NOVEMBER, 1960 35 CENTS

PF REPORTER

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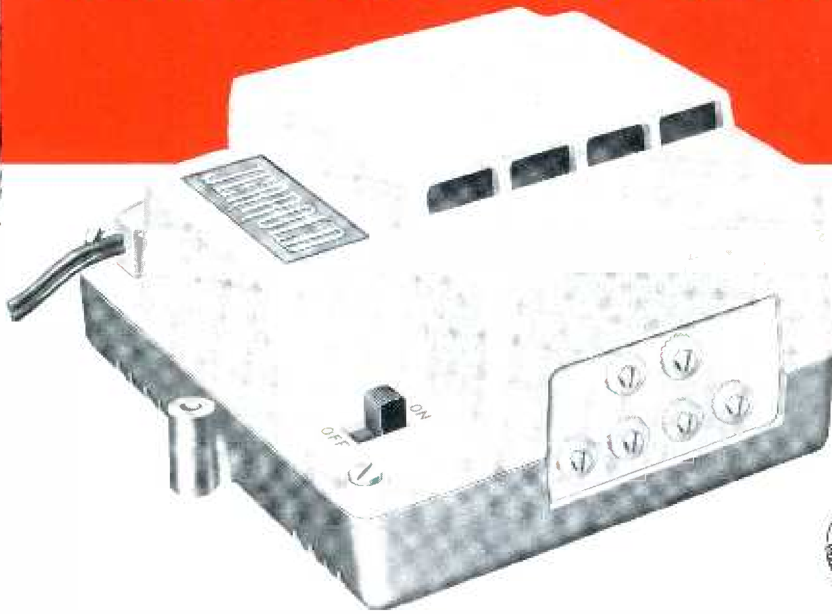

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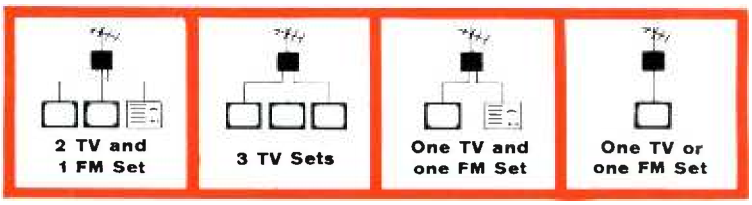

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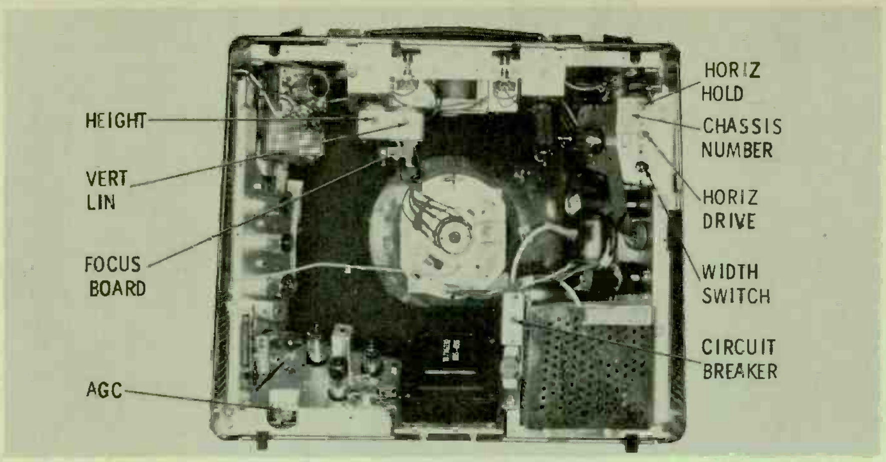
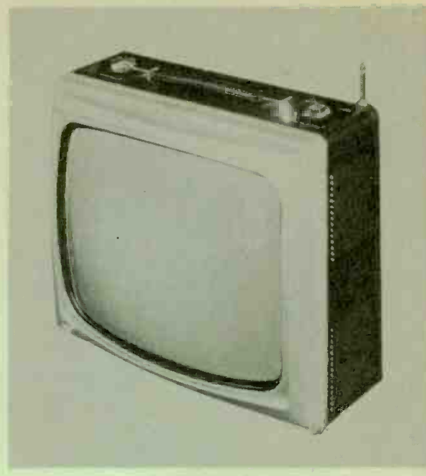
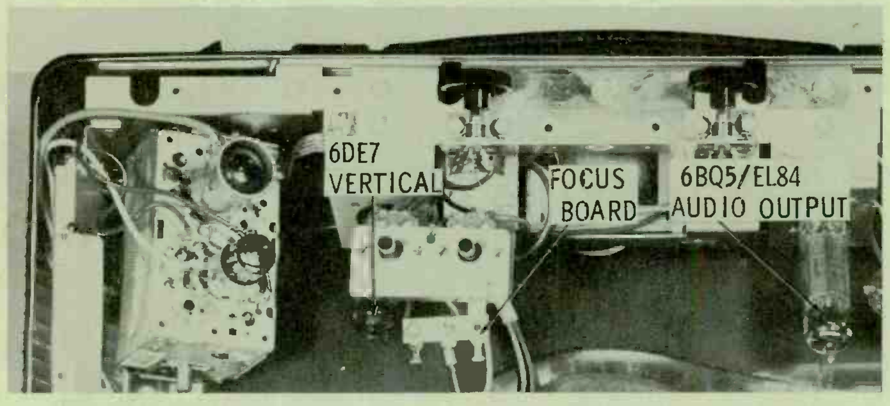
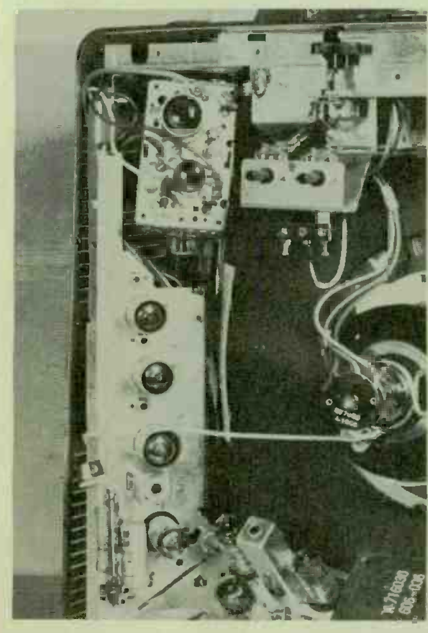
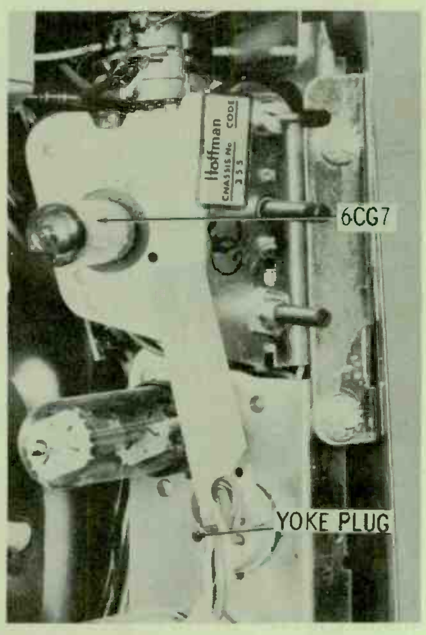
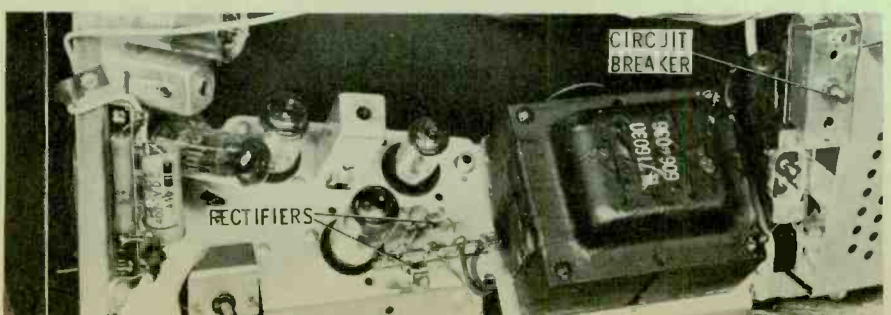












Hoffman Model K1919 Chassis 355

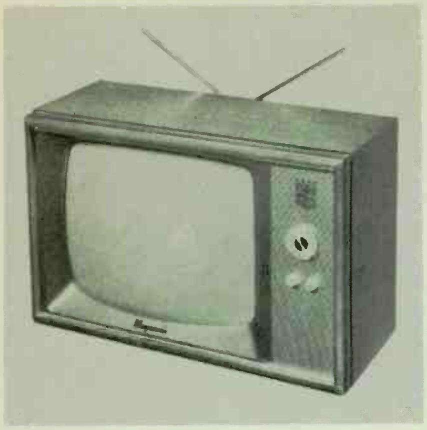
Hoffman's 1961 portable line is represented by this 19", 110° model with bonded safety shield. Three different-colored cabinets of the same design make up the entire series. All are equipped with a monopole antenna, which is built into the rear cover along with a matching balun transformer. Operational controls are top-mounted; thumb-wheel knobs protruding through the upper part of the back cover control brightness and vertical hold.

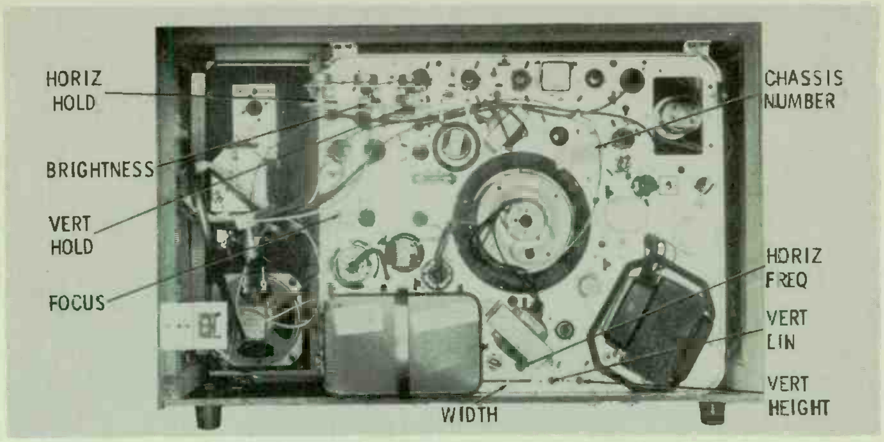
The rather unusual 16-tube chassis nestles compactly around all four sides of the picture-tube bell. Conventionally wired, the component sides of the chassis are easily accessible after removal of the wrap-around cabinet (nine screws hold it in place). A strip of metal foil taped to the neck of the picture tube under the yoke provides proper horizontal linearity. When replacing the picture tube, be sure to tape the foil strip in the same location on the new tube. Also, be sure to use *Mylar* tape or the equivalent to prevent the possibility of arc-through.

The top part of the chassis carries the 6BQ5/EL84 audio output stage and a 6DE7 combined vertical multivibrator and output. Since the vertical circuits are supplied with boost voltage through the height control, and B+ through the output transformer, this part of the chassis is ideal for the location of the focus terminal board.

The left and right chassis contain the RF, IF, video, and horizontal sweep circuits. The subchassis with the 6CG7 horizontal oscillator circuit is mounted at a more extreme angle to provide room for the speaker. The yoke plug contains a jumper to complete the cathode circuit of the horizontal output tube. Since the phosphor of the picture tube may be damaged if the yoke plug or any tube in the horizontal circuit is removed while power is supplied to the set, be sure to disconnect the power before breaking these circuits.

On top of the base chassis, a pair of silicon rectifiers are connected in a full-wave, voltage-doubler configuration. There is a trend for manufacturers to employ this circuit in conjunction with a power transformer. However, it is unusual to find a transfromer-powered chassis protected by a circuit breaker, as is the case in this Hoffman portable.





Magnavox Model 1MV139D Chassis V34-01-00

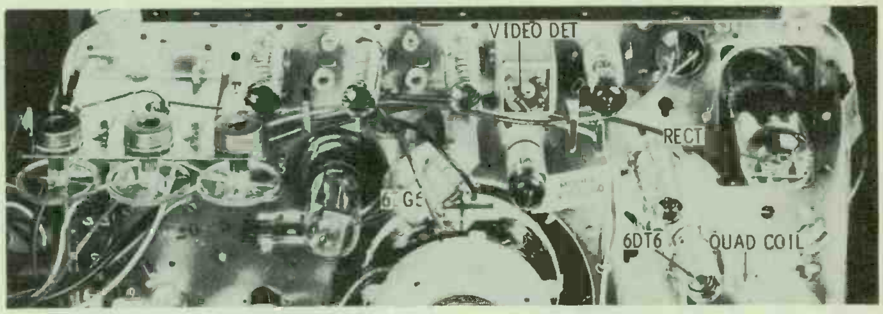
This model from the 1961 Magnavox line sports a 19YP4, 110° picture tube. Other versions of this same chassis may use a 23MP4; neither tube type utilizes a bonded faceplate. A removable trim strip along the top of this model provides access to the face of the picture tube for cleaning. The only operational controls on the front are the push-pull off-on switch, volume, contrast, and tuning. (Some versions have remote control.)

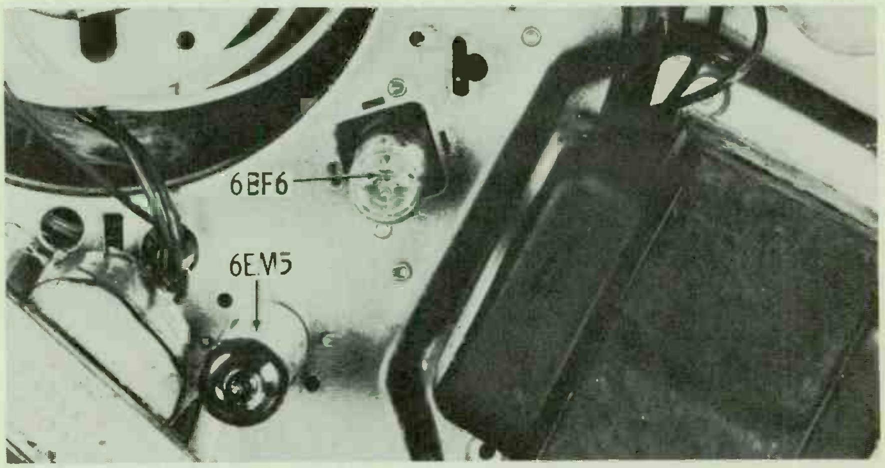
Rear-mounted controls for horizontal hold, brightness, and vertical hold are equipped with thumb knobs which protrude through the rear cover. Setup controls are well labeled and easily accessible. The conventionally-wired, 18-tube, vertical chassis follows the same general layout used in previous years.

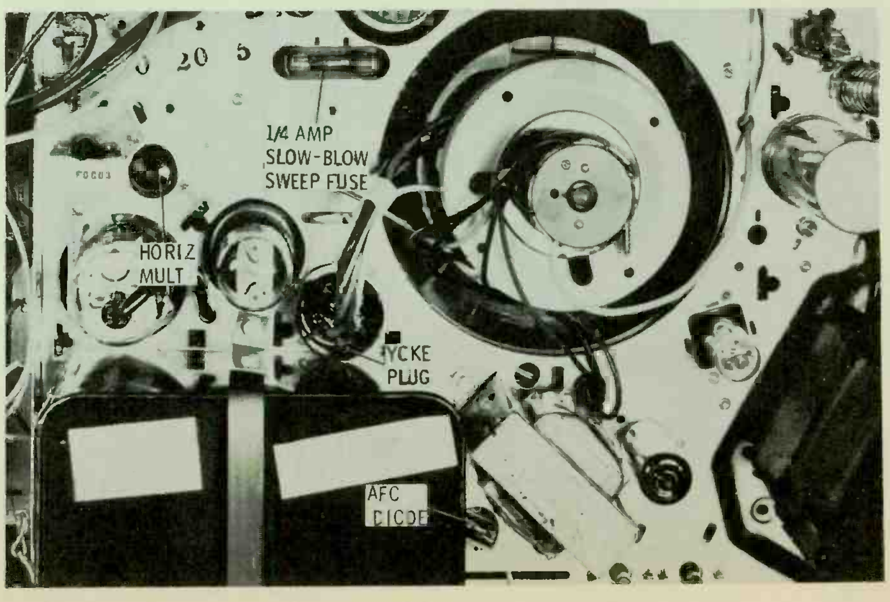
All of the signal-handling circuits are located along the upper half of the chassis. The 5U4GB B+ rectifier, in a rather unusual recessed mounting, is completely removed from the remainder of the power supply, so that the effects of its heat on other circuits is minimized. In the photo, the top cap has been removed from the video IF output transformer to show the soldered-in 1N64 video detector. The quadrature-coil adjustment is located on top of the "canned" coil in the locked-oscillator audio detector circuit, which uses a conventional 6DT6. Just to the right of the control panel, you'll find either a 6DG6 or 6W6 serving as the audio output. The tubes are used interchangeably and can be replaced with either type.

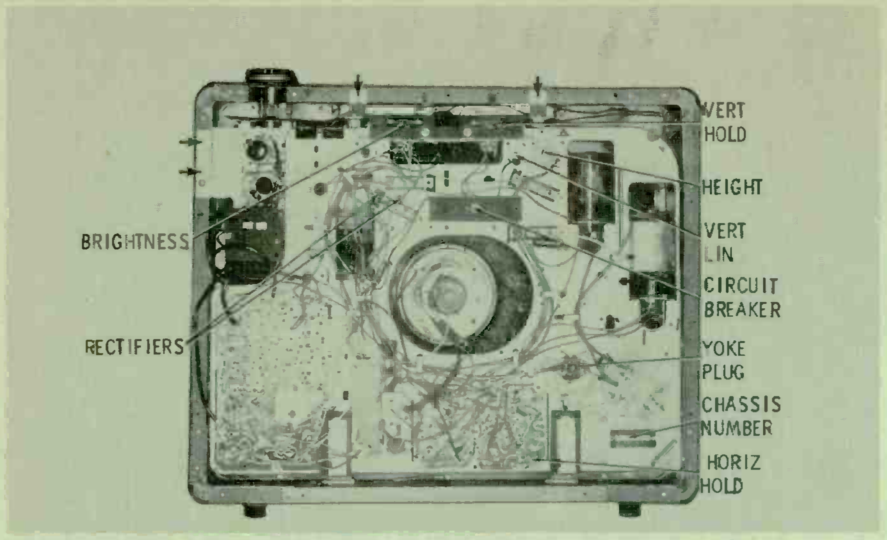
The remainder of the power supply and the vertical deflection circuits occupy the lower right part of the chassis. Magnavox has again reverted to the use of a 6BF6 as the first section of the vertical multivibrator circuit; the combined output and multivibrator stage incorporates a 6EM5. The transformer-powered chassis uses a 1½" length of #24 wire (located beneath the chassis) as a filament-protection device.

A ¼-amp, slow-blow fuse provides sweep-circuit protection. As in previous years, the horizontal sweep circuits occupy the entire lower left-hand corner of the chassis. Also, the same circuit layout is employed, with the plug-in, dual-selenium horizontal AFC diode positioned along the right side of the high-voltage cage.





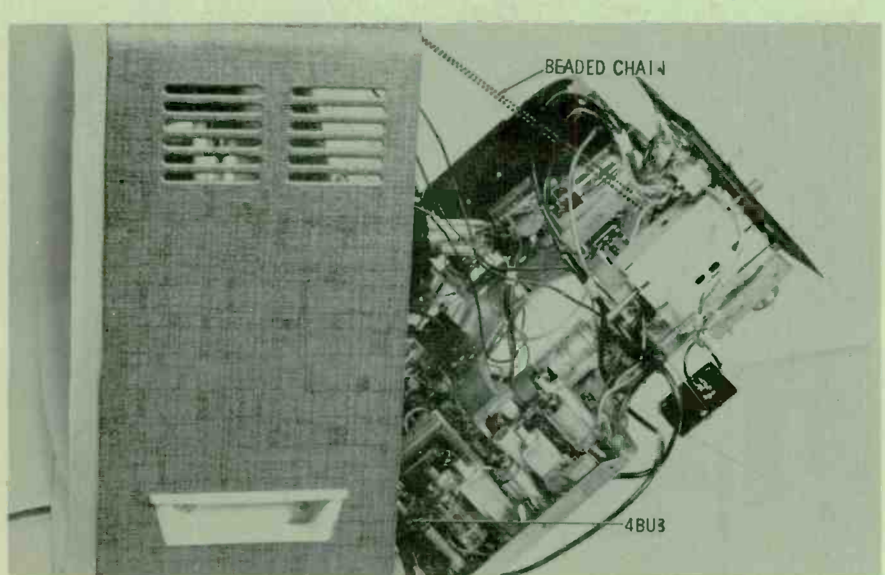




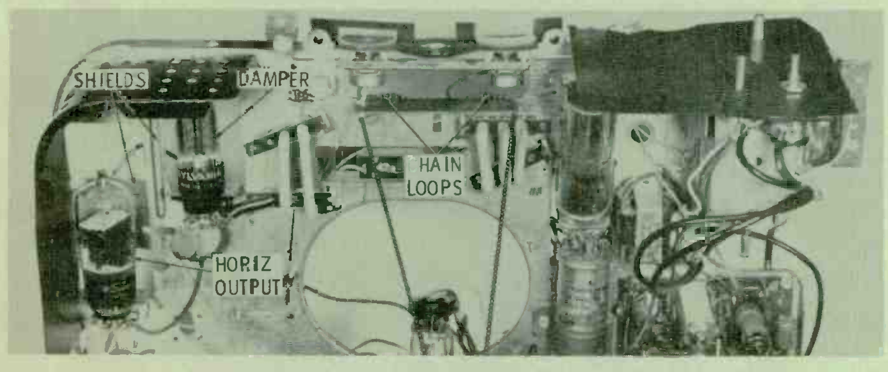
Silvertone Model 1118CH
Chassis 528.51680

Representing the *Medalist* series of 1961 Silvertones, this 21" portable has a west-coast twin with a PC prefix to the model number and a 456.51680 chassis. The series includes 12 basic models and 3 basic chassis (-680, -740, -760) used in 17", 21", and 23" versions. The 23" models have a bonded safety shield. In this model the mask is held in place with two screws in the cabinet bottom which, when removed, permit access to two springs holding the safety glass in place.

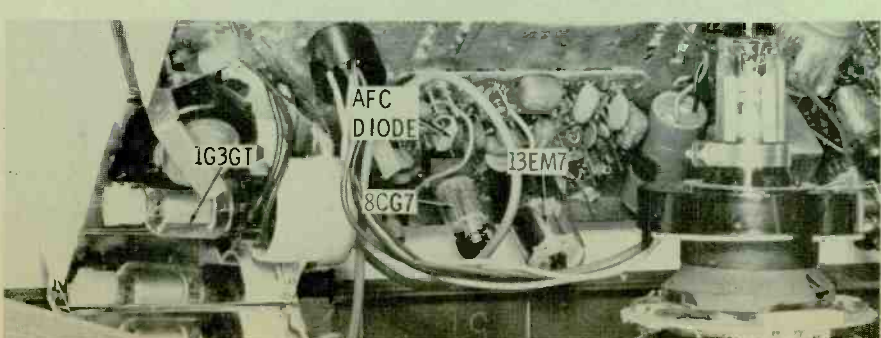
With the back removed, it's readily apparent how such a thin cabinet design is possible; the vertically-mounted chassis is turned around so the tube side faces forward. This feature is quite similar to some CBS chassis of days gone by. In order to gain access to the tubes, remove the knobs from the top-mounted controls and the four metal screws indicated by the heavy arrows. The top of the chassis will then tilt back. As you can see, most of the wiring is contained on two printed boards. The 15-tube chassis has a 450-ma series-filament circuit, and a pair of silicon diodes connected in a conventional half-wave doubler circuit. A circuit breaker provides protection for the B+ supply.



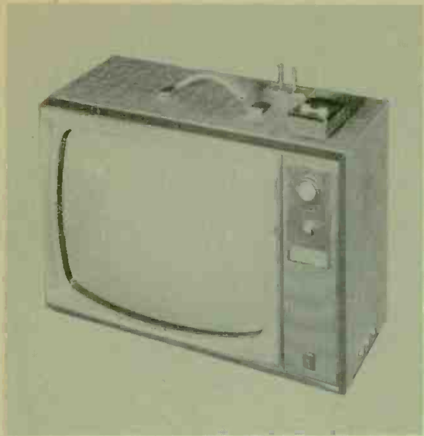
With the chassis tilted out at about a 45° angle, it's held in place by a beaded chain. All signal circuits are contained on the printed board on the right side. When compared to the '60 *Medalist* series, this board contains two major circuit changes. The third video IF and detector circuit uses a 3CB6 and crystal diode as opposed to last year's 6AM8 circuit, and a 4BU8 serves the keyed AGC and sync separator stages.

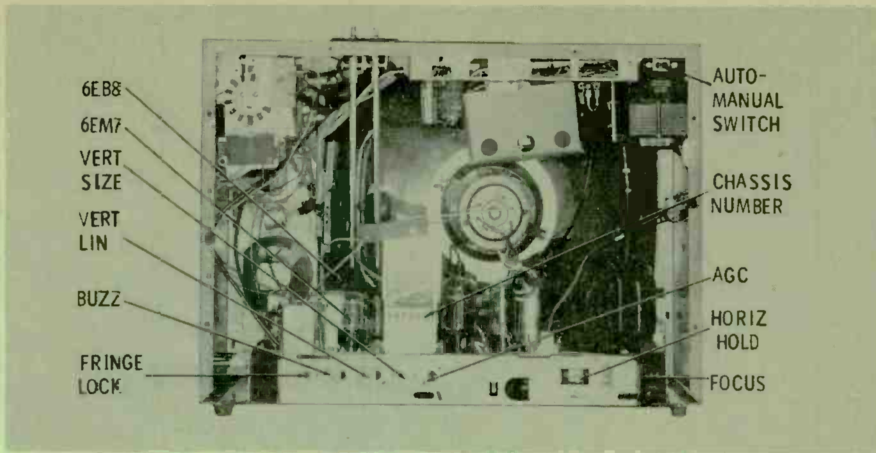


At the top of the chassis, the beaded chain is looped around and under a formed metal support so it can be released to lower the chassis to a horizontal position. The high-temperature horizontal output and damper stages are placed as far away from the remaining circuitry as possible, and are partially surrounded with heat sinks and radiation shields.



As the chassis tilts out, it automatically exposes the flyback and 1G3GT. The printed board along the bottom edge contains the dual-triode 13EM7 used in combined vertical multivibrator and output stages, in addition to the horizontal AFC diode unit and 8CG7 horizontal multivibrator.





Zenith Model F2215L Chassis 16F25Q

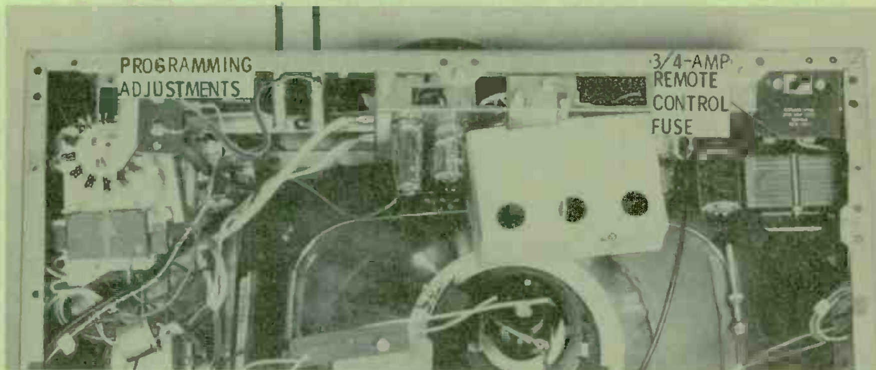
Power and remote tuning are two specific features of this 19" portable. Other models using the same basic chassis employ conventional tuning, and some are equipped with a timer switch which functions much like the sleep switch of a clock-radio. Of the 38 models using 8 variations of this chassis, 13 use a 17DQP4 picture tube, while the other 25 use the 19ASP4 incorporated in this model. This 19" tube doesn't utilize a bonded faceplate; however, the mask easily pries out to provide access to the safety-glass retaining screws.

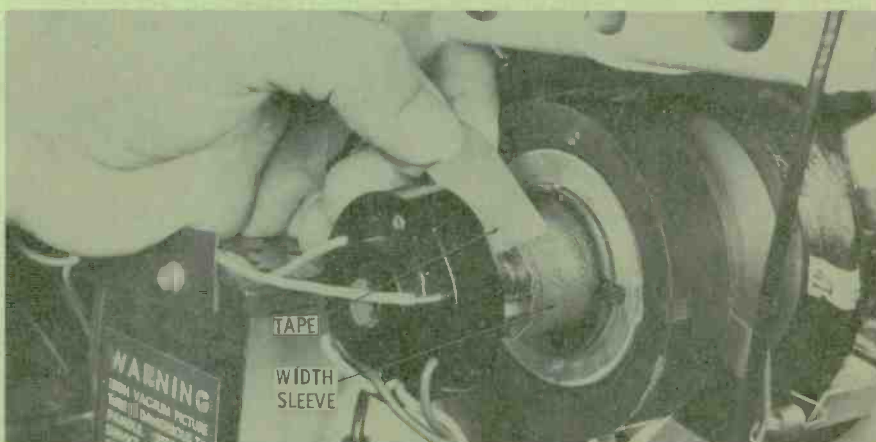
All service adjustments for the 16-tube, conventionally-wired chassis are labeled on the rear apron; the operational controls (other than off-on-volume and tuning) are mounted along the side. Either a 6EB8 or 6GN8 may be used in the video amplifier-sound IF application, and a 6EM7 or 6EA7 in the vertical deflection circuit. The manufacturer suggests using the original type when replacement is necssary. One of the major servicing features of these models is a removable plate held in place on the bottom of the cabinet by four metal screws. Removal of the plate provides access to all below-chassis wiring.

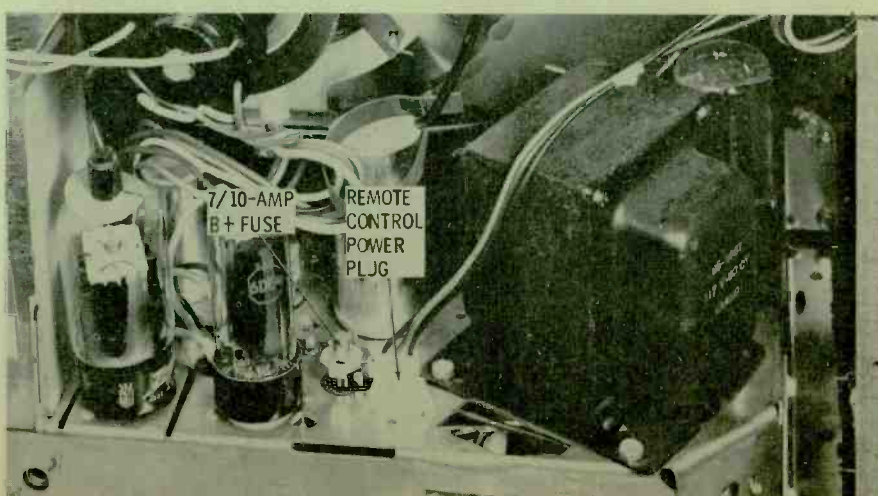
Mounted at the top of the cabinet, the *Space Command 300* remote-control chassis is a carryover from the 1960 line. It uses 6 tubes to provide unidirectional channel selection, power on-off, and volume control; a ¾-amp, slow-blow fuse is connected in series with the AC line for protection. Programming adjustments are accessible without removing the back. Positioning the cams so they point toward the shaft causes the channel to be skipped, while a 90° turn in either direction causes the tuner to stop on the associated channel.

