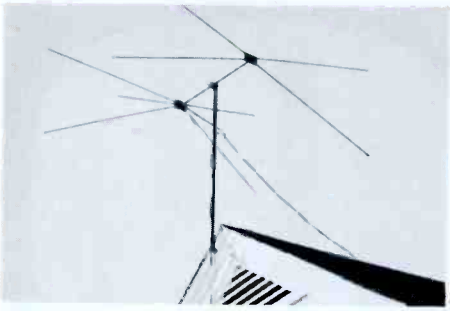
D. Very snowy pictures may be due to corroded antenna terminals or a short in the lead-in.



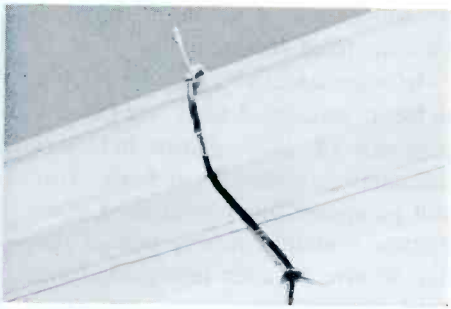
E. Ghosts or multiple images will result when the antenna is pointing in the wrong direction.

F. Bending, snow, poor detail, and flopping is also caused by improper antenna direction.

(Photos permission of NBC)



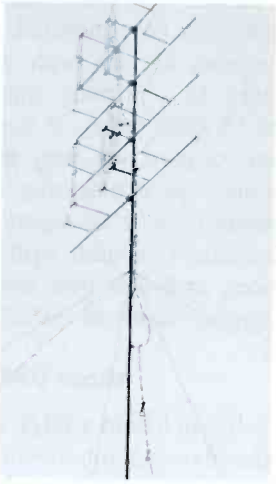
Two separate leads to the same antenna unbalance the system and cause ghosts or multiple images. Use of a two-set coupler permits the antenna signal to be fed to both sets without any such unbalance.



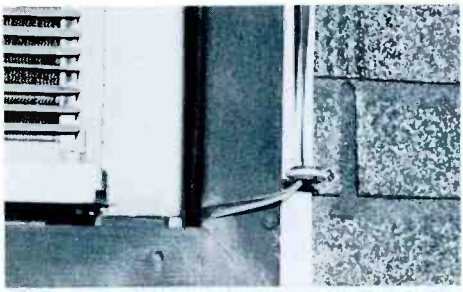
Notice that the lead-in wire is resting on the gutter. In a proper installation, long stand-offs are mounted above and below the gutter, and the lead-in is suspended to prevent signal loss and lead-in wear.

This large, high-gain antenna had been properly installed; however, the ravages of time have taken their toll. The broken stand-offs permit the lead-in to sway in the wind, and the conductors to flex and break.

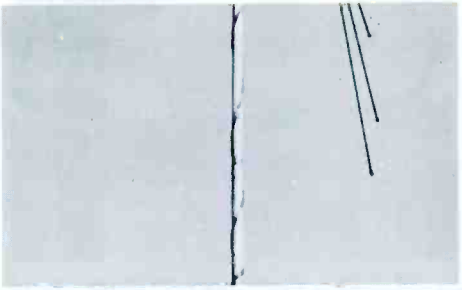
An antenna mast poked through the roof shows poor workmanship and presents a possible fire hazard if it is struck by lightning. The lead-in is also improperly installed, passing through the roof and touching the mast.



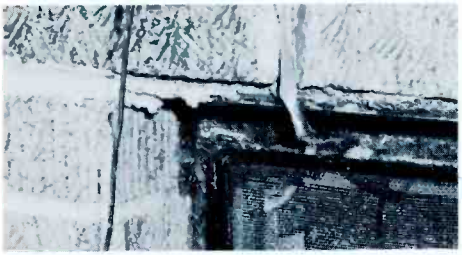
In this example a stand-off insulator is screwed into the center of the roof, with the lead-in wire laying on the roof. Contact between the wire and the roof weakens the signal, and such installations may easily cause roof leaks or other damage.



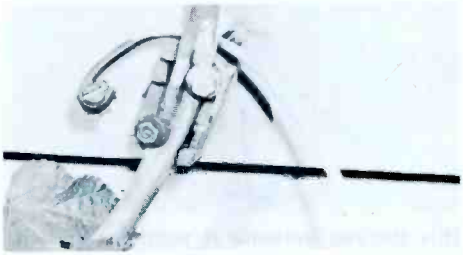
Notice the absence of a drip loop where this lead-in enters the house, and consider how rain water will run down and collect within the window frame. Also note the absence of a lightning arrestor, which is needed to drain off static charges picked up by the antenna system.



With the lead-in wire wrapped around the mast, the set would actually work better if it were not connected to the antenna at all. The lead-in should be well supported and routed out and away from all metal to prevent loss of signal and excessive pickup of unwanted noise.



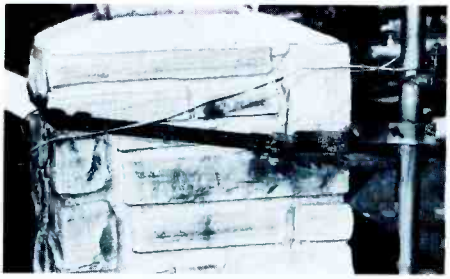
It's not a good idea to have the lead-in entering through a metal window. Proper entry also calls for a drip loop. Actually, the lead-in should not enter through the window at all, but through a suitable insulator in the window casing.



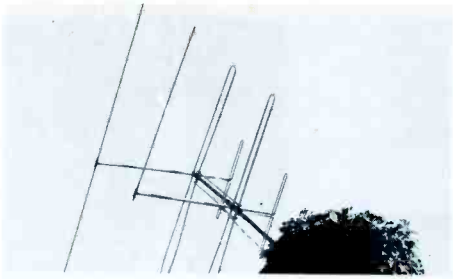
This oval-shaped tubular lead-in is cracked, partly because the lightning arrestor is designed for another type of lead-in, but also because of exposure to the weather. Such cracks let moisture reach the conductors, and cause trouble.

Even though a lightning arrestor is used in this installation, it provides no protection whatsoever. The absence of the ground wire, which should be attached to the bottom of the arrestor, and the fact that there is no ground rod, indicates how poorly this system was installed.

Corrosion at the terminals robs your set of needed signal, often causing a snowy picture. If other parts of the antenna aren't rusted or corroded, installation of new screws and terminals, and sanding of the surface around the screw holes may be all the repair required.



By all rights, these rusty chimney straps should have broken long ago. If your mounting hardware looks like this, have it replaced with stainless steel or aluminum before the whole business comes down and damages the roof — or worse yet, harms some innocent passerby.



This chimney-mounted antenna and supporting mast are quite weather-beaten. Heavy winds have blown off one of the rear elements and changed the shape of two others. The net result of such damage is to make the system inoperative. A new mast and antenna are needed.

This stacked antenna is partially broken, resulting in an inoperative system. If a duplicate of the broken half cannot be obtained, the entire antenna should be replaced. If used in a local area (within 15 to 20 miles of the station), the good section may serve satisfactorily.

This lead-in is fastened to the house with a wire staple, and has neither drip loop nor lightning protection. Too, its close proximity to the metal coal chute has a bad effect on the signal. An entrance fixture, arrestor, ground wire and stand-off insulators should be used.

This serviceman is just about ready to enter the house and attach the antenna lead of his quick-rig, antenna-comparison setup to the customer's set. Your local serviceman can demonstrate the improvement offered by a properly installed antenna with similar equipment.

WORK NEEDED		COST ESTIMATE Time	Material	YOUR FIGURES Time	Material	NOTES
Correct lead-in entry		½ hour	to $3.00			Entry fixture included
Replace lead-in		½ hr. per 50′	to $5.00 per 50′			Cost varies with type and grade
Replace antenna		1 hr.	$5.00 up			Your serviceman should choose antenna type
Install mounting hardware		1 hr.	to $10.00			Material cost varies with type of mount needed
Reroute lead-in		½ to 1 hr.	to $2.50			Lead-in should be properly suspended and insulated
Install lightning arrestor		¼ hr.	to $2.00			
Ground arrestor		¼ hr.	to $3.00			Includes cost of ground rod & copper conductor
Orient antenna		½ to 1 hr.	.....			
Replace antenna mast		1 hr.	to $5.00			
Ground antenna mast		½ hr.	to $5.00			Materials slightly higher for non-standard inst.
Install guy wire		1 hour	$3.00 up			Time & material costs are for basic needs.
Install outlets for additional sets		1 to 3 hrs.	$7.50 to $60.00			Higher material costs include signal amplifier
Complete installation		2 to 4 hrs.	$15.00 up			Single set installation for normal signal areas
Add rotator		2 hrs.	$40.00 up			
Install tower		4 to 12 hrs.	$75.00 up			Cost varies with type of base and height of tower.

To use chart, place checkmarks in boxes corresponding to the defects you find. Then write in the time required to repair each one, and the approximate cost of needed materials. Total the time figures and multiply the result by $5.00 and $7.50 to obtain an approximate range for labor charges. Adding material costs to these figures will give you a rough idea of total cost.

This Homeowners TV Antenna Handbook comes to you through the courtesy of:

Wherever you see this sign  you will find dependable servicing information.

Prepared by Howard W. Sams & Co., Inc., Indianapolis, Ind., with the cooperation and assistance of leading electronic parts and equipment manufacturers, distributors, and service organizations.

POWERED DISTRIBUTION SYSTEMS

Manufacturer	Model	Description	Price	
			list	net
Blonder-Tongue	B-23	VHF-FM amplifier-coupler	23.95	14.95
Blonder-Tongue	DA8-B	8-outlet distribution amplifier	94.50	58.50
Blonder-Tongue	MLA	VHF antenna or line amplifier	142.50	85.50
Jerrold	HSA-46	5-set home-system amplifier	49.95	33.30
Jerrold	HSK-300	Complete home system	67.75	43.98

The powered systems and amplifiers listed are primarily intended for use in residences. Other units and accessory items to complete a system are available from the respective manufacturer. For more detailed data on any of these powered systems, consult your local parts distributor.

ROTATORS

Use rotators with thrust bearings on heavy or stacked arrays, or in areas subject to ice, snow or high winds. All rotators listed use four-wire cable (round or flat) except as noted. Use of five-wire line is suggested for rotators requiring four conductors for operation; this provides a spare conductor if one breaks.

Manufacturer	Model no.	Indicator	Description	Price	
				list	net
Alliance	U-98	Compass	Automatic	44.25	26.55
CDR	AR-1	Compass	Automatic	46.95	28.17
Philco	AP-1	Compass	Automatic	50.48	30.28
Trio	TR-2M	Compass	Standard	44.95	26.97

TOWERS

Manufacturer	Model	Height	Type of Base	Price	
				list	net
KTV	740-K	40′	Concrete	119.50	74.00
Rohn	6G	50′	Ground	121.35	78.60

Chiefly, towers are needed to increase antenna height, although many homeowners would consider a tower-mounted antenna in lieu of one on the roof. Structures are self-supporting to the heights given if anchored to the house 10 to 12 feet above ground. For towers higher than 50′, use concrete base and guy at 50′ level. Tower-mounting base sections should extend below concrete into gravel bed for proper drainage.

ANTENNA and SET COUPLERS

Manufacturer	Two-Set	Three-Set	Four-Set	Hi-Lo Ant.	UHF-VHF	Hi-Lo-UHF
Amphenol-Borg	114-088 3.75/2.25	114-098 3.95/2.37	114-090 5.75/3.45	114-094 3.75/2.25	114-061 3.75/2.25	114-074 4.75/2.85
Anchor	C-202 2.95/1.77					
Blonder-Tongue	A-102 2.95/1.80		A-104 3.95/2.40	A-105 3.50/2.10	A-107 3.50/2.10	
Charles Eng'g	Wizard 300 1.95/1.20	couples up to 30 sets with additional units				
JFD	BC-2 2.85/1.71	BC3 3.20/1.92	BC4 3.60/2.16	AC10 3.50/2.10	AC20 3.75/2.25	AC30 4.85/2.91
Jerrold	MF-2 4.50/2.70		MF-4 5.75/3.45			
Mosley	902 3.10/1.86		904 6.25/3.94			
RCA	240A1 1.90/1.15					
Superex	FC 2.49/1.49					
TACO	825-2 3.75/2.02	820-3 3.20/1.73	820-4 3.60/1.94	1425A 4.15/2.24	1460A 3.65/1.97	852 3.85/2.08

The two-, three- and four-set couplers listed are of the passive type (no gain), and should be mounted so that the branch leads are as nearly equal in length as possible. Weatherproof two-set couplers work best when mounted near the antenna.

Antenna matching transformers are designed to permit more than one antenna to be fastened to the same down-lead in multiple antenna installations. These matching units are passive and should only be used in relatively strong signal areas.

The products in the foregoing charts are not a complete listing of all those available, but a cross-section of typical components.

THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

Much Snow—No AGC

The picture on an Arvin Chassis TE- tubes have had no effect. In either position of the AGC switch, I measure a positive 0.4 volts at the top of C9 in the RF branch of the AGC circuit. Voltages at the plate of the keying tube and at the grids of the AGC-controlled IF amplifiers are also a fraction of a volt positive. I have checked all components in the AGC circuit, but haven't found a defective one.

When I place a probe on the grid of the first section in the 6BQ7 cascode RF amplifier, a snow-free picture appears and the VTVM indicates a negative voltage. Everything in the RF input circuit checks good as far as I can tell.

SAM E. ELLIS

Oak Ridge, Tenn.

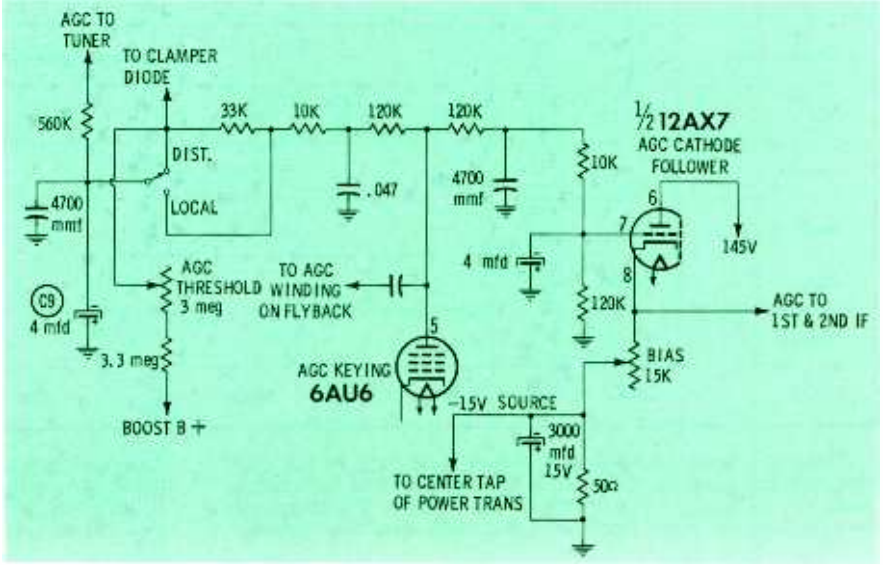
It's not unusual for the AGC voltage to be zero or even slightly positive when the signal getting through the IFs is too weak to develop any appreciable AGC bias. Since the RF and IF stages in your set should be operating at maximum gain with no AGC applied, the receiver's failure to produce a strong video signal is probably due to tuner or IF trouble rather than an AGC defect.

By touching the RF amplifier grid, you are somehow bringing the video signal up to its proper level and thus allowing the AGC system to develop the usual negative control voltage. Here is further evidence that the AGC system is probably okay.

There is a strong possibility that an open connection in the antenna input circuit is preventing the signal from entering the tuner. You can introduce a signal with the test probe because it acts as a crude antenna. Dirty or loose tuner contacts should be suspected as causes of an open input circuit. Some other type of defect, such as a short in the antenna matching transformer, could also result in a loss of signal.

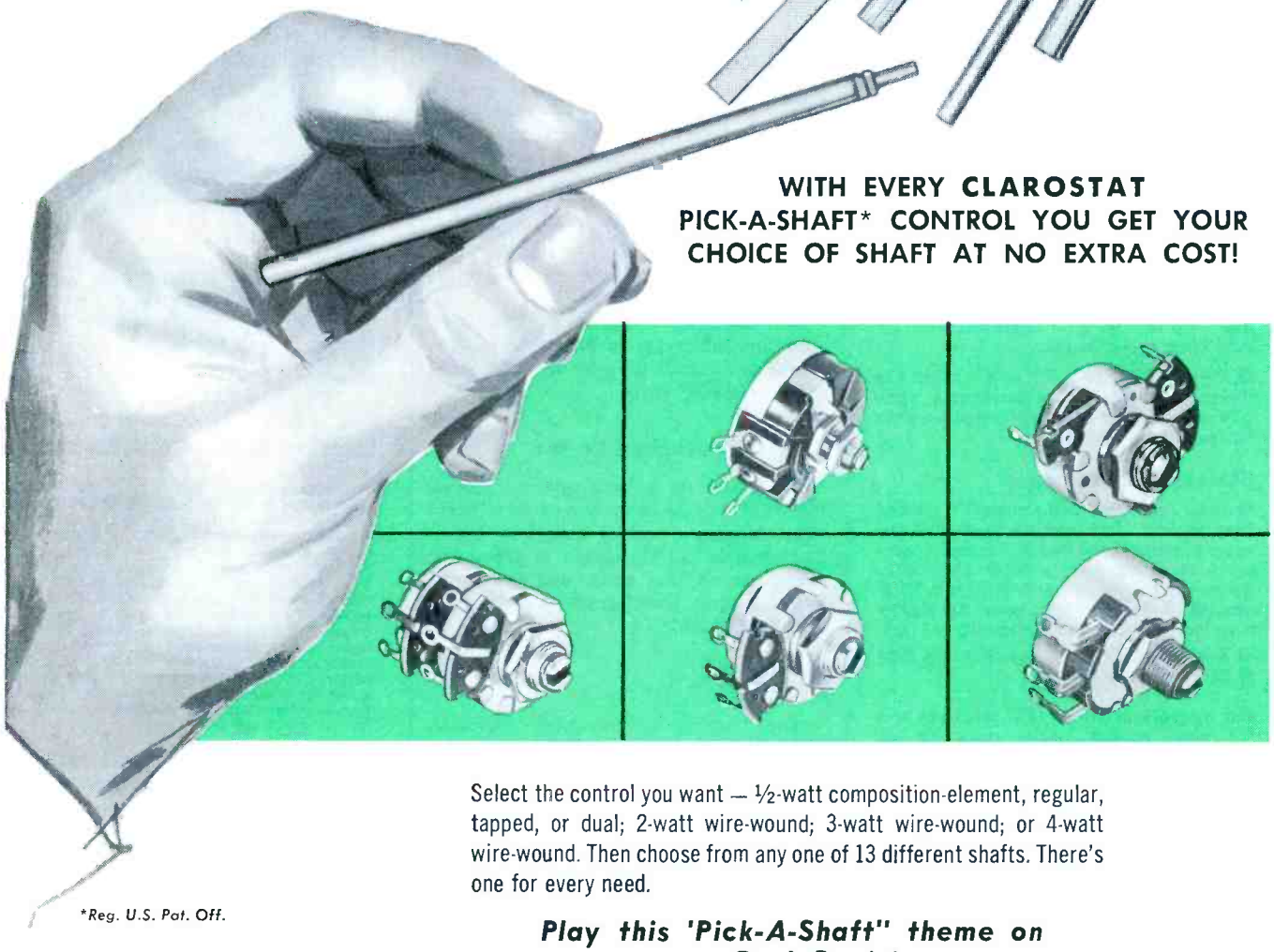
The RF amplifier stage might be dead, or at least defective enough to prevent passage of a signal. Watch for burned-out components that might have been caused by a previous tube failure. In cases such as this, disturbing the circuit with a test probe sometimes allows a signal to get past a defective stage by capacitive coupling.