Resembling a piece of copper screen wire encased in plastic, the width sleeve used with this chassis looks a little unusual. A piece of tape firmly holds the sleeve in position. If the sleeve is adjusted or removed, the manufacturer specifies that its gap be positioned facing the high-voltage connector.

The entire right side of the TV chassis is devoted to the power supply and horizontal deflection circuits. A 7/10-amp, type-N fuse is connected in the B-minus lead of the transformer to provide B+ protection, and a 1½" length of #24 copper wire is used to protect tube filaments.







VIDEO SPEED SERVICING

Olympic

See PHOTOFACT Set 485, Folder 1

Mfr: Olympic **Chassis No. JA**

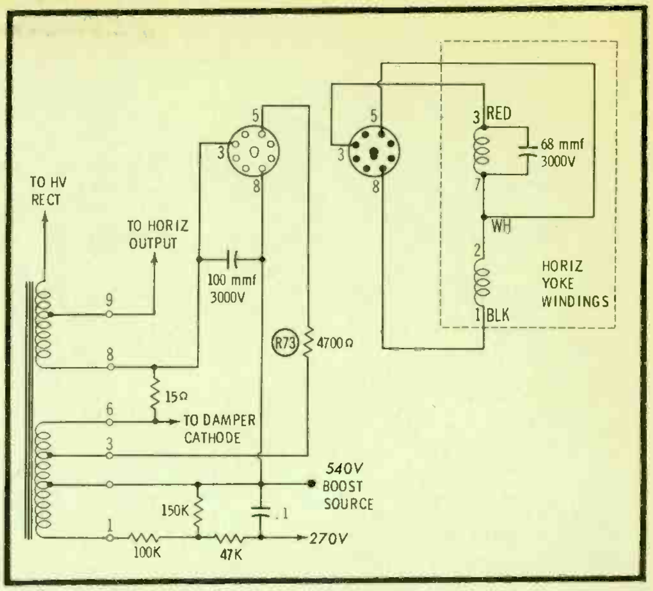
Card No: OL JA-1

Section Affected: Raster.

Symptoms: Insufficient width; streaks in picture.

Cause: Resistor in horizontal yoke circuit burned and reduced in value.

What To Do: Replace R73 (4700 ohms).



See PHOTOFACT Set 485, Folder 1

Mfr: Olympic **Chassis No. JA**

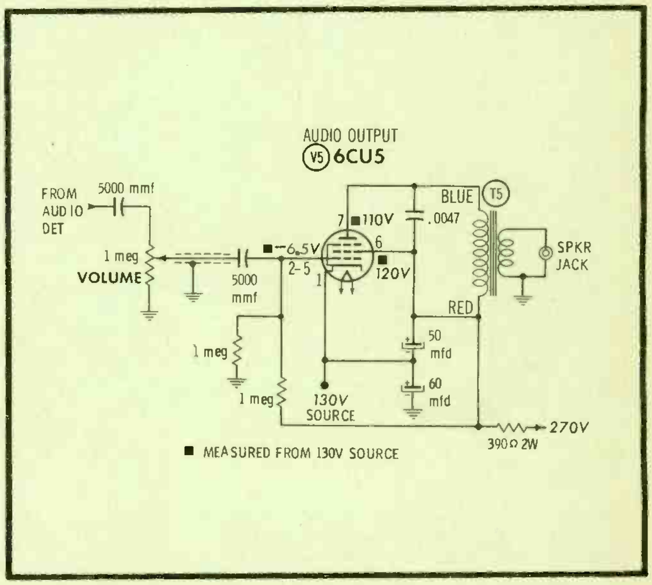
Card No: OL JA-2

Section Affected: Sound and pix.

Symptoms: No sound; no picture.

Cause: Open audio output transformer.

What To Do: Replace T5.



Mfr: Olympic **Chassis No. JA**

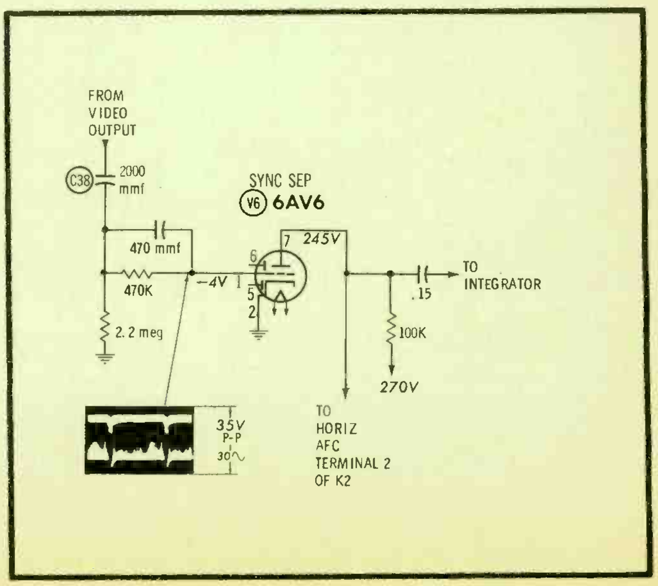
Card No: OL JA-3

Section Affected: Sync.

Symptoms: Vertical rolling; horizontal tearing.

Cause: Leaky video-to-sync coupling capacitor.

What To Do: Replace C38 (2000 mmf).



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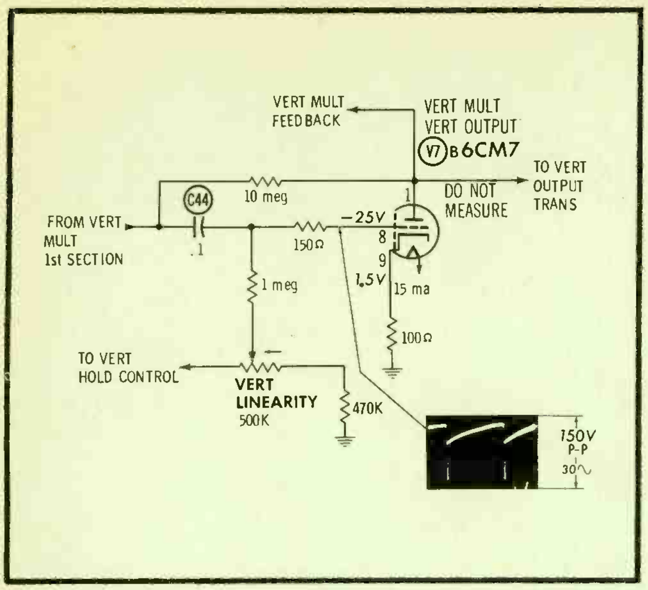
See PHOTOFACT Set 485, Folder 1

See PHOTOFACT Set 485, Folder 1



Mfr: Olympic **Chassis No. JA**

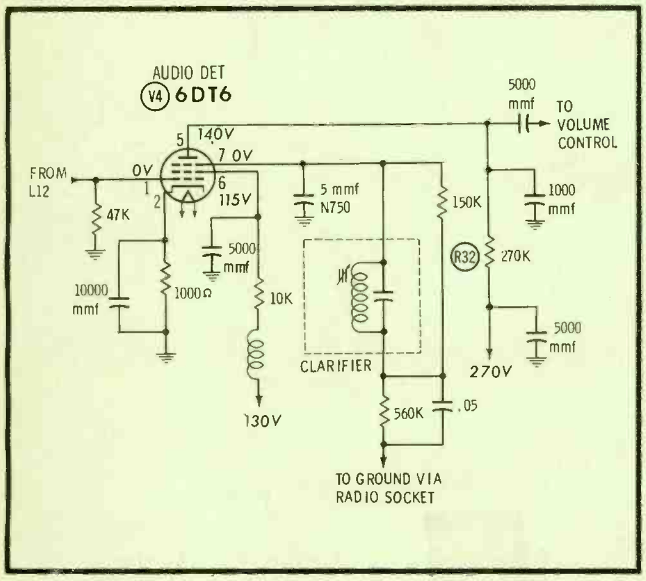
Card No: OL JA-4

Section Affected: Raster.

Symptoms: Vertical linearity gets progressively worse as set continues to play.

Cause: Leaky coupling capacitor in vertical multivibrator.

What To Do: Replace C44 (.1 mfd).



Mfr: Olympic **Chassis No. JA**

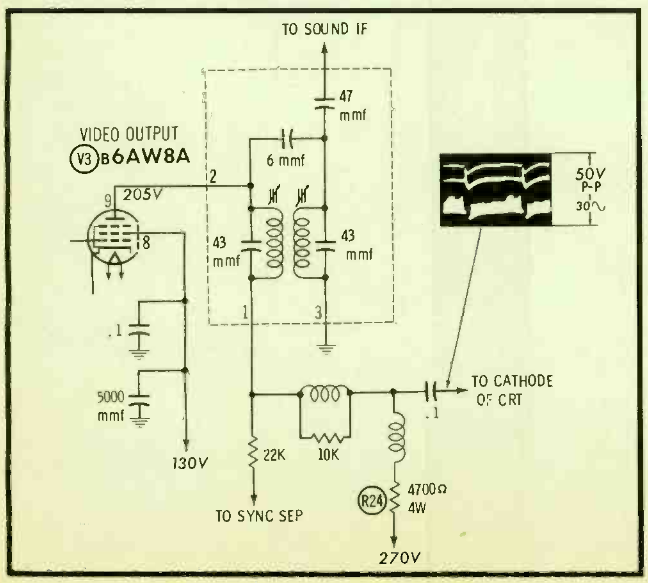
Card No: OL JA-5

Section Affected: Sound.

Symptoms: Weak and distorted sound, becoming worse as receiver plays.

Cause: Plate-load resistor of audio detector increases in value.

What To Do: Replace R32 (270K).



Mfr: Olympic **Chassis No. JA**

Card No: OL JA-6

Section Affected: Pix.

Symptoms: Picture smeared and generally poor in quality.

Cause: Plate-load resistor of video amplifier is burned and has decreased in value.

What To Do: Replace R24 (4700 ohms — 4W) and check V3 (6AW8A).

See PHOTOFACT Set 485, Folder 2

Mfr: Westinghouse **Chassis No. V-2384-1**

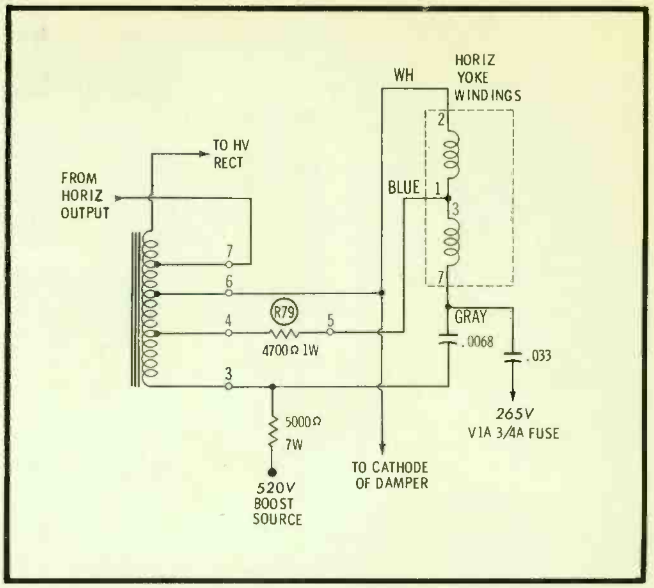
Card No: WE 2384-1-1

Section Affected: Raster.

Symptoms: Insufficient width.

Cause: Resistor in series with yoke center tap burned and decreased in value.

What To Do: Replace R79 (4700 ohms — 1W).



Mfr: Westinghouse **Chassis No. V-2384-1**

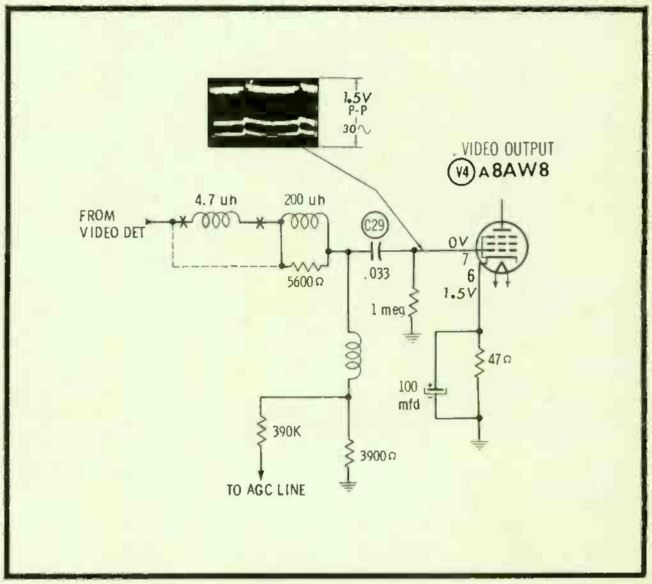
Card No: WE 2384-1-2

Section Affected: Pix and sound.

Symptoms: Picture flashes on and off; sound disappears along with picture.

Cause: Intermittently open coupling capacitor between video detector and video output.

What To Do: Replace C29 (.033 mfd).



Mfr: Westinghouse **Chassis No. V-2384-1**

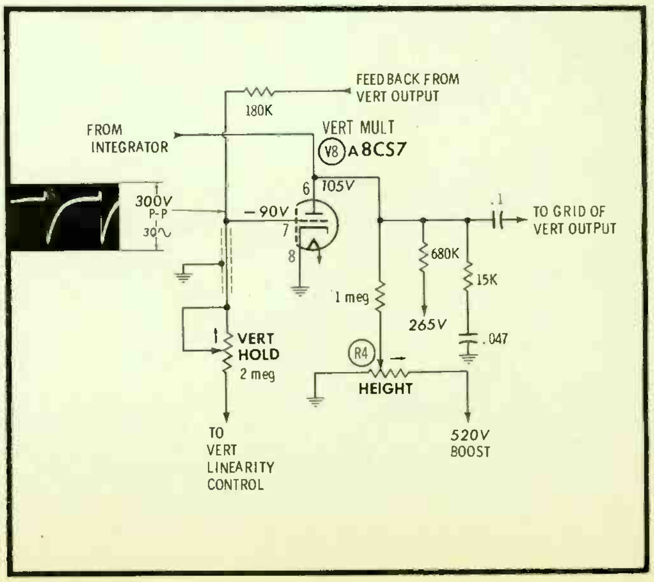
Card No: WE 2384-1-3

Section Affected: Raster.

Symptoms: As height control is adjusted, flashes and streaks appear in raster.

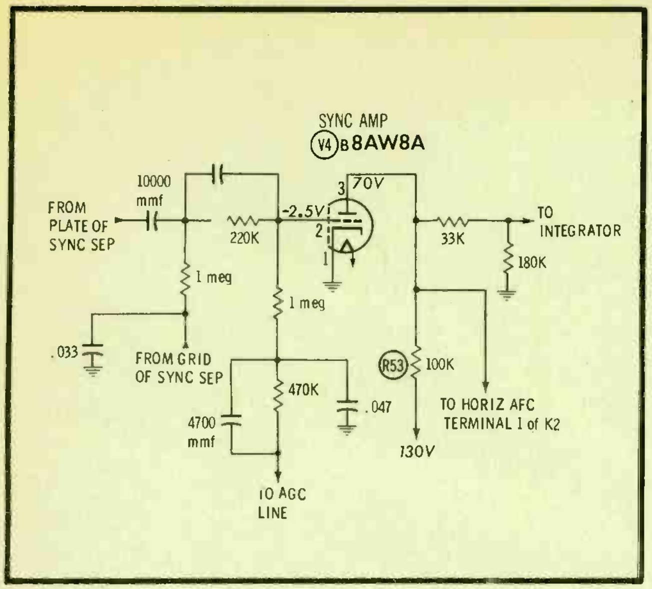
Cause: Open ground connection on height control.

What To Do: Resolder ground connection on R4, and recheck action of control.



See PHOTOFACT Set 485, Folder 2

See PHOTOFACT Set 485, Folder 2



See PHOTOFACT Set 485, Folder 2

Mfr: Westinghouse **Chassis No. V-2384-1**

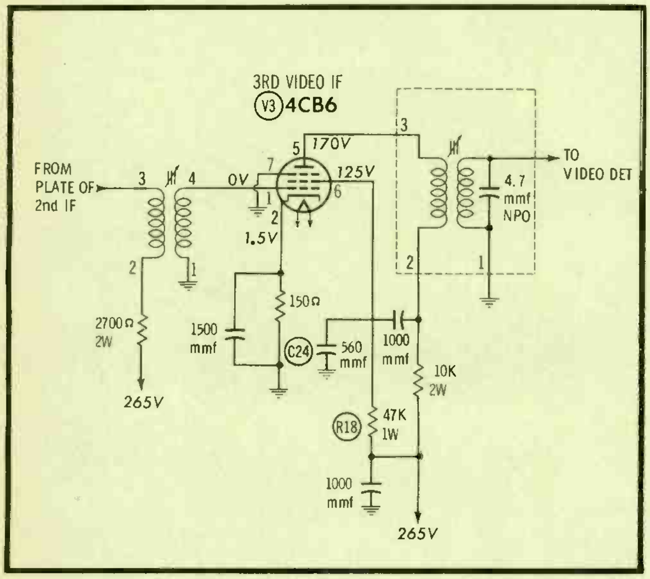
Card No: WE 2384-1-4

Section Affected: Sync.

Symptoms: Loss of vertical and horizontal hold, gradually developing as set plays.

Cause: Sync-amplifier plate-load resistor increases in value.

What To Do: Replace R53 (100K).



Mfr: Westinghouse **Chassis No. V-2384-1**

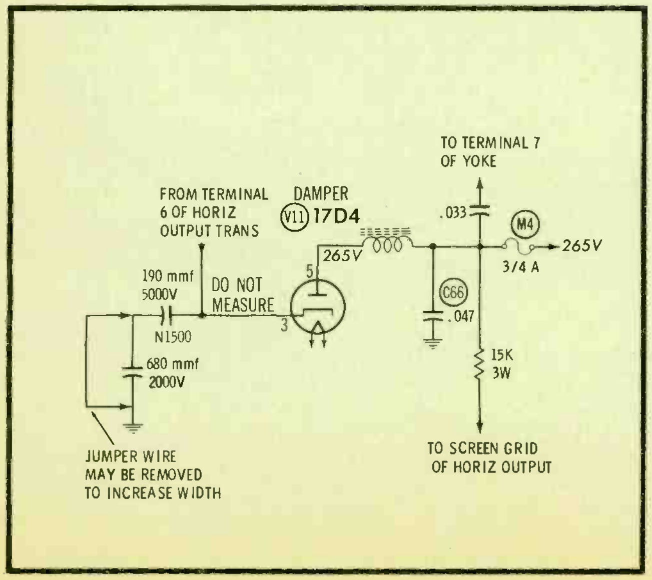
Card No: WE 2384-1-5

Section Affected: Pix and sound.

Symptoms: No picture or sound.

Cause: Shorted screen-bypass capacitor and open screen resistor in third IF stage.

What To Do: Replace R18 (47K—1W) and C24 (560 mmf).



Mfr: Westinghouse **Chassis No. V-2384-1**

Card No: WE 2384-1-6

Section Affected: Raster.

Symptoms: Sweep-circuit fuse blows frequently.

Cause: Leaky filter capacitor in plate circuit of damper.

What To Do: Replace C66 (.047 mfd) and M4 (¾ amp—250V, slow-blow).

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MODERN CASE: Handsome grey Hammerloid finish on heavy-gage steel. Measures 8⅞" high, 14⅝" wide, 9½" deep. Weighs only 21 pounds.

See the remarkable new TCA-1 TRANSFARAD at your Sprague distributor or write for descriptive folder M-792a to Sprague Products Company, 105 Marshall St., North Adams, Massachusetts.

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*Trademark

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ABC

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PF REPORTER

including Electronic Servicing

VOLUME 10, No. 11 NOVEMBER, 1960

CONTENTS

ABOUT THE COVER

Along about this time every year, dealers and servicemen face a whole new crop of TV receivers. To serve the best interests of their customers (and their own, too, of course), they need to learn a little bit about a lot of sets—and fast! A digest of all the pertinent facts you need to know about 16 major TV lines for 1961—utilizing all the space we could muster on 13 consecutive pages—begins on page 32 of this issue.

Letters to the EDITOR

Dear Editor:

We were somewhat surprised to note several errors in the text devoted to the Hoffman Model 3703 in the August *Previews of New Sets.* In the first paragraph, reference was made to the fact that this model contains a stereo amplifier, but no phono. Actually, this particular model is merchandised with an external matching stereo record changer. Since this fact is not contained in the information in our service notes, it's understandable that you missed it.

In the second paragraph, your copy states that only the right-channel amplifier is used for TV sound. On the first page of our Service Bulletin No. 1101, under the heading "Mark 5 Entertainment Selector," Item 1 says, "The sound from the TV receiver will play through both amplifiers and both speaker enclosures, thus producing the program through a total of six (6) loudspeakers and the dual channel stereo amplifier in your Mark 5 receiver." However, the third paragraph in your write-up ends with, "Another point you will want to keep in mind is that the right-channel speakers are the only ones used for TV."

There is also a statement in the third paragraph saying that "the usual tube placement chart is conspicuous by its absence." This really hurts, because we pay a premium to silk-screen the tube-location chart on our backboard—not only showing the tube types and locations, but also keying the tube pins.

E. J. GREANEY

National Service Manager
Hoffman Electronics Corp.
Los Angeles, Calif.

Mr. Greaney wrote us just shortly before his untimely passing in September—news we received with deep regret.

We stand corrected on the use of both amplifiers for TV sound; however, the tube placement chart was not in evidence on the rear cover of the model we analyzed.—Ed.

Dear Editor:

Your articles by Mr. Milton Kiver are so elucidating and to the point that I want to comment to the "editorial letter box" about same. They alone are worth the annual subscription fee, and are unequalled in any other electronic service magazine.

J. M. SCHILDZ

Lindenwood Radio & TV
St. Louis, Mo.

Dear Editor:

I have just finished reading the last of the series of seven articles by Milton S. Kiver on servicing the basic circuits of a TV receiver. These were very good, and a round of applause is due him.

FRED DASI

(address not given)

We heartily agree that Mr. Kiver is "the most." The first of his new series (2 parts), describing methods for testing transistors, begins on page 24 of this issue. His newest Howard W. Sams book, "Servicing Transistor TV Receivers," is now available from your local distributor.—Ed.

Dear Editor:

The enclosed piece is being circulated by Airview Electronics of New York City. I'm passing it along with the idea that you might want to give your readers a chance to keep up with New York thinking on a most vexing problem.

Of course, this proposed calendar change is not something that will be accomplished overnight, or even in a fortnight of Sundays—but a beginning has to be made somewhere!

HARRY M. LAYDEN

Bronx, N. Y.

ULCER-FREE CALENDAR

Gen.	Fri.	Fri.	Thur.	Wed.	Tues.	Mon.
8	7	6	5	4	3	2
16	15	14	13	12	11	9
23	22	21	20	19	18	17
31	30	29	28	27	26	24
38	37	36	35	34	33	32

ADVANTAGES

1. Every job is a rush. Everyone wants his order delivered yesterday. With this calendar customers can order on the 7th and have delivery on the 3rd.
2. All customers want their deliveries on Friday, so there are two Fridays in each week.
3. There are seven extra days at the end of each month for those end of the month rushes.
4. There is no 1st, 10th, or 25th of the month; therefore, bills will not have to be paid.
5. There are no bothersome nonproductive Saturdays and Sundays.
6. A new "General Day" each week permits orders to be cancelled, style changes made, and other matters re-opened; for instance, a style change made on the 8th may reach you on the 5th, but you may make the change even though the goods were shipped on the 6th. Everybody will be happy, and we will soon have an ulcer-free industry.

Thanks, Harry. It's just what we needed to get this issue published on time!—Ed.

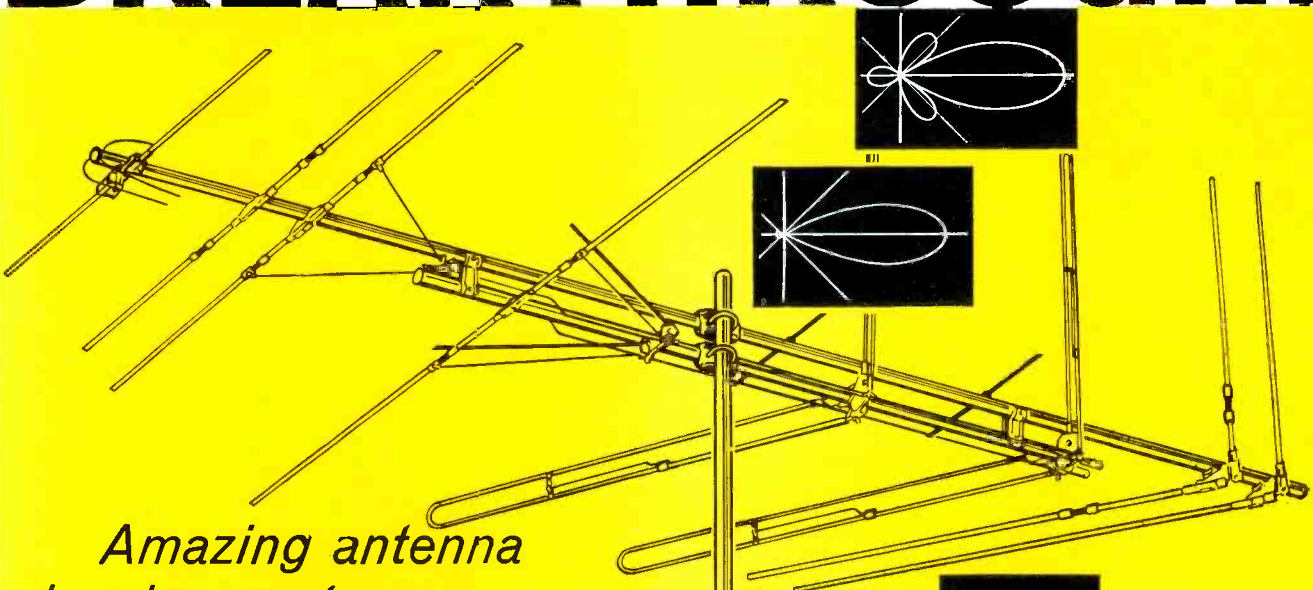
Dear Editor:

Looking back through your 1958 *Test Equipment Annual,* we noticed the following statement on page 47: "Marker injectors which maintain the size of a marker constant at any point on a re-response curve, out on the base line or in the bottom of traps, have been available for several years."

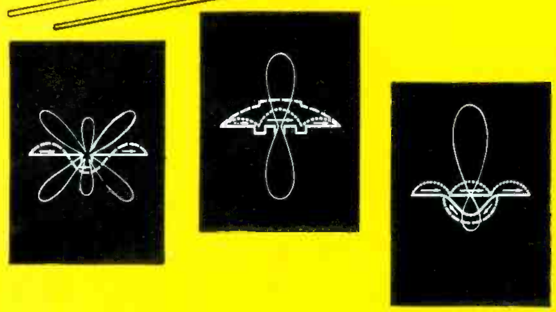
Our present alignment generator has an internal marker oscillator built into it, with the output mixed with that of the sweep signal. Would it be possible to modify or add to this unit so that it will perform as stated above? There are times when it is almost impossible to see the marker at all, no matter how the controls are manipulated and/or the generator output is coupled into the TV set.

• *Please turn to page 16*

BREAKTHROUGH!



Amazing antenna developments now make possible...

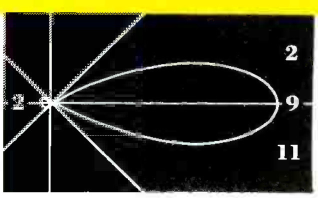


PEAK POWER ON EVERY CHANNEL

with the TACO

T-BIRD

Now—for the first time—Peakpower on every channel plus a directivity pattern clean as a whistle! Advanced antenna engineering on a specially-built test range by the most competent group of antenna engineers in the country now brings you the first high-gain, broad-band antenna with a single lobe—no side lobes—producing the sharpest pictures possible on any TV receiver . . .



A difference you can see on every TV screen! Elimination of side lobes ends displaced image (ghosts) to sharpen every channel. For the crispest, brightest pictures you ever sold—go T-Bird!

PACKED WITH PROMOTION

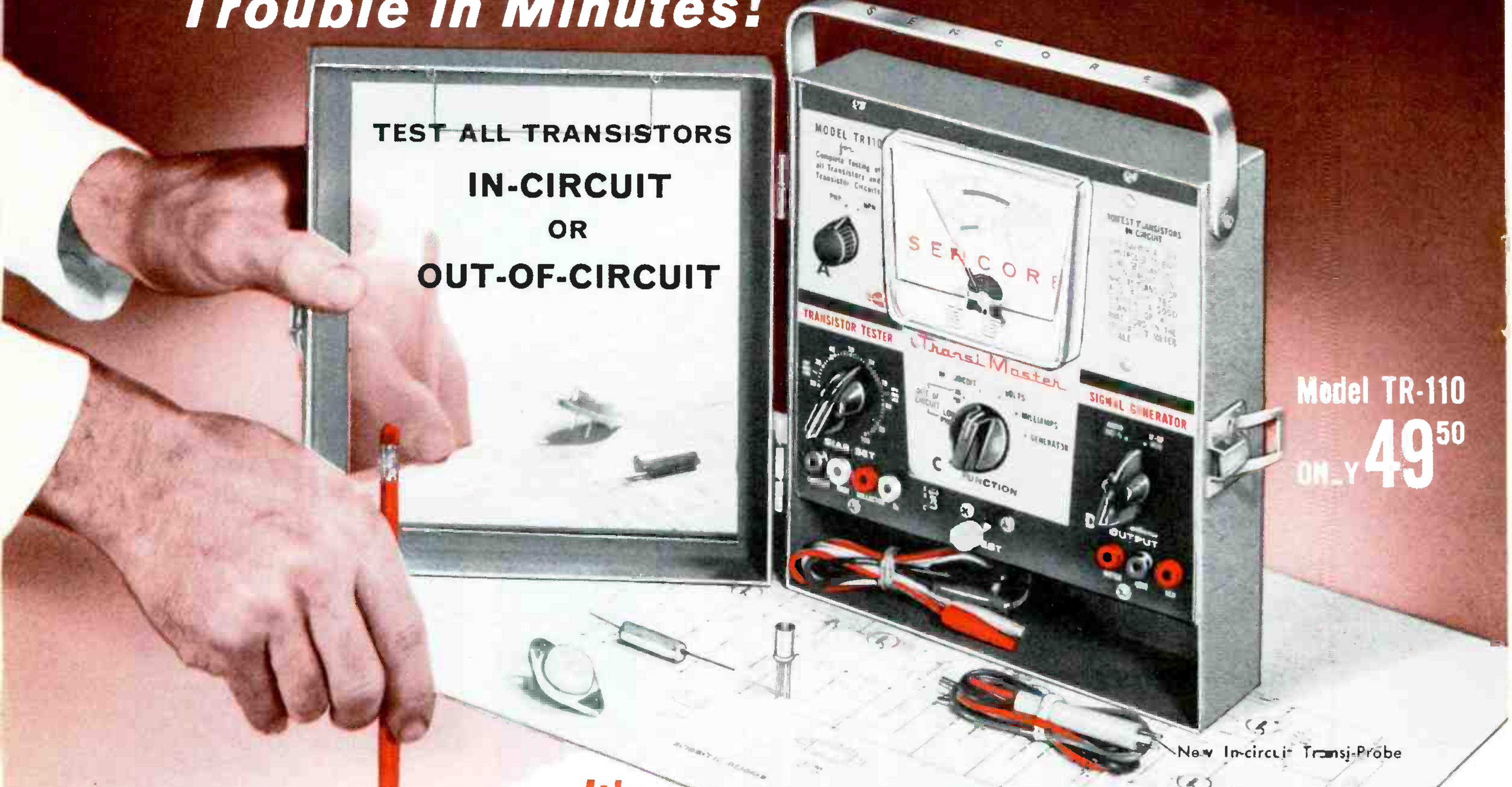
The T-Bird is pre-sold by the most powerful promotion ever, spearheaded by Allie Scollon and her Injun Puppets on TV and radio. Point-of-sale, direct-mail, magazine and newspaper ads, giveaways, bus cards, and everything else to make everyone ask for a T-Bird . . .

Ask your distributor or write for complete details . . .

TECHNICAL APPLIANCE CORPORATION, SHERBURNE, NEW YORK.

NEW SENCORE Transi Master

Analyze Every Transistor Circuit Trouble in Minutes!



New In-circuit Transi-Probe

It's a . . . COMPLETE TRANSISTOR TESTER • SIGNAL TRACER
VOLTMETER • BATTERY TESTER • MILLIAMETER

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

Now you can . . .

- **Test all transistors in-circuit** with a new unique AC GAIN check. It works every time and without the use of the set-up booklet.
- **Test all transistors out of circuit** with the AC GAIN check or with a more accurate DC current gain and leakage check.
- **Read current gain (beta) direct** for experimental, engineering work or for matching transistors.
- **Check diodes** simply and accurately with a forward to backward ratio check.
- **Signal trace** from speaker to antenna with a special low impedance generator. No tuning, adjustments, or indicating device needed for transistor radio trouble shooting. Just touch output leads to transistor inputs and outputs until 2000 cycle note is no longer heard from speaker. (Generator output monitored by meter.) It's a harmonic generator for RF-IF trouble shooting and a sine wave generator for audio amplifier trouble shooting.
- **Check batteries** under operating conditions as well as the voltage dividers with a special 12 volt scale.
- **Monitor current** drawn by the entire transistor circuit or by individual stages with a 0 to 50 Ma current scale. A must for alignment and trouble shooting cracked boards.

Benefit from these Sencore extras

- Lists Japanese equivalents.
- Automatically determines NPN or PNP.
- Mirror in detachable cover to reflect opposite side of printed board.
- Special clip to fit between batteries for current check.
- Transi-probe for making in-circuit transistor checks.

Color . . . . modern two tone gray
Size . . . . 8" x 7⅝" x 3"
Weight . . . . only 5 lbs.
Meter . . . . 0 to 3 Ma, 3½", 5% tolerance, modern plastic
Batteries . . . . two size "C" cells

ALL PARTS ARE SENCORE® MADE IN AMERICA

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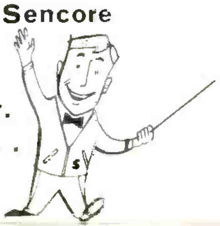
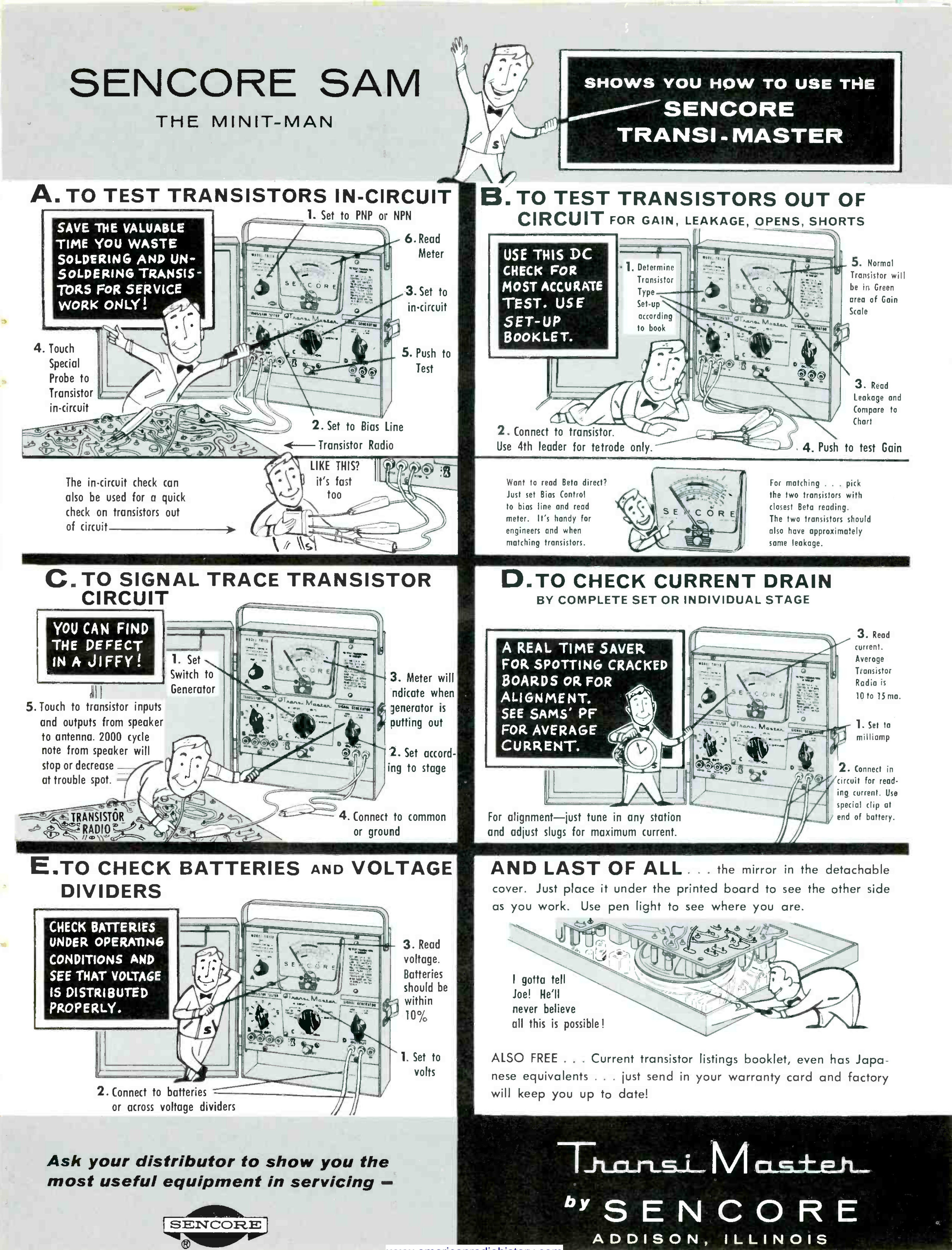
ADDISON, ILLINOIS

Like to try it? Let Sencore Sam show you how and then see your Sencore Distributor. He has it in stock. . .




SENCORE SAM
THE MINIT-MAN
SHOWS YOU HOW TO USE THE SENCORE TRANSI-MASTER
A. TO TEST TRANSISTORS IN-CIRCUIT
SAVE THE VALUABLE TIME YOU WASTE SOLDERING AND UN-SOLDERING TRANSISTORS FOR SERVICE WORK ONLY!
1. Set to PNP or NPN
6. Read Meter
3. Set to in-circuit
5. Push to Test
4. Touch Special Probe to Transistor in-circuit
2. Set to Bias Line
Transistor Radio
The in-circuit check can also be used for a quick check on transistors out of circuit
LIKE THIS? it's fast too
B. TO TEST TRANSISTORS OUT OF CIRCUIT FOR GAIN, LEAKAGE, OPENS, SHORTS
USE THIS DC CHECK FOR MOST ACCURATE TEST. USE SET-UP BOOKLET.
1. Determine Transistor Type Set-up according to book
5. Normal Transistor will be in Green area of Gain Scale
3. Read Leakage and Compare to Chart
2. Connect to transistor. Use 4th leader for tetrode only.
4. Push to test Gain
Want to read Beta direct? Just set Bias Control to bias line and read meter. It's handy for engineers and when matching transistors.
For matching . . . pick the two transistors with closest Beta reading. The two transistors should also have approximately same leakage.
C. TO SIGNAL TRACE TRANSISTOR CIRCUIT
YOU CAN FIND THE DEFECT IN A JIFFY!
1. Set Switch to Generator
3. Meter will indicate when generator is putting out
5. Touch to transistor inputs and outputs from speaker to antenna. 2000 cycle note from speaker will stop or decrease at trouble spot.
2. Set according to stage
TRANSISTOR RADIO
4. Connect to common or ground
D. TO CHECK CURRENT DRAIN
BY COMPLETE SET OR INDIVIDUAL STAGE
A REAL TIME SAVER FOR SPOTTING CRACKED BOARDS OR FOR ALIGNMENT. SEE SAMS' PF FOR AVERAGE CURRENT.
3. Read current. Average Transistor Radio is 10 to 15 ma.
1. Set to milliamp
2. Connect in circuit for reading current. Use special clip at end of battery.
For alignment—just tune in any station and adjust slugs for maximum current.
E. TO CHECK BATTERIES AND VOLTAGE DIVIDERS
CHECK BATTERIES UNDER OPERATING CONDITIONS AND SEE THAT VOLTAGE IS DISTRIBUTED PROPERLY.
3. Read voltage. Batteries should be within 10%
1. Set to volts
2. Connect to batteries or across voltage dividers
AND LAST OF ALL . . . the mirror in the detachable cover. Just place it under the printed board to see the other side as you work. Use pen light to see where you are.
I gotta tell Joe! He'll never believe all this is possible!
ALSO FREE . . . Current transistor listings booklet, even has Japanese equivalents . . . just send in your warranty card and factory will keep you up to date!
Ask your distributor to show you the most useful equipment in servicing –
SENCORE
Transi Master
by SENCORE
ADDISON, ILLINOIS

Letters

(Continued from page12)

At other times and frequencies, the marker generator swamps the curve, sometimes even without showing the marker pip.

A separately-controlled pip that could be placed anywhere on the response curve without causing distortion would be a serviceman's dream, and I am wondering if it could be secured without placing another mortgage on the property.

A. W. McAuly

Oakmont, Pa.

This type of equipment is known as a "marker adder" or "mixer adder." The only modification required for using such a unit with your present sweep and marker generator would be the removal of the marker-signal connection going to the sweep output jack, and the installation of a separate marker-output jack. Everyone ready for a new "Test Equipment Annual"?—Ed.

Dear Editor:

In reference to the article, "That's the Way the Horizontal Sweeps" (May issue), I am interested in knowing how the yoke-current waveform W6 was obtained. The text stated that a 10-ohm resistor was placed in series with the low side of the yoke, and that the scope was connected directly across this resistor.

With the circuit as shown in Fig. 1 of this article, I should think the ground side of the scope probe would effectively short out the damper circuit. If you could clarify this point, it would be most helpful.

May I say that the entire article was very informative and interesting.

George Ohanian

Lawrence, Mass.

Obtaining the waveform is quite simple, the only requirements being those stated in the text. Any scope used for normal servicing can be used; it won't short out the damper circuit as long as the low side of the scope probe is not grounded to chassis. All you are doing is connecting the scope in parallel with the added resistor so you can view its voltage waveform. This calls for a little extra caution in measurement, since the entire scope chassis then assumes a high positive potential with respect to the TV chassis. Since the scope input has a very high impedance, it will not significantly load the yoke circuit or distort the sweep unless the test is attempted on the "high side" of the yoke.—Ed.

Dear Editor:

Please send me two copies of the 1958 and 1959 *Subject Reference Indexes* to PF REPORTER. I have a copy of every issue to date and wouldn't take anything for them.

Joseph M. Catalono

Crestwood, Mo.

They're on the way, Joe. You'll find annual indexes for years prior to 1957 in the December issues (some still available—50c each). The 1960 index will be published this coming January, and will be supplied free on request. A monthly index now appears on the reverse side of the Catalog & Literature card in the back of each issue.—Ed.

Dear Editor:

Enclosed herewith is my renewal order.

I, like many others, also find you have not only a very interesting but also an educational magazine, well worth the subscription price. I've weeded out my subscriptions to all other electronic magazines except PF REPORTER, since I find it covers about all the things in which I am interested.

The letters to the Editor are also very interesting and at times amusing.

Howard M. Stang

Elyria, Ohio

We appreciate both the bouquets and the renewal order, Howard. But when all the letters are as nice as yours, we have a hard time making the answers as entertaining as we'd like!—Ed.

MAKE COMPLETE TUBE TEST
FASTER, MORE ACCURATELY

Model 650
DYNA-QUIK

Simply by checking all the tubes in the set, and testing each tube completely the Dynamic Mutual Conductance way, you can

SELL MORE TUBES PER CALL
INCREASE YOUR INCOME*
SATISFY MORE CUSTOMERS
SAVE COSTLY CALL-BACKS
INSURE YOUR REPUTATION

*Actual experience shows TV servicemen average 2 extra tube sales per call. 5 calls per day in 5 days means as much as $50.00 more income per week.

Widely Used and Preferred by Thousands of Professional Servicemen Everywhere

B&K

Model 650 *Dynamic Mutual Conductance* PROFESSIONAL TUBE & TRANSISTOR TESTER

With multi-sockets and other B&K features, you can accurately quick-check most of the tubes widely used in television receivers, plus popular home and portable radio tubes. Includes spare sockets for new popular types. Tests each section of multiple tubes separately. Checks for Gm and all shorts. Makes highly sensitive grid emission and gas test. Checks for leakage and life. Shows true tube condition on "Good-Bad" scale and in micromhos. B&K patented bridge circuit. Also tests transistors.

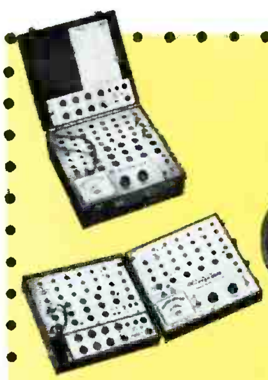
Net, **$179.95**

Model 550 *Dynamic Mutual Conductance* PROFESSIONAL TUBE TESTER

Real professional instrument for the limited budget. Provides 52 sockets to quick-check most of the TV and radio tubes usually encountered in everyday service work. Tests each section of dual-section tubes separately. Checks for Gm and all shorts. Makes highly sensitive grid emission, gas, and leakage test. Shows tube condition on "Good-Bad" scale and in micromhos. B&K patented bridge circuit.

Net, **$119.95**

Model 550
DYNA-QUIK



Shows how easily the new "610" fits into Models 550 and 650

NEW Model 610 ACCESSORY TEST PANEL

Increases Capacity of Model 500, 550, or 650 Dyna-Quik

TO TEST BOTH OLD AND NEW TUBE TYPES

including New TV Types, Thyratrons, Voltage Regulators, Auto Radio Hybrid Tubes, Battery Radio Tubes, European Hi-Fi Tubes, and most Industrial Types

Comes in 3 types:

Model 610-500 for use with Model 500 Tube Tester
Model 610-550 for use with Model 550 Tube Tester
Model 610-650 for use with Model 650 Tube Tester

Simply by adding Model 610 to the Dyna-Quik, you have all the advantages of fast multi-socket testing, plus freedom from obsolescence. Enables you to test all present plus future TV, radio, and other tube types. Measures genuine dynamic mutual conductance.

Net, **$49.95**

NEW TUBE INFORMATION SERVICE

Get test data on new tubes even before you encounter them in the field.
Subscribe now to *New Tube Information Service* for owners of B&K tube testers.
Issued every 3 months, at $2.50 per year.

B&K

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Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

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

because

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

because

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

because

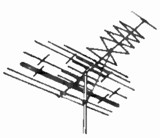
JFD all-out advertising *sells* for them in powerful national mass media—such as Look, TV Guide, Successful Farming, Farm Journal, Progressive Farmer.

because

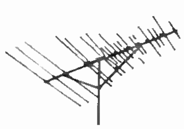
JFD sales stimulators such as cloth patches, decals, mobiles, banners, displays and direct mail give them the *complete* package to *sell* new customers.

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

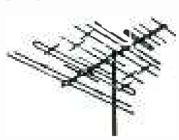
HI-FI HELIX
Silver or Gold Anodized



HI-FI BANSHEE
Silver or Gold Anodized



HI-FI FIREBALL
Silver or Gold Anodized



THE BRAND THAT PUTS YOU
JFD
IN COMMAND OF THE MARKET

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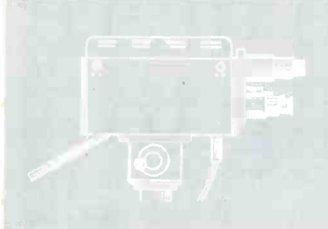
JFD International, 15 Moore Street, New York, New York • **JFD Canada, Ltd.**, 51 McCormack Street, Toronto, Ont., Canada



The Electronic Scanner

1961 TV Training Sessions

Technical training sessions on the 1961 line of **Westinghouse** TV receivers will be conducted at hundreds of locations throughout the country this fall. Trained specialists will describe 1961 circuitry, placing special emphasis on new circuits and mechanical designs such as remote control systems. Troubleshooting techniques will be given a large share of attention, and each serviceman will receive a training manual plus a 1961 "Pocket Master." Contact your nearest **Westinghouse** distributor for details on meetings in your area.

Test Equipment Development Center

Hickok's new research and development center in Cleveland, utilizing 1400 square feet and 52 engineering personnel, will be devoted to the development of new instruments for the electronic industry.

Walter Cerveny, Chief Engineer for the company (far left) looks on as engineer J. D. Feher explains advantages of unique rack-mounting principle to Einar Carlson and P. H. Neville.

Success Story

Among the servicemen groups who viewed the newest **SENCORE** slide film, "Old Tubes Seldom Die . . ." was this happy crew of Compton, Calif. Fred Bowerman, R.T.A. president, was host at his Mobile TV Service Lab. Other "Time-Saving Service Clinics" were also held recently at Denver, Colo. and Indianapolis and Richmond, Ind. Ed Flaxman, **SENCORE** v.p., presided at all four meetings. According to Herb Bowden, company president, the acceptance of **SENCORE** test instruments by servicemen has resulted in a 150% sales increase over last year. During the last 4½ of the 10 years it has been in operation, the company's net worth has increased more than ten times. Not bad, considering a start with less than $1,000 capital and 1,000 feet of factory space!

Which Tubes to Carry?

Inventory lists to guide servicemen in stocking tube caddies are now being provided with each of three service cases available through **General Electric** tube distributors. Stock guides of 162, 228, and 365 tubes are recommended for the three cases. Incidentally, one of the many helpful items noted in **G-E's** new dealer sales promotion catalog is a set of TV Service Shop Plans. Your **G-E** distributor can get them for you — only 50c.

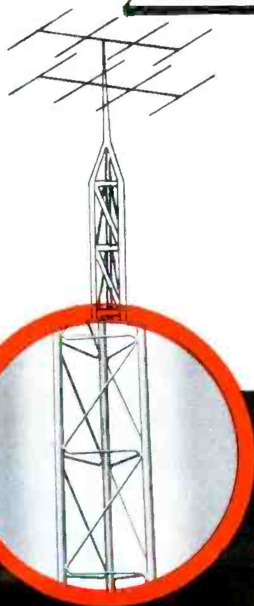
Opportunity Knocks

Fidelitone's nationwide "Fall Harvest" program, in which trade and consumer advertising is calculated to reach 2½ million readers every month, will feature the "Pyramid Point" diamond needle. Described as the first really new shape in a phonograph needle since its inception in 1887, the new concept in phono needles is named for its contour, which rides along the record "walls" without slipping into the "valleys."

make your first move to ROHN

You Have the Greatest Sales Potential by Far With America's MOST COMPLETE LINE OF

TOWERS—MASTS
ROOF TOWERS
Installation Accessories



From every standpoint, ROHN Towers offer you MORE . . . more quality, more variety, more advanced design, more sales features, more service, more total sales and more PROFITS! Move forward with these ROHN items!

ROHN TV TOWERS

ROHN makes the finest towers available for television reception! Illustrated is the No. 25 with amazing "zig-zag" cross bracing design. The entire tower is rated 33% stronger than other similar sized towers. Yes, sell and install the No. 25 up to 50 feet self-supporting or, properly guyed, up to 360 feet!

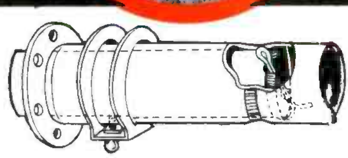
Or if you prefer, sell the popular ROHN No. 6 tower with the famous "Magic Triangle" cross-bracing. Both are fully HOT DIPPED GALVANIZED AFTER FABRICATION! Sections in easy-to-handle 10 ft. lengths.

ROHN COMMUNICATION TOWERS

Here you have FIVE complete lines of heavy-duty, FULLY ENGINEERED communication towers to fulfill any communications requirement. Shown is the ROHN "SS" tower which is self-supporting up to 130 feet. Other models —(30-40-50-60) are available in heights up to 630 feet when guyed! Handle these towers for the demand in your area. There's a complete NEW catalog on this line. Get a copy so you'll have it on hand.

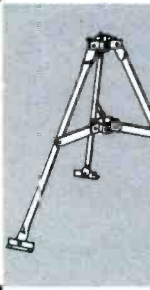
AMATEUR "FOLD-OVER" TOWERS

Specially designed "fold-over" towers are the best ever designed for amateur radio and experimentation. They are the most desired because they "fold-over" completely so you work on the ground for ease and safety. Three sizes, including heavy-duty type to handle any needs. All hot dipped galvanized.



TELESCOPING MASTS

Unexcelled in design, structural strength, and sales appeal. All popular sizes, heights, and weights available. Also, mast tubing in exact specifications that's demanded today.



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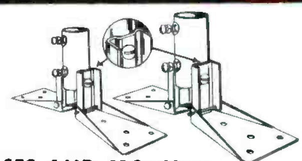

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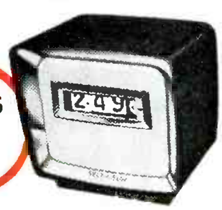

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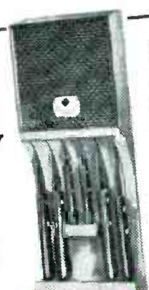

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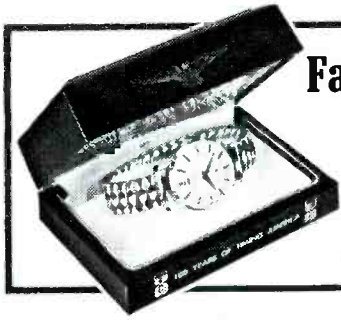

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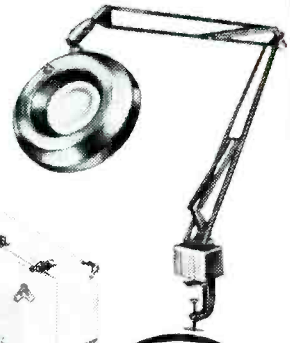

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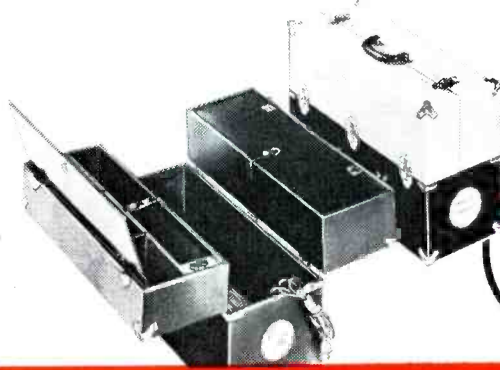

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Shop Talk

by Milton S. Kiver

understanding TRANSISTOR TESTERS

While experience tends to prove, on the whole, that transistors fail less often than vacuum tubes, a considerable number of transistors *do* fail. Therefore, anyone working on transistorized circuitry—whether it be in radio or television receivers, or in industrial equipment—must become familiar with the various ways in which transistors can be tested, together with the reasoning behind these tests.

While a number of tests can be performed on a transistor, just as a number of tests can be performed on a vacuum tube, servicemen will find that the test equipment designed for their use is capable of performing three primary tests. These include checks for shorts, leakage and gain.

Short Test

The basic short test employs the circuit shown in Fig. 1. Here, the base and emitter elements are tied together and connected to one side of a battery. The other side of the battery connects to the collector through a suitable milliammeter and a current-limiting resistor. The transistor is back-biased, so very little current should flow. If this is found to be true, no internal shorts exist in the transistor. However, if a sizable current is produced, the resistance between the collector and one or both of the other two elements is too low. (Note: This is not a test for leakage current, which we will discuss in a moment. This test simply determines if there are any short circuits within the unit.)

Most transistor testers do not incorporate a short test because the leakage test, which is normally part of all test procedures, will usually detect short circuits by an indication of excessive current flow. However, a few instruments do perform the short test, and the instructions state that transistors should be subjected to this test first. It is interesting to note that the short test has a direct counterpart in tube testing, where a similar test is always made prior to the check for gain.

Leakage Test

One of two leakage tests is almost always performed by transistor testers, and some instruments perform them both. The most common leakage test uses the circuit in Fig. 2. The emitter is connected to one side of the battery and the collector to the other side, while the base element is left unconnected. A small milliammeter and a suitable current-limiting resistor are included in the hook-up. The amount of current in the circuit depends on the temperature at which the transistor is being checked, the resistivity of the germanium or silicon, and the applied voltage. If there is a short circuit within the device, or if there is any contamination on the transistor surface which would enable a sizable current to flow, the meter reading will be abnormally high. It is desirable for this reading to be as low as possible.

In most instances, the meter dial has a special leakage scale divided into different-colored segments, or marked off into separate regions, bearing such notations as high, medium, and low (or poor, fair, and good). As long as the transistor does not test in the poor or high regions, it can be considered usable. Some leakage is to be expected however, and will almost always be encountered. As a general rule, small signal transistors have considerably less leakage than power transistors. Also, germanium transistors have more leakage than silicon transistors. In all cases, any short circuit or low-resistance path through the

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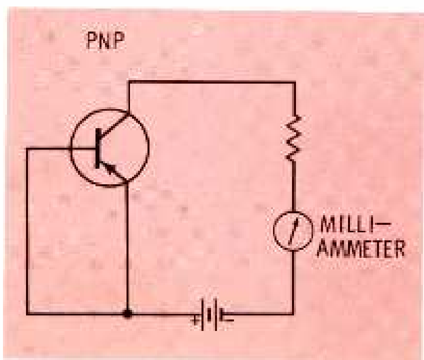

Fig. 1. With reverse bias on transistor, any sizable current indicates short.

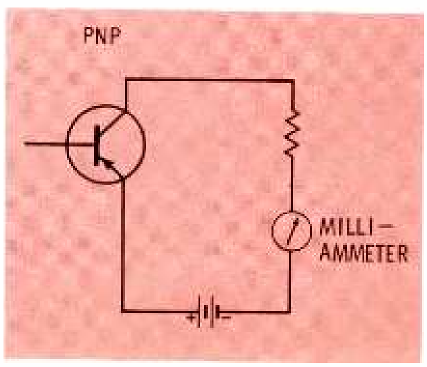

Fig. 2. Open-base circuit for checking leakage between emitter and collector.

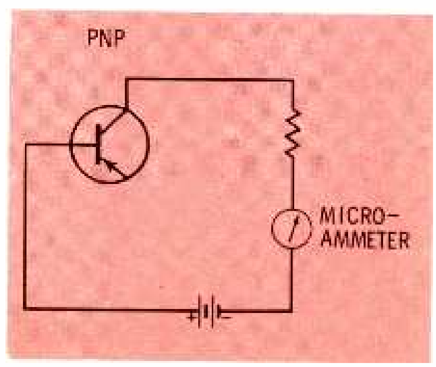

Fig. 3. Open-emitter circuit for measuring minute base-collector leakage.

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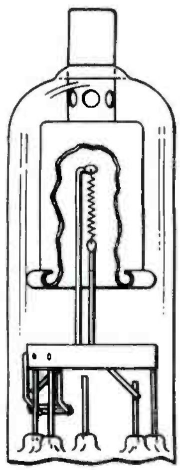

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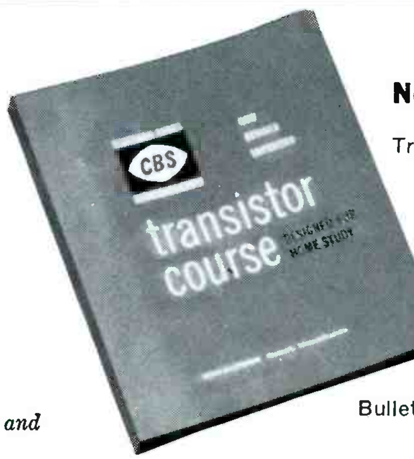

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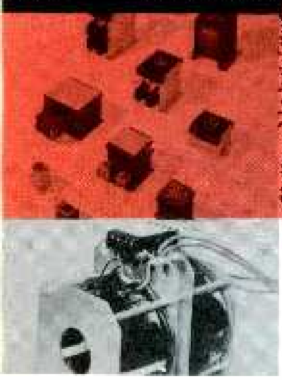
BY ALAN ANDREWS

APPLICATIONS of MAGNETIC AMPLIFIERS



Magnetic amplifiers are taking over many industrial jobs from vacuum-tube amplifiers, especially where high power is required. These rugged devices are used in lighting, power, heating, and motor-control circuits, as well as in servo systems, voltage regulators, timers, counters, computing circuits, and many other applications.

Their basic principle of operation consists of placing a variable inductive reactance in series with a load across a power supply, so that the current through the load can be varied. In Fig. 1 (a simplified diagram of a typical magnetic amplifier), two load windings on a common core pass current on alternate half-cycles of the AC supply voltage. A control winding on the same core receives direct current which can be varied to increase or decrease the degree of magnetic saturation of the core. In turn, this varies the reactance in the load circuit. Since only a small amount of power in the control winding can regulate a much larger load current, the device is classified as an amplifier.

To understand how the reactance is affected by core saturation, let's take a short excursion into the operating theory of inductive components. The permeability of the core, or its ability to conduct magnetic flux, is closely proportional to the applied magnetizing force—until point 1 in Fig. 2 is reached. After this point, the permeability drops sharply, so that further increases in magnetizing force do not produce proportional increases in the amount of core magnetism. The portion of Fig. 2 between points 1 and 3 represents the region where the core approaches full saturation.

The key point in this discussion hinges on the steepness of the permeability curve from point 1 to point 3. The inductance and inductive reactance also follow an identical curve; therefore, when the core is just barely saturated, a relatively slight addition or subtraction of magnetizing force causes a large change in reactance. This explains why the current in the control winding of a magnetic amplifier need not be large.

Increasing the control current drives the core farther into saturation; from the permeability curve in Fig. 2, we can see that the reactance of the load windings will decrease, and the load current will increase. On the other hand, a decrease in control current will tend to desaturate the core, thereby increasing the series reactance and reducing the current delivered to the load.