By some freak coincidence or combination of defects, a malfunction in the AGC system might have something to do with your trouble—but this is unlikely. Try clamping the AGC line if you want to make certain whether the keying circuit is good or bad.



Choose the shaft

YOU WANT...



WITH EVERY CLAROSTAT PICK-A-SHAFT* CONTROL YOU GET YOUR CHOICE OF SHAFT AT NO EXTRA COST!

Select the control you want — ½-watt composition-element, regular, tapped, or dual; 2-watt wire-wound; 3-watt wire-wound; or 4-watt wire-wound. Then choose from any one of 13 different shafts. There's one for every need.

Play this 'Pick-A-Shaft" theme on your Cash Register

*Reg. U.S. Pat. Off.

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In Canada: CANADIAN MARCONI CO., LTD., TORONTO 17, ONT.

The unusual IF branch of the AGC system in this receiver deserves a closer examination, even though it probably has nothing to do with your present difficulties. Note that the connection from the keying tube to the IF strip is made through a cathode-follower stage (half of a 12AX7). The AGC bias for the IFs, which is tapped off directly from the cathode of the 12AX7, is the resultant of two opposing voltages. One of these is a fixed potential of —15 volts obtained from B—, and the other is a variable positive voltage developed by tube current passing through the BIAS potentiometer in the cathode circuit. The control is normally adjusted so that these two voltages will cancel each other under no-signal conditions, producing approximately zero volts on the IF branch of the AGC line.

Arrival of a signal causes the output voltage of the keying tube to shift in a negative direction, thus increasing the bias on the cathode follower. The cathode current of the 12AX7 then goes down, and less positive voltage is developed across the cathode resistance. As a result, the cathode voltage shifts in a negative direction to provide the needed IF bias. If the 12AX7 ever burned out or became completely cut off, the IF-AGC voltage would drop all the way to —15 volts.

The cathode-follower circuit has the important advantage of providing a high degree of isolation between the AGC circuit and the IF strip.

Puckered Raster

The raster on a Westinghouse Model H966KU21 is severely bowed in at both sides, forming a sort of hourglass shape. I've changed all capacitors in the horizontal circuit, the yoke, and the horizontal output transformer, but haven't cured the trouble.

JIM PHILLIPS

Lavonia, Ga.

The "hourglass" symptom indicates that the horizontal scanning lines in the middle portion of the raster are shorter than those at the top and bottom. Line length would vary in this manner if 60-cps amplitude modulation were present in the yoke-driving signal. Perhaps the gain of the horizontal output stage is fluctuating at a 60-cps rate. A symptom of this nature suggests the possibility of AC power-line interference — but not the kind we are accustomed to seeing.

I recently saw a very similar case of trouble in a Philco Model 51-T1833. As shown in the test pattern (photographed on a round picture tube), there were two indentations on each side of the raster. It was discovered that 120-cps interference from the full-wave power supply was causing this condition. In this set, the grid of the horizontal output tube receives a fixed bias from a negative 15-volt tap on the low-voltage supply. Improper filtering of this B— voltage allowed a 120-cps signal at 135 volts p-p to appear on the B— line (see wave-

more money shorter hours

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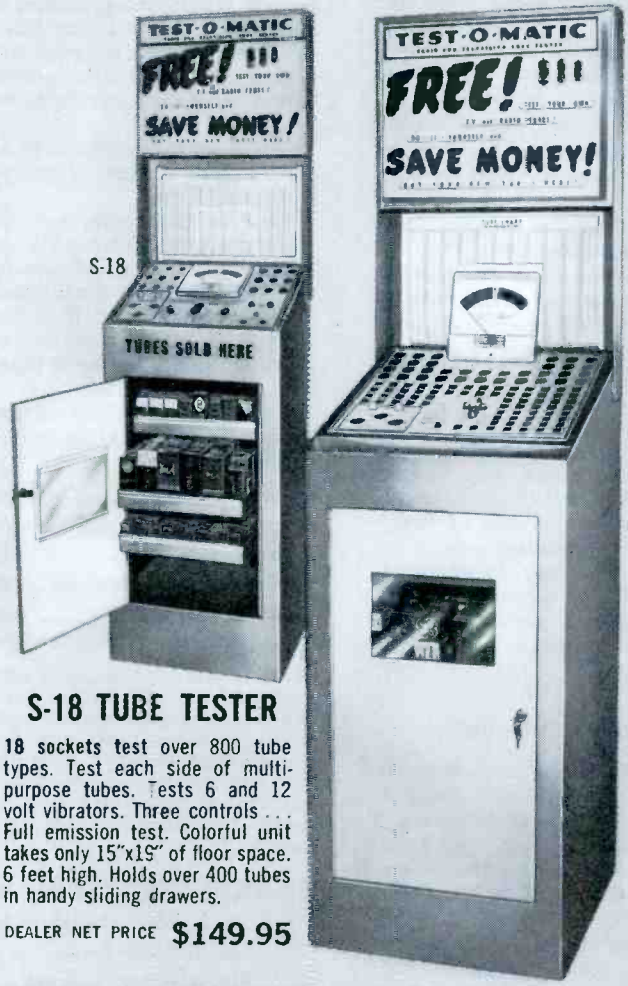
PROFIT PRODUCING
LABOR SAVING
QUALITY PRODUCTS

NEW PORTABLE P-18
TUBE TESTER FOR
SERVICE CALLS

LEG UNIT EASILY
ATTACHABLE.

TABLE MODEL T-18
SELF-SERVICE TUBE TESTER



S-18 TUBE TESTER

18 sockets test over 800 tube types. Test each side of multi-purpose tubes. Tests 6 and 12 volt vibrators. Three controls . . . Full emission test. Colorful unit takes only 15"x15" of floor space. 6 feet high. Holds over 400 tubes in handy sliding drawers.

DEALER NET PRICE **$149.95**

NEW PORTABLE P-18

Handsome, lightweight (12 lbs.) portable tester contains same testing panel as S-18. Available in black-grained finish attache case. Operates 110V AC.

DEALER NET PRICE **$79.95**

TABLE MODEL T-18

The Shell T-18 and L-18 have the same panel and performing qualities as the S-18 (shown at the far left). This model, with easily attachable leg unit, can be utilized with profit making success in your own service shop. One low cost unit can be used to attract "do-it-yourself" customers, while the other models with tube storage cabinets can be spotted in high-traffic stores to sell your tubes and services for you.

T-18 DEALER NET PRICE **$91.85**
L-18 DEALER NET PRICE **$99.95**

DELUXE 102 SELF-SERVICE TUBE TESTER

- Engineered to accommodate new type tubes as they are produced
- Largest selective tube chart available, lists and checks more tubes than any other self-service tube tester
- Complete emission tester
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- 102 sockets, one knob control
- Stores over 400 tubes
- Checks each section of multi-purpose tubes

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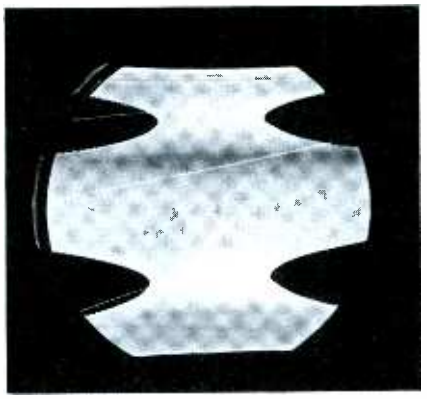

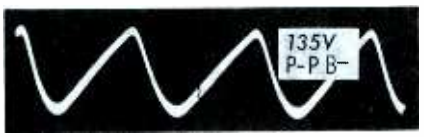

form), and this spurious signal was odulating the horizontal drive signal.

The trouble originally began when the input filter capacitor in the power supply opened up. (In this receiver, it is wired between B+ and B—.) Failure of this filter resulted in excessive pulse voltage on the B— line, which finally broke down a 10-mfd supplementary filter capacitor between B— and ground. With all filtering removed from the B— line, it was no wonder that a tremendous ripple waveform appeared on it.

Since your Westinghouse set uses a half-wave voltage doubler circuit with a ripple frequency of 60 cps, you could logically expect power-supply filter trouble to produce a single hourglass pattern instead of the double pattern observed on the Philco set. The defect in the Westinghouse is not directly comparable to the one in the Philco, since the former doesn't have a B— circuit; however, I suspect that some combination of filter-capacitor failures is producing your present trouble. I would start by checking C2, a multisection unit containing the input filter as well as a plate-decoupling capacitor for the second section of the horizontal oscillator.

Wrong Grid Voltage?

According to the PHOTOFACT schematic for Magnavox Chassis CTD447, the grid voltage on the first section of the horizontal oscillator is supposed to be –0.5 volts when the oscillator locks into sync. I am servicing one of these sets, and its oscillator will not lock in except at +0.8 volts. No components have been found defective, and horizontal alignment has been followed to the letter.

FRANCIS L. MURPHY

Joliet, Ill.

A reading of +0.8 volts on the oscillator grid is well within tolerance, if you consider the variations in component characteristics from set to set as well as differences in conditions of measurement. Therefore, I wouldn't worry about the slight discrepancy unless the oscillator tends to be unstable in operation.

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By Calvin C. Young, Jr.

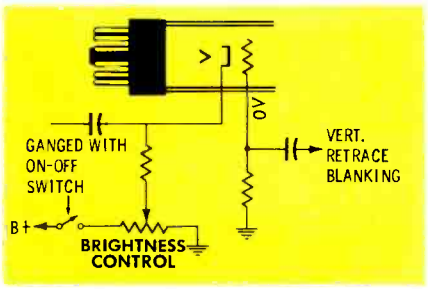


Fig. 1. Spot elimination circuit used when brightness control is connected in cathode circuit of the picture tube.

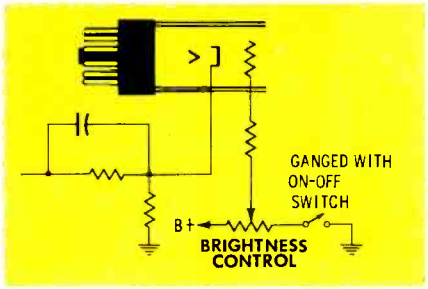


Fig. 2. Spot elimination circuit used when brightness control is connected in the grid circuit of the picture tube.

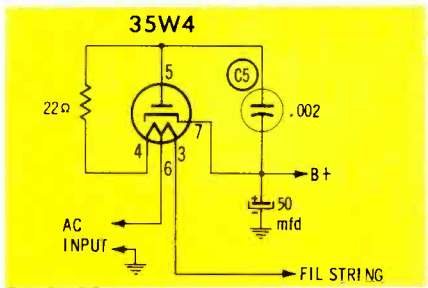


Fig. 3. 35W4 circuit showing low-impedance path to ground if C5 shorts.

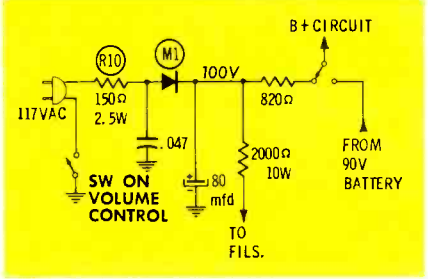


Fig. 4. B+ circuit in Philco portable.

Residual Spot on CRT Screen

If your experiences have been anything like mine, you may not have been able to completely convince some customers that the "lingering spot of light" on his TV screen won't damage the picture tube. In fact, you may not be entirely sure yourself. If skepticism is further compounded because the spot became apparent only after you installed a new picture tube, you are ready to dig into the pros and cons of the question—as well as a solution to the problem.

It is normal for a spot of light to appear in the center of the TV screen for a few seconds after a set is turned off. If this spot is very intense and lasts for more than 5 to 10 seconds, the screen *can* be damaged if the condition is not corrected.

What causes the intense spot of light? It is, in fact, the result of a combination of conditions, i.e., the high-voltage filter network contains considerable capacitance and B+ energy to the sweep circuit decays very rapidly when the set is turned off. This means that a considerable charge is still stored in the high-voltage filter. Since the cathode of the picture tube is still hot enough to emit electrons, there is no sweep, high voltage is applied to the anode of the CRT, and electrons are drawn away from the hot cathode and strike the screen. The resultant spot lasts until the high-voltage charge is dissipated, or until the cathode cools and no longer emits electrons.

The solution to the problem is very simple; dissipate the charge stored in the high-voltage filter before the sweep circuits cease to operate. How can this be done? It's really easy. Simply install a switch in the brightness control circuit. This switch must be ganged with the on-off switch; therefore, the existing SPST on-off switch has to be replaced with a DPST switch. The extra switch section can then be wired into the brightness control circuit so that either a zero bias or positive bias condition is created.

If the brightness control is located in the cathode circuit, connect the switch between the brightness control and B+ as shown in Fig. 1. This causes the bias on the picture tube to shift to zero the instant the set is turned off; the resulting heavy conduction rapidly discharges the high-voltage capacitor.

When the video signal is DC coupled to the cathode of the CRT, the brightness control may be located in the grid circuit. In such cases, wire the extra switch between the brightness control and ground (Fig. 2). Turning the set off then causes grid voltage to rise to the value of B+. The corresponding

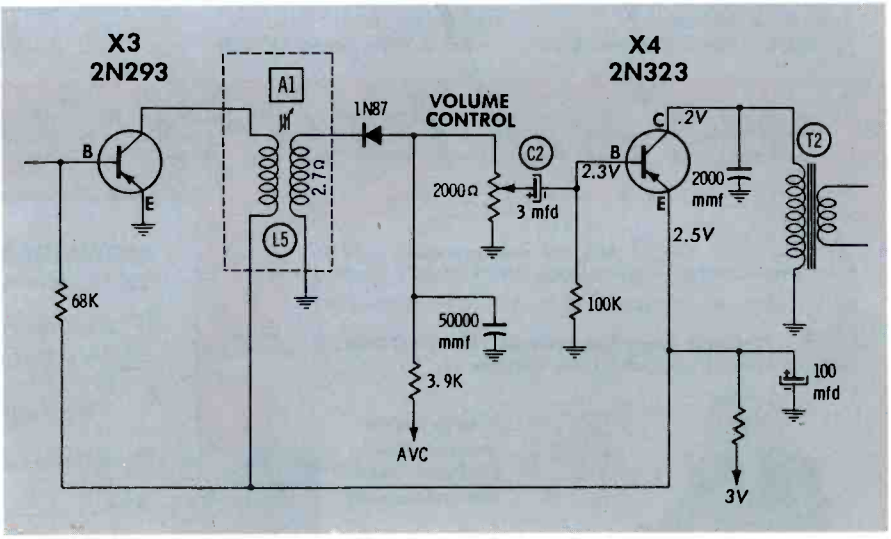
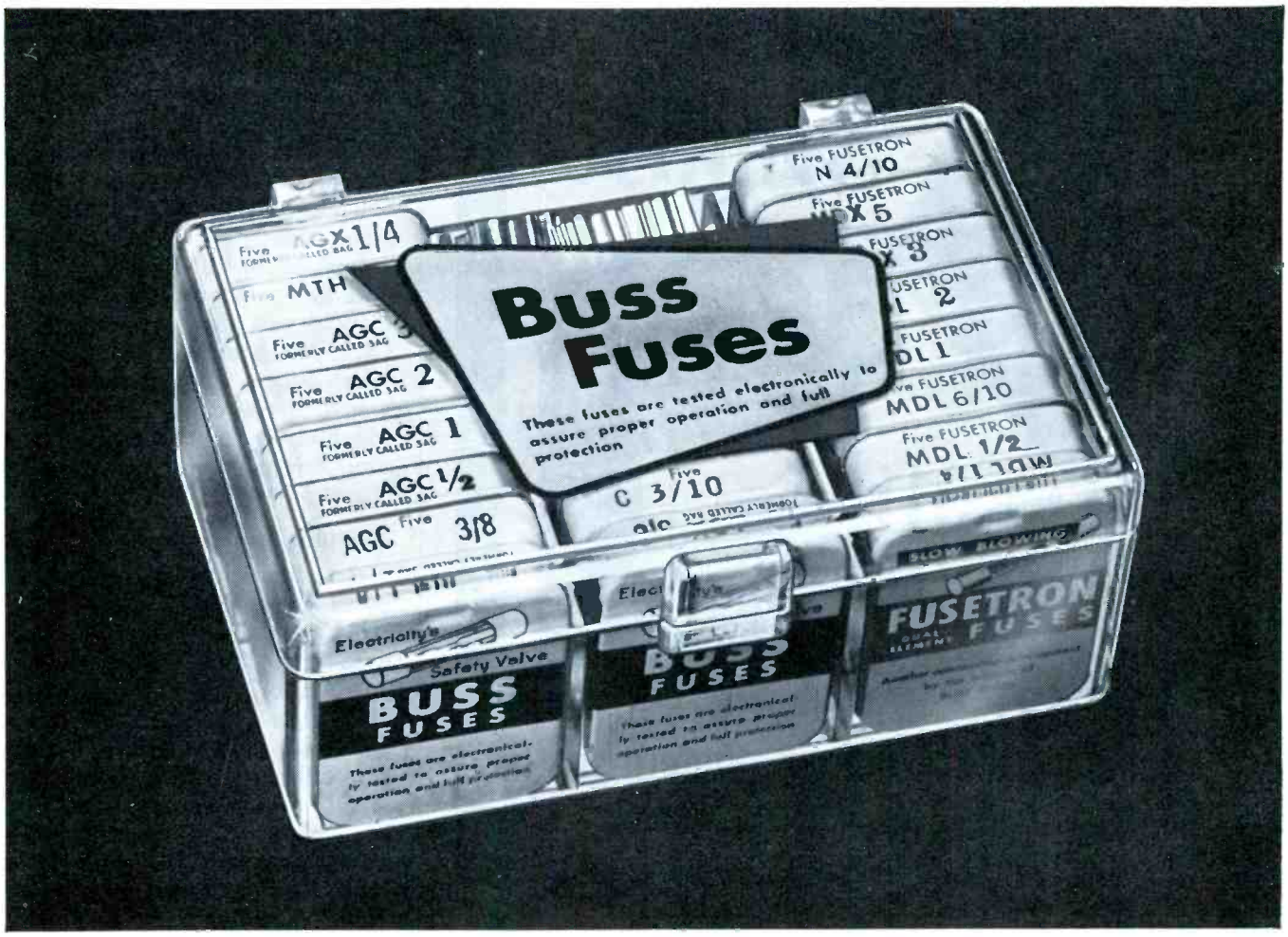


Fig. 5. Transistor circuits can be checked by signal injection and noise agitation.



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heavy conduction in the CRT rapidly dissipates the high-voltage charge.

Even though the addition of a spot-eliminator network necessitates replacement of the on-off switch and the control assembly to which it is attached, cost of the project is minor and shouldn't exceed $10, including labor. Materials alone will run around $2.50 to $3.00.

If the spot suddenly appears on that older set after you install a new CRT, you should very seriously consider adding the spot-eliminator switch. If you check carefully, you will probably find that the volume control is noisy and should be replaced anyway.

Rectifier Burnout in AC-DC Radio

Recently, it was my sad experience to encounter a brace of AC-DC radios with identical trouble symptoms—completely inoperative. A quick check with a filament continuity tester revealed a bad 35W4 in each case. Without further thought, new tubes were installed and both sets turned on for a test run. When five minutes passed and neither radio had uttered a sound, the 35W4 tubes were removed and retested. Again, they were defective; one half of each filament was open.