Fig. 1 is a combination of a pictorial and schematic diagram, used primarily to illustrate circuit action. In practice, a saturable reactor may be shown on schematic diagrams in a number of different ways. Several of these appear in Fig. 3. Although only two coil sections are shown in each case, more would probably be used in actual practice. Fig. 3A is somewhat pictorial, while 3B is a conventional transformer diagram. The letters SR (for saturable reactor) may not always be included. The diagram of Fig. 3C has been adopted by several interested groups and seems to be making some headway toward becoming the standard symbol. Many manufacturers, however, still use some other symbol.

Bias and Feedback

An AC control current is often desired instead of DC, but the application of *pure* AC to the control winding would introduce problems. For instance, if the applied control voltage periodically reversed in direction, the changes in magnetic flux would *lag* the voltage changes by a time interval determined by the core material. This lagging effect, called *hysteresis,* would greatly reduce the degree of control which could be obtained. Core materials are chosen for their low hysteresis ratings, but this condition cannot be eliminated entirely.

Here's another problem that discourages the use of a pure AC control input: If the flux continually changes direction, the core will be saturated during only a small portion of each control alternation; thus, control will be obtained over only a portion of the input signal.

To make it possible to feed an AC input to the control winding, a DC current, called *bias,* is added. Its effect on circuit operation is shown in Fig. 4. With the bias current added, the operating point is shifted to the right as indicated by

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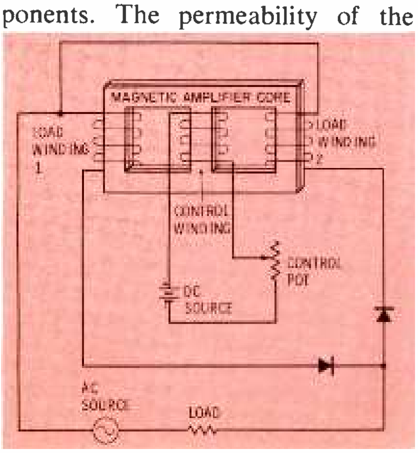

Fig. 1. Simplified diagram of self-saturating magnetic amplifier circuit.

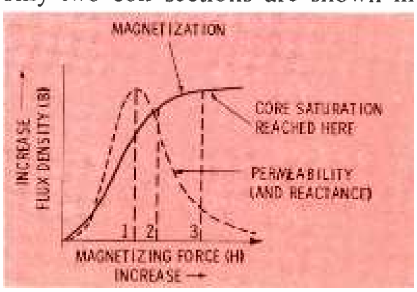

Fig. 2. Inductive reactance sharply drops as saturation point is reached.

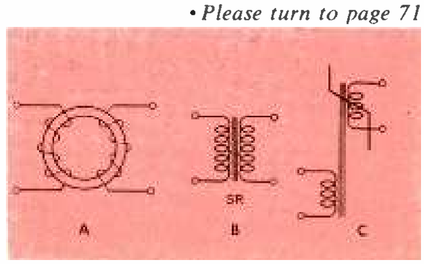

Fig. 3. All these symbols have been used to represent magnetic amplifiers.

Servicing NEW DESIGNS

by Thomas A. Lesh

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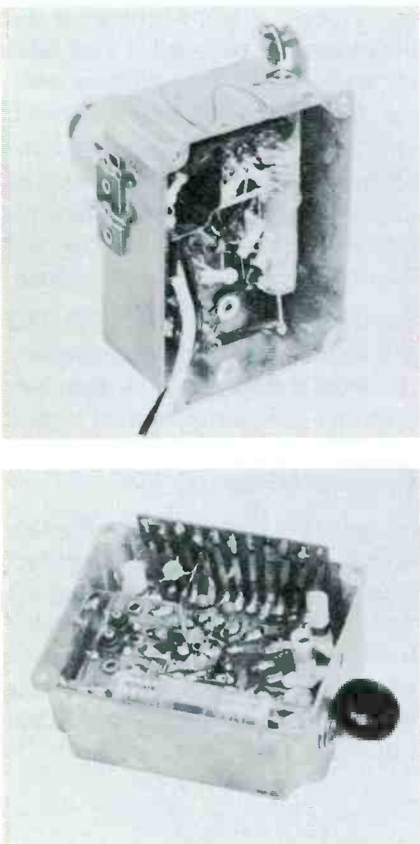

Fig. 1. Two different styles of one-tube FM tuners made in Western Germany.

Just a few years ago, when the hi-fi boom first began to pump new life into FM radio broadcasting, practically all receiving equipment was designed to please the serious audiophile. The prospective buyer had a wide choice of deluxe FM tuners for use in high-fidelity systems, but he had to hunt awhile if he wanted a small, self-contained radio that would pick up FM stations.

The market has changed greatly since then. A sizable demand for inexpensive FM radios has arisen among people who are more attracted by FM's high-quality programming than by its technical features—and this need is now being met by most of the major radio manufacturers. In addition, domestic production of FM car radios has begun in earnest.

Table Radios

Since table FM receivers have been practically absent from the market for such a long time, the new models are almost complete strangers.

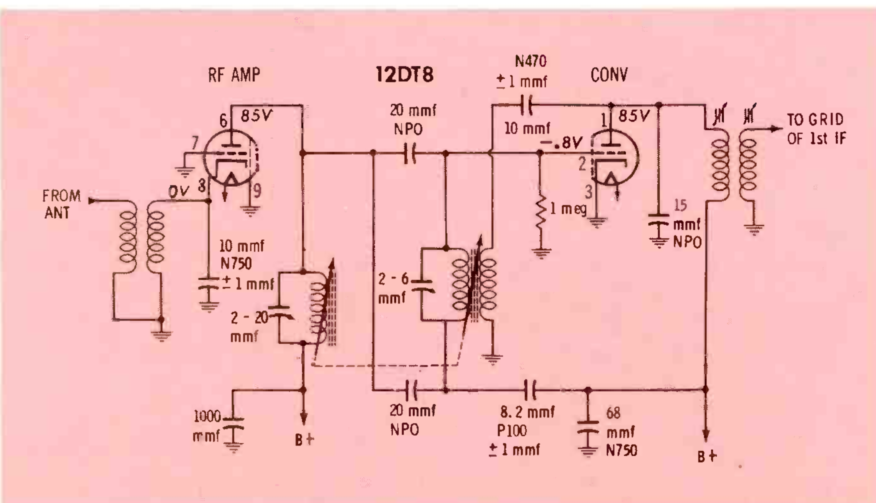

Fig. 2. Schematic of unit in Fig. 1A; note temperature-compensating capacitors.

The simplest AC-DC radios in the FM field are following a consistent circuit pattern. FM-only sets typically have five tubes, plus a silicon or selenium rectifier to supply B+ voltage; for FM-AM combinations, a 12BE6 is added to serve as an AM converter. The FM lineup is usually as follows: 12DT8 dual-triode RF amplifier and converter; a pair of 12BA6 IF stages; a 19T8 as ratio detector and AF amplifier; and any one of the popular miniature beam-power tubes (35- or 50C5, 35- or 50EH5) in the audio output stage.

RF Tuner

The most interesting innovation in the new crop of FM receivers is the "front end," which currently tends to be mounted on a small subchassis (somewhat like a TV tuner) containing all RF and frequency-converting circuits. This trend began with units of the type shown in Fig. 1, made in Western Germany. Some models are of hand-wired construction, as in Fig. 1A, while others of recent vintage contain a printed wiring board (Fig. 1B). The single tube is generally a 6DT8 or 6AQ8/ECC85, or a series-string counterpart of one of these types. In this dual triode, the RF section usually operates as a grounded-grid amplifier, while the second section is an *autodyne* converter—combining the functions of oscillator and mixer.

In the autodyne stage, oscillation is maintained by feedback from a plate-circuit tickler coil to a tuned tank in the grid circuit (see Fig. 2). In some other tuners of generally similar design, the tank is in the plate circuit and the feedback coil is at the grid—but the mode of operation is still basically the same.

FM radio field

The weak incoming RF signal is applied to the grid, where it modulates the oscillations in such a way that a 10.7-mc IF signal is developed across the output transformer of the stage. In Fig. 2, note that the RF signal is coupled to *both* ends of the oscillator tank through identical 20-mmf capacitors. This feature serves to keep RF out of the tank circuit.

The tuning slugs are mounted on a plastic rod that slides back and forth inside the oscillator-RF coil form. The dial cord, which travels over a pulley on the outside of the tuner housing, is attached to one end of this rod. The position of the slugs is established by the cord pulling against spring tension. Thus, a slipping or improperly-tensioned dial cord would be intolerable in this unit!

Most versions of the one-tube tuner have no AFC circuit, but depend on the generous use of temperature-compensating components to stabilize oscillator frequency. Capacitive feedback from the converter plate circuit to the grid circuit aids stabilization. (Note the 8.2-mmf feedback capacitor in Fig. 2—one of the rare uses of a controlled *positive* temperature coefficient.) In the occasional models where AFC *is* employed, it generally consists of a simple network including a semiconductor diode.

Several American manufacturers are also making one-tube RF tuners for FM radios, likewise utilizing the 12DT8 and similar tube types. The General Instrument tuner in Fig. 3 has many features in common with those already discussed. The latest version of Granco's coaxial tuner uses the dual-triode circuit and subchassis-type construction, but the tuning elements are worm-driven, piston-type variable capacitors instead of movable slugs. The Standard Coil FM tuner in Fig. 4A is also gear-driven; however, it differs from the Granco and other units in many respects, including the use of rotating brass slugs for tuning.

The converter-circuit schematic

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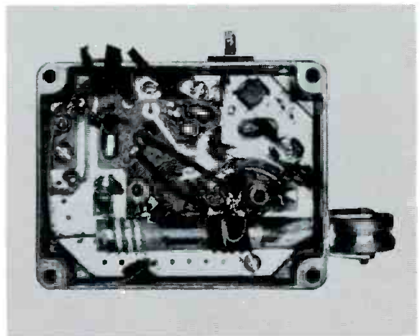
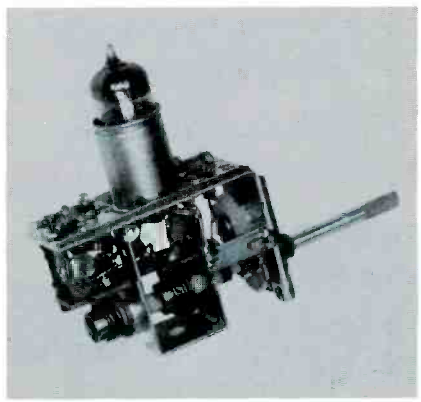
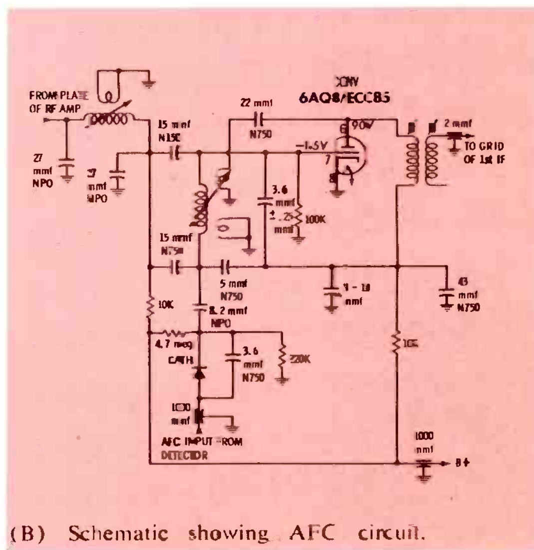


Fig. 3. General Instrument FM tuner also features "pull-cord" slug tuning.



(A) Photo showing gear drive system.



(B) Schematic showing AFC circuit.

Fig. 4. Standard Coil FM radio tuner.

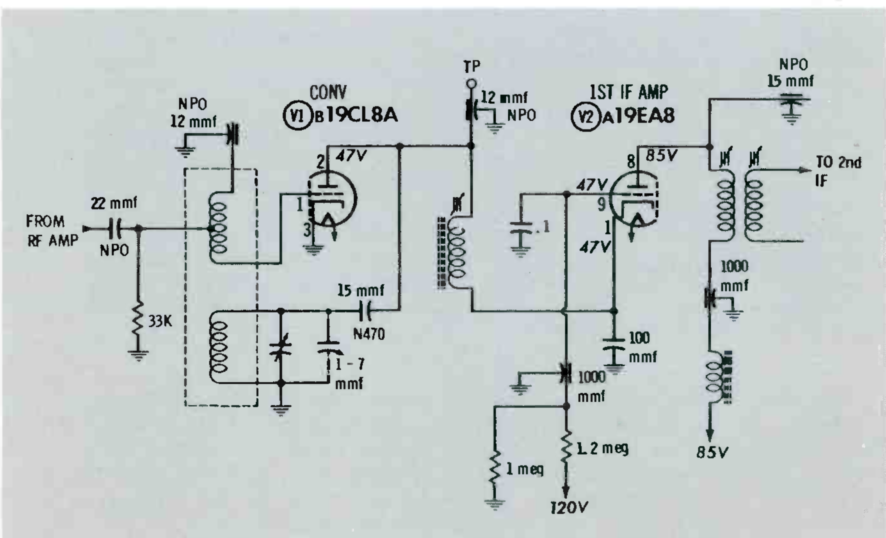
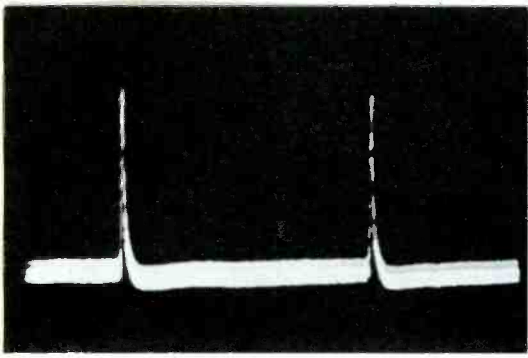
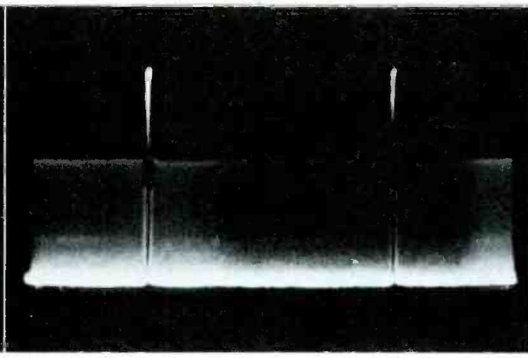
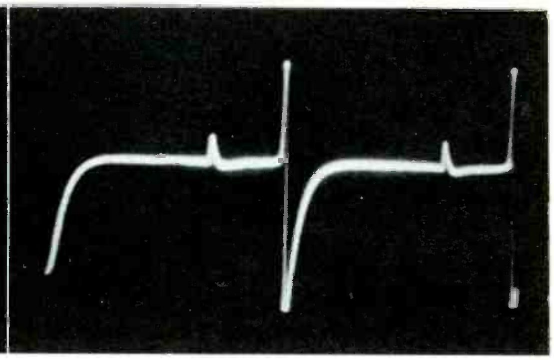


Fig. 5. Converter and first IF of Sarkes Tarzian radio are in series across B+.







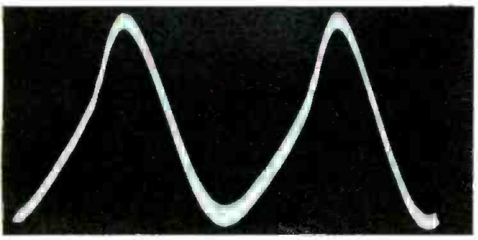
The waveform showing the 60-cps sync-pulse output of the vertical integrator is helpful in dealing with cases of unstable vertical sync. While you have the oscillator disabled to prevent its feedback signal from obscuring the sync pulses, use the opportunity to view the *input* waveform of the integrator. (See middle photo.) In many sets using a conventional vertical multivibrator, it is normal for the vertical sync pulses at this point to have a somewhat greater amplitude than the horizontal pulses (represented by the hazy area in the waveform). Equal heights for the two sets of pulses many also be considered normal in some circuits, but noticeably smaller vertical pulses may well be the underlying cause of jittery vertical hold.

For a quick check to establish the presence of sync pulses at the integrator output, don't disable the oscillator—merely use the hold control to induce a slight vertical rolling of the picture. The sync pulses should then appear as small "traveling" positive pips, as shown in the third waveform.

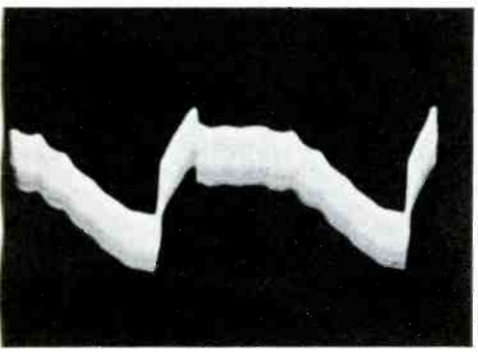
Key waveforms normally shown on schematics become familiar through constant "re-view," and it doesn't take long to become skilled at recognizing deviations from the normal patterns. However, once you recognize a fault at one of these key check points, you are apt to lay down the scope probe and rely on other means of further isolating the cause of the trouble.

But why change horses in midstream? In many cases, you can save time by checking other waveforms in search of further clues about the trouble at hand. Although these waveforms are not generally shown in service data, many of their patterns are fairly consistent from one set to another, and radical departures from the norm will pinpoint the trouble to a few specific components.

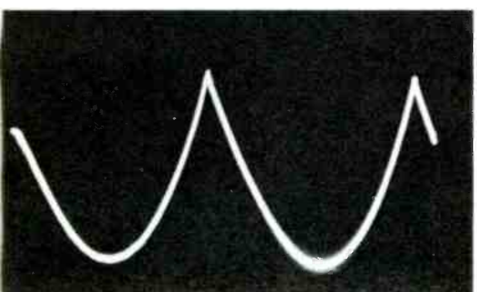
SECONDARY



Theoretically, there should be pure DC on the AGC line of a normally operating receiver. In actual practice, you're more likely to encounter a slight amount of either sync, vertical, or video energy at this point. The signal will seldom exceed 1 volt peak to peak under normal conditions—and it may be much weaker. However, with an AGC filter capacitor open, you can expect this signal to increase in amplitude by 10 or 20 times. Excessive modulation on the AGC line can produce a number of different trouble symptoms including complete loss of video, negative picture, hum bars, or poor synchronization.

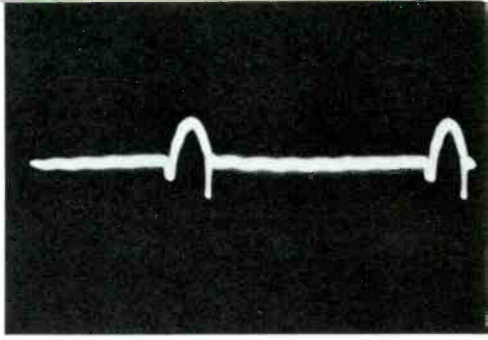


When the boost B+ is used to supply plate and bias potentials for several other circuits in a receiver, the boost source is usually well filtered. Although you'll normally find a certain amount of ripple modulation along this line, the AC component should be relatively minute compared to the DC voltage. If the signal at the boost source is viewed at one-half the horizontal sweep rate, or 7875 cycles, you will probably note a waveform similar to that shown. In most cases, however, you'll also find an equal amount of vertical energy when viewing the pattern at a 30-cycle scope-sweep rate. If a decoupling or filter capacitor associated with the boost supply is open, horizontal energy may reach the vertical section and cause unusual blanking symptoms or poor vertical sync. On the other hand, if vertical energy reaches the horizontal section, it can produce raster bends, poor horizontal linearity, or erratic horizontal sync.

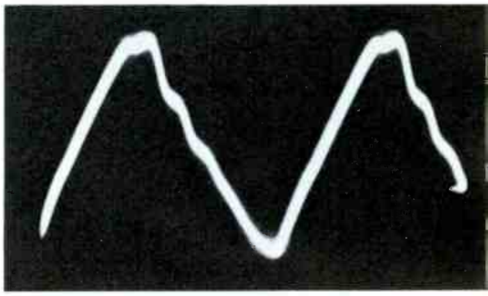


The signal on the cathode of a vertical output tube normally varies with the setting of the linearity and height controls, and the deflection angle also has some bearing on the amplitude. Typical values are .5 to 3 volts peak to peak in circuits which employ a linearity control in the cathode circuit. With an open electrolytic cathode-bypass capacitor, the waveform takes on a sawtooth shape, and its amplitude increases to about 25 volts peak to peak. This fault generally causes vertical shrinkage of the raster, with distorted linearity and possibly foldover; however, the serviceman may not notice these symptoms because they can often be corrected by resetting height and linearity.

When you're confronted with a problem that involves loss of horizontal sweep, and you find a satisfactory drive signal on the grid of the output stage, how can you quickly check to see if the output tube is conducting? One of the simplest ways is to look at the waveform on the cathode. This may come as somewhat of a surprise, but even if this pin is grounded, you should still be able to detect a horizontal pulse in the neighborhood of .01 to .05 volts peak to peak (or higher)—provided the tube is conducting. You need only connect the "hot" scope lead directly to the cathode pin of the tube socket and attach the ground lead to the chassis a few inches away. Sensitivity of the scope must, of course, be adequate to produce at least a slight indication.

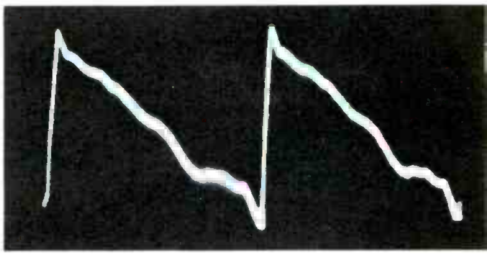


Scoping the screen of the horizontal output stage can often pinpoint the cause of raster bending, poor linearity, or a ringing condition. Here, we have pictured a typical waveform obtained at this point. Normal amplitudes may vary from 4 to 40 volts peak to peak, depending on how well the screen is bypassed to ground or cathode. Should you ever encounter a signal with an amplitude of from 100 to 200 volts, check for an open screen-bypass capacitor. It also pays to check this point for any unwanted vertical-sweep or power-line modulation by setting your scope at a 30-cycle sweep rate.

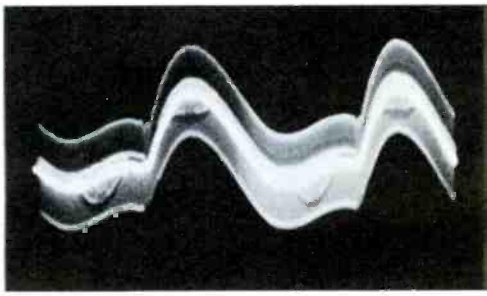


TV WAVEFORM CHECKS

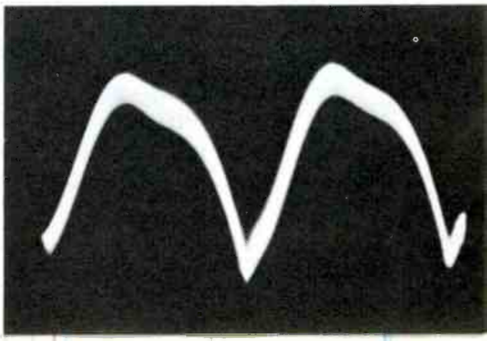
You'll also find a certain amount of normal signal voltage at the screen of the video amplifier or output tube. Even with this point well bypassed by an electrolytic, you'll generally be able to observe either a composite video signal or a damped pulse resembling that shown here. The set may function properly with a signal as strong as 10 volts peak to peak at this point; however, when the amplitude shoots up to 40 or 50 volts, be on the lookout for an open bypass. Symptoms resulting from this fault include a dark and smeared picture, excessive contrast, hum modulation bars, and unstable sync.



When troubleshooting to find the source of 60-cycle modulation, picture ringing, or similar interference problems, you may find it advantageous to check the cathodes of the video IF stages for any unusual or excessive waveshapes. Normally, there will be a small positive DC potential on the cathode pin, but no detectable AC signal will be developed across the cathode resistor. In a few receivers, however, you may notice a slight 60-cycle or video component at these points. The amplitude of this waveform should be considerably less than 1 volt peak to peak; if it isn't, check for defects such as heater-to-cathode leakage within the tube itself. This procedure can actually be quicker than substituting or testing the IF tubes.



If any signal can be detected at the screen grid of a video IF tube, it will most likely consist of a 60-cycle pulse with a peak to peak value of less than 1 volt. When isolating the cause of picture ringing or hum modulation, you may suspect that one of the IF stages is oscillating, or that a stray AC voltage is modulating the video signal via the screen-grid circuit. Any unusual signal on the screen grid should prompt you to check for poor B+ filtering, leakage in the tube, or an open bypass capacitor. Sometimes, however, it is normal for a weak, distorted composite video signal to appear on the screen of the final video IF stage—especially if this element is connected directly to the bottom of the detector-transformer primary without the use of a decoupling network.



Spotlighting the 1961 TV-lines

Highlights of circuit features in all the new fall TV lines.—*by Joe A. Groves*

What do the new 1961 TV's hold in store for the serviceman? Do the "old standard" circuits predominate, or is there a whole flock of new ones to contend with? What has the swing to 19" and 23" picture tubes done to the sweep, video, and high voltage circuits? These are only a few of the questions servicemen have as new models begin to flood into the field.

If you're a service dealer, you've no doubt been briefed on the selling points of some of the new lines—but what about the "insides" of those fancy cabinets and cases, and how do they compare with others on the market? You need this intimate knowledge to talk intelligently about your product.

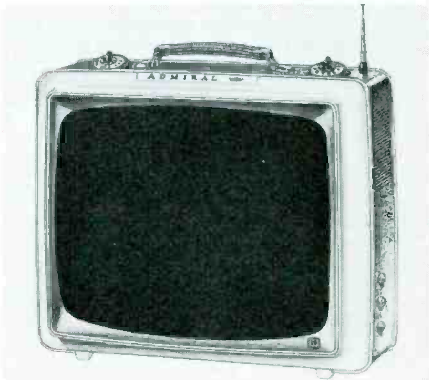
If you've confined yourself strictly to servicing, you too will be called upon to discuss the new crop of sets by many of your customers. Remember, they look to *you* as authority, and in order to maintain a "well informed" status in their eyes, you must have some concept of what the new sets are like.

Here, after spending several weeks actually examining many of the sets, and studying hundreds of schematics, is a condensation of our findings—confined to the pertinent facts on the lines of sixteen manufacturers.

Admiral

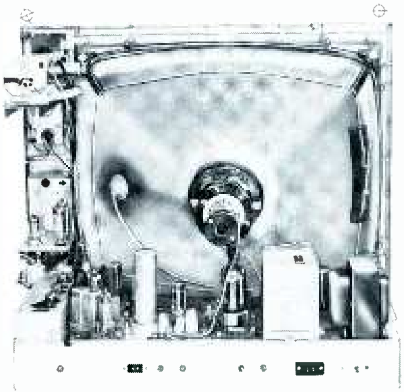
Three basic chassis series form the nucleus of Admiral's 1961 black-and-white TV line, which ranges all the way from a 14-tube, transformerless *Thinman* portable, to an 18-tube, transformer-powered console that includes a stereo amplifier in the audio section. Sweep circuits vary to accommodate picture tubes with deflection angles from 92° to 114°. All picture tubes feature the new square-cornered shape, and are of two sizes—23" with the bonded safety shield, and 19" without. Some chassis are equipped with a 7-transistor *Son-R* remote control receiver which operates at the command of mechanically-produced supersonic signals.

Circuits common to all chassis in the line include a 'BU8 keyed AGC-sync separator, cathode - coupled horizontal multivibrator with dual-diode horizontal AFC, combined vertical multivibrator and output circuit, crystal-diode video

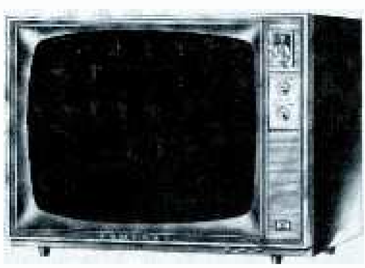


detector, 'DT6 quadrature-grid sound detector, and circuit-breaker protection.

Three 19" chassis—all using a 114° CRT, the 19XP4—form the "low end" of the line. The smallest of these, the 15G1B, is a 600-ma series-filament version using two silicon rectifiers in a half-wave doubler circuit. The 15E1 and 15F1 are transformer-powered, 5U4-equipped units used in the higher-priced portables and 19" consoles. Remote control is an added feature of the 15F1 only. Two video IF stages and a 6AW8A video amplifier develop an output signal of 80 or 95 volts peak to peak (depending on chassis). A single printed board carries all of the signal circuits.



"Leader" models in the 23" *Presidential* line use a 92° picture tube, the 23AHP4, and either the 16-tube 20K7 or the 18-tube 20L7. The audio circuits mark the difference between the two groups. The 20K7 uses a single 6AS5 for the output, while the 20L7 employs a three-tube stereo circuit with a pair of EL86/6CW5's. Both chassis have a power transformer and 5U4 rectifier, a 6DE7 dual triode in the vertical circuit, and a three-stage video IF section which helps raise the signal output of the video amplifier to 125 volts. Two printed boards contain most of the wiring in this series.



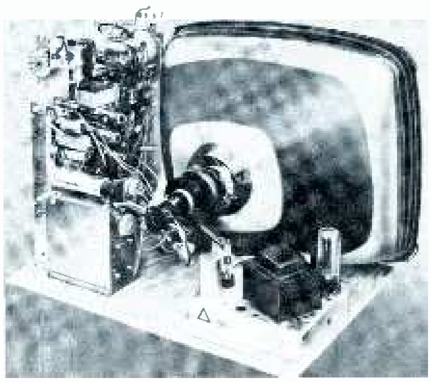
The big *Imperial* series uses the 20A7, 20B7, or 20C7 chassis with a 110° picture tube—either a 23CP4, -GP4, or -HP4. The basic 20A7 layout contains one more tube than the 20K7, using a 6FM5 pentode and half of a 6CG7 to replace the 6DE7 in the vertical circuit. The remaining half of the 6CG7 is put to use as an added sync phase inverter. The 20B7 chassis is equipped for remote control, while the 20C7 goes "all out" and includes a stereo amplifier with two EL86/6CW5 ouput tubes. A phono and a three-tube AM or seven-tube AM-FM tuner are also included in the 20C7 series.

DuMont

New models introduced in DuMont's 1961 line, all members of the 700 series, use Chassis 120602 through 120605. The 90° picture tube is the same for all versions—a 23YP4 with bonded shield. The 120603 and -5 chassis differ from the others in the sound circuits, omitting the output stage and using a separate stereo amplifier with two pairs of push-pull EL84/6BQ5's. These are found in combination models that also have an AM-FM tuner, a phono, and a supersonic remote control device using an electronically-generated signal—the same system used in the '60 line. All versions are equipped with *DuMatic* power tuning and *Perma-Tune* "do-it-yourself" preset fine-tuning adjustment, also carried over into all the new chassis.

Other than the differences noted above, the chassis are identical. Conventionally-wired and transformer-powered, these units have their power supplies mounted on a separate subchassis. Three video IF stages are employed ahead of the single 12BY7A video amplifier. In the sound circuits, a 6T8 functions as a ratio detector, AF amplifier, and AGC clamper. (This was conventional just a few years ago, but today it's a rarity).

Another old standby, a 6AL5, is used as an AFC detector to control the catho-



de-coupled multivibrator in the horizontal sweep circuit. Vertical sweep comes from a 6EM7 dual triode in a combined multivibrator and output circuit. One-half of a 6BU8 provides amplified AGC in a non-keyed arrangement; the other half serves as the only sync stage in the receiver.

Emerson

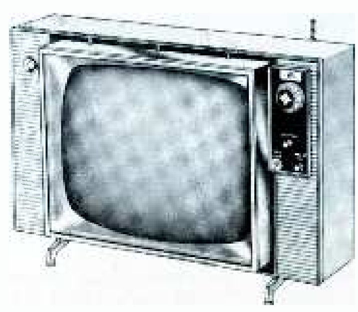
The 1961 Emerson line centers around one basic chassis design even though 10 chassis numbers prevail. The predominant differences are in the choice of tuner, and in circuit variations to permit the use of additional radio, amplifier, and remote control chassis. The remote system, a supersonic version carried over from the '60 line, operates by means of an electronically-produced signal. Chassis 120530C, -552E, -553F, -554E, -556F, and -557E all use a 114° 19AXP4 without bonded shield, while the 120-549C, -550D, and -551C utilize a 110° 23CP4 with shield. The horizontal circuit comes in for considerable revision in the 114° series, because of the increased deflection-current demand. Output-tube screen voltage is increased 10 volts, the flyback and yoke are changed, boost filters are increased in value, and higher values of anti-ringing components are required.

All of the chassis have a single printed

board that contains most of the circuits except for the power supply, audio output, and sweep output stages. The complement of 17 tubes includes a 5U4 in the transformer-type power supply. The audio output tube, a 6CU5, doubles as a voltage divider in the B+ circuit. A 6AS8 pentode-diode, serving as a third video IF amplifier and video detector, feeds the pentode section of a 6AW8A, which amplifies the video signal to 115 volts peak to peak. These chassis provide a LOCAL-DISTANCE control for adjustment of the voltage divider that furnishes delayed AGC bias to the tuner from the 6BU8 AGC keyer. Horizontal sweep is controlled by a conventional multivibrator with dual-selenium-diode AFC, and vertical sweep comes from a 6AW8A triode section and a 6FM5 pentode in the familiar combined multivibrator-output circuit.

General Electric

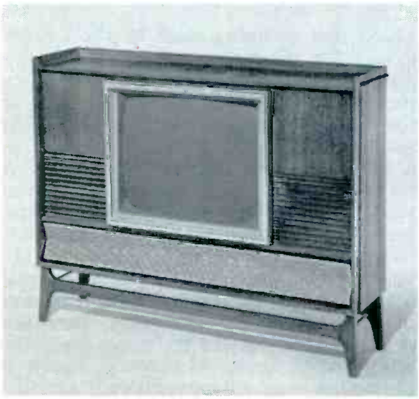
As in previous years, G-E's line is made up of two basic chassis; for '61, they're numbered M6 and U5. These are refined versions of the 1960 designs, following the same structural pattern. This year marks G-E's entry into the combination field, so minor circuit modifictions have been made to accommodate additional radio tuners, amplifiers, and remote control units. Remote-equipped models will use either an improved version of 1960's four-button RF system, or a new, three-tube supersonic type that uses two transistors to generate the signal. Some models are equipped with "do-it-yourself" preset fine tuning, which has been termed *Automatic Fine Tuning* by G-E. Picture-tube options include the 17DLP4, 19ZP4, 21ESP4, and 23KP4—all 110° or 114° designs without a bonded shield. A three-stage video IF, a horizontal multivibrator controlled by dual-diode AFC, and a 6AU6 sound IF stage feeding a 6FM8 or 6T8 ratio



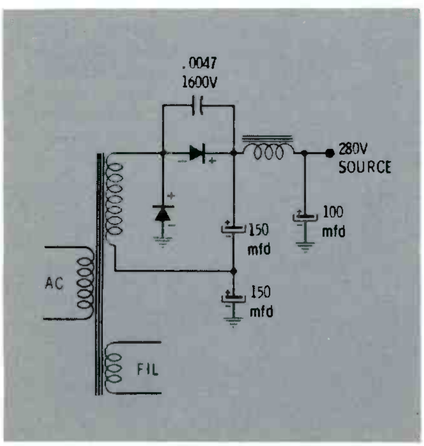
detector-AF amplifier are among the major features common to both chassis.

The smaller M6 chassis, used in the *Designer* series, incorporates a power transformer and 5U4 rectifier in its power supply. The 135-volt "low B+" potential is derived from the 6CU5 audio output stage. AGC bias is obtained by blending and filtering a combination of two signals—the output of the video detector and the grid signal of the triode-type sync separator. The single video amplifier is the pentode section of a 6CX8, and the combined vertical multivibrator and output circuit uses a 6DN7 dual triode.

"Big brother" U5 offers two stages of



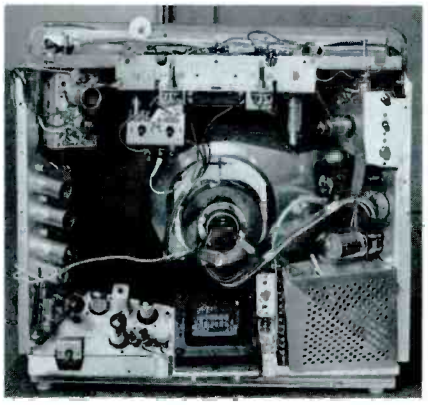
video amplification, a 6AW8 pentode section and a 6AQ5, designed to furnish a 160-volt peak-to-peak drive signal to the grid of the CRT. (High voltage in this chassis, by the way, is 18 kv.) AGC is developed by the keyed triode section of the 6AW8; the RF branch of the AGC line is clamped by an extra diode in the 6T8 ratio-detector tube. A new high-gain 6EW6 pentode appears in the final IF stage. The audio output tube is a 6BQ5, with the cathode circuit returned to ground instead of acting as a low B+ source. A 6DN7 vertical sweep tube is found in the U5, as well as in the M6; this time, however, it is wired as a blocking oscillator for feeding an independent output stage. Instead of teaming a 5U4 with its power transformer, the larger G-E chassis uses a pair of germanium rectifiers in a full-wave voltage-doubler circuit (see schematic). This reflects a growing trend in many '61 lines.



Hoffman

Five chassis, numbered 355 through 359, constitute Hoffman's 1961 line. Bonded-shield 110° picture tubes (19-AFP4 or 23CP4) are used in all models. The transformer-type power supply includes a 5U4 tube in every chassis except the 355, which uses silicon rectifiers. Hand-wired construction is used throughout the line. Covering a range from portables to combinations, the various chassis carry many minor variations. Two supersonic remote control units are used — a two-button system producing mechanically-generated signals, and a four-button unit using a transistorized oscillator to generate four different signal frequencies.

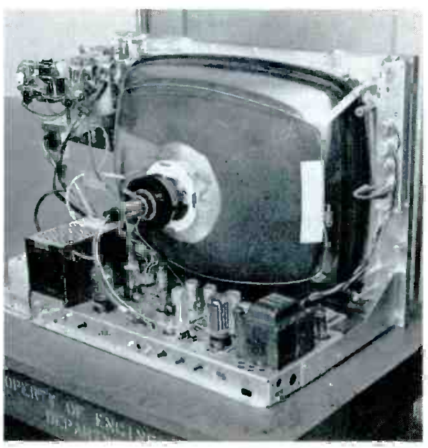
A 6AW8A serves as the video output and keyed AGC circuits in all chassis. The 6DT6 quadrature detector is unusual in that an AM REJECTION control is con-



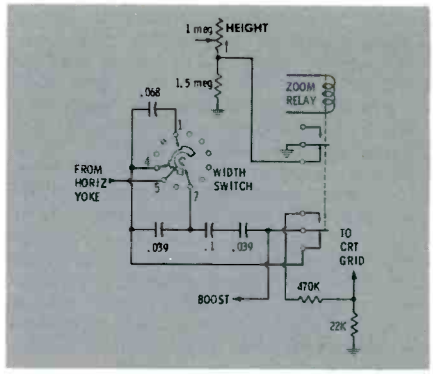
nected in the cathode circuit. Three-stage video IF strips, horizontal multivibrators, and 6BQ5-equipped audio output stages are common to the full line.

Physical layout is the prime difference between the *Nine-teen* series (Chassis 355) and the rest of the line. Employed in 19" sets, this chassis is shaped like a picture frame mounted vertically inside the cabinet, with circuits on all four sides. Electrically, this 16-tube chassis is set apart from all other Hoffmans by the above-mentioned use of silicon B+ rectifiers, and by the employment of a 6DE7 in a combined vertical multivibrator and output circuit.

Chassis 356, 357, 358, and 359, comprising the *Continental* series, are all basically the same. These 18-tube units offer a feature seldom seen these days—a 6CG7 in a cathode-coupled vertical multivibrator feeding an independent 6DT5 output stage. "Do-it-yourself" fine tuning is available in all members of



this series except the 356. Chassis 357 and 359 carry over an interesting feature from the 1960 line—a *Lite Scope* circuit which varies the resistance in the brightness-control circuit in direct proportion to changes in ambient light. In addition,



the 359 chassis has a ZOOM or PICTURE MAGNIFIER circuit that increases the size of the image appearing on the screen. This is accomplished by increasing the amplitude of the vertical drive signal and adding two capacitors in series with the width-switch connection to boost. Also, a slight positive voltage is applied to the CRT control grid to increase beam current (see schematic).

Magnavox

Magnavox's '61 TV line is made up of two new chassis and a revamped version of the existing 30 Series. The new 33 and 34 Series form the middle and low ends of the line, respectively, while the revised group of chassis (30-20 through 30-24) retains its position at the top. Picture tubes come in all available sizes from 19" through 27", and employ deflection angles of 90° to 114°. As in previous years, a wide range of models are developed by combining each of these basic TV chassis with various additional equipment (such as AM-FM tuners, stereo amplifiers, and phonos) in numerous arrangements.

All these chassis are transformer-powered (with 5U4 rectifier), conventionally wired, and mounted vertically. The single video output stage is a 6EB8 pentode section in the two newer series, or a 12BY7 in the 30 Series. Sound detection is performed by a 6DT6 in all cases, and the audio output tube is put to use as a B+ voltage divider. In some versions which use an external audio amplifier chassis, the set's own output tube is relieved of its duties as an amplifier; but it is retained in the chassis so it can continue its voltage-dividing job. Keyed AGC and two triode

sync stages are used throughout. While the 30 Series stays with the "old reliable" 6AU6 in the AGC function, the 33 and 34 Series have changed over to the pentode section of a 6GH8.

The 33 and 34 Series chassis are

quite similar to each other, except for the following major points: The vertical circuit of the 33 Series uses a 6CM7 as a blocking oscillator and separate output stage, while the 34 Series has the familiar combined multivibrator and output circuit including a 6BF6 and a 6EM5. The diode sections of the 6BF6 are utilized as clampers for the AGC and horizontal-blanking circuits—another special feature of the 34 Series.

The 30-20 to -24 series chassis have many minor variations in control-panel layout and cabling arrangements, in order to accommodate different combinations of accessory equipment found in combination TV-radio-phono and similar units. The circuits are very much like those of the 34 Series, but individual tubes replace some of the dual-section types, thus accounting for the higher number of tubes encountered in the 30

Series. Chassis coded 30-20, -22, and -23 all use the 6DG6GT "audio output" tube only as a voltage divider, and feed the output of the sound detector to an external amplifier. In the 30-21 and -24 Series, a 6AT6 stage of audio amplification is added to drive a self-contained output circuit.

Motorola

The most interesting innovation in Motorola's new line is the 19" transistorized portable. However, there are also eight other basic chassis that cover the field from 14" portables through 23" combinations. In all, 10 different CRT's are employed, with deflection angles ranging from 90° to 114°. Motorola favors the bonded safety shield for all the 19" and 23" types, excluding the one in the transistor set.

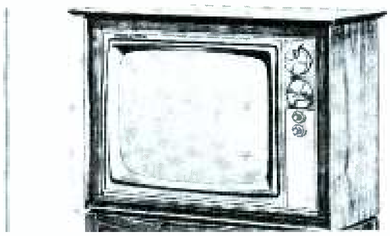
Although the different chassis groups vary greatly in tube types used, as well as in wiring methods and physical arrangements, the tubed chassis are consistent enough in basic design so that we can classify them into three broad groups. Furthermore, some design features are common to every chassis in this line. All have three stages of video IF and a single video output stage. With the exception of the TS-574 chassis, all have a single sound IF, a 'DT6 sound detector, and a simple one-stage audio output circuit. Keyed AGC, noise-immune sync, and the combined vertical multivibrator-output circuit are also used throughout, although the exact design of these circuits does vary a great deal.

Chassis TS-432 is used in the *Astronaut* transistorized portable set. Since there are far too many unique features of this chassis to allow adequate coverage in this review, we'll concentrate on the points we think you'll be most interested in knowing. All told, there are 25 transistors—22 PNP and 3 NPN types. The only tubes in the set are the CRT and a 1S2A high-voltage rectifier. (The latter delivers a 15-kv output.) In addition, there's an assortment of 12 semiconductor diodes and rectifiers serving various functions. Some of their applications are truly unique; for example, one of the diodes replaces a conventional integrator network, while others rectify pulse voltages from the flyback to obtain higher B+ voltages for the video output stage and the picture tube. The main power supply is a full-wave type with a regulated output of 19.5 volts; besides acting as a B+ source, it also charges the battery when the switch is in the off position and the TV is plugged into the AC line.

One of the very few 14" portables still available on the American market is the set using Chassis TS-434, carried over from last year's line. A similar chassis, the latest revision of the TS-430, is found in 17", 90° portables of the type shown. Both series are 16-tube, conventionally-wired chassis with 600-ma series-string tubes. Here's a brief rundown of differences between them: The 430 uses a pair of selenium rectifiers in a half-wave doubler circuit, while the 434 uses a single silicon rectifier to supply B+ voltage. The horizontal AFC stage in the 17" chassis takes in both diode sections of a 6CN7, whereas a dual selenium diode is found in the 14" version. Three triodes in the 430 perform the respective jobs of keyed AGC tube, noise limiter, and sync separator; on the

other hand, the 434 uses a single 3BU8 to serve all these functions.

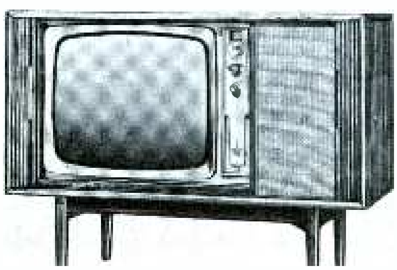
Sharing the next higher step on the ladder are Chassis TS-433 and -435—used in 17" and 19" sets, respectively. Both series feature slim portable models with 110° picture tubes, and the 435 finds further use in the *Harbinger* line of 19" consoles and table models. The RTS-435 has a *Golden Satellite* two-function remote control—a supersonic system using a mechanically-generated signal. One all-inclusive "plug-in" printed board with color-coded conductors characterizes these 15-tube, series-filament chassis. A couple of familiar features in this design are a half-wave doubler (with two silicon rectifiers) and a 3BU8 keyed AGC-sync separator stage. Either an 8EB8 or an improved similar type, the 8GN8, serves



as a video output tube and as the first section of the vertical multivibrator. A plug-in dual selenium diode is used as a phase detector to control a 5GH8 sine-wave horizontal oscillator. Modules appear in the sweep oscillator circuits, and printed component combinations are found in many applications.

"Full-size" (21" and 23") sets use four distinct chassis types—the TS-567 in 21" receivers, the TS-568 in most 23" units, the VTS-569 in the 23" *Drexel* "fine-furniture" line, and finally the TS-574 in stereo combination sets.

The lowest-priced chassis of the group (the 567) has a 15-tube series filament string, while all others have a transformer-type power supply with 5U4 rectifier. (The 569 adds a supplementary 5Y3.) A couple of features common to all 23" sets, but not shared by the 567, are a new high-transconductance 6GK6 pentode in the video output circuit, and a sync phase-inverter stage following the 3BU8 sync separator. In the horizontal sweep section, the features follow a different lineup; the 568 and 574 employ a multivibrator circuit, while the 567 and 569 both have the newer sine-wave type of oscillator. All chassis use 90° or 92° picture tubes except the 569, which drives a 110° 23GP4. To supply the increased sweep power demanded by the greater deflection angle, the 569 employs a 6EZ5 vertical output tube in place of the 5- or 6AQ5 found in other chassis.



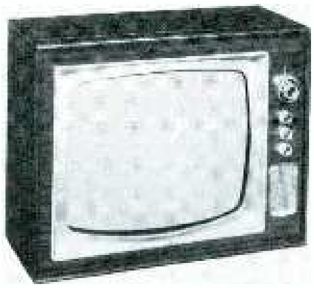
Modules and component combinations find their way into all but the 569. In the 574 only, the audio output circuit is omitted, and a separate stereo amplifier serves as the audio section.

Olympic

This year's selection of Olympic models leans heavily toward combination sets, with such diversified extras as AM radios, standard AM-FM tuners, "dual-channel" AM-FM tuners (for receiving stereo simulcast transmissions), stereo phonos, and remote control. There's a wide variety of picture-tube sizes, ranging from 17" to 24".

The line is a long one, comprising 14 chassis (not counting UHF versions); however, the various designs all have an underlying family resemblance. All but the KE chassis have two video IF stages and use the audio output tube as a B+ voltage divider; the KE chassis, on the other hand, has three IF's, and its EL84/6BQ5 audio output tube is not tied in with the low B+ network. Most chassis use the new 6EJ7/EF184 pentode—a high-gm, frame-grid tube—in the second IF spot. Quadrature FM detection, a cathode-coupled horizontal multivibrator with dual-diode AFC, and a combined vertical multivibrator-output circuit are common to all designs.

Chassis KU is the smallest of the line. It's an 11-tube, series-filament version with two silicon rectifiers wired in a conventional half-wave doubler circuit. AGC voltage is obtained by filtering the output of the video detector, and the



only sync stage is a triode section of a 5B8 acting as a separator.

The remaining chassis can be sorted into two groups, depending on deflection angle and type of low-voltage rectifier used. (All are transformer-powered.) Chassis JV, KRZ, KW, KV, and KZ are 110° or 114° units with a pair of silicon diodes in a full-wave voltage-doubler configuration. On the other hand, the KA, KB, KC, KD, KE, KRB, and KRD are 90° chassis using a 5U4.

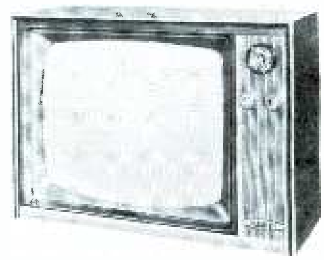
Olympic has joined the roster of manufacturers using a 6BU8 as an AGC keying tube and sync separator; this feature appears in all transformer-type chassis except the JV, KA, and KV. The exceptions use the filtered video-detector output as AGC bias and employ the triode section of a 6AV6 for sync separation. (The diode sections of the 6AV6 are unused.) These sets also employ the pentode section of a 6AW8 in the video output stage, whereas the 6BU8-equipped chassis have changed over to a higher-gain 6GN8 or 6EB8 video tube. The sound section in the KC, KD, KE, and KW offers a *3D* feature—a system of tone compensation achieved by degenerative feedback.

Packard-Bell

To gain a comprehensive understanding of Packard-Bell's 1961 line, three groups of chassis need be considered—although there are at least two variations of each chassis. The line ranges all the way from 17" portables, through an assortment of 19" and 21" types, to 23" consoles and combinations. Neither 19" nor 23" picture tubes are equipped with bonded safety shields. Optional extras include AM-FM tuners capable of receiving simulcast transmissions, stereo amplifiers, and even connections for future installation of reverberation units. Wired remote controls are currently offered, with wireless units scheduled for introduction later in the year.

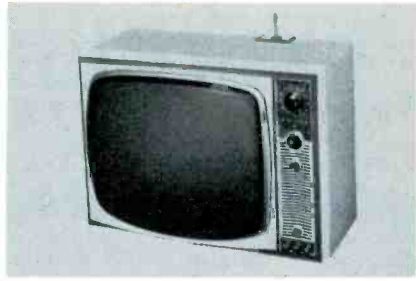
All chassis are conventionally wired. Among their standard features are three video IF's, a cathode-coupled horizontal multivibrator, and a combined vertical multivibrator and output circuit.

Only a handful of '61 designs use 450-ma series-string tubes, but Packard-Bell's *Custom* series (Chassis V8-8) is one of these. On the other hand, the *Compact* series (Chassis V8-7 and -9) have 600-ma strings. Both groups have a complement of 15 tubes, along with a half-wave doubler power supply using silicon rectifiers. Other design features common to both series are individual horizontal AFC diodes instead of a potted dual assembly; 'DT6 audio detection; an 'AS8 pentode-diode serving as a third IF amplifier and



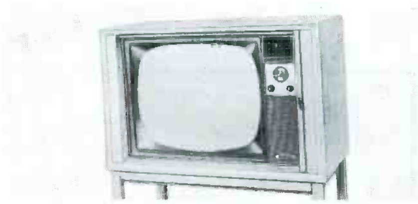
video detector; AGC derived from the detector output; and a single 'EA8 triode-pentode constituting the entire video and sync section.

There are three *Decorator* groups utilizing versions of the 88 Series chassis. All are equipped with a power transformer and 5U4. The basic 17-tube 88-8 chassis employs a crystal-diode video detector, a 6EB8 as a video output and noise inverter, and a dual-diode unit for horizontal AFC; it also differs from the smaller chassis series in that keyed AGC and a 6BN8 ratio detector-AF amplifier circuit are added. The 88-10 is the same as the 88-8 except for circuit variations made necessary by the addition of wired remote control. The 88-11 has a different audio circuit that uses a 6AL5 as a ratio detector and feeds the demodulated signal to an accessory AM-FM stereo



chassis. The latter, in turn, feeds the signal back to a three-tube stereo output circuit on the TV chassis.

The 98D10 and 98D11 *Signature* chassis are 20-tube, transformer-powered units using a 5V3 rectifier. A 6AM8 serves as third IF and video detector; a two-stage video amplifier (using a 6CB6 and 6CX8 pentode section) includes a PICTURE FIDELITY control to permit varying its high-frequency response. Keyed AGC and noise inversion circuits are again employed, but this time they use a 6AN8 pentode section and half of a 12AX7. An additional stage of sync amplification puts the triode section of the 6AN8 to use, and two diodes of a 6BN8 provide a horizontal AFC. Sound circuits vary from



the 88 Series in that the remaining half of the 12AX7 noise inverter serves as an additional IF stage. Wired remote controls are included in both versions. The AF amplifier and audio output circuits of the 98D11 feed only an auxiliary speaker in the chairside remote-control box, while the output from the TV cabinet itself comes from an added stereo amplifier with push-pull pairs of EL84/6BQ5 output stages.

Philco

A new supersonic remote control, using mechanically-generated signals, can be field-installed in some '61 Philco sets by service dealers—or it may be installed at the factory. The line includes nine different chassis, with one basic design for compact portables and another for the larger models. A variety of 17" to 23" picture tubes are used; only one of these, the 23CP4, has a bonded shield. Minor circuit variations provide for adding an AM-FM tuner, phono, or reverberation unit.

A new 6HJ8 is used as a third IF and video detector tube, except in the 11H25 chassis (which uses a 6AM8A). The audio detector circuit is a carry-over of Philco's special quadrature type utilizing a 'CS6 tube. Triode-type noise inverters and sync separators are used throughout; so is the combined vertical multivibrator and output circuit, which includes a tube of the 'DR7 type. Dual selenium diodes in the horizontal AFC circuit control a cathode-coupled multivibrator in all chassis.

The 11H25 and 11J27 chassis, found in compact 19" portables, contain two printed boards and a 15-tube, 450-ma series filament circuit. The usual half-wave voltage doubler, with two silicon rectifiers, is also used. The AGC circuit in this series is reminiscent of a design which gained some popularity in the early '50s; the contrast control provides a variable voltage for AGC to the IF's. Optional *New-Matic II* remote control is available for use with these chassis. This is an air-operated unit with a hollow, flexible tube connecting the chassis to a control plunger.

The basis for the *Mark II Cool-Chassis* line is the 16-tube 11N51 and its variations, the 11N51A, -52, -52A, -53, -54, and -55. These units drive a 23CP4 CRT and have provisions for remote control and various other accessories. Transformer-powered, they use a pair of silicon rectifiers in a full-wave doubler circuit. A 6BY8 is employed in a keyed and clamped AGC circuit—a feature seldom seen these days.

RCA Victor

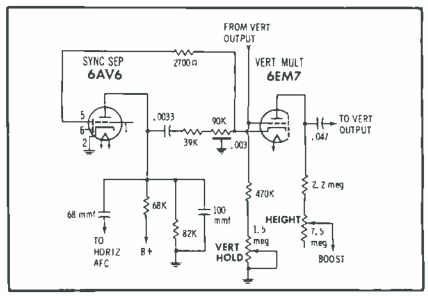
Six styles of picture tubes—ranging in size from 17" to 23", and having deflection angles of 90°, 110°, and 114°—are used in the five chassis series of RCA's 1961 lineup. All 23" versions use a 23EP4 with bonded shield, while the only 19" to have this feature is the 19AFP4 used with the KCS134 chassis. A wide variety of additional items such as AM-FM tuners, two- or three-section stereo amplifiers, and phonos, are used in conjunction with various chassis. In addition, there is a choice of two remote controls. Both are supersonic systems; however, the control signals are mechanically-generated in the two-button version, and electronically-produced in the three-button type.

All chassis are transformer-powered and contain two printed boards. The IF strip includes a new 6GM6 pentode (with semiremote cutoff and high transconductance) in the second stage, and continues the use of a sharp-cutoff, high-gm 6EW6 in the third stage. Other circuits carried over into all the new chassis are a 6EB8 pentode section in a one-stage video amplifier, and also a 6DT6 quadrature detector feeding a 6BQ5 audio output stage. The KCS131 and -2 use a 5U4 low-voltage rectifier; all others are equipped with a pair of silicon rectifiers in a full-wave doubler circuit. A new concept in RF-tube design, the

6CW4 *Nuvistor,* is introduced in some models.

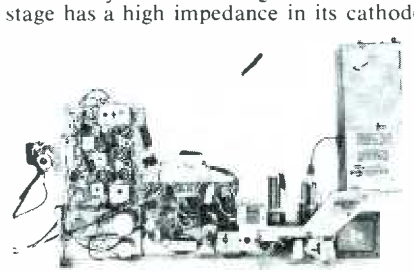
The KCS130 chassis used in 17", 110° *thin-line* portables, and the KCS134 employed in 19", 114° *veri-thin* table and "totable" models, have essentially the same circuits, but differ in layout. The separator is a 6EB8 triode section, and a 6EA8 operates as a sync amplifier and keyed AGC tube. A combined vertical multivibrator-output circuit, conventional in design, makes use of a 6DR7. The horizontal circuit is the same type of modified *Synchroguide* system as last year's RCA design—a blocking oscilator with a transformer in the grid-cathode circuit, preceded by a triode AFC stage.

"Full-size" table models, consoles, and combinations are divided into 21", 90° types (using Chassis KCS131) and 23", 110° types (outfitted with Chassis



KCS132). These two series, in addition to the KCS133 used in 19", 114° portables, are electrically very similar to each other except for differences in certain sweep components and in the low-voltage rectifiers. In these 18-tube chassis, the 6DT6 tube has been adapted to the keyed AGC function—marking the first time it has ever been used as anything but a sound detector. Other notable features are AGC clamping, noise inversion (by the triode section of the 6EB8), and the use of a 6AV6 triode as a sync separator. A dual-diode phase detector, preceding the triode AFC stage, increases the stability of the modified *Synchroguide* horizontal sweep circuit.

An unusual feature of the combined vertical multivibrator and output circuit (see schematic) is that negative sync pulses are applied to the cathode of the first stage—which, in turn, is connected to the plate of a diode section in the 6AV6 sync separator tube. The diode is normally nonconducting, so the vertical stage has a high impedance in its cathode

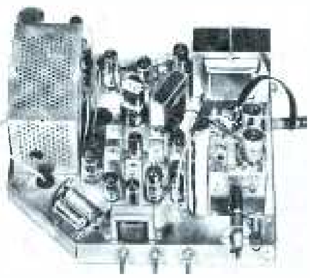


circuit. However, when a sync pulse arrives, the vertical-sweep tube immediately begins conducting, and its cathode voltage rises. This causes the diode to conduct, thereby providing a low-impedance shunt across the cathode circuit so that the multivibrator tube can draw sufficient current for rapid discharge of the vertical sawtooth-forming network.

Setchell-Carlson

Again in 1961, Setchell-Carlson's line includes some conventional and some *Unit-Ized* chassis; both types are hand-wired. Picture-tube sizes of 17", 19", 23", 24", and 27" are used with four chassis designs. A wide assortment of combinations can be assembled by adding supplementary plug-in units such as AM and FM tuners, mono and stereo amplifiers, and phonos, to the *Unit-Ized* chassis.

All receivers employ an unusual combination of a power transformer and a half-wave silicon-rectifier voltage doubler. Another feature, the *Picture Tube Saver*, consists of an 8-volt filament source, series dropping resistor, and provisions to short across the resistor when the CRT has weakened. A three-stage video IF strip and a 6CS6 sync separator are found throughout the line. The vertical sweep circuit in all chassis consists of a 12AU7 cathode-coupled multivibrator followed by a separate 6EM5 pentode output stage.



Two similar 17-tube chassis, the C106A and 361, do not employ the *Unit-Ized* feature. The former is mounted only in 17" (110°) portables, while the latter is used in 19" (114°) as well as in 23" (110°) receivers. Both designs incorporate a 6EB8 as a video amplifier and AGC keyer, and also a sound circuit consisting of one 6AU6 IF, a 6BN8 ratio detector-AF amplifier, and a single 6AQ5 output tube.

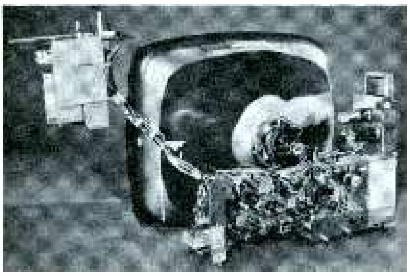
The *Unit-Ized* chassis for the *Custom* line is made in two alternate versions—the 159 (for 90°-92° sweep) and the 159X (for 110° sweep). Both types use 23" picture tubes with bonded safety shield. The 159 has six plug-in subchassis, and its power supply is mounted on the main chassis—whereas that of the 159X is on a seventh plug-in unit. The 23 tubes used in this series include two video amplifiers, a 6CB6 and a 6AQ5; a 6CL8A as a keyed AGC and sync phase-inverter tube; and a 6AL5 phase detector to control a 12AU7 horizontal multivibrator. The sound circuit is well supplied with tubes, including two 6AU6 IF's, a 6AL5 ratio detector, an audio amplifier and phase inverter section utilizing both sections of a 6CL8, and finally a push-pull pair of 6AQ5's.