The chassis were removed and thorough checks for shorted filters were made. Results were negative, and there was no trace of burned resistors. Stopping to analyze the circuit (Fig. 3), I suddenly realized that only one thing could cause this trouble—the .002 capacitor between plate and cathode of the 35W4 tube had to be shorted. This completed a low impedance path between the AC line and chassis through one half of the 35W4 filament, a 22-ohm resistor, and the input electrolytic. The reactance of a 50-mfd capacitor is about 53 ohms at 60 cps, and the cold resistance of the 35W4 tube filament between pins 4 and 6 is only 8 ohms; thus, with this capacitor shorted, a total resistance of only 83 ohms exists across the line the instant the switch is closed. Result—a surge of 1.41 amps will flow, and one blown 35W4!

To avoid this type of repeated 35W4 failure, measure between pins 5 and 7 of the tube for shorts or leakage (use the X100K scale on your VTVM or VOM). This check can often be made without pulling

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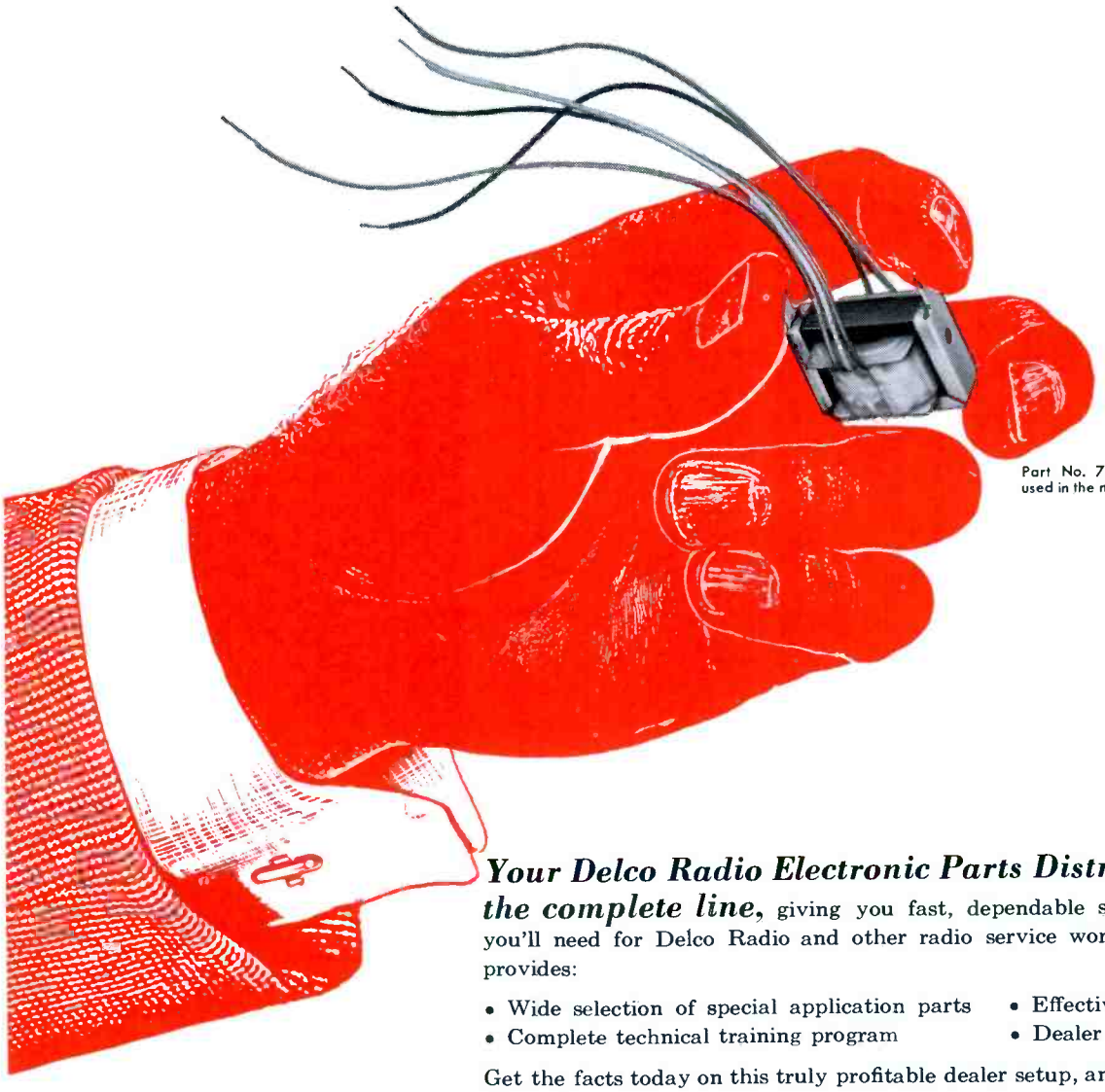

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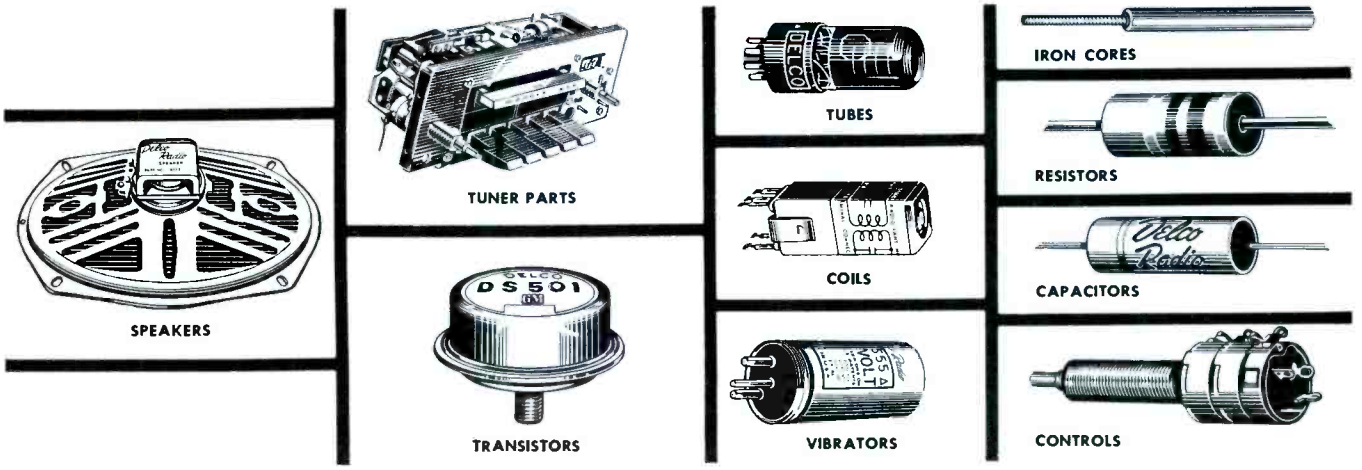

the chassis. However, even pulling the chassis (a 4 or 5 minute job) is better than burning out a perfectly good replacement tube.

Radio Squeals on Test Run

A short time ago, a technician friend reported the following incident. He had been given a Philco Model 675 portable radio to repair, and after locating a defective 150-ohm 2.5-watt surge resistor (Fig. 4) and checking the circuit for shorts (none were found), he applied power to give the receiver an operational check.

The resulting audio squeal was quite disconcerting. After a solid hour of circuit tracing the printed wiring board and making numerous voltage and resistance checks, the technician found himself no nearer the solution. Just as he was ready to give up in despair, a co-worker returned to the shop for the day and, seeing the disgusted look on our struggling technician's face, offered to help with the set if he could. When the situation had been explained, he said simply, "I know just what the trouble is. Put the bottom cover on the chassis and your squeal will stop." He continued, "The volume control case is grounded to the B-minus buss through the bottom cover. With the cover removed, the case is floating and picks up a feedback signal — result, squeal."

This same basic chassis is employed in Philco Models E670, E672, E675 and E676, so be on the alert when you service these units, and don't lose time hunting for squeals that aren't troubles. In fact, you should make it a habit to replace all shields and covers before operating either a radio or TV. This will eliminate cases such as the one just related.

Intermittent Transistor Portable

A customer very wisely brought this radio into the shop during the off season. When questioned, he said he wanted to be sure to have it fixed before the weather turned nice. He complained that the volume would go up and down intermittently. The condition was worse when the volume control was tapped lightly.

The chassis, speaker, and antenna assemblies were removed from the case and customary visual checks

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1N2078 Maximum ratings (100°C) capacitive load:
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Average D. C. Output Current	500 mAdc
Peak Recurrent Forward Current	5 Amps.
½ Cycle Surge Current	30 Amps.
Full Load Voltage Drop @ 25°C	1.1 Volts
RMS Input Voltage	130 Volts
Minimum Series Resistance (for capacitive filter)	5 ohms, 10 watt

TUNG-SOL

for poor solder connections, broken foil strips, and shorts on the board were made—with negative results. Since there was no rush on this job and there were several others to be dealt with first, the intermittent was put aside.

When the unit was finally tackled again, preliminary voltage checks were made at the base, collector, and emitter terminals of each transistor, but no serious discrepancies were noted. At this point, a signal was injected at the base of the audio driver transistor X4 (Fig. 5). The generator was connected to the base through a capacitor, and the output kept just high enough to get a response from the speaker. When the audio output decreased with the setting of the volume control, and actually fell to zero at the minimum setting, the technician knew control operation was normal, and the 3-mfd coupling capacitor was good. At minimum setting of the control, the 3-mfd capacitor shorted out the AC signal and resulted in no output. If the capacitor had lost capacity (usual when it fails), there would have been output from the speaker.

Now that the audio section had been checked and found okay, the next step was to check the last IF (X3) and detector stage. Shorting the base to the emitter of a transistor actually causes a reduction of current, and is a form of agitation test much like grounding the grid of a vacuum-tube amplifier. This was done in the circuit of X3. The resulting output, even at maximum volume, was almost inaudible.

Since the voltages associated with X3 had been previously checked and okayed, the detector diode was the next suspect. Checking its forward and reverse resistances while still connected in the circuit produced a reading of a few ohms in the forward direction and 150K ohms in the reverse direction. Since one side of the diode was supposed to connect to ground through the 2.7-ohm winding of L5, and the other side through the 2,000-ohm volume control, it was obvious there was an open in the circuit. Subsequent checks revealed that both leads to the secondary coil of the detector transformer had broken from their terminals.

The shield was removed from the coil, and small wires soldered be-

Fig. 6. Temperature-controlled iron has detachable cord and pre-tinned tip.

tween the terminals and coil leads. It was also noted that the original leads had been single wires which were drawn very tightly to their connector terminals. Trying to analyze the failure, it was decided that normal flexing of the board—or some sudden force (dropped radio, etc.) —had caused the wires to snap. Enough slack was included in the wire jumpers to prevent a recurrence of the trouble.

Temperature-Controlled Soldering Iron

For the technician who prefers to use a soldering iron, the new Weller "Magnastat" is sure to make a hit. The three models currently available include the TC40, TC60 (shown in Fig. 6) and the TC120. The numerical suffix of the model designation is the same as the wattage rating of the particular iron. All three feature screw-in pre-tinned tips and detachable cords. Weight of the irons including the AC cord are 5.5, 6.7 and 11.2 ozs., respectively.

The tip screws into the iron and over the heating element (see Fig. 7), a feature that is largely responsible for the iron's ability to retain correct soldering temperature even when making repeated connections. The model TC-60 was tested in the lab and found satisfactory for all service jobs that didn't require soldering to the chassis. The compactness and light weight, plus the cool handle (even after prolonged operation), make this a very nice service tool. In addition, the temperature-controlled feature increases tip life because of reduced oxidation. ▲

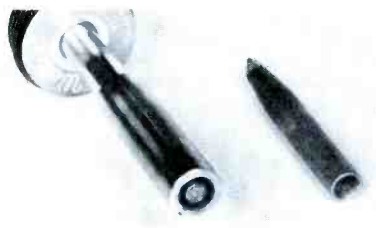
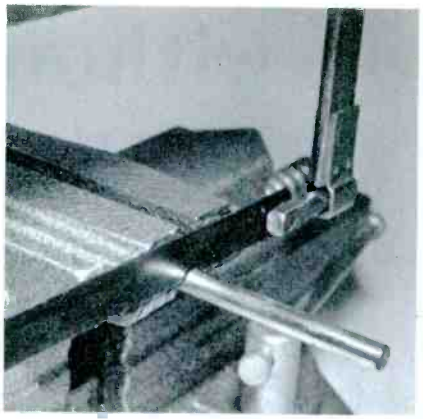


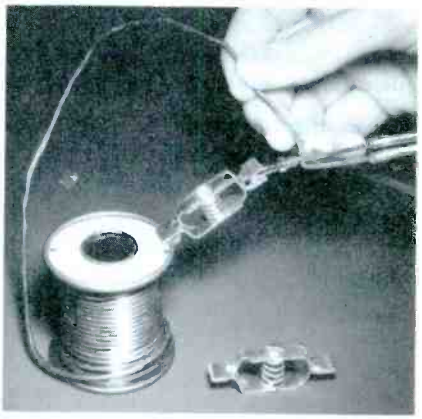
Fig. 7. Tip screws over heating element for efficient transfer of heat to tip.

TIPS for TECHS



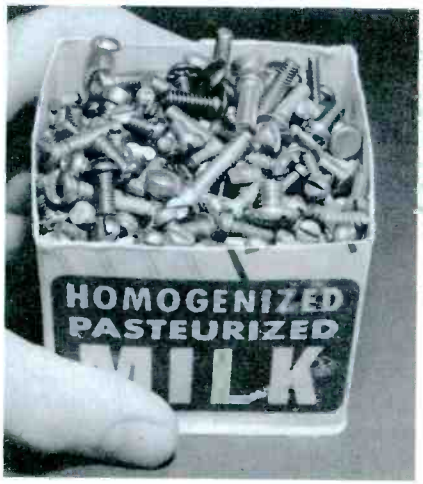
Sawing Off Shafts

When you want to use a hacksaw to cut off a length of control shaft, solid plastic rod, or small pipe, use the technique shown in the photograph. Clamp the work in the vise so that the cut marker on the shaft is even with the ends of the vise jaws. The jaws will guide the saw blade, and you won't have to waste time filing the end of the shortened shaft to square it.



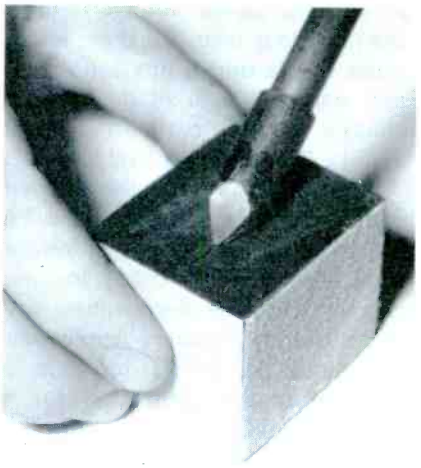
Twin Clips Lend Helping Hand

If you have some of those double-ended Mueller No. 22 twin clips lying around the shop, keep a couple on the bench where they will always be ready for use as a helping hand. Here's one application: When you are doing some soldering on small, loose parts, just clamp one end of the clip to the edge of your solder spool and use the other end to hold the work.



Parts Container

Do you have a shop drawer you would like to divide into small compartments for storage of hardware and small parts? Cut the bottom portions from a number of waxed-cardboard milk cartons and use these as separate lift-out containers for various categories of parts. Then, if you should have to ransack one compartment for a hard-to-find item, you can take it out and turn it upside down on the bench without disturbing the other compartments in the drawer.



"Scratch-Block" for Bench

Six pieces of various grades of sandpaper can be cemented to a block of wood about 1½" square to make a handy "scratch-block" for the service bench. You can use it for sharpening tools, wiping away scale from the tip of a soldering iron or gun, cleaning corroded metal parts (plugs, etc.), and removing sharp edges from freshly cut pieces of metal. It will come in mighty handy for all sorts of uses on the bench—even for lighting matches, and sharpening pencil points!

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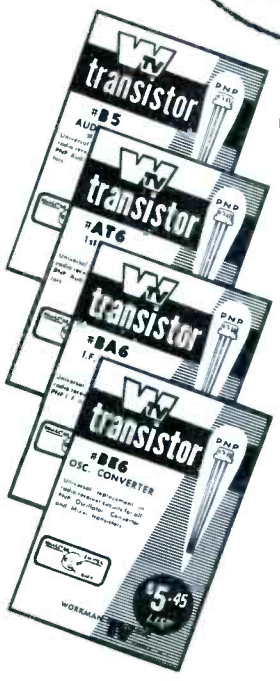

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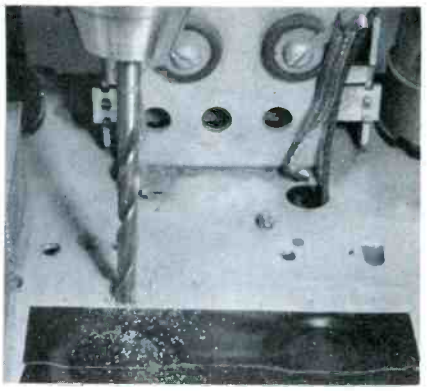
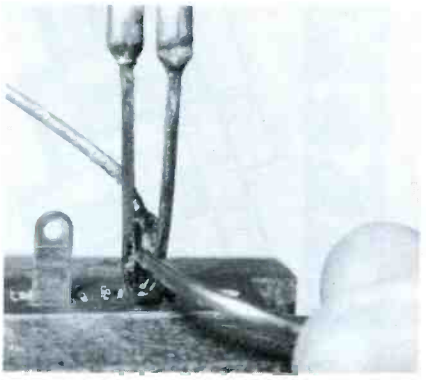


Mask Sockets When Drilling

When you have to drill a hole in the top of a chassis near a tube socket, it's a good idea to cover the open socket with masking tape. Otherwise, metal chips could fall down through the opening and possibly cause short circuits by bridging the gap between two bare wires or between solder lugs and chassis ground. If you don't have some wide masking tape handy, overlapped strips of plastic electrician's tape will work just as well.



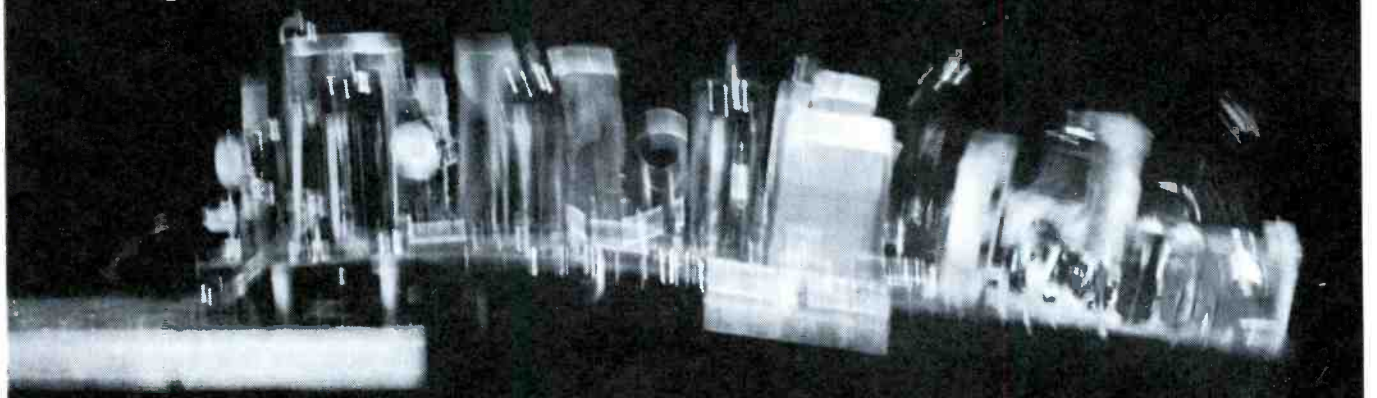
Feed Solder Through Gun Tip

The "through-the-tip" soldering technique shown enables you to do a better and faster soldering job on terminal-strip lugs or other broad, flat surfaces. The side of the tip (not just the point) is placed against the work to provide a greater area of contact for more rapid heat transmission. Feeding the solder through the loop in the tip warms it on its way to work and causes it to melt faster.