Sylvania

The 1961 Sylvania line uses refined versions of the same basic chassis which is now in its fourth year of production. Known as the *Super S-110* chassis, the '61 revision is installed in a variety of 17", 19", and 23" sets—all "strictly TV." To form combination outfits, the TV receivers are used together with other pieces of equipment housed in matching *modular furniture* cabinetry. Initial-production 23" models used a CRT with a plain bonded safety shield. However, this has been changed to a 23ATP4 (earlier designated as an AR23ANP4/23ATP4), in which the shield has been given an anti-reflection treatment. The same type of shield is used on the 19AUP4 CRT serving the 19" models.

Only minor circuit variations appear from model to model, in the form of *Halolight*, *Picture Prompter* (do-it-yourself preset fine tuning), *Magic Touch* remote control, etc. The basic circuitry remains essentially unchanged, even when picture-tube size considerations and cabinet shapes dictate changes in physical layout.

Chassis numbers for '61 include the following series: 546, 547, 548, 549, 550, and 552. In case you're not too familiar with Sylvania's basic *S-110* design, here's a quick rundown on the circuitry—including all the latest fea-

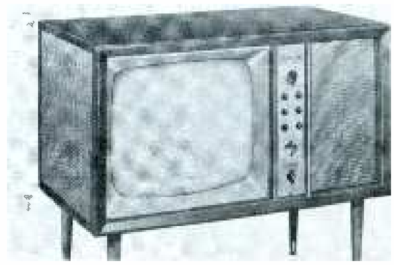


tures. A 16-tube, series-filament unit, the chassis uses silicon diodes in a half-wave doubler circuit. Printed wiring predominates. A video IF strip containing three 3BZ6's feeds a 1N295 connected in a shunt detector circuit. The video output and horizontal AFC circuits of the '61 chassis share a new 8ET7 pentode-dual diode. The triode section of a 5BR8 serves as a keyed AGC tube, while the pentode section is used in the sound IF spot to drive a 6BN8 ratio detector and AF amplifier. Single-stage audio output, 3CS6 sync separator, and conventional horizontal multivibrator circuits are employed. The 10DE7 used in the combined vertical multivibrator-output circuit of earlier models has been replaced with a new octal-based 10EG7 dual triode. Another change involves the width-control circuit; a voltage-dividing potentiometer in the screen-grid circuit of the horizontal output stage is now used in place of a width coil. Furthermore, a horizontal linearity coil has been added to the damper circuit.

Trav-Ler

All of the '61 Trav-Ler chassis center around one basic design, and only 19" and 23" tubes are employed. The 23AHP4 is a 92° type found in Chassis 1051-90, a 20-tube combination that incorporates an AM tuner, phono, and stereo amplifier. 23MP4's and 19XP4's (both 114° tubes) are used in Chassis 1051-60 and 1160-140, respectively. None of Trav-Ler's CRT's are equipped with a bonded shield.

All chassis are conventionally-wired and transformer-powered. Circuits common to all versions include a 1N87 video detector, 6AW8A video output, keyed AGC and sync separation from a 6BU8, and a stage for sync phase inversion. Dual selenium diodes control a cathode-coupled horizontal multivibrator. The combined vertical multivibrator and output circuit always uses half of a 6CG7 for the first stage; however, the output section varies, with a 12B4A serving the 92° version and a 6DT5 sweeping the 114° tubes.



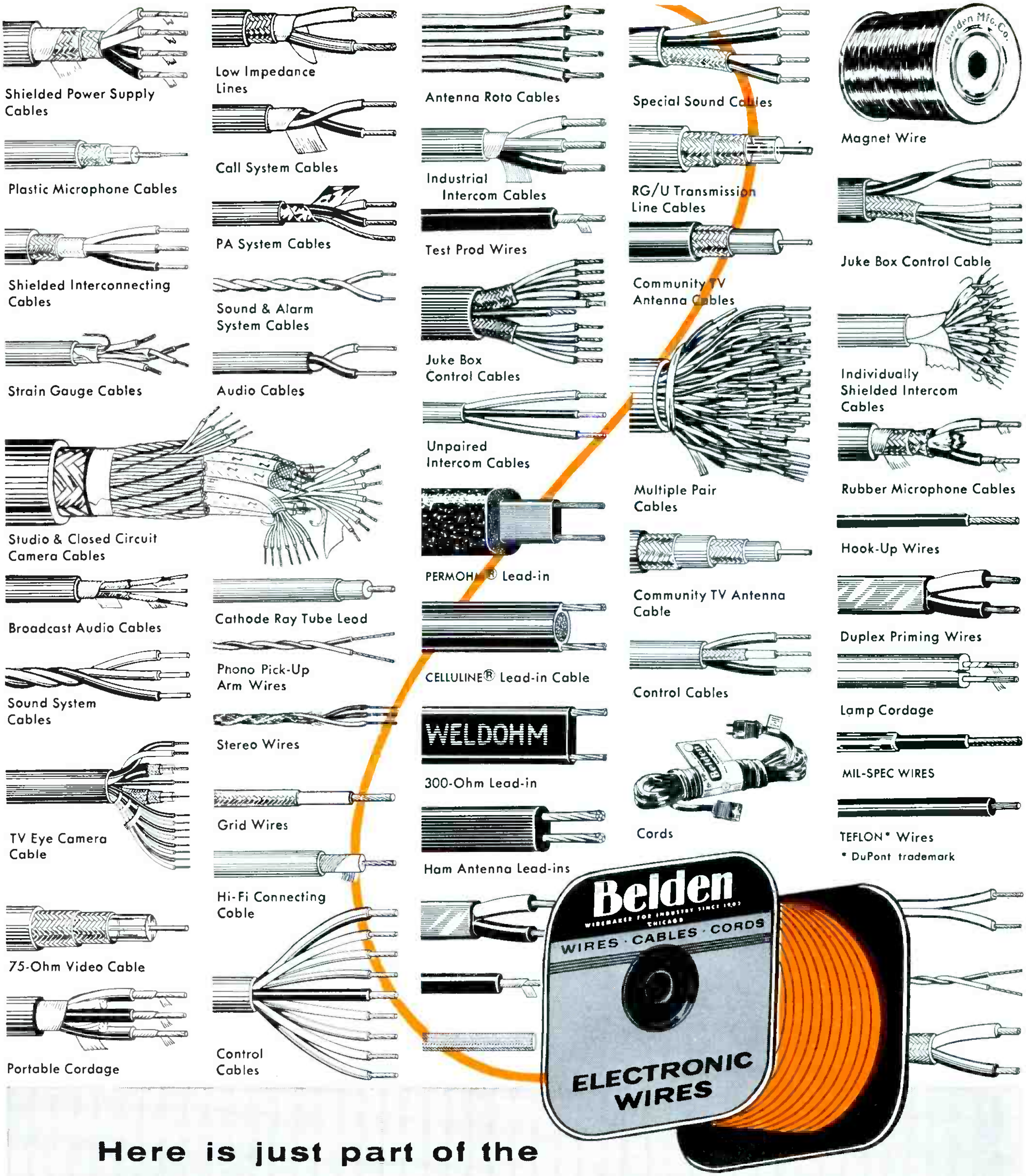
Instead of having an ordinary audio output stage following the 6DT6 quadrature detector, Chassis 1051-90 uses a three-tube stereo circuit. Among this set's other features are a 5V3 rectifier, two video IF stages, and a two-tube AM receiver. The other 23" chassis, the 1051-60, is the same except for the omission of the AM radio, a single-ended audio output stage, a 5U4 rectifier, and the 114° CRT requirements noted earlier for the vertical circuits—plus differences in the flyback, yoke, and boost filters. The 1160-140, a 19" version, duplicates the 1051-60 except for the change in CRT and the addition of a third video IF stage.

Westinghouse

Two different remote control units are available with some 1961 Westinghouse models. Both operate on the supersonic principle, with the two-button version mechanically producing the signal, and the four-button unit doing it electronically by means of a transistorized circuit. The line features five chassis, used in an assortment of 17", 19", and 23" models—all straight TV sets, with no combinations being offered at this writing.

Printed wiring is used for most of the circuitry in all chassis. Three stages of video IF and single-stage video amplification are found in every member of the line. The sound circuits consistently have one IF (a triode section of a 6FV8), a 'DT6 quadrature detector, and a single output stage. The conventional combined vertical multivibrator - output circuit, dual horizontal AFC diodes, and cathode-coupled horizontal multivibrator, are also used.

Three chassis serving the 17" and 19" group are the V-2384, V-2409, and V-2412. The first and last of these are 15-tube chassis with 450-ma series filaments and a pair of silicon diodes in a half-wave doubler configuration. The 19" *Decorator* series uses the V-2409, a 16-tube chassis equipped with a power trans-



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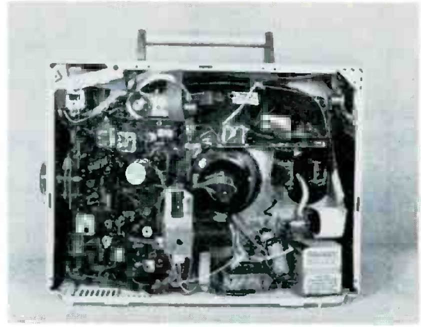
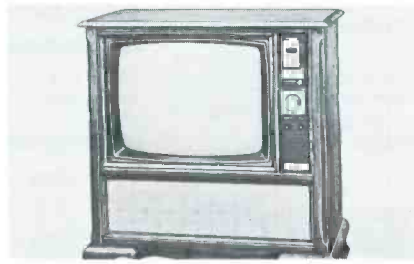


former and a 5U4. Some models in this group employ the two-button remote control system. In all the above chassis, AGC is derived from the video-detector output and sync-separator input signals. Separate triode sections serve as sync separator and sync noise inverter, and the vertical sweep tube is a 'CS7 dual triode.

The 17-tube V-2411 series of 23" chassis are very similar to the 19" V-2409 except for the addition of a 6AU6 in a keyed AGC circuit, the use of a higher-gain 6EB8 video output tube in place of a 6AW8A, and the substitution of a 6EM7 vertical sweep tube for a 6CS7. In the V-2389 chassis, largest in the line, the tube total is brought up to 18 by replacement of the dual-triode vertical multivibrator-output tube with a 12DT5 pentode and the triode section of an



extra 6FV8. The pentode section of the latter tube is put to work amplifying the video-detector output signal and feeding it directly to the sync separator. A center-tapped 12-volt filament winding on the power transformer allows the use of three 12-volt tubes (12DT5, 12AX4-GTB, and 12DQ6B) alongside the regular 6-volt types. The above chassis also switch from a 6AQ5 audio output tube to a 6BQ5.

Zenith

One basic circuit design underlies the entire 1961 Zenith line, although many optional features such as remote control, AM-FM tuners, stereo amplifiers, and timers are offered. The timers turn the set off, as is done by the "sleep" switch on a clock-radio. Three supersonic remotes, dependent upon mechanically-generated signals, provide various control functions. Picture-tube sizes range from 17" through 23". The 17" and 19" versions require 110° and 114° deflection circuits, while all 21" and 23" chassis have only 90° or 92° sweep.

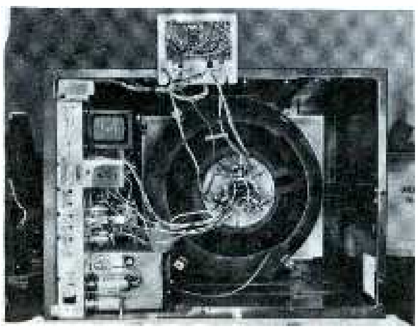
Two different physical layouts of the hand-wired chassis are used to accommodate it to large and small cabinets. The 16F25 and -6 series use the smaller of the two versions in the 17" and 19" sets. Chassis 16F24Q, using the largest remote system, an AM-FM tuner, and a stereo amplifier, omits the audio output stage from the TV chassis; this is the greatest deviation of any set from the standardized circuit pattern.

The '61 chassis are designated 16E23, 16E24Q, 16F21, 16F23, 16F24Q, 16F25, and 16F28. Additional suffixes of U, Q, and T indicate UHF, remote control, or timer options. Three stages of video IF, a crystal-diode video detector, and a 6EB8 or 6GN8 video output tube constitute the video-signal chain. The audio circuits retain the 6BN6 detector which has been used for a number of years. There are considerable variations in the tube used as a low-voltage rectifier; 5U4's, 5V3's, and recently-introduced 3DG4's find their way into various chassis. A 6BU8 serves in the keyed AGC and sync separator circuits, with no assistance from any sync-amplifier or phase-inverter stages. In the sweep circuits, vertical deflection is obtained from a 6EM7 or 6EA7 dual triode in a combined multivibrator and output circuit, while the horizontal section uses the modified "Gruen circuit" (sine-wave oscillator, reactance tube, and phase detector) carried over from last year's line.

Color

The 1961 color sets show signs of progress in the process of evolution. No major, industry-shaking breakthroughs have occurred; however, there's no doubt that the '61 lines carrying color receivers are offering the best units yet made available. At present, information is available on only the Admiral, Packard-Bell, and RCA Victor models; but Olympic has announced a color set that should be available soon.

Minor variations in numerous circuits, introduction of new tube types to achieve greater stability and reliability in already-existing circuitry, and new approaches to old problems are to be found in all chassis. Higher-gain tubes, revised AGC and noise-limiting circuitry, replacement of potentiometer-type focus circuits by variable-inductance circuits, and convergence-circuit variations are the predominant areas of redesign in the different chassis. Because of the complexity of color circuits, space does not permit a detailed explanation of all circuit changes at this time; however, these will be further explored in a later coverage.



DOLLAR & SENSE *Servicing*

Gift Time. We begin to get that "Christmas is around the corner" feeling about the time we're on our final helping of Thanksgiving turkey. In the midst of preparing for the Holiday mood, we turn our thoughts toward providing something special for our own customers. However, promotion plans for the Christmas season should be finalized long before Thanksgiving . . . if they are to pay off.

What part of your advertising budget in this season will be used for gifts? Who'll get them, and how will they be distributed? Think about your proposed gift; will it fill a need for your customers in their homes? Will it stay in sight and be used? You want your "morsel of remembrance" working for you as long as possible.

Don't forget the kids. A little gift, such as a toy glider or a package of balloons, will give you more word-of-mouth advertising than you'd think. It's amazing, but kids don't forget such favors—and they won't let their parents forget, either!

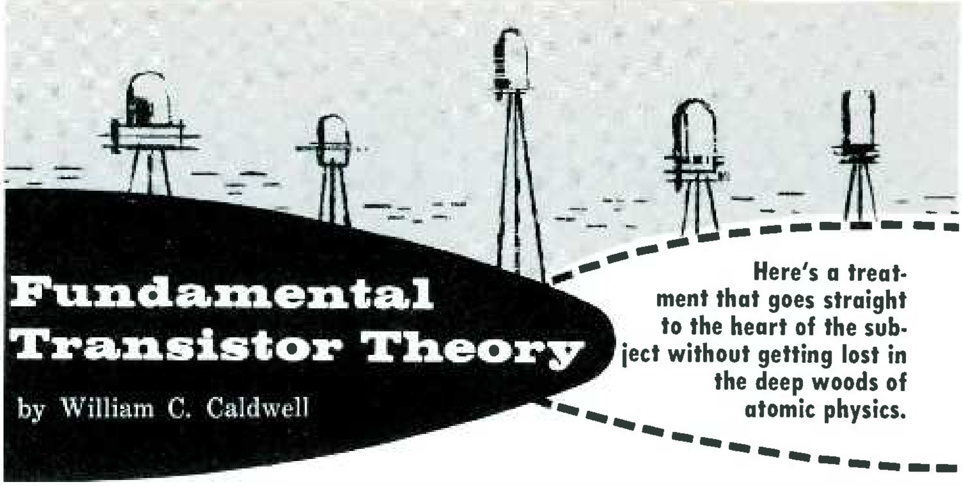
To show what can be done in the way of Christmas promotions, William Dufer, Jr., of Binghamton, N. Y., has written to tell us what several shops in his area are planning for the holiday season. He reports for instance, that Colonial TV of Johnson City will equip its home-call men with comic books and bags of crunchy candy to present to the small fry. Personalized greeting cards, carrying a photo of the crew and signed by every man, will also be sent to all customers. Tucked inside each card will be a $1 credit memo that can be applied to the first 1961 transaction reaching a minimum of $7.50.

Haloway-Cooper of Binghamton will make a personal telephone call to every customer, wishing him a happy holiday season and asking if his set is performing well. In addition, newspaper ads will offer *Christmas Radio-TV Service Bonds* in $10 to $50 denominations at a 10% discount, stressing their practicality as gifts for friends and neighbors, and especially for senior citizens who depend greatly upon radio and TV for entertainment.

Ang's TV Shop of Endicott will promote service by advertising a "pre-Christmas physical" for radio or TV sets, to keep them in top shape during the peak of the winter season. This shop's ads in local papers will offer a free Christmas tree with every new picture tube sold between the 5th and 20th of December.

Lange's TV in Vestal will install a gift-wrapping bar presided over by a group of housewives working four-hour shifts. The public will be invited to come in and have gifts wrapped for a token charge of four for a quarter—just about enough to cover the cost of the materials. It's hoped that many who come in to have their gifts wrapped will watch the bench men at work, will be favorably impressed, and will call on Lange's whenever they need service in the future.

This, then, is a sample of the Christmas plans already worked out by forward-thinking radio-TV servicemen. Within a single trading area, we find a variety of ways and means to reach one common goal—the garnering of both business and good will.



Fundamental Transistor Theory

by William C. Caldwell

Here's a treatment that goes straight to the heart of the subject without getting lost in the deep woods of atomic physics.

The simple diode, which has long been used to detect or rectify signals,* is the backbone of the transistor. A short review on how diodes work will help in understanding transistors.

A typical modern diode may be of germanium, silicon, or a similar material. These materials, in pure crystalline form, make extremely good insulators; if no other materials were added, the diode would be unable to pass any current, and would therefore be useless. However, the diode is actually divided into two sections (*di* meaning two), and a certain amount of "impurity" is added to each section. The impurity is simply a different type of material which supplies current carriers (Fig. 1) of either negative or positive polarity, depending on the material added in the manufacturing process. One type of impurity will produce N-type carriers, which are negative; and another impurity will provide P-type carriers, which are positive.

The presence of these free current carriers allows the diode to become a fairly good conductor under the conditions shown in Fig. 2. When a battery is connected as shown, the junction between the N and P sections is literally flooded with current carriers. This means the resistance of the diode to current flow is very low. The reason the diode allows current to pass is that there are plenty of free current carriers at the junction of the two diode sections.

To more clearly understand the principle of conduction through a diode, refer to Fig. 2 again. The negative battery terminal is connected to the N section of the diode, which contains free, movable electrons. Since like polarities repel each other, the negative field of the battery pushes the electrons toward the junction. Likewise, the positive pole of the battery repels the positive carriers toward the junction. It takes only a small voltage to give the charged carriers sufficient energy to cross the junction, and once they start moving, a constant exchange takes place. As negative carriers move into the P region, positive carriers cross into the N region (a fact which will become important later on). For the moment, however, the main thing to remember is that current carriers move through the diode and back into the battery. An ammeter placed in the circuit, as in Fig. 2, will indicate current is flowing.

The Nonconducting Diode

But let's suppose the same diode is connected to the same battery, except that the polarity is reversed as shown in Fig. 3. The negative electrons in the N section are now attracted by the charge at the positive terminal of the battery, and the positive current carriers in the P region are attracted by the charge

Editor's Note: Material in this article has been excerpted from the new Howard W. Sams book, *Practical Transistor Servicing*, by William C. Caldwell.

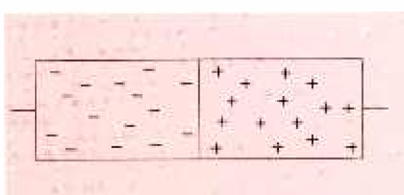


Fig. 1. Adding impurities to crystal material produces charged carriers.

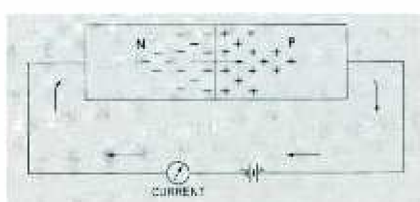
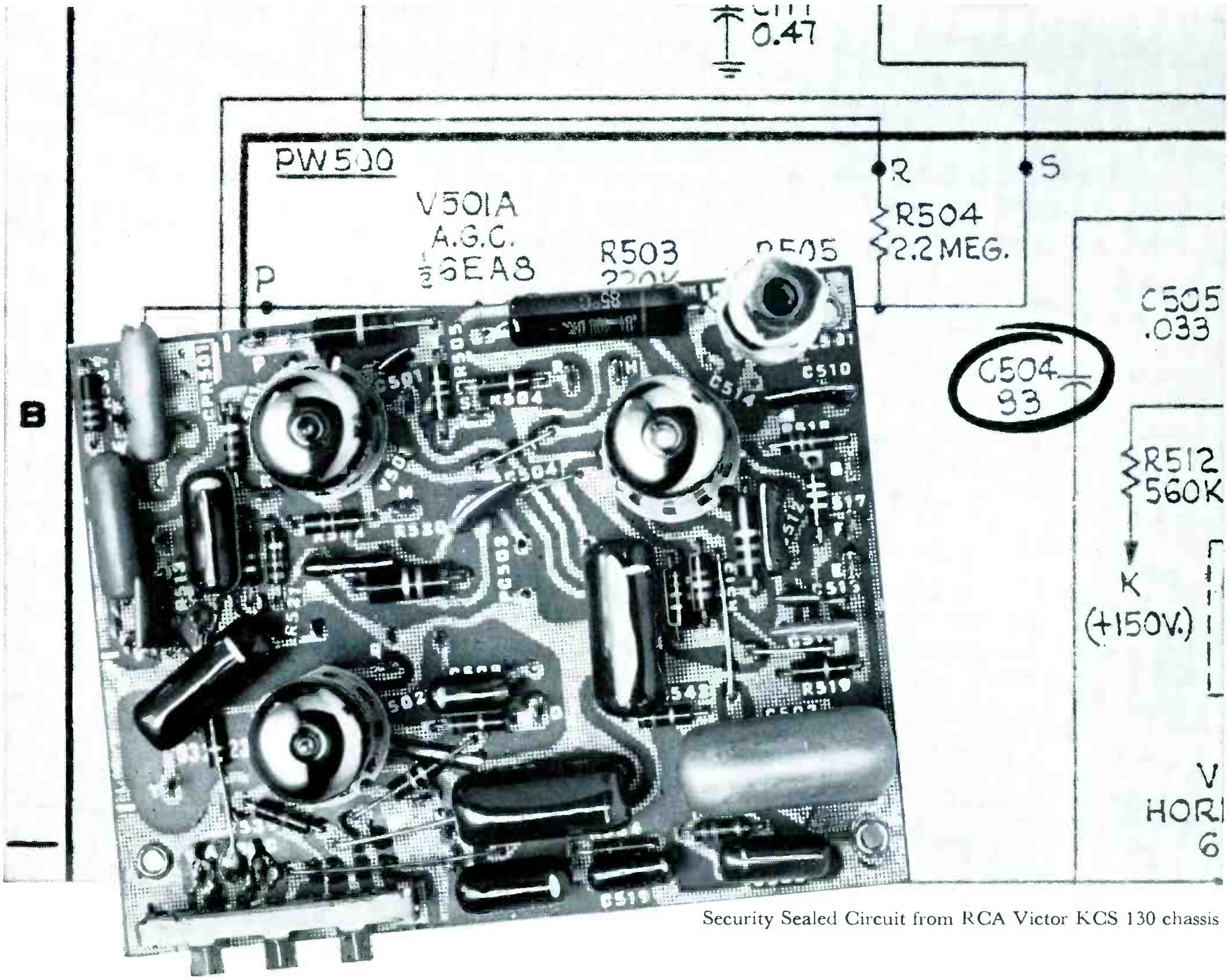


Fig. 2. Diode current will flow when battery voltage has proper polarity.



Security Sealed Circuit from RCA Victor KCS 130 chassis

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(Average time—10 seconds)

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With this all-important fact in mind, take a good look at the RCA Security Sealed Circuit in the picture above. All components are plainly marked. So are meter and scope take-off points and signal injection points. RCA Security Sealed Circuits take the *guesswork* out of servicing. That's for sure!

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Next time a customer asks, explain that printed circuitry is the mark of modern, dependable, easy-to-service home entertainment equipment—such as RCA Victor!

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at the negative terminal. The result is that both varieties of current carriers in the diode are pulled *away* from the junction, instead of toward it. This leaves no free carriers in the center of the diode, so this area again becomes an insulator, just as it was before the N- and P-forming materials were added to the pure crystal. The battery current is now blocked, and current flow ceases. Even if the battery voltage is increased, practically no current will flow. We say "practically" because a very minute "leakage" current (due to heat or moisture) does exist.

Ohmmeter Causes Diode Action

When an ohmmeter is placed across a diode, the resistance shown will be low or very high, depending on which way the leads are connected. The reason is that the ohmmeter is really just a milliammeter connected in series with a battery. (See Fig. 4.)

The negative lead of the ohmmeter in Fig. 4A is connected to the N side, and the positive lead to the P side, of the diode. This forces N and P current carriers across the junction, creating a low internal resistance. Current from the ohmmeter battery can now flow through the circuit, and the meter indicates a fairly low resistance (usually under 100 ohms). This reading is

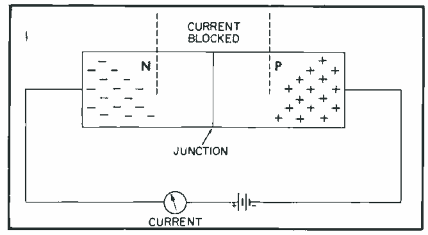


Fig. 3. Reversing battery connections will block current through the diode.

actually a result of the current flow through the conducting diode and the meter, but the meter face is marked in ohms. In other words, a lower ohms reading indicates a greater current flow through the meter.

Now examine the circuit in Fig. 4B. The only difference between it and the one in Fig. 4A is that the ohmmeter has been turned so the positive lead is connected to the N side of the diode, and the negative lead to the P side. The polarity of the internal battery is such that the free current carriers are attracted away from the center of the diode. This creates an insulated area in the diode, making it void of all current carriers, both positive and negative. Battery current is now blocked, so nothing flows through the meter. The ohmmeter reading is thus very high; it theoretically should read infinite resistance, but there is always a very slight leakage current which causes the meter pointer to deflect to some degree.

Having now proved that diode resistance can be high or low, depending on the polarity of the voltage connected to it, let's see what this means as far as a transistor is concerned.

The NPN Transistor

A curious and interesting effect occurs when three instead of two diode sections are placed together. Fig. 5A shows a P-type section, containing free positive current carriers, positioned between two N-type sections. Actually, two diodes have been formed, but diodes 1 and 2 both use a common P section in the middle. The schematic symbol for this arrangement is shown in Fig. 5B.

The first question that arises is, "What happens when a battery is connected across this structure?" Fig. 6A shows the battery connected in one direction, and Fig. 6B shows it connected in the other direction. In both examples, one of the diodes is biased in the high-resistance direction, causing free current carriers to be pulled away from the junction and leaving a blank area which blocks the flow of current. The reason is that the positive pole of the battery is always connected to one of the N sections, attracting negative carriers toward the outside edge and away from the junction.

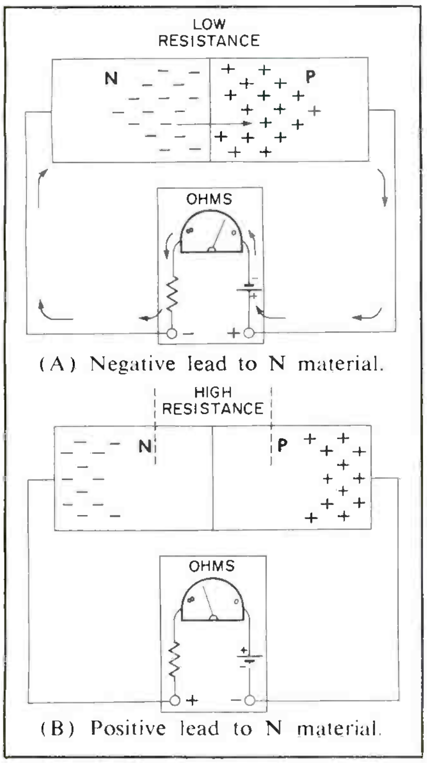


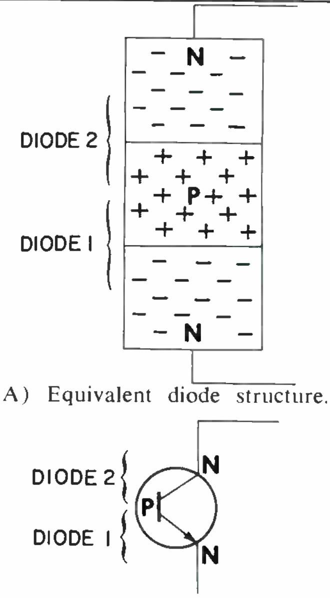
Fig. 4. Action of carriers when an ohmmeter is connected across the diode.

If the battery and meter shown in Fig. 6 were both part of an ohmmeter, a similar action would take place. The current through the circuit would be quite small and the resistance would be fairly high. This reading is called the *leakage resistance*.

The battery voltage in Fig. 6 can be increased to several volts, and still very little current will flow. With increased battery voltage, however, there is a good source of current — but the blocked area must be unblocked before carriers can cross the junction. The simple method used to unblock the insulated area is the secret of transistor action.

Adding "Forward" Bias

The easiest way to make current flow through an area where there are no free current carriers is to send some current carriers into the area. This is done very simply in Fig. 7. A small voltage is connected across diode 1 only. The battery is connected so the polarity is in the forward, or low-resistance, direc-



(A) Equivalent diode structure.

(B) Schematic symbol.

Fig. 5. Inside an NPN transistor.

tion (negative pole connected to the N material, and positive pole to the P material). This causes negative carriers to be pushed upward and into the P area. Most of these carriers will travel on through the narrow P area and enter the formerly blocked area of diode 2. Once the carriers have filled the upper N area, the larger battery keeps them moving into the output circuit, as indicated by meter M2 in Fig. 7A. The electrons continue to flow through the larger battery and back into the bottom N region, their point of origin.

A very small current will also flow in the input circuit (see meter M1), but it is much less than the M2 current because the input voltage is less. Thus, introduction of a small current has caused a much larger current to flow — which can be termed *current gain*. In Fig. 7B, the same circuit is redrawn to show the use of a transistor symbol. There are several reasons why this NPN transistor has gain when used in the basic circuit just shown:

1. The P area is made much narrower than the N areas, allowing negative carriers to cross it easily once they are started.
2. The negative carriers are easily pushed out of the bottom N area because the small battery is connected across diode 1 in the forward, or low-resistance, direction — the direction which makes cur-

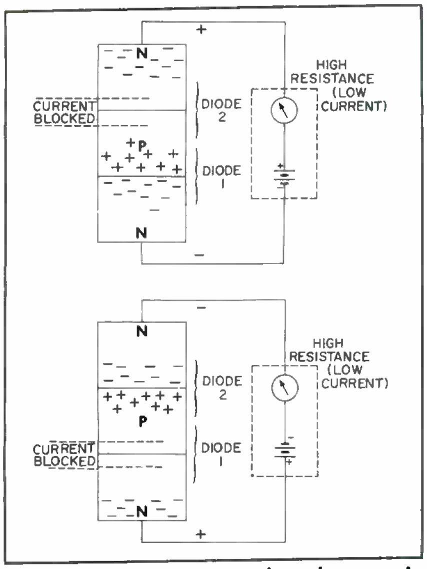


Fig. 6. Carrier action when battery is connected across an NPN structure.

rent flow easily.

3. The output battery, being larger than the input battery, is able to draw more current once the transistor has been unblocked by the smaller battery.

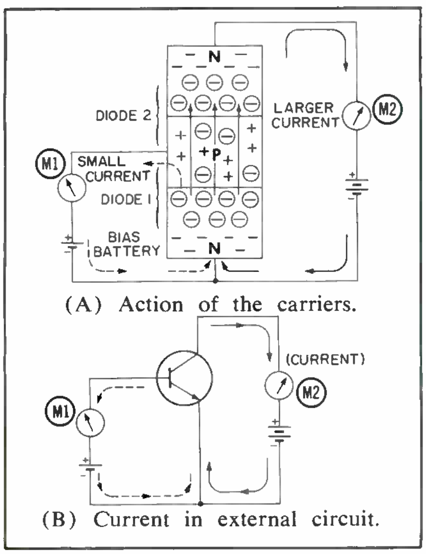
The PNP Transistor

The PNP transistor is similar to the NPN unit, except that the diode sections are arranged as shown in Fig. 8. An N section is sandwiched between two P sections, and the positive current carriers now become more important.

Again, regardless of in which direction the battery is connected, one of the diodes will be biased in the high-resistance direction—that is, the positive carriers will be attracted away from the center, and battery current will be blocked. However, if a small battery is connected across diode 1 in the forward direction, as shown in Fig. 9, that diode will start conducting slightly. (Notice that the positive battery terminal is connected to the P section and the negative terminal to the N section.) Even a small voltage in the forward direction will force positive current carriers out of the lower P section.

Most of the positive carriers pushed out of the lower P section travel upward and through the narrow N section. This means they will flood the upper P section and unblock the transistor. With current carriers available at all points in the transistor, the larger battery can now send its own current through the transistor and into the output circuit, as evidenced by meter M2.

As with the NPN transistor, the output current is larger than the input current because the voltage required in the input is extremely small. Since diode 1 is biased in the low-resistance direction, carriers are easily sent upward from the lower P area, even though the small battery may be only 0.1 or 0.2 volt. These carriers unblock diode 2 so



(A) Action of the carriers.

(B) Current in external circuit.

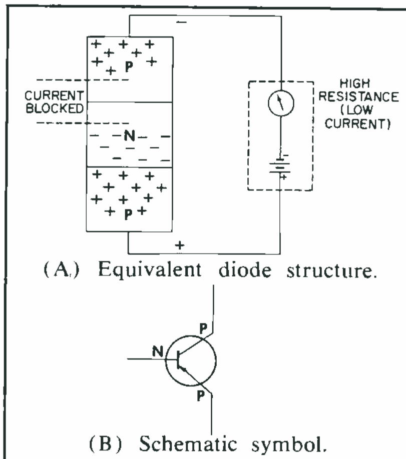
Fig. 7. Forward-biasing an NPN unit.

current from the larger battery can flow through.

Since the diode sections were reversed to make the PNP transistor, the batteries were also turned around when they were connected to the PNP transistor. This is the reason the arrows depicting input and output current are reversed in Fig. 9A, as compared with Fig. 7A; electrons always leave the negative pole of a battery and enter the positive pole. (The arrows show electron flow from the batteries and through the circuit *outside* the transistor.)

Identifying Transistor Elements

The bottom section of the input diode is called the *emitter* because it supplies the current carriers which permit transistor operation. It is often compared to the cathode of a tube, which produces the electrons for tube operation. The opposite end of the transistor, to which the output circuit is usually connected, is known as the *collector* because it collects the carriers which come out of the emitter; this simulates the plate of a tube. The middle section is known as the *base* because, in the manufacture of the transistor, it is usually made first, forming a base for the other two elements. The base in some ways acts like the grid in a vacuum tube, in that it controls the flow of current through the transistor.



(A) Equivalent diode structure.

(B) Schematic symbol.

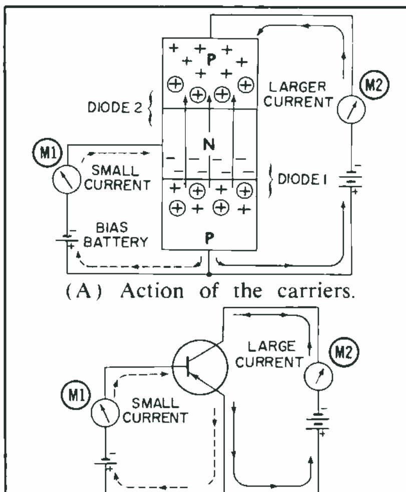
Fig. 8. Inside a PNP transistor.

In some schematics the emitter, base, and collector are labeled E, B, and C; in others, no letters are used. The emitter always has an arrow; the base is in the middle; and the collector is always at the end opposite the emitter, but contains no arrow.

When the emitter arrow points toward the base, the transistor is a PNP unit; when it points away from the base, it is an NPN unit.

Conclusion

All things considered, transistors are really much more simple than vacuum tubes. Once you understand the basic principles, as outlined in this article, transistor circuit servicing should be a snap. ▲



(A) Action of the carriers.

(B) Current in external circuit.

Fig. 9. Forward-biasing a PNP unit.

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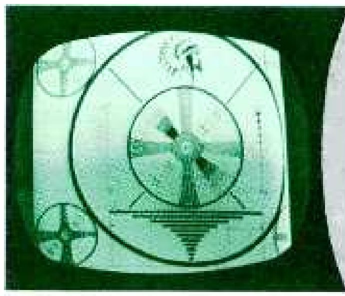


direct drive sweep troubles

The old direct-drive sweep circuit, as used in RCA's KCS47, -49, -68, and similar chassis series, still abounds in sufficient quantity to remind us that the "good old days" weren't always so good. The apparent simplicity of the circuit (when viewed schematically) is most deceiving when you're looking for troubles. The degradation of almost any component is enough to produce severe width problems. Interaction between the output and oscillator sections further complicates the situation. An understanding of the purpose of each component, as presented herein, will save you troubleshooting time on this circuit.

Initial Approach

Before attempting to do anything beyond replacing tubes, make sure the following conditions exist:

a. The oscillator is operating correctly. (If necessary, completely readjust this circuit before proceeding.)
b. The drive trimmer is correctly adjusted for maximum picture width without foldover.
c. The output tube voltages are correct (300 volts on screen, 6 to 8 volts on cathode, and –25 to –30 volts on control grid).
d. The width and linearity controls affect horizontal picture size.

If there are discrepancies in any of these areas, correct them before taking any other steps.

Refer to Fig. 1 and note the following circuit features:

1. The yoke and the primary section of the horizontal output transformer are in series from the boost B+ source to ground, via the output tube.
2. A 4.7-mmf capacitor parallels

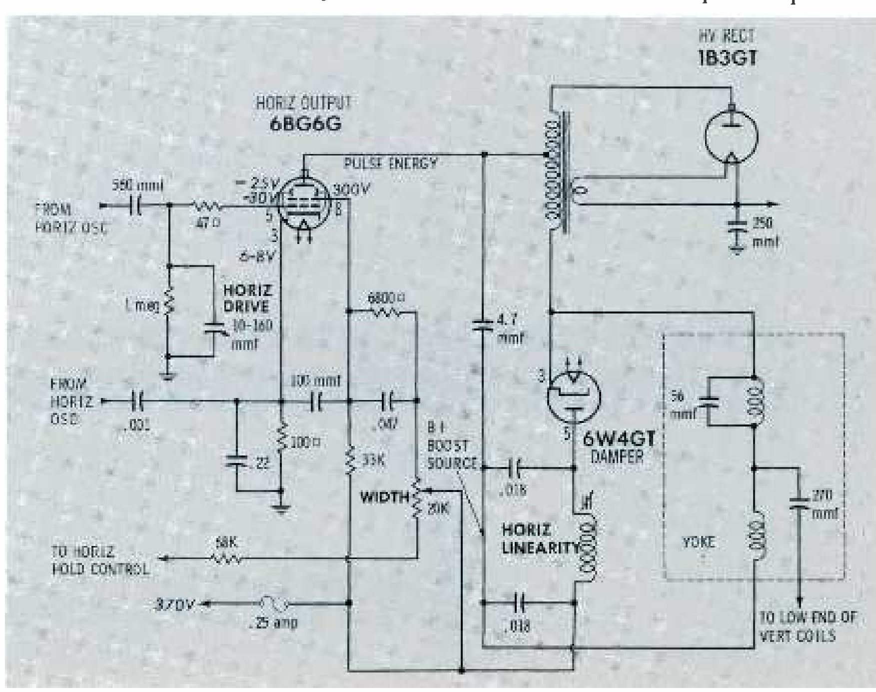
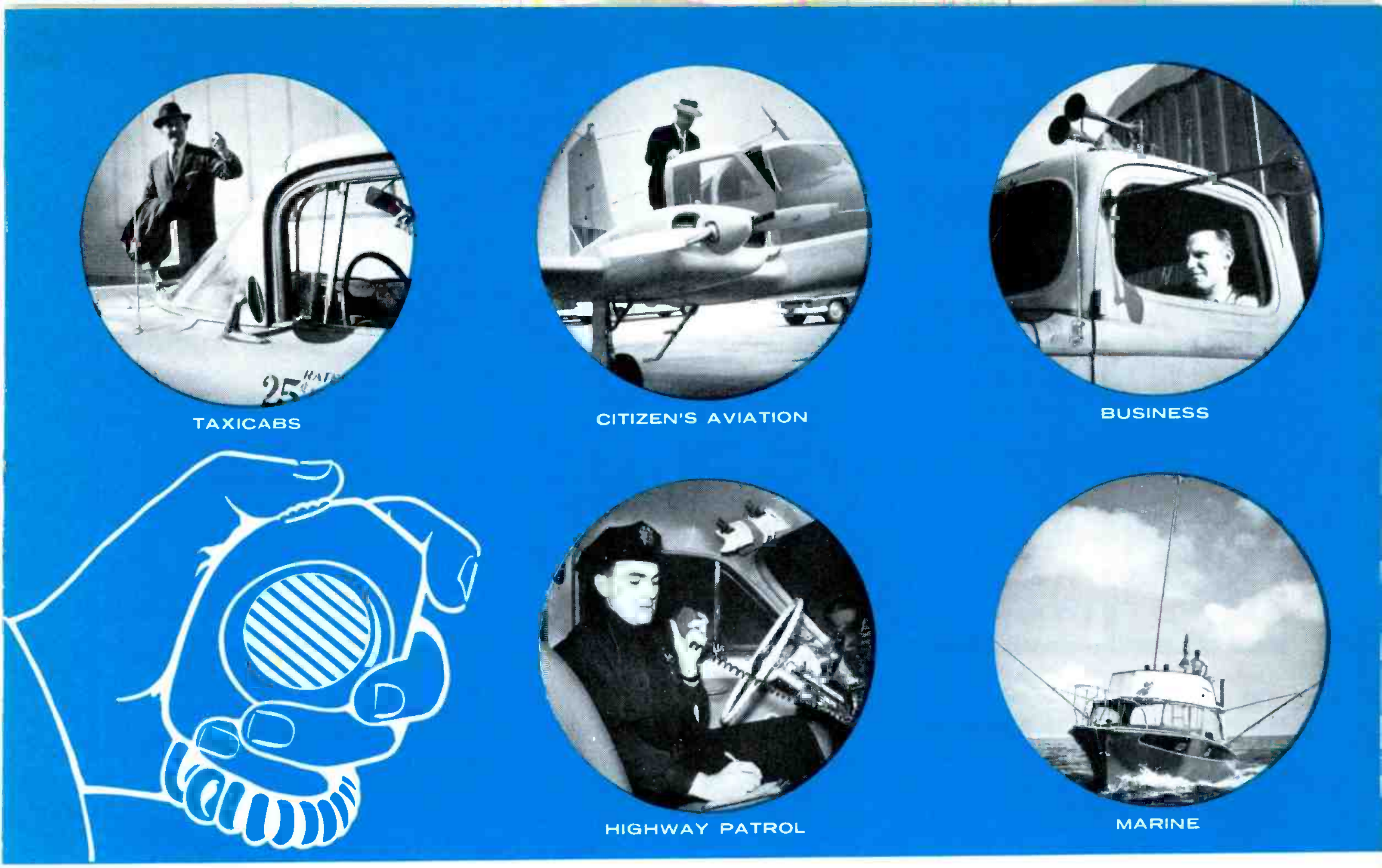


Fig. 1. Direct-drive sweep circuit used in several early RCA chassis.



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the yoke and transformer primary.

3. The linearity coil is in series with the yoke and the damper tube between boost and B+.
4. The width potentiometer varies the voltage to the screen of the output tube and to the horizontal hold control.
5. The screen grid is bypassed to B+ through an .047-mfd capacitor and a portion of the width control, and also to the cathode through 100 mmf.

With these factors in mind, let's analyze the circuit from a servicing standpoint. The width control affects over-all picture width, since screen potential directly controls output tube conduction. If the tube's plate current increases, a stronger current pulse is passed through the yoke, and more scanning energy is developed. A defect in the screen-grid circuit will result in a narrow picture with acceptable linearity.

The linearity coil, being in the damper circuit, affects the left side of the picture. A defect in the linearity-coil circuit, therefore, usually results in distortion of the left side of the raster. An inactive linearity coil (its adjustment produces no significant changes in the picture) is almost always caused by shorted turns in the coil itself. A loss of capacitance in either of the .018 capacitors can reduce the effect of the coil.

The 4.7-mmf capacitor from the transformer tap to the yoke is a special high-voltage unit which should be replaced only with an identical part. Loss of capacitance in this unit can result in a loss of width, generally in such a way that normal width with good linearity cannot be achieved.

The oscillator circuit is affected by any changes in its load—which, in part, includes the output stage. Adjusting the width control produces a change in load, but this effect is compensated since the voltage to the oscillator-control (AFC) tube is obtained from the width control. Thus, adjusting the width control automatically changes oscillator conditions slightly to make up for the change in load.

Adjusting the drive trimmer also changes the load on the oscillator, and often makes it necessary to readjust the horizontal frequency and waveform coils of the oscillator.

Since the screen grid is bypassed to B+ through part of the width control, a small amount of degeneration is built into the circuit. This is limited by the 100-mmf capacitor that bypasses the screen to the cathode. Slight blooming conditions that cannot be otherwise explained may be the result of a loss of capacitance in the 100-mmf component.

The yoke is a special unit which has low horizontal coil inductance (3 mh) and is subject to proportionately high pulse voltages. For this reason, extreme care must be exercised not to scrape or otherwise damage the insulation on the horizontal windings. Time, moisture, and the ravages of 3500-volt pulses will cause periodic failures in these yokes, but as a rule, they last for 6 to 8 years if ambient operating temperatures are reasonably low.

Any complete loss of sweep not due to a readily-detected open or short circuit condition (assuming correct functioning of the oscillator) may be caused by the boost capacitors (.018-mfd, 1000-volt units). If you find it necessary to replace the boost filters, be sure the new ones have at least a 1000-volt rating to prevent callbacks.

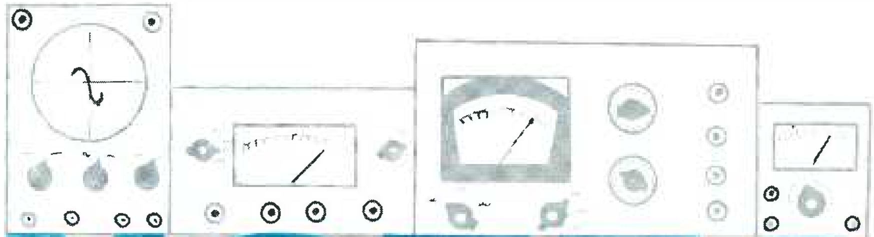
Portable CRT

Why is it that fate always picks your busiest day to make every set a shop job? And, wouldn't you know it, practically every chassis you pull has a cabinet-mounted CRT! You figure you can do without the picture tube, but to play it safe, you have to pull the yoke to operate the set on the bench.

If this is one of your problems, you'll be happy to hear about the *Tele-Check* now available from I.H. Mfg. Co., Inc.—a case-mounted 8″ CRT complete with yoke and test leads. (The Model CR-168S, shown here, also has a universal test speaker and audio output transformer.)

While it uses a 110° check tube and yoke, it's versatile enough to work with sets having deflection angles from 90° to 114°. Of course, you'll run the gamut of picture sizes and distortions as you connect the unit to first one TV and then another. However, as long as you're interested only in whether or not you get raster and picture, it fills the bill nicely.

The unit is ruggedly constructed and flexible in application, so it's a handy thing to have along on "no-raster" home calls. If the trouble centers in something other than a tube or fuse, it's a simple matter to substitute the *Tele-Check* for the set's CRT and yoke. This will tell you if the yoke or CRT might be the cause of your trouble—thus saving you from pulling the chassis and then finding you've left the culprit in the cabinet!



NOTES ON TEST EQUIPMENT

by *Les Deane*

Transistors Sound Off

The Parts & Accessories Div. of Motorola, Inc., Franklin Park, Ill. has recently introduced a new transistor tester. Pictured in Fig. 1, the instrument is completely self-powered and uses a built-in speaker as an indicator. It operates on a dynamic testing principle whereby an audible output quickly tells you whether a transistor is good or bad.

Specifications are:

1. *Power Requirements — two self-contained 6-volt batteries (not supplied).*
2. *Transistor Tests — detects shorts, opens, or excessive leakage and measures relative gain of either power or small-signal types of* PNP *and* NPN *transistors; test results determined by output of audio oscillator circuit.*
3. *Panel Features—*PNP-NPN *selector switch, relative gain control, and 4-element transistor test socket plus separate plug-in test leads provided.*
4. *Size and Weight — 3" x 5¼" x 4"; 1 lb., 6 ozs. less batteries.*

The instrument is housed in a small steel case with a metallic green finish. To install the necessary batteries, you merely remove six metal screws and separate the two "U" sections of the case. In addition to a standard transistor test socket, the front panel has three individual test jacks coded C, B, and E — corresponding to collector, base, and emitter. Test leads terminated with miniature alligator clips plug into these jacks and make it a simple matter to check transistors which cannot be plugged into the test socket.

To test a transistor, you simply flip the PNP-NPN switch to its proper position and, with the panel control fully counterclockwise, listen for an audio tone from the instrument's speaker. If a tone is clearly heard, the transistor is probably good—or at least is not shorted or open. To test for relative gain, the control is rotated slowly clockwise until a tone is no longer perceptible. The higher the setting reached, the higher the transistor's gain.

A leakage check is performed with

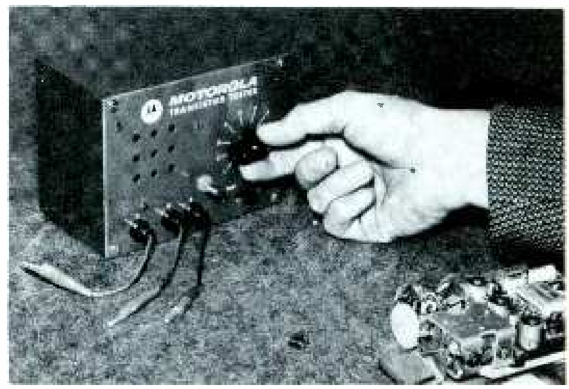


Fig. 1. Motorola's tester uses audio circuit for checking transistors.

the panel control in the maximum position that will still produce an audio indication. Position of the PNP-NPN switch is reversed for approximately ten seconds and then returned to normal. If you notice a change in pitch, or if a tone is no longer produced, the transistor is likely to have excessive leakage current.

I'm sure you'd like to know what makes the transistor under test "sound off," so let's take a look at the Motorola circuit in Fig. 2. The instrument evaluates the condition of a transistor by placing it in an audio oscillator stage. Variable control R1 permits manual adjustment of the oscillator feedback, and since the amount of feedback

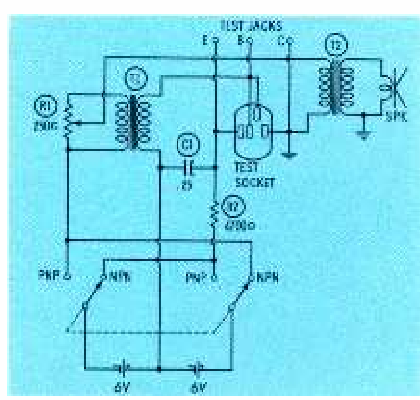


Fig. 2. Schematic of Motorola tester. Unit is powered by two 6-volt cells.

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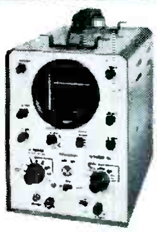

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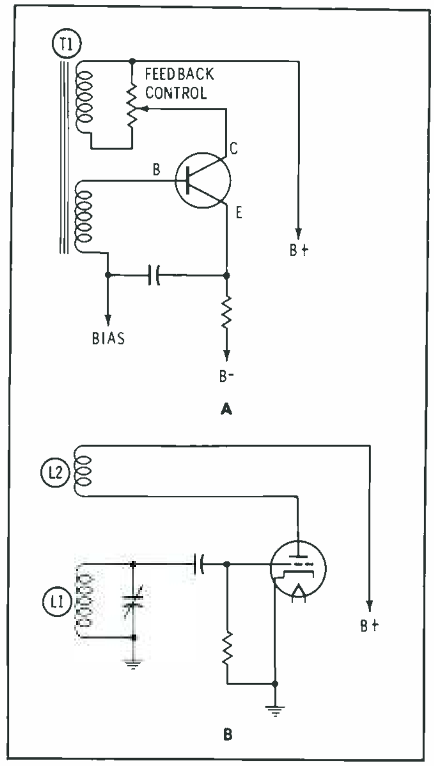


Fig. 3. Tester's basic oscillator circuit and comparable vacuum-tube stage.

necessary to sustain oscillation depends on the gain characteristic of the transistor, a relative indication is obtained by the control's setting. An output of the oscillator is sampled at T2 and reproduced by a 2" PM speaker.

A simplified schematic of the tester's oscillator circuit for an NPN transistor is shown in Fig. 3A. This common-emitter configuration might be compared to the more familiar oscillator stage of Fig. 3B. In the vacuum tube example, the amount of oscillator feedback is governed by the degree of inductive coupling between coils L1 and L2. This in turn depends on their physical proximity and the number of turns in each coil. The stage is tuned, of course, by adjustment of the variable capacitor in parallel with grid coil L1.

In the transistor circuit, feedback is made adjustable by a variable resistance that shunts the feedback winding of T1. Basically, both circuits of Fig. 3 are Armstrong oscillators; but in the untuned transistor stage, adjustment of the feedback control also causes the oscillator frequency to change. In a few cases where the feedback is reduced, the increase in frequency or pitch of the output tone may make it somewhat difficult to determine the setting at which oscillations cease. For example, I found that certain transistors may continue to produce oscillations, but at frequencies beyond normal hearing.

To check cutoff frequencies precisely, I monitored the tester's output on a scope; employing an audio generator as a reference, I used Lissajous patterns as a means of determining frequency. Cutoff frequencies for known good transistors I tested ranged from 5 to 20 kc. However, those of you unable to detect tones above 13 or 14 kc needn't be concerned; the indications obtained are relative, and as long as only one person's hearing range is involved, they are suitable for all practical purposes.

When I compared a few of the tester's gain indications with actual *beta* measurements, I came up with the following:

Known Beta	*Tester Setting*
20	8
38	8.5
60	9
100+	9.5

The feature that impressed me most about this unit was the simplicity of its test procedure. Even if you don't know whether the transistor to be tested is PNP or NPN, you won't damage either the transistor or the tester if you accidentally place the type switch in the wrong position. If you obtain no output on the first try, simply reverse the switch; an output should then be heard if the transistor is good. The switch position automatically identifies the class of transistor you are testing. The only thing you really have to know to operate the Motorola tester is the correct arrangement of element connections for different styles of transistors.

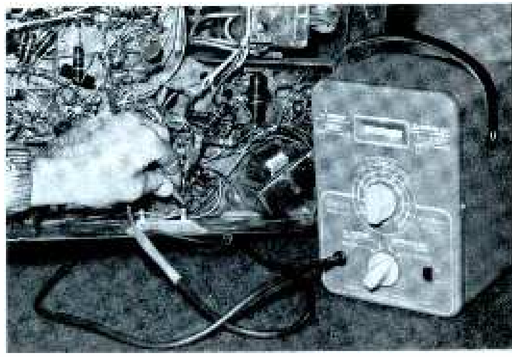


Fig. 4. In-circuit tester detects bad capacitors with low shunt resistance.

A "Wink" at Faulty Caps

The piece of equipment shown in Fig. 4 is manufactured by the PACO Electronics Div. of PACOTRONICS, Inc., Glendale, Long Island. Designed to speed radio and TV troubleshooting, the Model C-25 In-Circuit Capacitor Tester has a built-in eye that "winks" whenever it encounters a shorted or open capacitor. The instrument is available in either kit or factory-wired form.

Specifications are:

1. *Power Requirements — 105/125 volts, 60 cps; power consumption approximately 13 watts; transformer provides line isolation.*
2. *Shorts Test — detects shorted capacitors of all types "in-circuit"; positive indication obtained with shunt resistances as low as 10 ohms.*
3. *Open Test—detects open capacitors "in-circuit" for all values down to approximately 7 mmf; special oscillator test circuit provided.*
4. *Value Test — approximate value of electrolytics measured "in-circuit"; capacitances of from 2 to 400 mfd tested in two ranges; accuracy determined by circuit's shunt resistance.*
5. *Size and Weight—7½" x 5⅜" x 4¼", 6 lbs.*

Trying out a Model C-25 in the lab recently, I found it exceptionally useful in isolating troubles caused by defective capacitors—especially electrolytics. The instrument's most outstanding feature is that it permits you to check bypass, coupling, blocking, and filter capacitors without disconnecting them from the circuit, and with a relatively high degree of accuracy.

Reading over the test procedure in the PACO manual, I found the unit very simple to operate. After a brief warm-up period, you merely connect the clip leads of the shielded input cable across the suspected capacitor, place the function switch in the SHORT TEST position, and observe the tuning-eye indicator on the front panel. (By the way, the tuning indicator is one of the new rectangular-type eye tubes—an EM84.) If the capacitor is shorted, the eye will close. If the capacitor is not shorted, the eye will remain open—that is, provided the shunt or parallel resistance of the entire circuit is 10 ohms or above.

Incidentally, before making any of the in-circuit checks, you must remove power from the equipment and properly discharge the capacitor or capacitors to be tested. This protects the Model C-25 as well as yourself.

The block diagram of Fig. 5A illustrates the basic operation of the instrument during a shorts test. The 6.3 volts AC derived from the internal power supply develops a predetermined grid and plate potential on the 6C4 amplifier. The plate voltage of this stage, in turn, controls the potential on the input grid of the eye tube. Under normal conditions (with test leads either open or connected across a good capacitor), the tuning-eye remains open.

When a capacitor with a short of 10 ohms or less is connected across the test leads, the grid potential on the 6C4 will drop to zero. This causes the 6C4 current to decrease, and its plate voltage to rise. Since the plate circuit of the amplifier is connected to the input of the following stage, grid voltage on the eye tube increases, thus increasing its plate current and closing the eye. Experimenting with this test, I found that a capacitor with a short as high as 50 ohms will cause the eye to close partially. Therefore, whenever the eye starts to close in a circuit with fairly high shunt resistance, the capacitor may be leaky.

To check for an open condition in a capacitor, the test leads are again connected across the component in question, and the function switch is advanced to the OPEN TEST position. Provided the unit under test has a value of at least 7 mmf, the eye will remain open if the unit is good. If the capacitor is open, the eye will close.

The open test is illustrated in Fig. 5B. In this application, the 6C4 functions as a high-frequency oscillator. Its circuit employs an inductive feedback arrangement which takes into account the standing-wave properties of the input test cable. The cable leads effectively shunt the oscillator feedback coil, but when the ends of the cable are shorted (or connected across any good capacitor with a value not less than 7 mmf), feedback in the circuit is sufficient to sustain oscillations. Under these

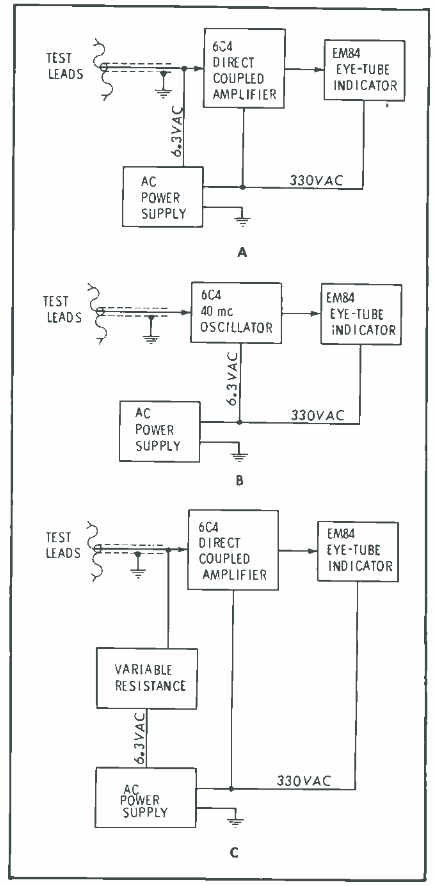


Fig. 5. Functional diagrams for the basic capacitor tests of Model C-25.

conditions, oscillator plate voltage holds the eye open.

When an open capacitor is connected across the end of the cable, the open line acts as a short across the feedback coils; this is because the length of the cable represents exactly one-quarter wave at the oscillator frequency of 40 mc. The resulting voltage-cancellation effect reduces feedback and, in turn, lowers oscillator grid voltage. As described in the shorts test, a drop in grid voltage and corresponding increase in plate voltage causes the eye to close.

The special test for electrolytics is intended only to reveal approximate in-circuit capacitance. The function switch is placed in either its third or last position, depending on the coded value of the capacitor tested. With the test leads

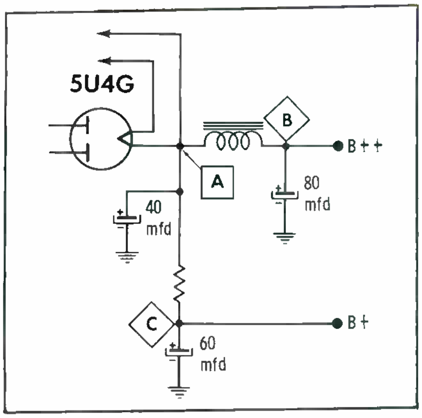


Fig. 6. Circuit used to check tester's ability to indicate capacitance values.

connected to the capacitor terminals, the capacitance dial on the front panel is adjusted for a minimum eye opening. The control dial is calibrated in mfd, and its setting indicates the in-circuit value of the electrolytic tested. Accuracy of these readings is determined mainly by the shunt resistance involved. Satisfactory shunt values for all capacitance ranges are listed in the instrument manual.

A block diagram of the electrolytic-measuring circuit is shown in Fig. 5C. Here, the 6C4 is again employed as a direct-coupled amplifier; its grid potential is determined by a divider network composed of a variable resistance and the capacitor under test. The 6.3 volts from the power supply is developed across this network to ground. Voltage appearing across the capacitor is applied to the grid of the 6C4; since the voltage increases as capacitance decreases, the variable resistance (capacitance dial) must be increased to maintain the grid at a level which closes the eye. The variable resistance, which is a dual potentiometer, is calibrated in capacitance. On the lower electrolytic scale (2-40 mfd), both resistive elements are employed; on the higher scale (40-400 mfd), one dual section is shorted out to compensate for the lower impedances offered by the capacitors in this range.