Solder Locks Nut

When you want to lock a nut on a screw, but there's no space for a lock washer, or no washer of the right size on hand, why not use solder? Tighten up the nut, heat it with a torch or iron, and flow solder into the screw threads. The solder-clogged threads will lock the nut fast. Application of heat from the torch or iron will unlock it again if necessary.

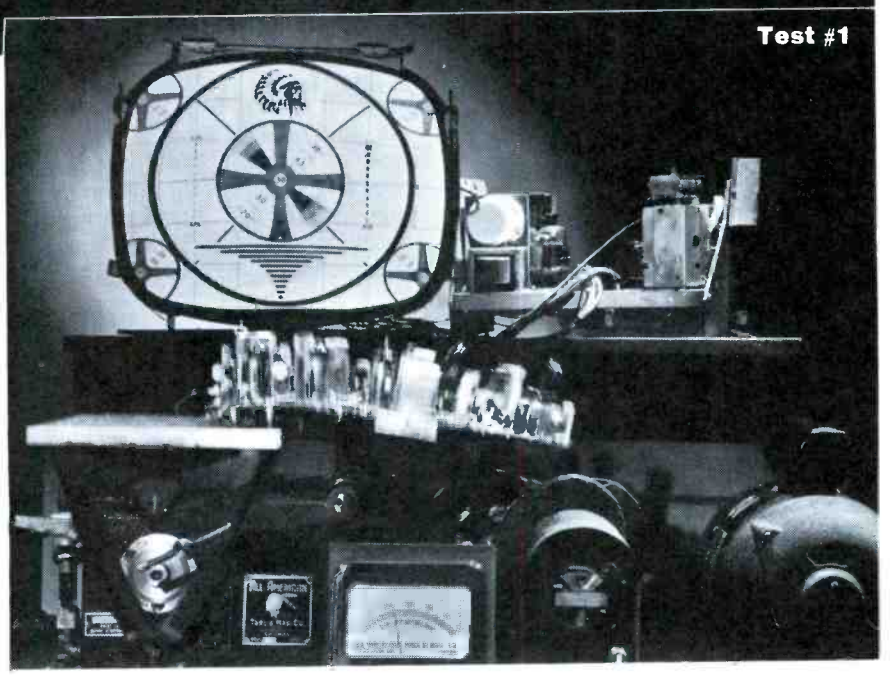
The greatest engineering advance in TV!

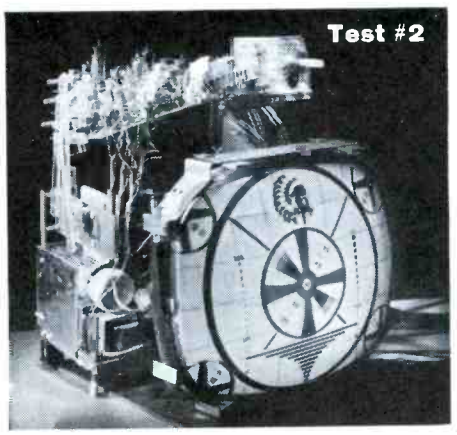


The new SYLVANIA "LIFETIME ENGRAVED CIRCUIT"

Torture Tested for Lifetime Reliability

This chassis (right) is being literally tortured on a vibration table. One end is fastened to the table, the other free and unsupported. In spite of being whipped up and down at speeds from 10 to 60 cycles per second, the picture continued to be clear and steady. Here's proof positive of the durability and dependability of the Sylvania "Lifetime Engraved Circuit."





Unretouched photographs of the toughest tests ever given an operating TV chassis—Note clear picture.

Bent back and forth over 3 inches 15,000 times per day!

The amazing "LIFETIME ENGRAVED CIRCUIT" keeps a clear, bright picture on the screen while one end is bent continually a distance of over 3 inches! There were *no* instances of loose connections, breakage, or failure of any kind!

The exclusive "Lifetime Engraved Circuit" ...in every SYLVANIA TV set.

Time Tip. "Jobs for a ninny" is what our office help calls such routine chores as stuffing direct-mail envelopes, cleaning up, filing and the like. However, almost everyone, no matter what he does for a living, has to perform a certain amount of work that lets him utilize only a fraction of his abilities.

Why not save these "ninny" tasks for times when you *feel* like a ninny? Some of us have trouble getting started in the morning, despite generous doses of coffee. If you're of this type, you'll get more work done in the long run by warming up on the simpler jobs instead of forcing yourself to leap right in and tackle one that'll put you under a strain. Other people start each morning full of pep (how do they do it?), but they run down like a clock toward the end of the day. If you're that type of person, you'd profit from planning your day's activities so that such things as bookkeeping and cleanup duties can be done after the more challenging part of the day's work has been completed.

$ & ¢

Suddenly It's Stereo. Visitors to a local hi-fi store hear music coming from a small room off to the side of the main showroom. When they poke their heads through the door of this room to see what's going on, POW!—they're instantly surrounded by stereophonic sound. Dual speaker systems have been carefully arranged so that the doorway will be the best spot for hearing the stereo effect.

Been having trouble explaining stereo to customers? Rather than *telling* them what it can do, *show* them as dramatically as possible. This doesn't mean that the system has to be bellowing at full volume; actually, a demonstration at a moderate sound level can be effective if the speakers are strategically placed and the listening area is free from distractions.

No matter how you work out your time budget, remember that its main purpose is to help you avoid spending the best hours of your day in dull work. In this way, you'll conserve your energy and enthusiasm so that it will be available for polishing off the really hard jobs.

$ & ¢

Welcome Back. Even though a power transformer adds *dollars* to the cost of a TV set, it makes *sense* from a standpoint of safety and serviceability. Accordingly, there seems to be a trend toward increased use of transformer-type power supplies in the latest models of moderately-priced table and console TV sets. Several manufacturers, such as Admiral, RCA and General Electric, who have built quite a few transformerless 21″ sets as "price leaders" in previous years, have equipped all their latest 21″ chassis designs with transformers. In addition, Westinghouse (which has been making series-string sets exclusively) has announced that a new transformer-powered black - and - white chassis series will be introduced this coming summer.

As for portables, all the '59 RCA models have a transformer-type chassis. So do the small Zenith sets which were introduced this winter. These two manufacturers now have completely "transformerized" lines.

It's encouraging to note that the brands which show increased use of power transformers are among the largest-selling makes. This means we can look forward to a greater number of "cold" chassis on future calls.

$ & ¢

Staying Clean. Why get sore arms from trying to carry a heavy, grimy chassis in an awkward position — just to avoid soiling your shirt? Drape a large, clean rag or an extra drop cloth over the edge of the chassis so that you can get a good tight grip without dirtying anything but the other side of the rag.

25,000 HOURS ..and still like new

New Westinghouse **Gold Star** Picture Tube

"Torture-Tested" an amazing 25,000 hours to prove it is ready to build customer confidence in your selling picture!

The most grueling test in TV history. To prove that this amazing new tube would live up to our engineers' predictions, a stock model Gold Star Tube actually underwent 25,000 hours of continuous operation . . . was still 80% as good as new! Then—and only then—was it approved for distribution, to make it the most reliable, most profitable tube you can sell.

In addition to testing standards never matched before, you'll find two other great advances in new Westinghouse Gold Star Tubes—advances which will greatly curtail call-backs and replacements that have dimmed your profit picture so long. They are . . .

40% More "Getter" in Electron Gun. Revolutionary design distributes 40% more protective material over inside of tube. Greatly reduces aging . . . keeps picture brighter longer.

New Aluminizing Method affords absolute maximum reflection . . . more usable light from the screen . . . a 20% brighter, sharper picture with greatly improved contrast.

Start rebuilding your profits now. Call your Westinghouse Distributor about new Gold Star Tubes today.

YOU CAN BE SURE...IF IT'S **Westinghouse**

Electronic Tube Division • Elmira, New York

NOTES on test equipment

informative reports from the lab

by Les Deane

Wide-Band Scope Kit

Electronic Instrument Co., Inc. of Long Island City, New York, better known as EICO, has recently introduced a 5" wide-band oscilloscope designed for both monochrome and color TV servicing. Pictured in Fig. 1, the Model 460 features push-pull DC amplifiers with a response useful to 10 mc.

Specifications and features are:

1. Power Requirements—105/125 volts, 50/60 cps; supply isolated from line and protected by fuse.
2. Cathode Ray Tube—5UP1 with green phosphor; illuminated, calibrated mask with dimmer control provided.
3. Vertical Input—frequency response from DC to 4.5 mc (+1db, -3db), down approximately 10 db at 10 mc; sensitivity 25 mv rms/inch; frequency-compensated attenuator provided in steps of 1, 10, 100, and 1000 ± 5%; input impedance 3 megohms shunted by 35 mmf unbalanced, and 6 megohms shunted by 20 mmf balanced; maximum input voltage 600 volts.
4. Horizontal Input—frequency response 1 cps to 400 kc (+1db, -3db); sensitivity .6 volts rms/inch; input impedance approximately 500K shunted by 35 mmf at 1 kc; expansion to 2x screen diameter without distortion.
5. Sweep System — internal sawtooth from 10 cps to 100 kc in 4 ranges, plus external capacitor input for sweeps as low as 1 cps; special V and H positions on sweep selector; sawtooth output jack provided on front panel; internal (+ or —), line (60-cps variable phase), or external sync available.
6. Other Features—internal 60-cps calibration signal 400 mv p-p ±5%, 3-volt rms signal also available on front panel; intensity modulation (Z axis) input on front panel requires approximately 3 volts rms to extinguish beam.

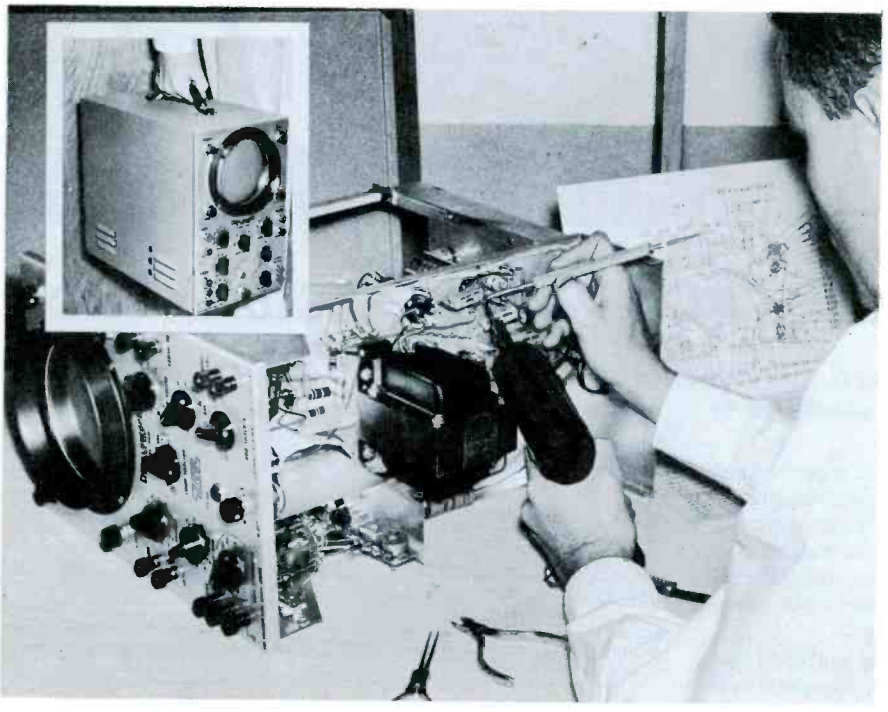


Fig. 1. EICO's 460 scope kit is easily wired and calibrated.

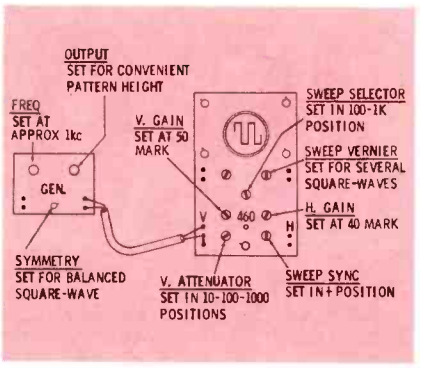


Fig. 2. Arrangement of equipment and control settings for calibrating V input.

Having secured a kit version of the 460, we assembled the unit shown in Fig. 1. As with any kit instrument, it took a few hours to complete, but no special tools or exceptional skills were required. Many servicemen interested in building kit-type equipment feel that they can wire the unit easily enough, but often have their doubts about the requirements needed to calibrate the instrument for accurate and reliable indications.

Since most of the instrument's applications are apparent from the above specifications, I will describe a portion of the calibration procedure, and thus shed a little light on this seemingly dark and mysterious problem.

After assembling the kit using the accompanying step-by-step instructions, a final check of wiring and a few resistance measurements are suggested before applying AC power to the instrument. The next steps involve astigmatic, DC balance, and linearity adjustments, requiring a VTVM or VOM to make a few simple voltage measurements.

To me, the most interesting phase of the calibration was the frequency compensation adjustments required for the vertical input system. Since stray capacities are introduced when wiring the input attenuator circuit, some form of compensation is necessary. In the Model 460, this is accomplished by three trimmer capacitors located near the left front corner of the chassis, one electrically connected in series with each attenuator pad. When these trimmers are properly adjusted, the input response for each attenuation setting should be relatively flat.

FASTEST

Now, in New Triplett Model 3414 you will recognize another answer to a long standing need—a FASTER, more versatile tube tester.

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Checks all today's and tomorrow's tubes (including new series filament tubes). .With BV adapter TV picture tubes can be tested in the set.

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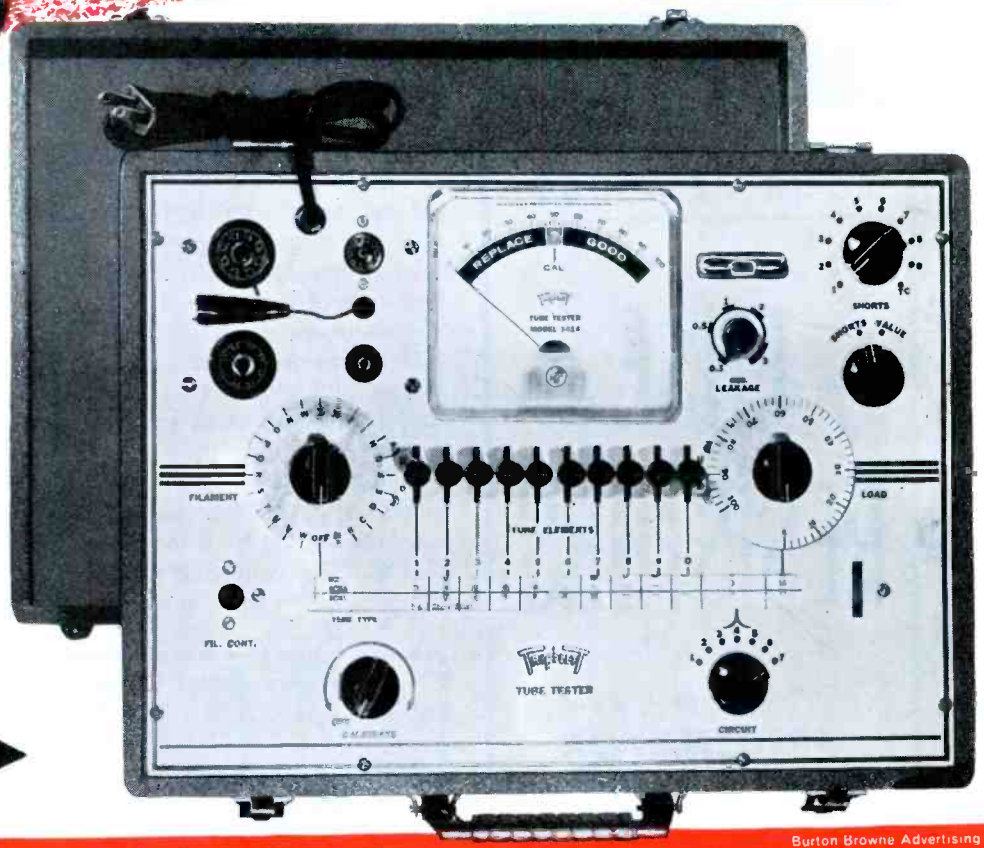

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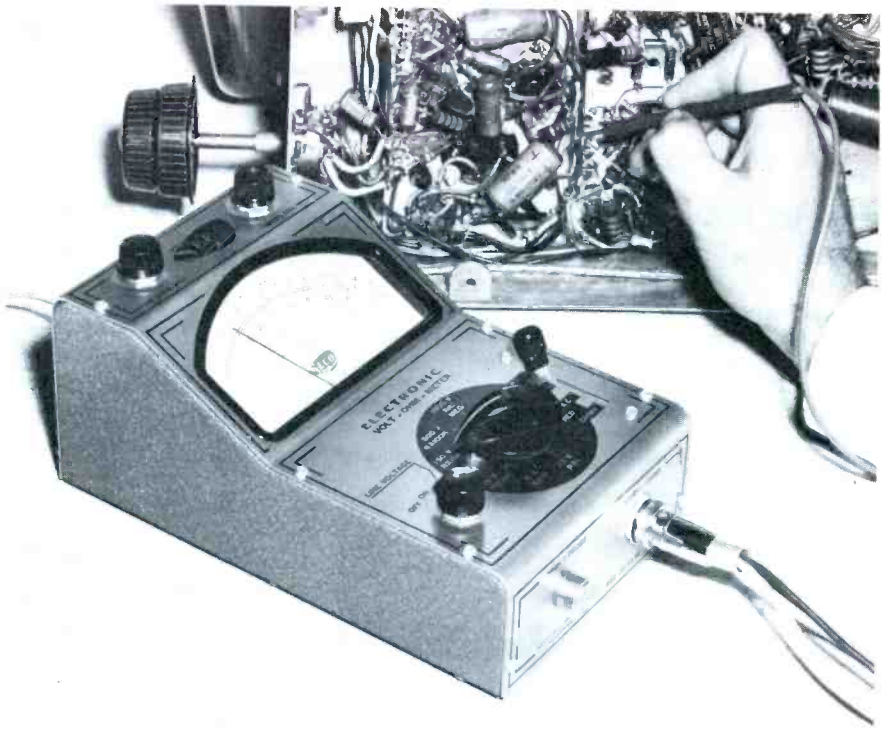
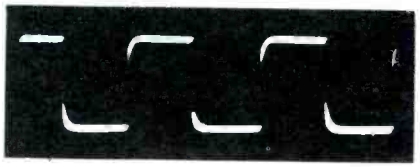


Fig. 4. The Seco VTVM features convenient ranges for radio and TV troubleshooting.

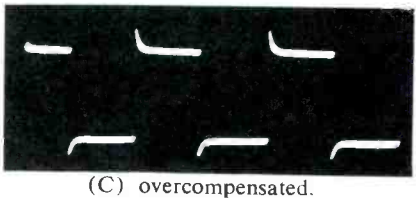
Although the manual outlines a method for adjusting the compensators using an internal sawtooth signal, it also mentions a more preferred method, calling for the use of a square wave generator. Since I had such an instrument available, I connected the equipment and made the necessary adjustments as illustrated in Fig. 2. Applying a 1-kc square wave to the vertical input terminals of the scope, I placed the attenuator in its X10, X100, and X1000 positions, and adjusted the corresponding trimmers for the most accurate square wave reproduction possible.

When first checking response, I found the circuit was undercompensated, as evident from the waveform of Fig. 3A. Adjusting the proper trimmer, I was able to sharpen the



(A) undercompensated,

(B) correct compensation,



(C) overcompensated.

Fig. 3. Reproductions of square wave.

leading edges of the wave, and obtained the normal pattern shown in Fig. 3B. Turning the trimmer in the opposite direction, however, I noticed the leading edges of the wave would peak or tend to overshoot. This condition indicated overcompensation, represented in Fig. 3C. (Incidentally, since the front bezel is designed to fit standard photographic equipment, I was able to take the waveform pictures directly from the CRT.)

The remaining calibration procedures included a check of internal calibration voltage using a voltmeter, setup of the V and H sweep frequencies employing the calibration voltage and a 15,750-cps signal from a TV receiver, and a check for high frequency response in the vertical amplifier system. Three peaking coils are provided for high frequency response adjustment, but these are pre-set at the factory and should be very close to the correct setting for the specified response.

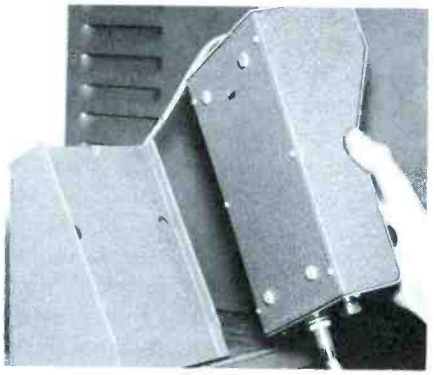
VTVM for Bench, Shelf, or Wall

The Model 208 vacuum tube voltmeter pictured in Fig. 4 is produced by Seco Mfg. Co., Minneapolis, Minn. It features something different in case styling, and comes complete with test leads and special mounting stand.

Specifications and features are:

1. Power Requirements—105/125 volts, 50/1200 cps (also available for 220-volt operation); one self-contained 1.5-volt battery.
2. DC Voltmeter—ranges 0 to 1.5, 5, 15, 50, 150, 500, and 1,500 volts; input resistance 11 megohms; range extended to 50,000 volts with accessory high-voltage probe; input resistance with probe 1100 megohms; zero center scale provided.
3. AC Voltmeter—rms ranges 0 to 1.5, 5, 15, 50, 150, 500, and 1500 volts; input impedance approximately 1.3 megohms up to 2 mc; with detector probe, useful to 250 mc or higher.
4. Ohmmeter—ranges Rx1, 10, 100, 1000, 10K, 100K, and 1 meg; center scale 10; zero and ohms-adjust controls on panel; special scale provided for EIA standard values with tolerance indicated.
5. Meter—4½", 200-ua movement with burnout protection; accuracy within 3% on all ranges.
6. Size and Weight—5¼" x 8½" x 3½", 5 lbs. shipping weight.

When examining the Model 208, I found its physical design unusual enough to be worthy of a brief description. The instrument's case is formed into an L-shape, with the



(A)

(B)

Fig. 5. A bracket is supplied with the Model 208 for shelf or wall mounting.

meter scale sloping across the right angle of the L. The line cord extends from the top end of the case, and the zero- and ohms-adjust controls are mounted directly above the meter.

On the plane below the meter near the right edge of the case, you'll find a lever-type switch with which to select the function of the instrument (+DC, -DC, AC, or OHMS). It also indicates the proper test lead to use with each function. Once familiar with this lever action, you can select the desired application even without looking.

In the center of this same plane, you'll find a rotor-type switch that enables a choice of any range within a rotation of only 180°. Just to the left of the range selector is an OFF-ON switch having a special position for measuring line voltage independently from the internal bridge circuit.

The lower end of the case features two separate connectors. The one on the left is used for high voltage and RF applications, while the other serves as an input for all other measurements. The cable supplied with the meter has three 40" test leads. Each is color-coded—black representing common or ground, gray for DC measurements, and red for ohms and AC volts.

Another physical aspect of the unit is the special mounting bracket furnished with meter case. To realize its usefulness, I tried attaching it to both a bench shelf and a wall. Mounting the bracket on a shelf as shown in Fig. 5A, I noted that it was easy to use and also safe because of the interlocking groove-and-tab arrangement on the back plate of the case. The meter must be lifted up and out to remove it from the bracket. For the shelf position, there are two mounting holes in the base of the bracket, but for wall mounting as shown in Fig. 5B, there are two other holes in the back brace. With the instrument securely held on the edge of a shelf or on a wall behind the service bench, you'll usually find it within easy reach; thus, if desired, you can quickly remove it from the bracket and lay it down beside the equipment you are working on.

The most interesting electrical characteristic of the Model 208 is the unique ohms scale (see Fig. 6). The upper ohms scale is conventional, having markings from zero to infinity. The lower scale, however, is calibrated in standard EIA values and is used for rapid tolerance checks for resistors coded with these common values.

As an example of how this scale is employed, let's suppose you wanted to see if a 6800-ohm resistor with a silver band was within its normal 10% tolerance. Placing the range selector in the R x 1000 position, the meter needle should come to rest somewhere near the 6.8 mark on the lower scale. If the resistor is within a 10% rating, the needle will definitely stay between the small graduations on each side of the 6.8 line. If this same component were rated with a 20% tolerance, the needle should then register between the two adjacent values of 5.6 and 8.2. ▲

Fig. 6. A special ohms scale is provided on Seco meter for standard values.

AUDIO FACTS

servicing HI-FI equipment

part 3

by Alan Andrews

Good hi-fi is a result of precise design of equipment and components. If a piece of audio equipment is to retain the qualities which result in good high-fidelity performance, the unit must be serviced with special care. A repair has not necessarily been completed when a defective part has been replaced. Is the equipment working as well as it formerly did? To make sure, you may have to analyze its performance with test instruments. Making accurate measurements of performance will also come in handy when a customer complains, "My hi-fi just doesn't sound right."

Much of the test equipment used in radio and TV servicing can also be used for audio. There are applications for AC and DC voltmeters, ohmmeters, tube checkers, and oscilloscopes. RF generators also come into play when you are servicing hi-fi tuners.

In addition, instruments especially designed for audio work are needed. These include the audio VTVM, audio wattmeter, audio signal generator, harmonic distortion analyzer, and intermodulation distortion analyzer. Most servicemen do not need much familiarization with the audio VTVM and signal generator, but the others are not as well known.

An audio VTVM is much like any other VTVM except that it is designed strictly for audio work. On most AC voltmeters, 3 volts is the full-scale reading on the lowest range. This is not small enough for hi-fi work, so most audio VTVM's have an AC range as low as 0.01 volt full scale. They are designed for AC measurements only, and are more accurate than ordinary VTVM's in the audio range. Of course, a conventional VTVM is all right for measuring DC voltage or resistance in hi-fi equipment.

Distortion Measurements

In many specific cases of trouble, the complaint might be classified simply as a "loss of fi." The serviceman should first listen and try to determine why the sound is imperfect. Hum, noise, turntable rumble, variations in record speed, and poor frequency response are easily recognizable. If none of these symptoms are noted, then look for distortion of the audio signal. True hi-fi can exist only when all kinds of distortion are held to an extremely low level. The most troublesome types can be detected with special equipment—one instrument to measure harmonic distortion and another for intermodulation.

Harmonic distortion is caused by nonlinear operation of the amplifier stages. Additional harmonics (whole-number multiples of the fundamental) which were not a part of the input signal are thereby introduced, causing the various tones to sound differently from the original sound. This type of distortion is measured in terms of the percentage of total signal amplitude consisting of unwanted harmonics. Fig. 1 shows a block diagram of a typical harmonic distortion analyzer. A sine-wave audio generator (not a part of the analyzer) is used to supply an input signal to the amplifier under test. If there were no harmonic distortion,

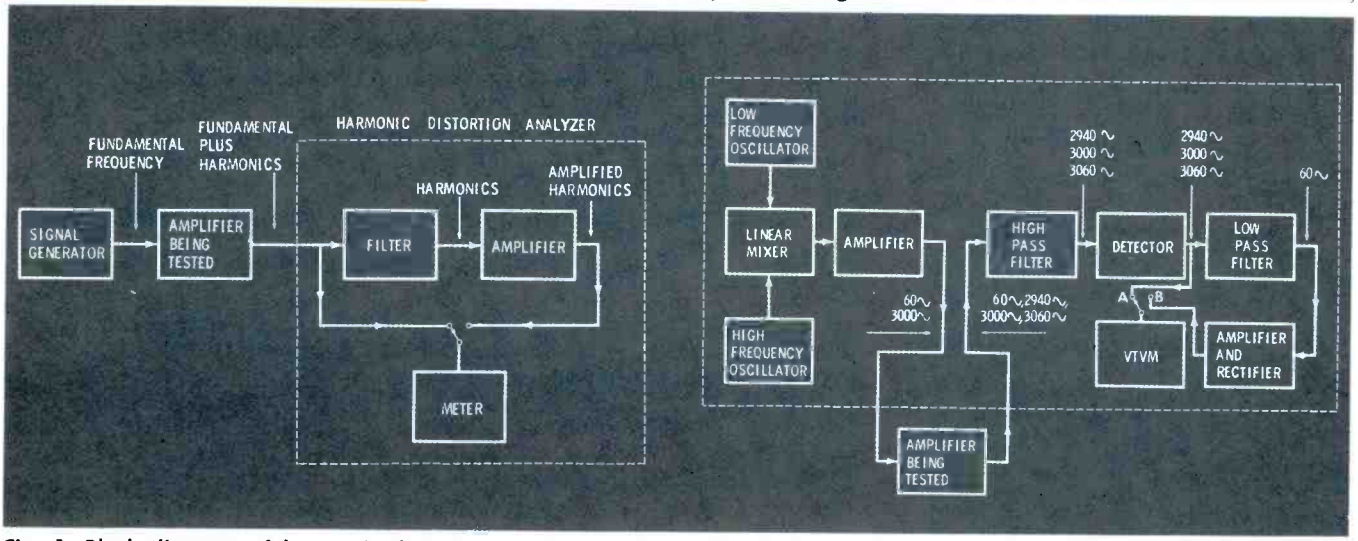


Fig. 1. Block diagram of harmonic distortion analyzer and test setup including signal generator and audio amplifier.

Fig. 2. Intermodulation analyzer feeds two signals to amplifier and measures beat-frequency distortion in output.

only the single frequency injected by the generator would be present at the amplifier output. Since all amplifiers introduce some harmonics, the output signal consists of the fundamental frequency plus the added harmonics.

This composite signal is applied to the input of the distortion analyzer (enclosed with broken lines in Fig. 1). The meter selector switch is set to the position shown and the meter adjusted to a predetermined level (usually marked). This level represents the total amplitude of the entire signal, including the added harmonics. Next, the meter switch is changed to the other position to read the output of the analyzer's internal amplifier, which consists only of the added harmonics. A filter eliminates all frequencies lower than and including the fundamental, leaving only the harmonics to be amplified. This filter is either a high-pass type (which eliminates all frequencies except the harmonics) or a rejection type (which eliminates only the fundamental). An advantage of the high-pass filter is that it also eliminates hum and some of the circuit noise, permitting a more accurate distortion reading. The meter reading is in percentage of distortion.

A reading of 4% indicates that 4% of the total signal amplitude consists of harmonics which were added by the amplifier being checked. For good reproduction, the total harmonic distortion should be less than 2%. Up to 5% is considered to be within the limits of acceptable reproduction, however.

Intermodulation distortion is also caused by nonlinearity, but the additional frequencies produced are not whole-number multiples of a fundamental frequency. These new frequencies are produced when two or more signal frequencies heterodyne to produce sum and difference frequencies; for example, if signals of 80 and 2000 cps are heterodyned, frequencies of 1,920 and 2,080 cps are produced.

Measurement of this type distortion involves applying two different frequencies to the amplifier being checked, and measuring the amplitude of the additional signals produced. A block diagram of an intermodulation distortion analyzer is shown in Fig. 2. The two oscillators

produce signals of 60 and 3,000 cps, which are mixed and amplified before being applied to the input terminals of the amplifier being tested. If intermodulation is occurring, two additional frequencies (2,940 and 3,060 cps) will be present at the output of the amplifier. These, plus the original 60- and 3,000-cps signals, are fed in at the proper terminals of the analyzer. A high-pass filter removes the 60-cps component, leaving the other three.

A detector, similar to the one in an AM radio receiver, rectifies this composite signal. A low-pass filter following the detector eliminates the 3,000-cps signal and the high-frequency components of the 2,940- and 3,060-cps signals, much as the RF is eliminated in a receiver. This leaves only a 60-cps signal component, which represents intermodulation distortion.

In measuring IM distortion, the switch (Fig. 2) is placed in position A to measure the total amplitude of the three higher-frequency components. The gain control is adjusted to produce a full-scale reading on the built-in VTVM, and then the switch is changed to position B. The resultant reading gives the percentage of the total signal produced through intermodulation, and is read as a percentage of intermodulation distortion. Good reproduction demands that this figure be kept below 5%, although up to 10% is often considered acceptable.

Phono Measurements

Any unwanted sound introduced at the input of an audio system, including hum, noise, or interference, will be carried through the entire system. Phono and tape mechanisms

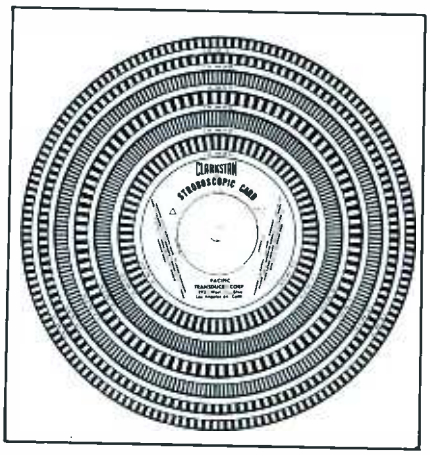


Fig. 3. Phonograph turntable speed can be checked with this stroboscope disc.

can introduce a variety of these undesirable sounds, and precise measurements are required to properly evaluate the condition.

Phono and tape recorder motors sometimes vary in speed, causing unwanted changes in the pitch of reproduced sounds. Those changes which occur at a rather slow rate are called *wow*; the faster ones are called *flutter*. These variations frequency-modulate the signal, and the extent of this modulation can be measured with a wow and flutter meter.

To check a phono, a test record can be used to supply a steady sine-wave signal. The output from the phono cartridge is applied to the flutter meter, where amplitude variations are clipped from the signal. This leaves only the frequency variations, which are then changed into voltage variations by a discriminator circuit resembling those used in FM receivers. This voltage actuates the meter, which reads "percent of flutter." Stated as an equation:

$$\% \text{ flutter} = \frac{\text{max. freq.} - \text{min. freq.} \times 100}{\text{avg. freq.}}$$

A flutter reading of less than 1% is acceptable; better-quality units may register as low as 0.1%.

Actual speed of the turntable may be determined quite easily by the use of a stroboscope disc like that shown in Fig. 3. It should be observed on the rotating turntable under 60-cps AC lighting. The markings for standard turntable speeds are spaced so that they appear to stand still when the speed is correct. If the marks appear to be moving in a clockwise direction, turntable speed is too fast; if counterclockwise, rotation is too slow.

In many tests and measurements involving phono operation, test records can be used to advantage. A type often used includes bands of different frequencies from about 50 to 10,000 cps, each at a constant amplitude. Other test records contain material for use in checking intermodulation distortion, stylus wear, hum, rumble, tracking, wow and flutter, etc.

Hum and Noise Measurements

Hum in an audio unit should be measured with an audio VTVM or wattmeter connected across a dummy output load. Apply a steady input signal, set the volume control for maximum output, and note the output reading. Next, disconnect the signal source and ground the input terminal. A standard phono plug with the tip and shield short-circuited is a handy item to have in this case. With the volume control still at maximum, reset the meter range switch until an AC output is measurable; this is the hum amplitude. If decibel scales are available, the db difference between signal and hum can be determined by merely subtracting one reading from the other. Using an AC voltmeter, the db difference can be calculated according to the formula:

$$db = 20 \log \frac{E1}{E2}$$

For a wattmeter, use the formula:

$$db = 10 \log \frac{P1}{P2}$$

Noise level can be measured in the same way.

Hum and noise levels of 60 db below maximum signal level are desirable in high-quality systems. Hum and noise are always more notice-

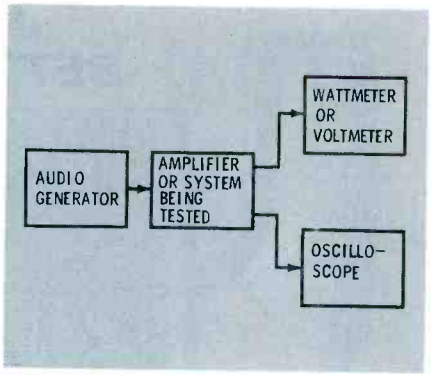


Fig. 4. Setup for testing frequency response of a hi-fi amplifier or system.

able with low-amplitude signals, especially when certain types of records are used as a program source. For example, a small amount of hum that would be objectionable on a low-level piano recording might not even be noticeable on recordings of other material.

Frequency Response

Since a basic requirement of hi-fi is its ability to handle the complete range of audio frequencies, it is often desirable to measure the frequency response of a system. This can be done using the arrangement shown in Fig. 4. A sine-wave audio generator supplies a signal to the amplifier or system under test. The frequency of this generator is varied over the entire audio range, and the output reading for each frequency is plotted on a graph. Normally the response drops off at each end of the range, and the upper and lower frequencies at which output drops to 70.7% of the maximum level are considered the limits of response.

To obtain a better idea of the actual frequency response, a high signal level should be used because lack of response shows up more often at high levels. If tone controls are included in the units being tested, they should be adjusted to settings that would produce a flat response in a normally-operating amplifier.

Other types of measurements may occasionally be required in audio work, but this article has described those most often required. Instruction manuals furnished with test equipment give specific information as to use of the equipment. They should always be followed for best results. In addition, some manuals may also suggest additional uses which will prove helpful. ▲

Transistors With Power

(Continued from page 35)

Fig. 8. Miniature converter delivers up to 265 ma at voltages up to 400 VDC.

the transistors operate as switches. The switching-type inverter is best for applications requiring high efficiency, while the amplifier-type supply is best where its size and weight and the waveshape of the AC output are the most important considerations. Fig. 9 is a block diagram of an amplifier-type inverter in which the output of a precision-frequency 400-cps generator is used to drive a diode modulator. This latter circuit generates a square-wave output which passes through two stages of tuned amplification, finally producing a sinusoidal waveform. The sine wave is then amplified to the required level by a two-stage, class-B, push-pull power amplifier. Voltage feedback in the amplifier stabilizes the gain and limits distortion. Part of

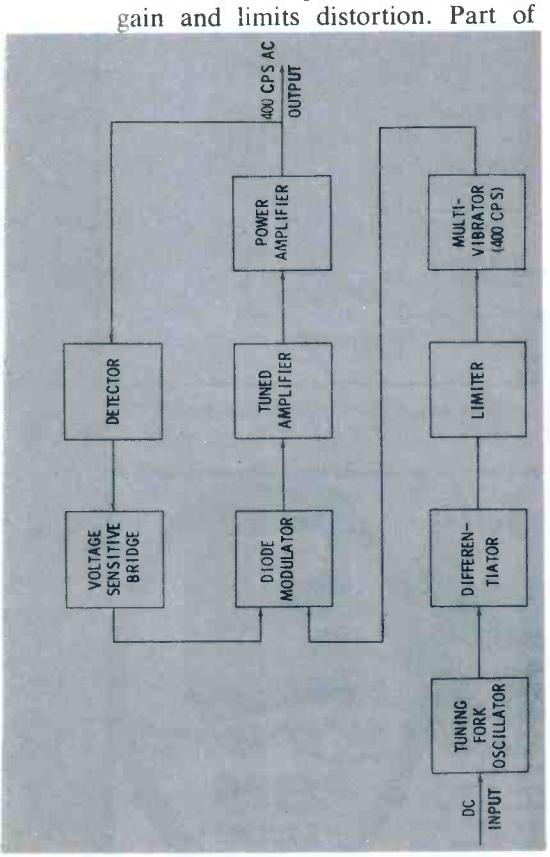


Fig. 9. Amplifier-type DC-to-AC Inverter provides well-regulated 400-cps output.

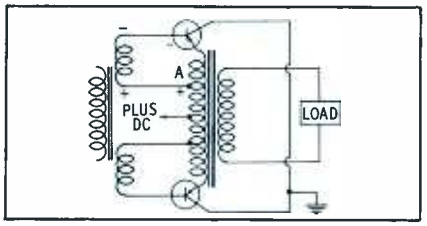


Fig. 10. Output of inverter is delivered by two power transistors in push-pull.

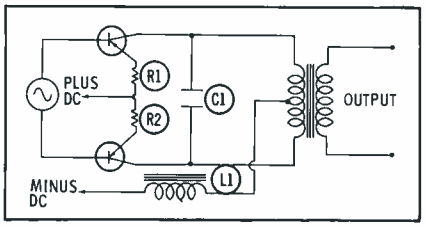


Fig. 11. Components C1 and L1 shape output waveform of switching inverter.

the AC output is also detected and applied to a voltage-sensitive bridge network, producing a DC error signal which is applied to the diode modulator in order to control the amplitude of the square wave. The use of both AC and DC feedback produces excellent voltage regulation.

The power amplifier stage in Fig. 9 is shown in detail in Fig. 10. This schematic shows that the collectors are physically grounded, but the circuit is not a true grounded-collector stage. Actually, it employs a compromise between grounded-collector and grounded-emitter operation. The collectors are grounded for heat transfer to the chassis. Each secondary winding of the input transformer is connected between a tap on the output transformer primary and the base of a transistor. In the p-n-p transistors used in this circuit, a negative-going signal applied to the base produces an increase in forward bias between base and emitter. This, in turn, causes an increase in current through the emitter-collector circuit and thus creates an increased voltage drop across half of the output transformer primary between the emitter and the center tap. The polarity of this voltage drop is such that the emitter is negative with respect to the center tap; therefore, the emitter is also negative with respect to tap A on the transformer.

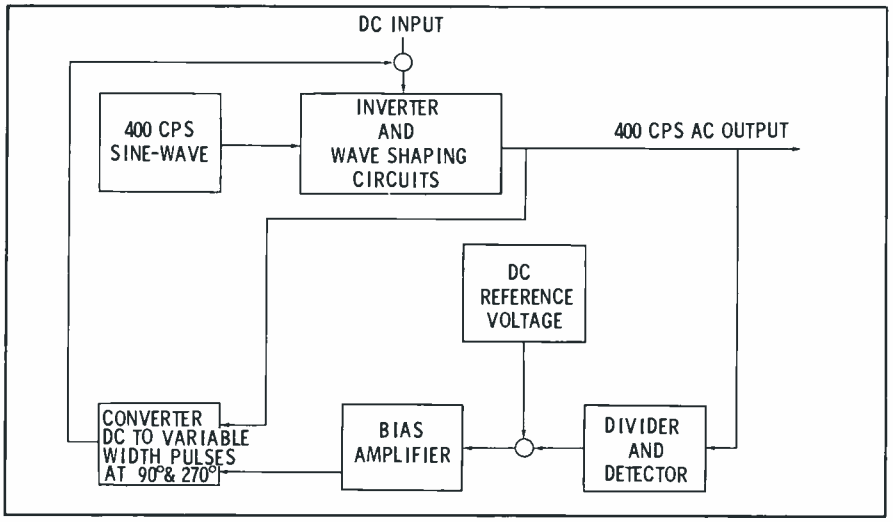


Fig. 12. Sample of output signal is fed back to input for voltage regulation.

As a result of the voltage produced between the emitter and tap A, a signal with a polarity opposite to that of the original input signal is introduced into the base-emitter circuit. When both of these signals appear in the base-emitter circuit, degeneration results; in other words, the resultant base-emitter voltage equals the difference between the input signal voltage and the induced voltage.

The class-B, amplifier-type inverter requires no harmonic filtering, except at low power levels, and it can be designed to operate with less than 3% distortion. For low-distortion power supplies putting out 100 watts or less, the size and weight of the class-B, amplifier-type inverter are less than for the switching-type inverter, which requires filter elements.

Fig. 11 illustrates an inverter output stage with two transistors acting as switches. Wave shaping is accomplished by the series inductance L1 and commutating capacitor C1, while the output transformer serves as a coupling device. At maximum circuit efficiency, distortion is approximately 5%. Less distortion can be achieved by increasing the current circulating in the filter, thus increasing the power-dissipation requirements of the transistors. In the switching-type output stage, the transistor is driven to saturation throughout the conducting half-cycle; thus, the output voltage will be directly proportional to the DC input voltage if conduction periods are held constant. Voltage can be regulated by controlling the applied DC, by varying the conduction period, or by using a magnetic device in the output AC line.

Experimentation of these possibilities led to the development of the system shown in Fig. 12, in which the DC input is controlled by regulation of the output voltage. A precision-frequency, 400-cps generator drives a switching-type inverter. A portion of the AC output is detected and compared with a DC reference voltage to obtain a control signal. After passing through a bias amplifier, this control signal is converted into a series of variable-width pulses which are mixed with the DC input to the inverter circuit. The effect of these pulses is to vary the apparent level of the input DC voltage. ▲

Across the Bench

(Continued from page 31)

to ground; therefore, a short from either the screen or plate to the suppressor had caused the trouble.

Audio

If the 4-tube sound circuit (it's the same for all models) in these receivers has given you trouble, you are a solid member of the Capehart club. It has worried the rest of us, too. Set your AGC too high and the sound will buzz. Permit sound trap L15 to become detuned and the effect will be miserable. Inherit a noisy audio amplifier and the results can be weird. If the 20-mfd screen bypass on the audio output stage becomes defective, fat sound bars will radiate through the power supply and promptly show up in the picture. In one CX-33 alone, I replaced the electrolytics, the coupling capacitors, the volume control, and the 1800- and 2200-ohm decoupling resistors. Afterwards, I carefully aligned the sound trap and ratio-detector transformer and came up with clean audio. Once in a while you have to follow much of this same procedure; however, when there are no defects in the circuit, AGC adjustment and a slight touch-up of the secondary (the top) of the ratio-detector transformer will be sufficient. But do check operation on all channels after the adjustments are made to see if an additional slight touch-up is needed. You might also position the balance control to its approximate center and align the local oscillator slugs with a fiber or plastic screwdriver for best sound and sharpest picture. It's good insurance against callbacks.

Fig. 4 Damper filament transformer is in high voltage cage under flyback.

Horizontal Oscillator and Output

In this circuit, there are external adjustments for horizontal hold, horizontal linearity, and horizontal drive. Troubles beyond setting these and making tube replacements can lead to mayhem. Even C82, the 30-mmf 6-kv capacitor, has alternate connections for changing width — terminal 2 on T3 for maximum, and terminal 1 for regular operation. And a horizontal output tube that's drawing excessive current can drive you nuts!

The horizontal oscillator is a series-fed Hartley using one winding of L17 (Fig. 3) as its tank coil. Cathode current through the lower coil induces voltage in the upper coil to cause the grid side of the tank to be positive. Plate current is thereby increased, and grid current through R91 charges C70. Upon saturation, the magnetic field around the tank coils collapses, charging C66 so that, along with the discharge of C70 through R91, V19 is biased beyond cutoff. The charge and discharge of C66 through the inductance either adds to or subtracts from the bias developed by C70 and R91, and makes V19 plate

Fig. 5. Crosshatch pattern aids in locating cause of "pie crust" distortion.

current vary between saturation and cutoff.

Frequency is controlled by reactance tube V18, which is connected across the resonant circuit of the oscillator. Bias on the grid of the reactance tube determines its capacitive load on the tank circuit and therefore controls the frequency of the oscillator. Bias control, in turn, comes from horizontal sync discriminator V17, which monitors and compares the phase of the incoming sync pulses with the phase of the signal generated by the horizontal oscillator. As long as these two signals are in phase, no corrective voltage is generated at the cathode of V17. As the oscillator drifts, however, an unbalanced condition occurs, and the difference voltage developed across R86 and R87 will lower or raise the bias applied to control tube V18. Its reaction on the tank circuit will cause the horizontal oscillator to speed up or slow down accordingly.

Following the oscillator stage, there is a discharge tube that develops the sawtooth drive for the horizontal output tube. The horizontal-drive poteniometer is located in the plate circuit, and permits the amplitude of the sawtooth signal to be adjusted. Horizontal frequency is adjustable through a tunable slug in L17. To make the frequency adjustment, remove the 6AL5 horizontal sync-discriminator tube and adjust the slug (B2 on the back of the chassis) until one slowly moving blanking bar is observed on the screen. Then replace the 6AL5. Next, decenter the raster until its left edge is visible. Adjust brightness to maximum and reduce AGC to make the blanking interval at the edge of the raster visible. It should be about ¼" wide; if necessary, pull out the chassis and adjust slug B1 on the bottom end of L17.

Troubles

Troubles in this circuit are about the same as for any other horizontal sweep circuit, with perhaps two notable exceptions. The filament circuit of the damper tube includes a 1:1 isolation transformer which is prone to primary - secondary breakdowns. The resultant arcing between the windings can be easily heard. The other problem has to do with replacement of the horizontal oscillator transformer L17 that apparently none of the major replacement parts manufacturers make. As for the remainder of the circuit, there's no cure-all except careful waveform checks and accurate DC voltage measurements. Boost should always be at least 350 volts higher than high B+, and high B+ (in the model 320 series and up) must approximate 300 volts. A note of warning: Use 1-watt parallel resistors for the combinations of R98-R99 and R100-R101; they're there for a reason. Remember, too, that erratic operation of the horizontal oscillator can cause a "pie crust"

effect ranging from slight darts and wiggles to complete loss of picture. I'm still recovering from one "pastry prodigy" that defied me for longer than I care to remember. If ever you're hesitant about "pie crust," use a crosshatch generator (Fig. 5) and quickly resolve any doubt. Believe me, you'll be thankful you did.

Alignment

Alignment is a serious business for even the better professionals, and should *never* be attempted until *all* other repairs are complete. A good earth ground is essential. Most sets built since 1950 have tuners and IF circuits that will stand a little detuning and still produce a satisfactory picture. If there is substantial drift, it is usually caused by a basic receiver failure. About the only circuits I consistently align are ratio detectors and discriminators in older receivers.

To demonstrate video alignment of one of these Capeharts, I did, however, completely IF align a CX-33 (run 3) receiver that I found to be in reasonable condition. In Fig. 6, note that the 26.25-mc marker falls between the 45 and 65% level on the vertical slope of the curve

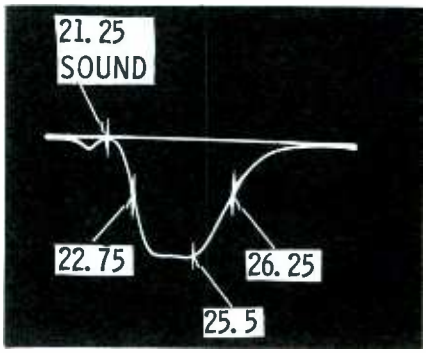


Fig. 6. IF response with markers.

and that the 25.5-mc marker is at the lip of the flat top. The marker at 22.75-mc is exactly in the knee of the trap. Note that the flat top has less than 10% tilt and valley allowance permitted.

In order to produce an alignment curve such as this, you need an oscilloscope with good sensitivity. The sweep generator also must have a flat output such as shown in Fig. 7,

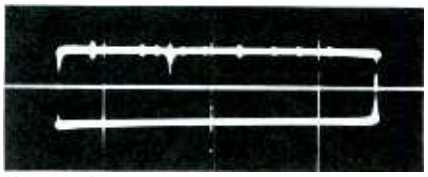


Fig. 7. Flat response from sweep generator obtained with demodulator probe.

and the marker should be calibrated to crystal accuracy on the range you're using. Calibrate your marker by beating the crystal harmonics against the signal generated by the marker oscillator. Simply feed the outputs of both generators (crystal and marker) into the demodulator probe of the scope. As the signals approach "null" or zero beat, the waveform rises to maximum and then drops to a straight line. This line is the valley between the peak you've just passed and the other that will appear with further rotation of the dial. It is the "null" that denotes identical frequencies. If you are using a 4.5-mc crystal as a standard, a succession of "nulls" will occur at 4.5, 9, 13.5, 18, 22.5, 27, 31.5, and 36 mc as you tune the marker generator. Close calibration is necessary for satisfactory alignment of *any* electronic equipment that uses precisely tuned transformers. It's a wise man who checks calibration of his instruments frequently, uses the prescribed AGC bias in every alignment, and takes advantage of his test equipment at all times. Many who do go to the bank every day. ▲

Horizontal Sweep

(Continued from page 33)

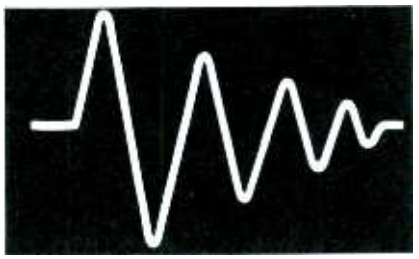


Fig. 7. Theoretical signal produced by pulsing a typical resonant circuit.

duct. Fig. 7 illustrates the signal which would be produced if a damper weren't employed. This signal would result because the flyback, yoke and various distributed capacities form a network that is resonant between 70 and 100 kc, and it is a property of a resonant circuit to oscillate when pulsed.

At the time the kickback pulse occurs, the DC cathode voltage of the damper is somewhat more positive than the plate voltage because of a positive charge remaining on C100. On the second half cycle of oscillation, the kickback signal reaches a negative value sufficient to overcome this positive bias on the cathode; as a result, the tube conducts and swamps out the remainder of the pulse. (The high pulse value at point Z of Fig. 6 occurs because the energy coupled to the Admiral's 110° yoke is greater than the energy coupled to the 90° yoke in the example shown in Fig. 7. In the Admiral, the transformer would have a step-up ratio of about 3.5; thus, the 5,000-volt pulse would be stepped up to a little over 17 kv — enough to produce the 16.5 kv desired at the anode of the 110° picture tube.)

Not all the kickback energy is dissipated by the damper during the initial cycle of oscillation. Instead, the damper conducts during succeeding negative half cycles (with diminishing strength) until the oscillations finally die out. This gradual, controlled release of energy causes the electron beam to be swept from the left side of the screen toward the center.

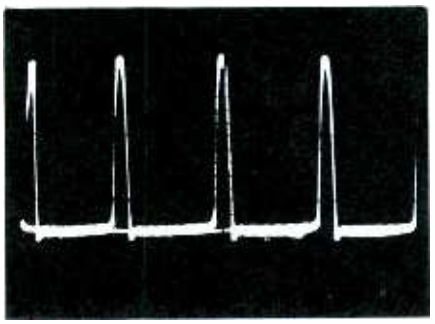


Fig. 8. Normal waveform at cathode of damper (5,000 volts p-p) taken with a 1000-to-1 capacitive divider probe.

While the damper tube is conducting, capacitor C100 is being charged in the polarity shown in Fig. 6. This capacitor continues to charge during the first half of the scan cycle until the positive potential on the top plate becomes great enough to bias the damper to cutoff.

During the time the damper is conducting, the output tube is being held at cutoff by grid-leak bias. By the time the damper has stopped conducting, the output tube begins to conduct and continues the sweep across the screen.

Sweep Control Adjustments

New TV models are divided into two classes as far as their horizontal sweep circuits are concerned—most deluxe units have adjustments, while a number of less expensive units have none. Between these extremes

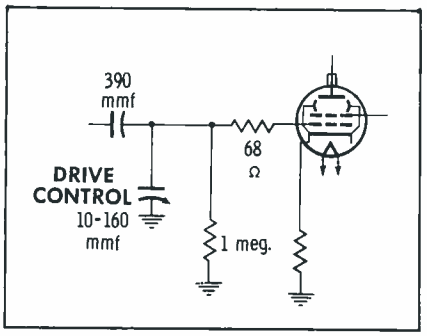


Fig. 9. Drive trimmer often is high-impedance leg of capacitive divider.

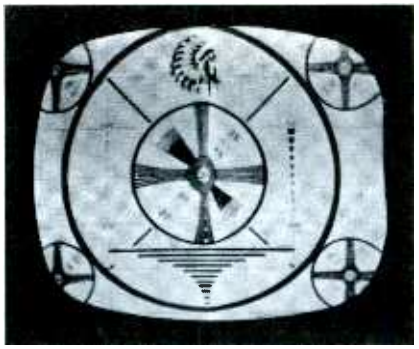


Fig. 10. Drive lines indicate too much drive signal to grid of output stage.

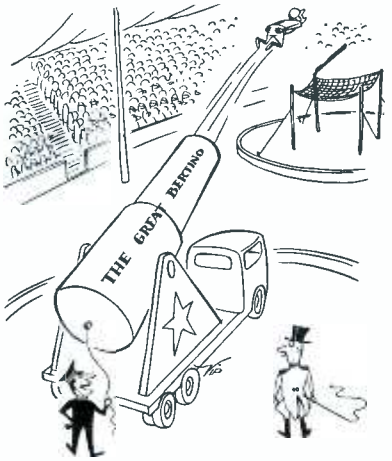
are sets with only a drive control. Since this is the control the technician will have to adjust most often, let's consider the consequences of its improper adjustment. In the most common configuration (Fig. 9), the drive control serves as the high-impedance leg of a capacitive divider network. Maximum signal is developed at the control grid when the drive trimmer is set for minimum capacity (full counterclockwise). As the trimmer is turned clockwise, capacity increases and the signal at the grid of the tube decreases. Since maximum change of capacity occurs in the last turn towards the clockwise extreme of rotation, a good preliminary adjustment position for the trimmer is one-half turn counterclockwise from snug. To reach the final and best adjustment from this point, either insert a milliammeter in the cathode circuit of the output stage and adjust the trimmer for minimum current with no drive lines (drive lines are illustrated in Fig. 10), or adjust for minimum voltage drop across the cathode resistor. If the set doesn't have a cathode resistor, you can install a 5- or 10-ohm unit for the test.

Width control takes Number Two position in the usage parade. Generally speaking, width adjustments will control raster width but won't affect linearity or change life expectancy of other horizontal sweep components. After adjusting the drive control, the width control should be adjusted to produce 5% overscan. This will prevent complaints about a narrow picture every time the AC line voltage drops a few volts. In most cases, width controls will not affect picture linearity and can therefore be adjusted in the home, even if a test pattern isn't being transmitted.

Linearity controls, very popular in earlier models, are now restricted mostly to deluxe sweep circuits. The setting of this control (usually a variable inductance in the boost circuit) affects width as well as linearity — also the current through the output tube. The linearity control should be adjusted for a dip in output-tube current, or for minimum current in keeping with good picture linearity.

Normal Voltage and Current Readings

CRT'S with wider deflection angles require more scan power. This fact is reflected in the voltages and currents associated with the



"Of *course* there's no smoke . . . I fired him off with a *JENSEN NEEDLE!*"

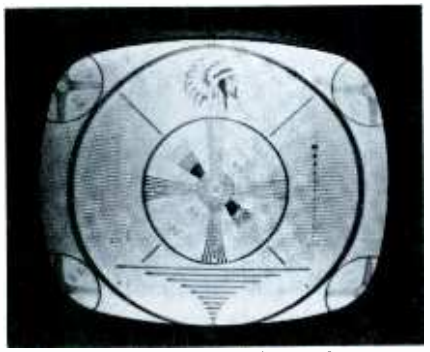


Fig. 11. Test pattern has about 5% overscan to allow for line fluctuations.

horizontal output amplifier tube. For instance, typical voltage and current readings for a standard 90° circuit would be 130 volts on the screen grid (6DQ6), 90 volts p-p grid drive, and 95 ma cathode current. In a 110° circuit of the same basic configuration, the readings would be 150 volts, 140 volts p-p, and 125 ma, respectively.

It should also be understood that the higher the current flow through the output stage, the higher the boost B+ will be. Again, the circuits with wider deflection angles will produce the higher boost voltages.

In Chart 1, we have given relative data on voltages and currents normally associated with the horizontal output stage. These values may not agree with those specified for a given receiver, but they are nonetheless useful as a guide when you are trying to determine the reason for flyback and other component failures. If you will use the data contained in the chart as a comparison guide, you should have little or no trouble with flyback failure due to improper voltages or currents.

The measured DC voltage normally present on the control grid is a function of many variable factors, including B+ voltage, coupling capacitor value, grid resistor value, and efficiency of the output stage; therefore, it cannot be predicted too accurately. Use the value given in service literature as an aid for any particular set. I use this voltage as a guide to tube conduction and leakage in the coupling capacitor; for instance, if there is a negative voltage, I know the tube is conducting. Use a calibrated scope to determine the amplitude of the driving signal.

Troubles You Can Expect

The next seven test pattern photos, one normal (Fig. 11) and

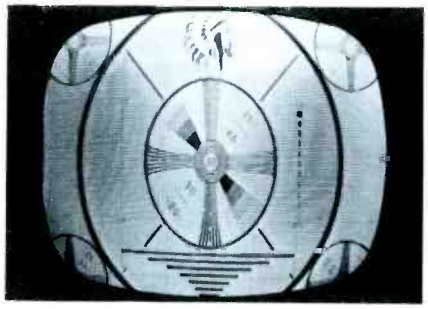


Fig. 12. Open screen bypass capacitor resulted in slightly narrowed picture.

six indicating troubles, were obtained in various ways from an Admiral 18A6C chassis (Fig. 6), and are generally applicable to other similar circuits.

At first glance, the test pattern in Fig. 12 may seem normal; however, if you look closely, you can see it is taller than it is wide. If height and vertical linearity were reduced to obtain a more nearly round pattern, there would be a black band at the top and bottom of the picture, indicating a need for more vertical sweep. In this instance, an open .047 mfd screen bypass capacitor was the culprit. In some circuits, an open screen bypass will be indicated by a very narrow picture accompanied by a telltale red glow from the plate structure of the horizontal output tube.

The screen voltage tends to rise when the bypass unit is removed. In the test case, it rose from 150 to 170 volts. When the screen bypass is good, there will be a very small signal developed across the screen resistor; however, an open resistor will cause a signal with an amplitude of several volts to appear at the screen grid. A normal signal level would be on the order of a few tenths of a volt.

The narrow picture in Fig. 13 resulted when the screen resistance in-

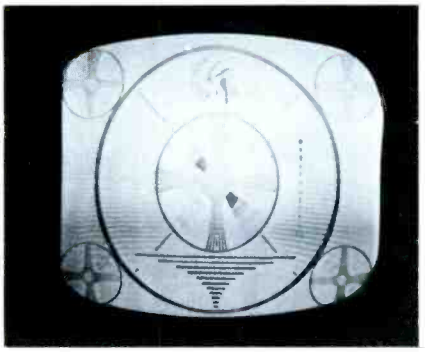


Fig. 13. Screen resistance went up from 12K to 39K; picture became narrow.

creased from 12K to 39K. This lowered the screen voltage from the normal level of 150 volts to 120 volts. As you can see, the picture is relatively linear and there is black space at both sides of the picture. This reduction of screen voltage was accompanied by a small decrease in cathode current and a corresponding decrease in the boost voltage.

The streaks and modulation bar in Fig. 14 resulted when the damper tube began to arc intermittently. The dark bar wasn't readily noticeable to the naked eye, but the camera (set to 1/50 sec.) recorded it anyway. A quick check for damper arcing can be made by lightly tapping the tube with a pencil eraser. White flashes across the screen indicate the need for a replacement.

The symptom shown in Fig. 15 occurred when half of the horizontal yoke opened. This symptom was accompanied by an increase in boost from the measured normal value of 640 volts to 750 volts. While this symptom won't be encountered often, it does emphasize that an open yoke is often accompanied by an increase in boost voltage, even if there is no high voltage and therefore no scanning lines visible on the screen.

Loss of picture, a dark spot in the center of the screen, and a narrow picture with a tendency to bloom (Fig. 16) resulted when the boost filter lost capacity and changed in value from .027 mfd to .005 mfd. Boost decreased from the normal 640 volts to 330 volts. At the same time, this defect delayed and changed the amplitude of the feedback signal normally applied to the AGC keyer plate; consequently, it knocked out the video signal.

Two other troubles, for which no

Fig. 14. Internal arcing in 6AU4 damper tube produced streaks in picture.

test pattern symptoms are shown, will occasionally be encountered. These defects are a shorted turn in the transformer and open damping-network components. In the first case, the symptoms might include evidence of some pulse voltage at the plate of the high-voltage rectifier, but little or no voltage at the cathode; low boost voltage; and, eventually, smoke from the transformer due to excess heat being developed in the shorted turn. This particular trouble is best located by using a flyback tester of the "Q" type. A shorted turn reduces the "Q" of the yoke, and the tester is calibrated to indicate a defective yoke if the "Q" is below a certain level.

When one of the damping capacitors opens (see circuit in Fig. 6), the 4.7K-ohm resistor from the center of the yoke burns. After this, there is a ripple in the left side of the raster, producing the familiar light and dark bars that characterize a lack of yoke damping.

Tube Defects

As previously indicated, a loss of capacity in the boost filter can cause a loss in video information to the picture tube because of AGC failure. I have, on several occasions, traced AGC failure to defective horizontal output tubes, yet there was little or no defect in the raster. Lab tests of

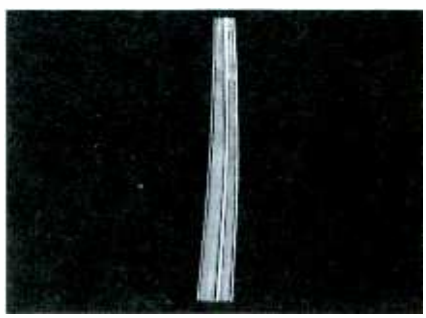


Fig. 15. Very dim vertical bar produced by open half of horizontal yoke.

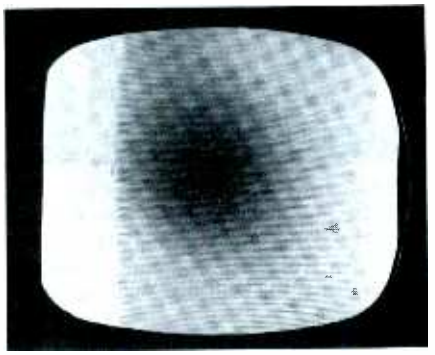


Fig. 16. Narrow raster, blooming, or a loss of picture can result from decrease in capacity of the boost filter.

the tubes in question revealed a slight gas content, apparently sufficient to change the phase of the output signal without reducing sweep or high voltage appreciably.

Don't forget those circuits that get their operating potentials from boost! Should any condition in the horizontal output circuit cause boost to be lowered by a significant amount, such troubles as poor vertical linearity, insufficient vertical sweep, poor focus, and even buzz in the sound can result. In Fig. 6, you will notice a network consisting of a 220K-ohm resistor, a .047-mfd capacitor, and a 560K-ohm resistor from terminal 8 of the transformer to pin 5 of the 6DT6. This is the plate voltage source for this tube, and low boost can cause distorted or weak sound. In fact, loss of boost in this type of set would kill the sound.

Conclusion

While the scope of this article has been relatively wide, the facts are pertinent to everyday servicing problems. If you understand how this circuit functions and how to make the required adjustments, and if you acquaint yourself with the trouble symptoms presented here, any difficulty you might have been experiencing with horizontal output troubles should be greatly reduced. ▲

How are *your* "Public Relations"?

Sorry, I didn't mean to pour salt on an old wound; I just thought if you had the time, we might work out a program to endear us to the hearts of those whom we serve.

Obviously, the first step in such a program would be to direct favorable publicity toward the service industry itself. This wouldn't be much of a problem if some tube-jockey would perform a tremendous service to the entire nation, like riding a satellite and keeping that transmitter beeping. Or, he could stimulate great public interest by sitting on the tower atop the Empire State Building and pointing south for the benefit of confused ducks. Maybe something a little more dramatic might do the trick. If one of us could just manage to find a sure cure for "Athletes Foot . . ."

We could also have TV men appearing on one of the better "give-away shows." (One of those that are left, that is.) If just one of them could win the big dough, all of us could bask in reflected glory for a little while, at least until some expert on the mating habits of the Tse-Tse fly knocks him off the throne. (That has a nice sound . . .Tse-Tse, even backwards.)

A 90-minute spectacular based on the romance and glamor of the service business shouldn't be too hard to promote, since two of the major networks are owned by tube manufacturers, and if this doesn't put our foot in the door, nothing will. If it flops, we can always make a panel show out of it.

Another thing we could do is TV spot commercials every fifteen minutes in a late, late, late show—we could have a man in a white doctor's coat, with the spotlight on his forehead, claim that "for that tired eyeball, those jumpy nerves from watching out-of-sync pictures, call your independent serviceman and remember, with doctors who know best, it's westerns two to one." Or, we could use spots in between soap operas in the afternoon, little cartoons in which cute moppets say in their cute way, "our serviceman is cute . . . he's nice to be near . . . he's lovely . . . he's engaged . . . he uses Burply's Bear Grease."

Then, a national beauty contest. No . . . not physical beauty . . . mental beauty. Each contestant has the electrodes of an encephalograph, (better look that one up, it's a brain wave indicator) attached to his head, and the one that produces the prettiest pattern on a "scope" wins a trip to the Siberian Salt mines (all expenses paid), a mink-lined tube-caddy, and an autographed picture of Frothingham Sturdley, the inventor of the self-stripping tuner slug, the hollow-ground chassis edge, and the one-jolt pilot light. He was given a medal and an annuity for life by the Framis Foundation for his work on the repair-proof knob and the plastic which dissolves when you try to clean it . . . with anything . . . even water. A great man, really great.

Some florist might be sold on the idea of creating a new flower for the profession and call it the "Repairman's Rose" or the "Tube Jockey Jonquil." How about the "Oscillator Orchid" or the "Selenium Sweet Pea?" On second thought, the odor of burning selenium doesn't tend to engender a spirit of aesthetic appreciation; in fact it . . . oh well, you can't pick a winner every time.

Soap operas on daytime radio, new songs, new dances all based on the life of man's best friend, the TV repairman, will elevate you to your proper place in your community." Just imagine "John's Other Test Probe" on radio, or songs such as "Insulation Is Funny, It Smells Something Like Money" or "When I Said You Had a Chassis Like Lassie, I Didn't mean You Were a Dog." Teenagers won't be able to resist dances called the "sync slink" or "the vertical roll."

There it is, your glorious future . . . oh, no, not mine . . . I've been thinking about becoming a part-time buggy-whip salesman.

Hybrid Auto Radios

(Continued from page 38)

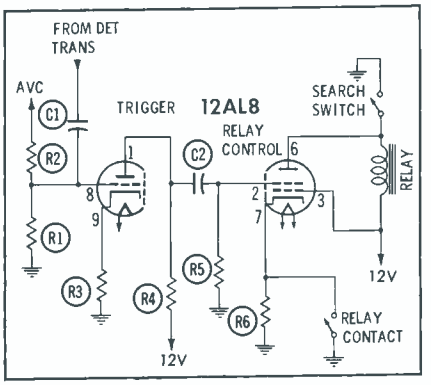


Fig. 5. Typical control circuit for signal-seeking mechanism uses 12AL8.

nique often spots faults that are not revealed by a tube tester. This is not to say that a tube tester doesn't yield useful information at times. If the roll chart on your tester gives settings for hybrid types, you can generally assume that these tubes will not be harmed if you give them a value test. AVOID TESTS FOR SHORTS AND LEAKAGE, however, unless you are certain that the test circuit is designed to handle hybrid tubes. Some short-test circuits apply more than 100 volts between tube elements, and this is far in excess of the maximum ratings of hybrid designs. If you are in doubt, it is safer to check for shorts by taking ohmmeter readings between tube pins.

Hybrid sets, like other radios, sometimes develop symptoms such as distortion or loss of sensitivity. Although many car-radio owners will tolerate considerable trouble of this kind before bringing their receivers in for repair, some customers are anxious to keep their sets in top-notch shape. Therefore, hybrid receivers which are only slightly defective will be brought into the shop from time to time. In such cases, results of troubleshooting tests should be analyzed with more than usual care. Mild troubles may not be recognized in a casual check of receiver operation — partly because hybrid designs are relatively new and unfamiliar, and partly because the tubes used in these sets are somewhat more critical in operation than conventional tubes.

The statement is sometimes made in service data that loss of input impedance is a common defect leading to replacement of hybrid tubes.

This condition is produced by a combination of many factors that affect tubes as they age. The effect on hybrid tubes is greater than for other types because of their close interelectrode spacing.

Let's consider a few effects of aging. For one thing, the physical spacing between grid and cathode can change, thereby altering the value of the input capacitance. In addition, the vaporized material which is "boiled" off the cathode tends to condense on certain other parts of the tube structure because of their nearness to the cathode surface. If this material sticks to the mica insulators, it causes interelement leakage; if it is deposited on the grid, the latter will emit electrons when heated in normal operation. Both leakage and grid emission tend to change the value of the contact potential, which is the grid bias established by tube conduction when no path is provided for DC current from grid to ground. Many hybrid tube circuits have an extremely high grid resistance (up to 10 megohms) so that contact potential can be utilized as bias voltage. If the aforementioned defects cause the contact potential to shift by more than a fraction of a volt, the operation of the tube may become nonlinear.

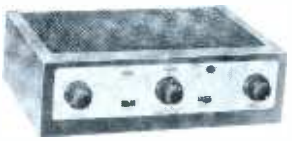
The problems encountered in hybrid-tube operation have been combatted by the use of special construction to stabilize contact potential and retard aging. For instance, the emitting material in the cathode is an alloy which produces minimum condensation on grids and spacers. Another interesting feature is the use of large grid supports which carry away heat in order to cut down on grid emission.

Of course, tubes are not the only possible cause of slight deficiencies in performance of hybrid radios. Such things as component or printed-circuit defects, troubles in output transistors, or misalignment should also be considered. Nevertheless, you should make sure that all tubes have been thoroughly checked before you dig too deeply into the rest of the circuitry. Remember that you have not made a truly positive test until you have substituted new tubes and checked the results of these substitutions under a wide variety of signal conditions. ▲

PRODUCT report

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

Control Preamplifier (No. 44A)



A new audio amplifier from EICO has an input selector combined with a 4-position equalization switch; level, loudness, bass and treble controls; and rumble and scratch filters. Model HF 65A, externally powered, is $29.95 in kit form or $44.95 wired, while Model HF 65, with built-in 6X4 power supply, is $33.95 in kit form or $49.95 wired.

Transcription Tone Arm (No. 45A)

The Garrard Model TPA/12 transcription tone arm has a plug-in head wired to accept either stereo or monaural cartridges. Tracking angle is fixed, and a simplified weight adjustment on top of arm has been adopted. Price is $19.50 .

Stereo Record Cleaner Kit (No. 46A)

The Walco *Stereo/Hi-Fi Discleaner Kit* includes a plastic squeeze bottle of *Formula "S"* antistatic and cleaning solution, a velvet pad to apply the cleaner, and another to dry the record after cleaning. The pads have a pile depth of .045" to match the standard groove depth of stereophonic discs. List price is $1.50 per kit.

Printed Circuit Repairs (No. 47A)

Small damaged areas on printed-circuit conductors can be repaired by brushing on new Walsco liquids that deposit silver or copper compounds on the printed board when they dry. *Silver Print* is available in two sizes: ½ Troy oz. (Cat. No. 36) or 1 Troy oz. (Cat. No. 36-1). The other liquid, *Copper Print* (Cat. No. 37-02), comes in a 2-oz. bottle.

Steam Iron Cleaner (No. 48A)

Sputtering or sluggish operation of a steam iron indicates that the inside of the iron is being clogged with scale deposited by hard tap water. *SSS-T*, manufactured by Fast Chemical Products Corp., is a liquid cleaner especially formulated for removing this scale without damaging metal parts of the iron.

Auto Radio Controls (No. 49A)

Centralab has introduced a full line of auto-radio controls which are exact replacements for those employed as original equipment. Controls for "private-label" brands of receivers, as well as for auto manufacturers' brands, are included in the line.

Audio Cables (No. 50A)

Contents of the Anchor Model HK 510 Hi-Fi Cable Kit are as follows: One 36" shielded cable with a phono plug at one end and free wire ends at the other; 18" and 72" shielded cables with phono plugs at both ends; a connector with phono jacks at each end; and an adapter to permit a phono plug to be inserted into an earphone jack.

Speaker With Dual Voice Coils (No. 51A)

Very little directional effect is obtained with sound waves at frequencies below about 150 cps, so it is not essential to use two separate woofers in a stereo speaker system. Accordingly, University has designed a 12" woofer with two separate voice coils (Model C-12SW) that can reproduce the lowest-frequency information from both sound channels. User net price is $39.50.

Heavy Duty Rotator (No. 52A)

Designed to support up to 1,000 lb. of dead weight, the CDR *Ham-M Antenna Rotor* is usable with large, bulky antennas such as "bedsprings" or amateur radio arrays. The brake has a solenoid-operated release and is rated to withstand 3,500 in.-lb. of lateral thrust. The indicator meter is calibrated in 5° steps, and can be read without energizing the rotator motor.

Miniature Silicon Rectifiers (No. 53A)

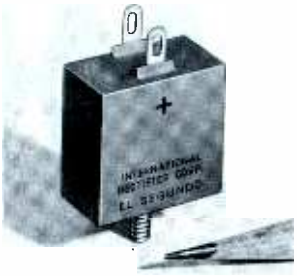
Tiny silicon rectifiers with pigtail leads, rated at 750 ma DC and having a volume of less than .004 cu. in., are being produced by Sarkes Tarzian. This new "F" series is available in voltage ratings of 200, 400 or 600V.

Crystal Mike (No. 54A)

A low-priced crystal microphone, Astatic Model M-150, is designed principally for use with tape recorders. Output is rated at —44 db, and frequency response is 30 to 10,000 cps. The case is of ivory-colored high-impact plastic, with a metal grille that has a golden finish. Comes equipped with 5' of highly flexible shielded cable. List price is $6.50.

Encapsulated Selenium Rectifiers (No. 55A)

A small selenium rectifier for relatively low-drain power-supply applications in radios, phonographs, and relay circuits, the International Rectifier Corp. Type QM50, is encapsulated in molded phenolic material. DC output current rating is 50 ma; maximum RMS input voltage is 130V. The rectifier can be stud-mounted, or the terminal lugs can be inserted directly into a printed-wiring board.



Electrolytic Substitution Box (No. 56A)

The Sencore *Electro - Sub* (Model ES 102) is a capacitor substitution box containing 10 separate electrolytics with values from 4 to 350 mfd. Maximum rating of all units is 450 volts. Surge-protection resistors prevent arcing or accidental healing of bad capacitors during tests. A spring-loaded slide switch completes the test circuit. When released, it automatically discharges the capacitor through the surge - protection circuit. Dealer net price is $15.95.

High-Gain UHF Antenna (No. 57A)

The parabolic reflector, which has long been used in point-to-point communications antennas to provide exceptionally high gain and sharp directivity, has been adapted for UHF-TV reception in the TACO *Diversitron*. A 4' reflector screen focuses signals on an anodized-aluminum folded dipole. Two versions, Model 3050 for channels 14-70 and Model 3050T for translator channels 70-83, are available at a list price of $24.95 each.

Coaxial Speaker (No. 58A)

The 12" woofer and the elliptical tweeter in the Sonotone CA-12A coaxial loudspeaker have separate voice coils. An inductor - capacitor network gives a crossover frequency of 2,000 cps. Over-all frequency response is 35-20,000 cps. List price of the coaxial unit is $27.50, and the woofer is separately available at $16. For a 3-way system, Sonotone recommends use of a WR-8 mid-range speaker in combination with a

Servicing Book (No. 59A)

A new book by Milton S. Kiver, "Television Analyzing Simplified," has been published by B & K Mfg. Co. The author outlines various approaches to TV servicing, with emphasis on the principles of signal tracing and signal substitution. He presents many specific suggestions for making efficient use of the B & K *Television Analyst* in troubleshooting different sections of a TV receiver. The 104-page book is priced at $1.

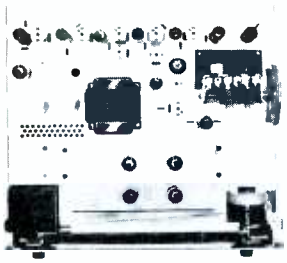
Flashlight Battery (No. 60A)

A new Size D dry cell for use in flashlights and many portable radios, the Mallory Type M 13, is encased in steel for prevention of leakage and corrosion and to provide better service under conditions of extreme heat or humidity. The steel jacket has a bright chrome finish with red and blue trim.

Test Leads (No. 61A)

Test leads are now being packaged in transparent Pliofilm bags as well as in rigid plastic tubes by Alpha Wire Corp. Various types of tips, including 5" prods, 1" needle-tip phone plugs, alligator clips, banana plugs, spade lugs, and right-angle meter tips, are supplied in a total of 12 different combinations. Leads range in price from $1.17 to $1.68 per pair.

Multiplex AM-FM Tuner (No. 62A)

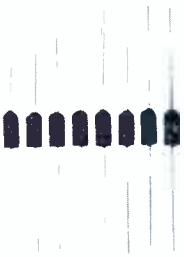


Stereo programs transmitted by a new FM multiplex method can be received by the Harman-Kardon *Ode* AM-FM tuner when outfitted with a multiplex adapter (in space provided on chassis). The tuner also features a "shaded-grid" tetrode RF amplifier. Price of the *Ode* (Model T250) is $149.95; the adapter (Model MA250) is $49.95 extra; an optional Model TC50 enclosure is $12.50.

Antenna System Display (No. 63A)

A wall-mounted display panel, 3' x 4' in size, helps dealers demonstrate the Jerrold *TV-FM Amplified Home Antenna System*. Focal point of the display is a brightly-colored, three-dimensional cutout that represents a cross-section of a home. The display contains a complete operating model of the antenna system; when connected to an outside antenna, it can supply signals to as many as five TV or FM receivers.

Silicon Rectifiers (No. 64A)



Eight different types of silicon rectifiers with pigtail leads and epoxy-resin cases are being marketed by Tung-Sol. Type 1N2078, which has a peak inverse voltage rating of 400 volts, is best suited for use in the power supplies of radios and TV sets. The PIV ratings of the other rectifiers in the series (Types 1N2072 through 1N2079) range from 50 to 500 volts.

Subminiature Electrolytics (No. 65A)

Litl-lytics are subminiature electrolytic capacitors made by Sprague for replacement use in transistor radios and similar equipment. These hermetically-sealed, aluminum-encased units will withstand operating temperatures up to 85° C. Terminal connections are welded. Leakage current is extremely low; the maximum value is 1 microamp for a 2-mfd, 6-volt capacitor or 3.5 microamps for a 300-mfd, 6-volt unit. Voltage ratings from 1 to 150 WVDC are available.

INDEX TO ADVERTISERS

latest JACKSON tube test data

TUBE TYPE	MODEL 648 FIL.	CIRCUIT D.	CIRCUIT E.	PLATE TEST	MODEL 115/715/561 FIL.	X.	PLATE	YZ
2EA5	2.5	A234	AC156	16XZ	2.5	5	30	2JMS
2EN5	2.5	235	4 7	65X 65X	2.5	-	28 28	5Q 6Q
12AF3	12.6	129	6	13W	12.6	3	18	7S
12ED5	12.6	AC123	A456	30Z	12.6	6	18	5JMR
7199	6.3	A129 127	C358* A46	18WY 18YZ	6.3	-	35 20	4RS 2PR

TUBE TYPE	MODEL 49 SEC.	A.	B.	C.	D.	CATH. SHORTS	E.
2EA5	P	2.5	3	2X	156	7	30
2EN5	D D	2.5 2.5	3 3	- -	2X 7X	5 5	47 47
12AF3	D	12.6	4	2	9	0	5
12ED5	P	12.6	3	2	567	1	4
7199	P T	6.3 6.3	4 4	X X	237 19	6 8	28 30

Latest Chart Form 648-21, 115/715/561-10, 49-4

CATALOG AND LITERATURE SERVICE

ACCESSORIES

1A. *E-Z-HOOK*—Convenient reference sheet titled, "How to Build the Five Most Useful Scope Probes," with schematics, mechanical component layouts, etc. *See ad page 80.*

ANTENNA SYSTEMS

2A. *AMPHENOL-BORG*—"Custom FM Reception Demands a Fine Antenna," a directed-to-the-consumer booklet on selection of FM antennas. *See ad page 28.*

3A. *CHARLES ENG.* — Technical brochure No. 101 tells how to use the Wizard 300 Electro-Magnetic set coupler in installations for homes, motels, apartments, etc. *See ad page 95.*

4A. *GENERAL CEMENT* — Broadside describing latest Telco antennas. *See ad 2nd Cover.*

5A. *JERROLD*—16-page booklet on Jerrold's amplified TV-FM Home Systen and how to obtain optimum TV and FM reception using a number of outlets throughout the home. *See ad page 73.*

ANTENNA TOWERS

6A. *KTV TOWERS* — 4-page brochure describing KTV towers. *See ad page 98.*

7A. *SOUTH RIVER* — Literature on new Bantam Tower Models BT-5 and BT-10 for TV antenna mounting. *See ad page 87.*

AUDIO & HI-FI

8A. *ARKAY*—Illustrated catalog gives specifications for award-winning hi-fi kits, including latest stereo components, radio and TV receivers, and test instruments. *See ad page 89.*

9A. *ELECTRO-VOICE*—Catalog No. 126 on public-address and general-purpose microphones. *See ad pages 14-15.*

10A. *JENSEN INDUSTRIES* — 1959 cross-reference booklet on phono needles. *See ad page 89.*

11A. *PICKERING* — Complete technical file includes valuable data on hum elimination, installation, maintenance, etc. *See ad page 52.*

12A. *SONOTONE*—"Stereo Simplified," complete explanation of stereo reproduction for the layman. *See ad page 75.*

13A. *UTAH RADIO*—4-page booklet describing new stereo amplifier-enclosure system. *See ad page 12.*

CAPACITORS

14A. *ILLINOIS CONDENSER*—Catalogs on new SMT Sub-Miniature, as well as general electrolytic capacitors. *See ad page 91.*

15A. *SPRAGUE*—M726 "Cerami-Chart," large wall chart of standard ceramic capacitor color codes with circuit application data for various types. *See ad page 10.*

16A. *TOBE DEUTSCHMANN*—Catalog No. 5701 on replacement capacitors and filters. *See ad page 66.*

COMPONENTS (MISC.)

17A. *MALLORY* — Silicon rectifier catalog (form No. 9-152), capacitor catalog (form No. 9-140), resistors, controls and switches catalog (form No. 9-136). *See ad pages 26-27.*

POWER SUPPLIES

18A. *ATR*—Manual on vibrators and inverters. *See ad page 18.*

19A. *ELECTRO PRODUCTS*—4-page folder covering uses and specifications of Model PS-2 dual-purpose filtered DC power supply. *See ad page 88.*

RESISTORS

20A. *IRC*—Catalog on S505 "Handy-Pak" carbon composition resistors. *See ad pages 24-25.*

SERVICE AIDS

21A. *CLAROSTAT*—Form No. 755259 on 225-watt power-resistor decade box which provides values of 1 to 999,999 ohms in 1-ohm steps. *See ad page 51.*

22A. *ROGERS MFG.*—Literature on the "Tel-A-Turn," new TV chassis cradle designed to decrease repair time, eliminate struggling with heavy, hard-to-handle chassis, and permit full 360° rotation and locking in any position. *See ad page 96.*

23A. *SERVICE INSTRUMENTS* — Mailer describing 10 most popular Sencore time-savers. *See ad pages 72, 78, 82, 88, 90, 96.*

24A. *SHELL* — TV Troubleshooter's Guide. *See ad page 53.*

TECHNICAL PUBLICATIONS

25A. *CBS-HYTRON*—Flyer PA-276 describing the new Transistor Home Study Course. *See ad page 13.*

26A. *PF REPORTER*—1958 Editorial Subject Reference Index.

27A. *PHILCO CORP.*—"1959 Service Dealer Handbook" covers the business side of service and provides a day-by-day business record. *See ad page 9.*

28A. *HOWARD W. SAMS*—Descriptive literature on all Howard Sams books covering servicing of TV, radio, hi-fi, etc. Includes data on latest books, "101 Ways to Use Your Sweep Generator" and "Tape Recorder Manual, Vol. 3." *See ads pages 55, 82, 95.*

TEST EQUIPMENT

29A. *ARKAY* — Complete specifications for test instrument kits, featuring advance design VT-10 Vacuum-Tube Voltmeter with large 6" meter. *See ad page 89.*

30A. *B & K*—Bulletin AP12-R gives helpful information on new point-to-point signal-injection technique with Model 1075 TV "Analyst"; other bulletins describe "Dyna-Quick" Models 500B, 650, and automatic 675 portable dynamic mutual conductance tube and transistor tester, plus Model 400 CRT cathode rejuvenator tester. *See ads pages 19, 80.*

31A. *DOSS*—Literature on new type transistor checker, also on CRT checker. *See ads pages 78, 82, 93.*

32A. *EICO*—20-page 1959 catalog shows how to save 50% on top-quality professional test instruments, ham radio gear and hi-fi equipment in either kit or factory-wired form. *See ad page 90.*

33A. *HICKOK*—New Test Equipment Catalog No. 38 describes latest radio-TV and communications testers. *See ad page 68.*

34A. *SECO*—New 2-color folder showing complete line of test equipment and service aids. *See ads pages 83, 94.*

35A. *SIMPSON*—Brochure No. 2060 includes descriptions of latest additions to company's line. *See ad page 58.*

36A. *TRIPLETT* — New Test Equipment Catalog No. 38-T describes latest electronic, electrical, radio, television and industrial testers. *See ad page 71.*

TOOLS

37A. *KEDMAN*—Catalog sheet describing 4 screwdriver displays and specifications on 14 kinds of screwdrivers in company's line. *See ad page 92.*

38A. *VACO*—New catalog on 5-piece screwdriver set and solderless terminals. *See ad page 98.*

39A. *WEN*—Data on new Model 909 souped-up ½ h.p. sabre saw that cuts anything from 6" logs to 2" steel pipe. *See ad page 18.*

40A. *XCELITE*—Latest catalog on complete line of serviceman tools. *See ad page 91.*

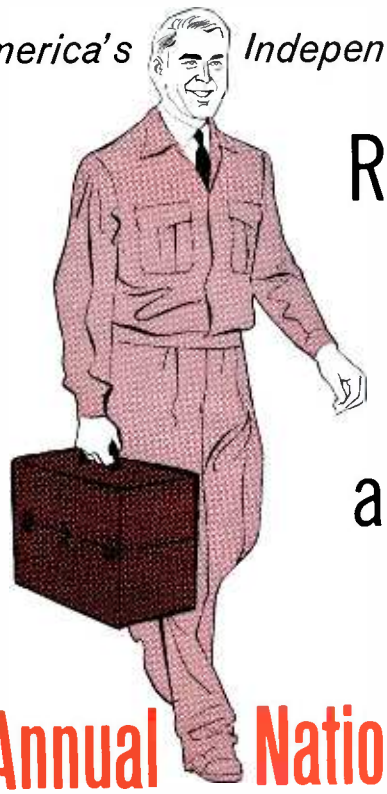
TUBES

41A. *GENERAL ELECTRIC*—New brochure on G.E. tubes: "Here's Why General Electric Receiving Tubes are Better," and "Receiving Tube Interchangeability." *See ad page 29.*

42A. *RAYTHEON* — Revised 14-page Television Picture Tube Characteristics booklet includes data on aluminized black-and-white and color tubes, face-plate deflection angle, bulb dimension, ion-trap requirements and basing diagram. *See ad pages 16-17.*

43A. *TUNG-SOL* — 30-page flip-style chart supplies electrical and physical characteristics for most important industrial, special-purpose and military tubes. *See ad page 61.*

To America's Independent Television Service Technicians:



RCA Offers You Valuable Advertising and Sales Support during...

5th Annual National Television Technicians' Week

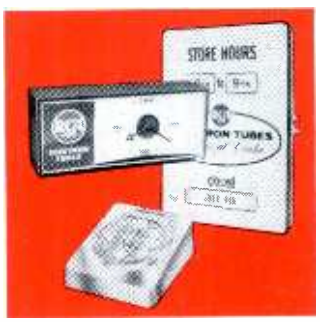
MARCH 23-28

NATION-WIDE ADVERTISING AND PUBLICITY... special NTTW ads in TV GUIDE will be read by over 25,000,000 TV viewers...TV and radio commercials on popular network shows...local newspaper ads with *your* name and address...publicity and news coverage—*all* directing customers to visit your shop for expert service!

NTTW PROMOTION PACKAGE...a colorful window display and two attractive window streamers advertising your expert service are included in this complete promotion package. Just team these with your golden NTTW symbol to impress passing traffic! Also included are local radio and TV spot announcements for your use...plus newspaper ad mats and local publicity releases. Here are all the tools you need to bring the national impact of NTTW right to your door.

NTTW SYMBOL...your special recognition symbol and RCA's special tribute to you! Finished in gleaming gold on a rich ebony base, it reflects your integrity, skill, experience. A symbol of confidence for your customers to see and remember!

VALUABLE, BUSINESS-BOOSTING NTTW ITEMS ...a handsome store clock ...a "store hours" door sign ...*and* a beautifully finished red bank to use as a consumer give-away are also available to you!

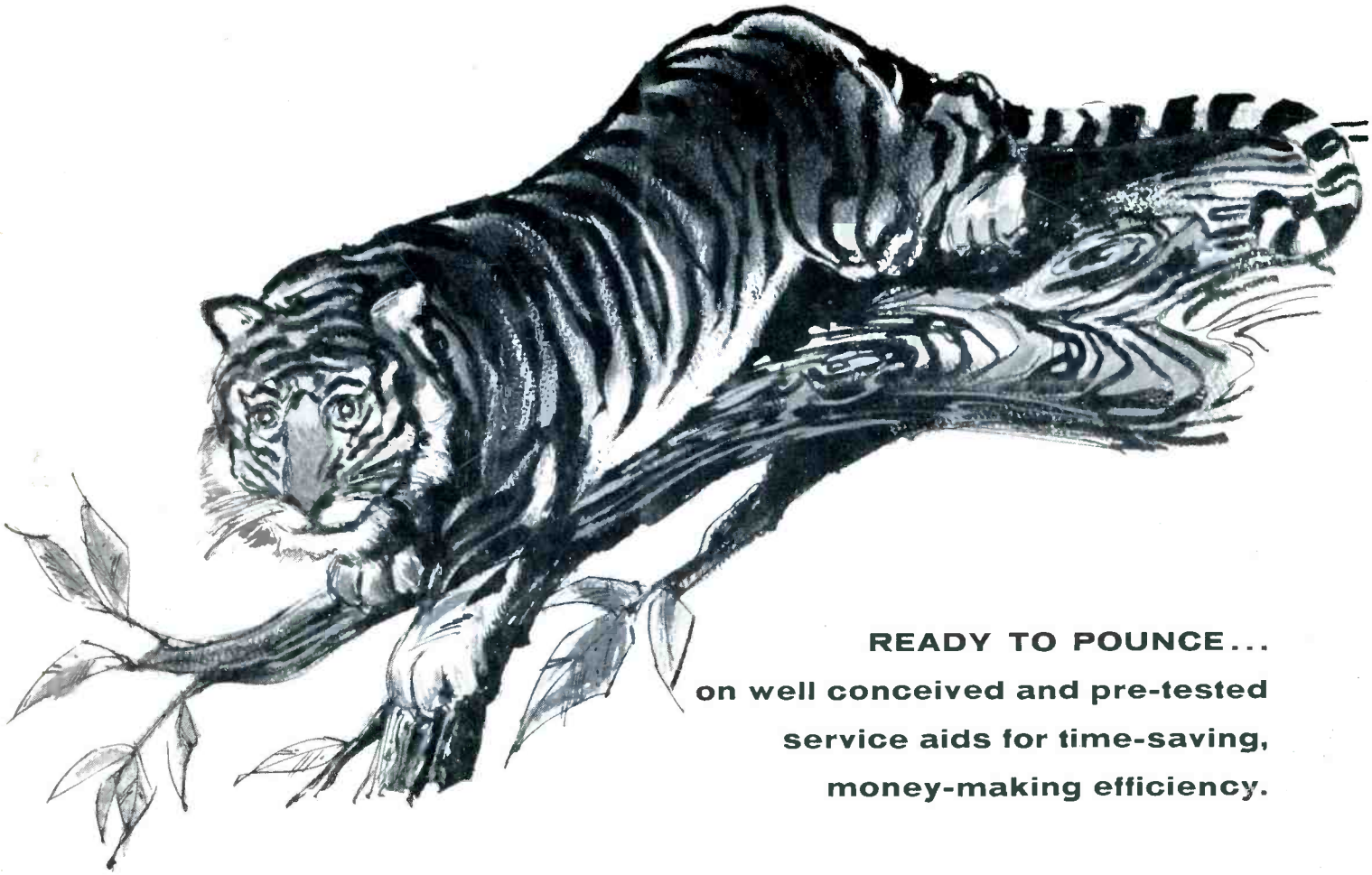


YES...SEE YOUR RCA TUBE DISTRIBUTOR TODAY FOR ALL THESE PROMOTION MATERIALS!

RADIO CORPORATION OF AMERICA

Electron Tube Division ***Harrison, N. J.***

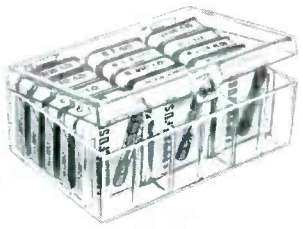
we see our customers as ...



READY TO POUNCE...
on well conceived and pre-tested service aids for time-saving, money-making efficiency.

LITTELFUSE

Des Plaines, Illinois



The Littelfuse Fuse Caddy for every serviceman's tube caddy.

Burton Browne Advertising