When I used this measuring technique on some actual equipment, I was truly amazed at the results. In the typical TV power supply circuit of Fig. 6, for example, I obtained a reading of 40 mfd at point A; 70 mfd at B; and slightly over 60 mfd at point C. Quick and easy measurements such as this can certainly help save a lot of time in pinpointing electrolytics which have drastically changed in value.

"Mighty Mite"

The "Mite" in this title refers to the compact, lightweight tube tester in the photograph of Fig. 7. The unit is "mighty" handy for the radio and TV serviceman, because it offers all of the basic tube tests with a simple and speedy setup procedure. The Model TC109, nicknamed the *Mighty Mite*, is one of the newest in the line of *time-saving* instruments produced by *SENCORE* of Addison, Ill. The tester features a removable chassis which can be permanently or temporarily mounted as desired.

Specifications are:

1. *Power Requirements — 110/120 volts, 60 cps; power consumption less than 5 watts in standby.*
2. *Tube Tests — checks over 1300 types, including 12-volt auto-radio tubes, for shorts, cathode emission, gas, grid emission, and grid leakage; results indicated on two* GOOD-?-BAD *scales and a relative numerical scale, plus a neon panel lamp; heater-to-cathode leakage sensitivity 50K ohms; questionable grid leakage represents somewhat less than 200 megohms.*
3. *CRT Test—picture tubes checked for shorts and emission; standard test socket and cable supplied.*
4. *Other Features—3½" D'Arsonval panel meter; six panel-mounted test sockets; 12-position selector provides heater potentials from 1 to 50 volts AC; two pin straighteners for miniature tubes; special enclosed inner chassis; stainless steel mirror in lid.*
5. *Size and Weight — case, 9½" x 8¾" x 3½", 8 lbs.; removable chassis only, 9" x 7½" x 2⅜", 4 lbs. (approx.).*

Fig. 7. SENCORE'S Model TC109 features a highly sensitive grid-leak test.

Experimenting with the *Mighty Mite* and employing it in some practical applications, I found it quite useful in catching tubes having hard-to-detect faults. The first thing I noticed when I fired up the tester was a special pilot lamp that illuminates the test sockets, controls, and meter. This feature is convenient when troubleshooting in dimly lit areas such as behind a TV set in a customer's home.

Aside from the function selector which enables you to choose the test desired, there are only four setup knobs on the front panel. These are labeled A, B, C, and D; each is positioned in accordance with the listings in the accompanying data charts. Since there are two octal and two miniature test sockets provided, the charts also designate the socket to be used for each tube.

Several accessory or auxiliary features of the Model TC109 are pointed out in Fig. 8. The tube data booklet, together with a test socket for picture tubes and a top cap lead, is housed in a small dual compartment at the top of the panel. The setup data is contained in a small ring-type binder to permit the addition of new pages. (SENCORE provides free listings of new tube types to purchasers of the TC109.)

Ease of operation and portability make the instrument ideal for rental to do-it-yourself fans. In addition, since the chassis and control panel is, in itself, a complete assembly (see Fig. 9), it can be used for custom installations in tube caddies, service bench panels, sales counters, etc.

When putting the Model TC109 to work in the lab, I tried to "trip up"

Fig. 8. A number of "extras" are found on the new *Mighty Mite* tube tester.

the tester by throwing a few curves at it. Using my prized collection of rejected tubes that have mostly "tough dog" defects, I proceeded with the tests given in the SENCORE instructions. Results are as follows:

Tube: 6BG6G with known good emission, no gas, but intermittent short.

TC109: Emission, grid leakage, and shorts tests all checked out good; however, when I tapped on the tube and rotated the element-selector switch, a momentary short was revealed by the neon indicator on position H-K. This immediately pointed to an intermittent heater-to-cathode short.

Tube: 50C5 which was known to be gassy.

TC109: Emission tested good, and no shorts were indicated. In the grid leakage test, however, the meter needle registered in the BAD area. This test apparently detects leakage resistance, grid emission, or gas.

Tube: 1B3GT known to be weak (low emission).

TC109: After the tube passed the shorts test, which incidentally may differ for various brands, I made sure the meter was calibrated and performed the emission test. The needle came to rest right on the line dividing the question mark area and the region labeled GOOD.

Tube: 6BZ7 with grid-to-cathode leakage in one triode section.

TC109: Emission checked okay, no shorts were indicated, and the grid leakage test produced a good reading—for the first few moments of the test. After checking leakage in the faulty section for about 30 seconds, the meter reading slowly crept into the BAD area.

Fig. 9. *Mighty Mite* chassis slips out after four screws have been removed.

Tube: 6AU6 known to develop excessive gas when sufficiently heated.

TC109: Initial tests revealed the tube to have good emission, no shorts, and also a satisfactory leakage reading. Since I knew the *Mighty Mite* could detect gas, I accelerated warm-up time by advancing the heater-selector switch one position. It would normally take this tube about four minutes to develop trouble in its original circuit. After only two minutes, however, I noted that the meter needle started to climb up the grid-leakage scale. Returning heater voltage to normal, I found that the reading reached almost full scale after 6 minutes of operation. This one is tough to spot, for even after the gas develops, the tube will still pass the emission and shorts tests of many instruments.

Tube: 35Z5 with one section of its filament open.

TC109: The test circuit failed to light the tube at all, immediately tagging it as bad. I have found that some testers, even elaborate types, will check this tube as good in an emission test. The only clue is that in a shorts test, a short will not be indicated on pin 2 as it should be. This can be easily overlooked, especially if emission is measured first.

To me, these experimental tests proved some points many of us fail to realize. It boils down to the fact that there's "tube checking" and there's "tube testing." When merely checking a tube, one may go through the mechanics of operating the instrument and then rely on immediate results without question.

When properly testing a tube, however, one should consider the trouble symptoms involved and how they might affect testing techniques. Most of us do this subconsciously. If we're out to find possible causes for an intermittent condition, a slow warm-up problem, or a trouble that could stem from excessive gas, we perform various tests accordingly. There's more to using a tube tester than meets the eye, and this is where the competent technician has it all over the do-it-yourselfer. ▲

Transistor Testers

(Continued from page 24)

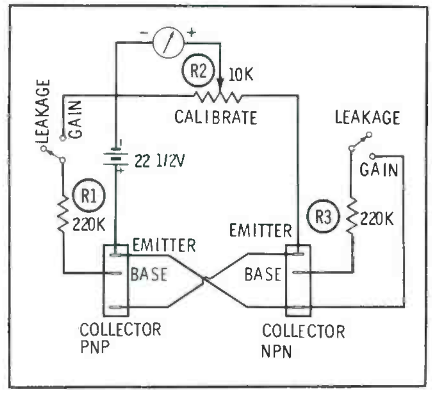


Fig. 4. Simple circuit gives relative readings of gain and leakage currents.

device will be revealed by an excessive flow of current.

The leakage current measured by the circuit of Fig. 2 is identified as ICEO. The first two subordinate letters indicate that the powering circuit is connected between collector and emitter, while the letter O means that the remaining element (in this case, the base) is open. The amount of current normally produced in the ICEO measurement is sufficient to actuate a milliammeter, which is convenient because it permits a relatively inexpensive movement to be used.

The second leakage test is the ICBO measurement, which involves use of the circuit in Fig. 3. The battery, meter, and current-limiting resistor are connected between base and collector, and the emitter is left open. Since the base-collector diode is reverse-biased, only a very small current should flow—considerably less than obtained in the ICEO measurement. To measure ICBO properly, a microammeter is required; because these are considerably more expensive than milliammeters, the more economical testers skip this measurement and perform only the ICEO test. This is generally acceptable, because the two quantities are related.

Gain Tests

If the transistor passes the leakage test, it is ready for the gain test. For this purpose, nearly all transistor testers utilize the beta test, in which a small current is introduced into the base circuit and the corresponding effect on the collector current is indicated. This gain test is preferred because most transistor applications use a common-emitter arrangement, with the incoming signal applied to the base, and the output signal obtained from the collector. While it is also possible to apply the incoming signal to the emitter and obtain the output signal at the collector, considerably higher current and power gains can be obtained with the first arrangement.

There are a variety of ways to perform the gain test. One of the simplest involves use of the circuit in Fig. 4. It performs two tests, leakage (ICEO) and gain. With a transistor in the appropriate socket, the LEAKAGE-GAIN slide switch is moved to the GAIN position, and the calibration control is rotated until the meter indicator is at full scale. The slide switch is then permitted to return to the LEAKAGE position, and the meter reading is noted. If the reading is less than full scale, it can be assumed that the transistor is satisfactory; the greater the difference between the LEAKAGE and GAIN reading, the better the transistor.

Let's examine what is being done here in more detail. When a transistor is inserted in the test socket and the LEAKAGE-GAIN switch is moved to the GAIN position, the calibration control arbitrarily sets this gain at full scale. This is done for all transistors, irrespective of what their true gain may be. When the circuit is returned to the LEAKAGE position, the base circuit of the transistor is opened and only the circuit between emitter and collector is complete. In other words, ICEO leakage current is being measured as a percentage of gain current. Note that this circuit does not directly measure beta, but indicates the difference between beta and leakage.

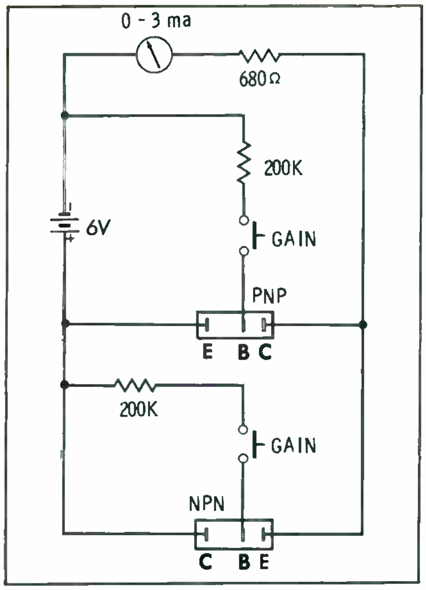


Fig. 5. Approximate value of beta can be computed from the meter reading.

A similar approach with a slight variation is employed in the circuit of Fig. 5. Separate push buttons are used for NPN and PNP transistors. With a PNP unit in the proper socket, leakage is measured with the base open; a positive voltage is applied to the emitter and a negative voltage to the collector through a suitable meter and current-limiting resistor. This duplicates the hookup in Fig. 2, which measures ICEO. If the leakage current is within limits, as indicated on the leakage scale, then the gain button is depressed. This connects a 200K-ohm resistor between the negative terminal of the battery and the base, supplying approximately 30 ua to this element. If the transistor can provide any gain at all, a larger current should flow in the collector circuit and be indicated by the meter. If we provide ten divisions on the gain scale, and use a 3-ma movement, one division will be equivalent to 300 ua. If we divide this 300 ua by the 30 ua fed to the base, a gain figure of 10 is obtained.

While the actual beta value of the transistor under test may not be indicated directly, knowing how this circuit operates makes it possible to arrive at the approximate value of this characteristic. This, however, is up to the ingenuity of the instrument user. Most inexpensive testers provide only an approximate indication of the beta value, which usually narrows down to whether or not leakage is within acceptable limits and gain is obtainable.

Fig. 6 uses the same basic circuit for checking ICEO leakage current, but another approach is taken in obtaining the gain measurement. A 6-volt battery is connected between emitter and collector. (A panel switch reverses polarity according to the transistor type.) Potentiometer R1 is connected across the battery, its center arm going to the base through 47K-ohm resistor R2. R1 is calibrated from 0 to 100 on the control panel, and the instructions specify settings which provide a mid-scale meter reading for all common transistor types. Thus, for any given normal transistor, R1 is set so that 1.5 ma flows in the collector circuit, deflecting the needle to the midpoint on the scale. If a transistor brings the needle to rest within the middle third of the scale, its gain can be considered satisfactory. However, a reading below center indicates lower - than - normal gain, and a reading above the center line indicates higher-than-normal gain.

Any transistor falling below the middle third of the range should probably be replaced. Any transis-

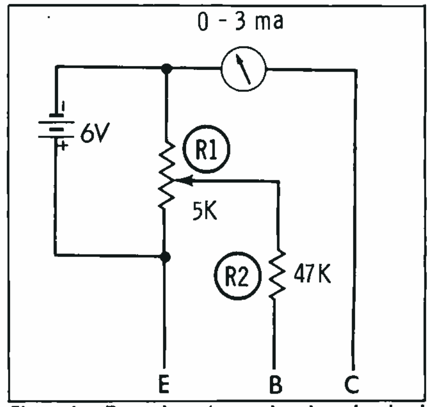


Fig. 6. Transistor's gain is checked against average value for same type.

tor which moves the needle above the middle third is obviously better than normal, *provided* its leakage is acceptable.

Notice that the test circuit of Fig. 6 does not actually indicate the beta value of the transistor under test. It does, however, provide a means of comparing the tested transistor's performance in accordance with predetermined average values. Thus, the information is somewhat more specific than that obtained with the other two circuits. In the circuit of Fig. 4, only a general indication of performance capabilities is determined. The circuit of Fig. 5 gives a somewhat closer indication of leakage and gain. In this case, if the needle moves only one division in the gain test, a beta of 10 is indicated. If the normal beta for the transistor is 50, obviously 10 is not very good. Using the circuit of Fig. 6, evaluation is possible without the necessity for mathematical computation.

In the January column, we will delve into several of the more complex transistor test circuits. In addition, a chart listing the currently available commercial testers will be included. ▲

Magnetic Amplifiers

(Continued from page 26)

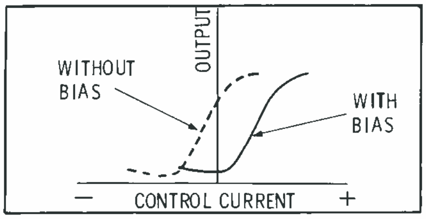


Fig. 4. To keep flux unidirectional, bias is added to AC control current.

the solid-line curve. Then, even when an AC control current is added to the bias, the direction of the flux does not change — only its magnitude. The effect is similar to that of vacuum-tube bias, which keeps the control grid negative even with an AC signal applied. The use of bias in magnetic amplifiers is called *flux reset*. If desired, the bias could be applied in the opposite direction to move the curve of Fig. 4 to the left instead of the right. Operation would be the same in either case, except that the control magnetization would be in the opposite direction.

Bias may be applied to the control circuit by means of a separate winding on the control leg of the core, or directly to the control coil along with the AC signal.

Feedback windings may also be wound on the control leg of the core to alter certain amplifier characteristics. The feedback signal is obtained from the output, just as in tube circuits. Positive or in-phase feedback causes the stage to be more sensitive, giving higher gain. However, in some cases, instability and nonlinearity may result, and the time lag of the unit is increased. (The latter occurs because feedback alters the L/R time constant which determines the degree of time lag.) Negative or out-of-phase feedback produces the opposite effects. Gain and time lag are both decreased, while stability and linearity are improved.

A Motor Control

Magnetic amplifiers are often used in the control of motors, as in the example illustrated by Fig. 5. This unit employs a push-pull type of circuit, designed so that the motor can be made to run in either direction. The two-phase motor is supplied with AC from the line through phase-shifting capacitors C1 and C2, and the resulting current through L12 is called the reference field. Operation of the motor depends on the *control field* produced by L13; if there is no current through this winding, the motor does not turn.

The control field should be about 90° out of phase with the reference field in order for rotation to occur. Motor speed is determined by the magnitude of the current through L13. (The current in L12 is constant). If the control field leads the reference, the rotation will be in a one direction; if it lags, rotation will be in the opposite direction.

The DC control voltage is applied to four series-connected control coils, L1, L2, L3, and L4. Two of these coils are used in each magnetic amplifier section, as compared to only one in the circuit of Fig. 1. Each control coil is coupled to a load coil, and four rectifiers are connected in the load circuits. The actual load in this arrangement is L13, the control field of the AC motor.

To circuit-trace the load circuit, we can assume the polarities shown across L9 and L10, since they serve as AC sources for the load circuit. Current travels from the negative end of L9, through the control field L13, diode M1, and coil L5, back to the positive end of L9. For the other circuit the current path is from the negative end of L10, in the opposite direction through L13, and then through M4 and L8 back to L10. For the next alternation L6, M2, L7, and M3 are conductive, but two currents still oppose each other in L13. As long as there is no DC control input, the load currents are equal and opposite, so there is no rotation of the rotor.

With a DC input of the polarity shown in Fig. 5, the control-current path through coils L1 and L4 is in the direction indicated by the arrows. The load coil currents are the same as previously given, but the values change. As shown, the arrows of L1 and L5 are in the same direction, so the magnetic fields of these coils reinforce each other and drive the core into saturation. This causes the L5 current to increase. In L4 and L8 the arrows are opposite, indicating a tendency to desaturate the core and decrease the current through L8. This means that the load current for the left circuit is greater than that of the right circuit, with the amount of difference determined by the magnitude of the DC control current. On the succeeding alternation L6 and L7 become conductive, with the L6 current the larger of the two.

If the DC control-input polarity were reversed, the motor would

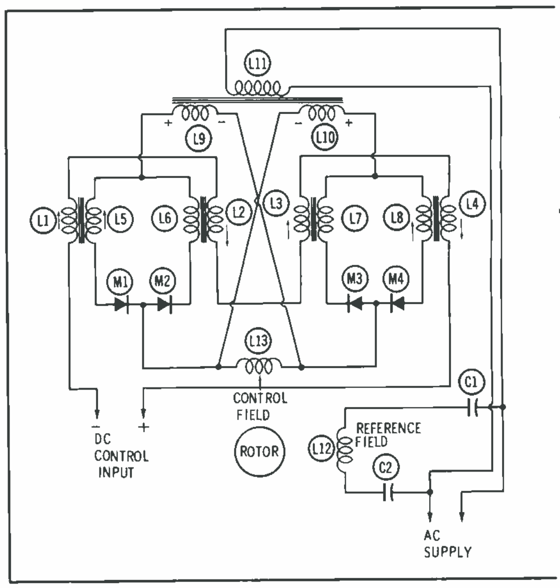


Fig. 5. Four-section magnetic amplifier controls motor speed and direction.

rotate in the opposite direction because the L13 current would be changed in phase by 180°.

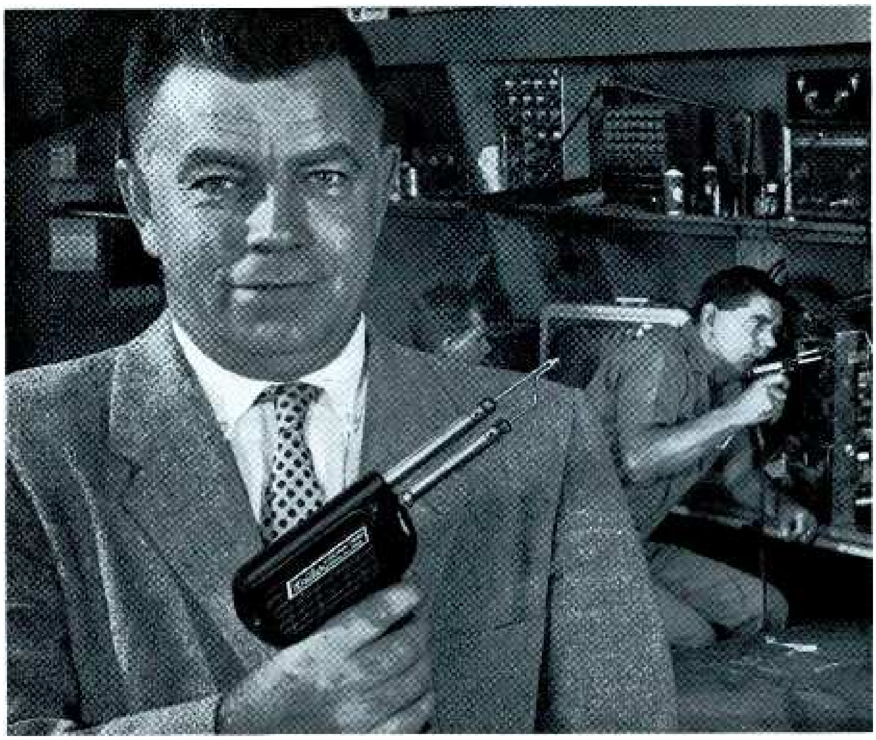
Temperature Control

Magnetic amplifiers can also be used for temperature control, as in the circuit of Fig. 6. Thermistor R1 and the heating element are both located in the oven whose temperature is to be controlled. A DC control input is used, and AC is used for the heating element—which in this case is the load. Two separate windings control the saturration level. The bias winding, in series with manual control R2 across the DC source, provides a means of presetting the temperature. The control winding is in series with the thermistor across the DC source, with the resistance of the thermistor determining the control current. These two windings are connected oppositely, so that they will have opposite effects on the saturation level.

The potential existing across the heating element determines the current through it, and therefore governs the heat produced. On each alternation of the AC input, the heating element is in series with one load winding and two diodes. The impedance of the load windings varies according to changes in the control circuit, thus regulating the potential across the heating element.

With very low current through the control winding, the saturation level is determined primarily by the bias-winding current. Saturation is then high, causing the load windings to have low reactance. Only a small portion of the AC is then dropped across the load windings; thus, a large voltage appears across the heating element, and the temperature increases.

As furnace temperature rises, the resistance of the thermistor decreases, allowing more current to flow through the control winding. This opposes the flux produced by the bias winding, thereby decreasing the saturation level. The impedance of the load windings then increases, making less voltage available across the heating elements. As the temperature begins to decrease, the opposite effects occur. The entire process keeps accurate



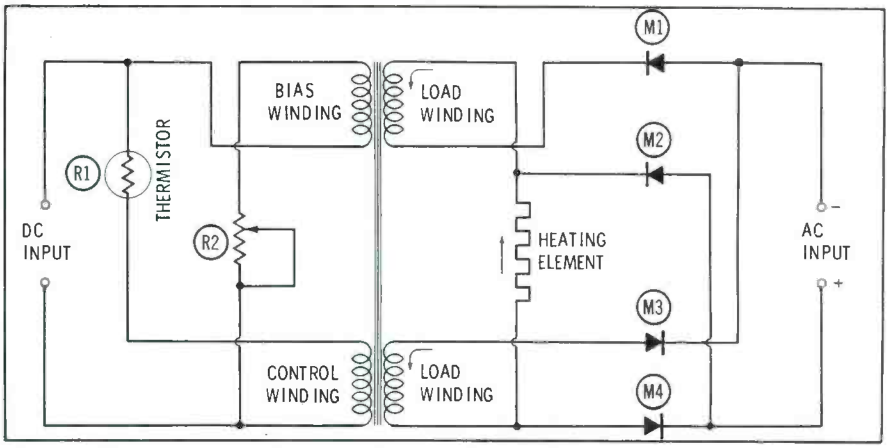


Fig. 6. Voltage across heating element is regulated to control temperature.

control over oven temperature.

Four diodes, used for self-saturation of the magnetic amplifier, are connected in the form of a bridge. With the AC polarity as indicated in Fig. 6, there is current through M3, the lower load winding, the heating element, and M2, back to the line. For the opposite alternation, there is current through M4, the heating element, the upper load winding, and M1, back to the other line terminal. In this way, current is always passed through the element in the same direction, and the load circuit is prevented from altering the core saturation level.

Servicing

The primary advantages of magnetic amplifiers are ruggedness and long life, and because of this the servicing and maintenance problems are minimized. Usually a preventive maintenance program or regular replacement procedure is not needed. The majority of the servicing problems encountered result from faults in some of the associated components such as relays or rectifiers, rather than in the magnetic amplifier. As to the inductors themselves, when operated safely within ratings, they are virtually indestructible. However, if the current rating is exceeded, one or more of the coils may open. Exceeding the voltage rating may produce shorts within the coil, or from coil to core, through breakdown of the insulation.

Operating at an incorrect frequency may also adversely affect operation. If the frequency of the AC load-circuit current is too high, the additional inductive reactance developed may decrease the load current so as to render the device inoperable. If the frequency is much lower than the rated value, excessive coil currents may damage the amplifier and possibly the load device as well. Changes of supply voltage cause changes of amplifier output, just as in other types of circuits. A decrease of frequency has the same effect as an increase of supply voltage. Decreased frequency also increases the L/R time delay because the theoretical minimum delay is the time of one half-cycle of the operating frequency.

In extreme cases, or over very long periods of time, it is possible that the characteristics of the core material may change. The saturation level and the shape of the hysteresis loop are two of these characteristics. However, in most cases we can dismiss this as being an unlikely trouble possibility. If it did occur, complete replacement of the reactor section would then be necessary.

The rectifiers used with the reactors are sometimes a source of trouble. One of the deterrents to earlier development of magnetic amplifiers was the lack of suitable rectifiers. Then, when improved versions were introduced (along with better core materials), high-quality magnetic amplifiers became feasible. Silicon rectifiers are quite often used because of the high front-to-back ratios of these units. Ordinary seleniums are usually not suitable; those used with magnetic amplifiers have front-to-back ratios better than 1000 to 1.

The saturable reactors in many magnetic amplifiers are potted, thus making the coils inaccessible. And while many circuit changes can be made theoretically, they cannot be made in a practical sense. ▲

THE TROUBLESHOOTER

answers your service problems

Impedance Ups and Downs

I've a question I can't seem to find the answer for. The situation is this: I'm using RG-59/U coax to feed a TV located across the room from a UHF converter. This way, I can use a short UHF transmission line to keep its losses at a minimum while still keeping the receiver in a better viewing location. I'm using matching transformers at the set and at the converter to match the input and output of my 72-ohm connecting cable; these are rated at 6 db gain from 72-ohm line to 300-ohm line. My question is: What gain or loss am I getting when the line goes from 300-ohm to 72-ohm?

EDWARD V. PELISSER
Hermiston, Ore.

The 6-db gain you mention is voltage gain, but at the same time you get a 6-db current loss. The power available (watts) remains the same except for line and transformer losses, which are only a few per cent. At the cable-input transformer, you get a current step-up and voltage step-down; but, once again, there is no significant loss in RF power. You can assume a total loss of 1.5 db in the transformers and 3.5 db per 100' of RG-59/U.

Your system is superior to twin-lead for one reason: The coax cable is immune to losses caused by its environment, whereas twin-lead is peculiarly prone to this kind of loss.

Trapezoid

An RCA Chassis KCS49A has a somewhat trapezoidal raster, with the left side compressed vertically. Substituting the yoke didn't fix it. What else could cause this symptom?

PAUL SHOFFLER
Springfield, Va.

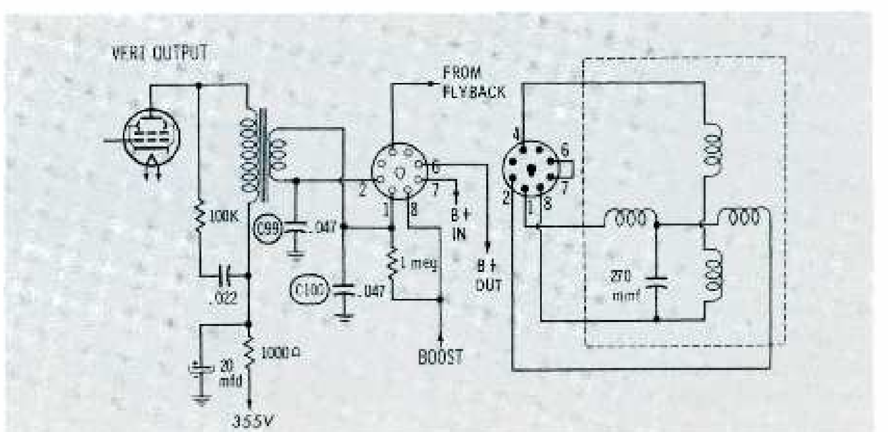
You were quite right in anticipating yoke trouble as the probable cause of this symptom. However, this chassis does incorporate a rather unusual vertical sweep circuit, and the most likely suspects in your case are the two capacitors C99 and C100 from the secondary of the vertical output transformer to ground. Substituting for these components should solve your problem.

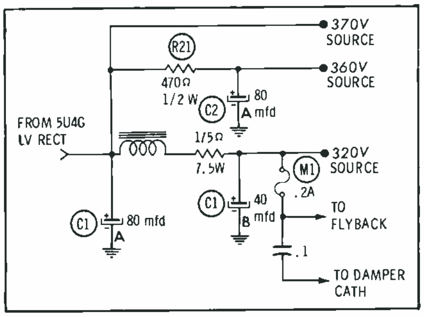
Did-It-Themselves

I just took in a Bendix Model 21K3 that has poor sound, a washed-out picture, poor focus, and a raster that won't fill out on the right side. The 470-ohm resistor R21 feeding the 360-volt source was burned and arcing to a nearby filter, and I thought I had an easy job until I checked C2A (the filter in the 360-volt line) and found it to be OK. I went ahead and tried replacing R21. With C2A disconnected, the new resistor didn't burn; but reconnecting the filter brought the resistor to a boil. I can stop the overheating by disconnecting the flyback circuit from B+; yet, when I checked the current through the sweep-circuit fuse M1, there was no hint of excessive current drain in this circuit. Help, please!

CHARLES E. KESTER
Clearfield, Pa.

Disconnecting the B+ line to the deflection circuits takes the load off a resistor in series with the 360-volt source? Let's have another look at the schematic! The sweep-circuit fuse M1 is shown connected to the 320-volt source; the 360-volt branch is supposed to feed only the video IF and tuner stages. Someone has evidently been there ahead of you, and has connected the lead from M1 to the wrong B+ source point. The heavy current drain of the sweep circuits through the 470-ohm, half-watt resistor is enough to





roast it, and incidentally to account for all your trouble symptoms. Trace out the B+ wiring and see if M1 hasn't been connected to C2A rather than C1B. Corrected wiring and another new resistor should solve this one for you.

Sympathetic Vibration

An Admiral radio-phono Model 6S12N sounds good on radio unless the volume and bass controls are turned up high. Then the whole case starts vibrating, and some way the oscillation becomes amplified. In phono position, the vibration is so bad that its interfering hum and buzz override even maximum volume.

Squeezing the case reduces vibration to almost nothing. Also, removing the chassis stops the condition completely. I'll sure appreciate any help you can give.

CURT BENTHAM
Willsboro, N. Y.

It seems the best answer is to eliminate the vibration. Make a close examination of the positioning of the radio chassis and the leads connected to it. Originally, a foam-rubber pad was positioned between the loudspeaker and the cabinet; be sure it isn't missing.

If you have not already done so, by all means try substituting for all the tubes. Heater-to-cathode leakage or a vibrating grid may be the source of your trouble. Make certain that none of the power leads are lying close to the audio output tube, or that an unshielded glass tube hasn't been "subbed" for any of the metal ones. Be sure the record-changer assembly is not screwed down tight to the chassis, but floating on the suspension springs provided to shock-mount it. Most important of all, make sure there is nothing loose on the case itself.

Electronic Organ Problem

I've just encountered a problem in servicing a Thomas organ, Model G, that's entirely new to me. When one of six or more keys in the upper two octaves is pressed, it continues to play until a note is struck in the lower half of the keyboard. Nothing I've tried so far has helped; anything you can suggest will be greatly appreciated.

EDWIN C. MYHRE
Mahtowa, Minn.

The condition you describe is known as "cipher." It's a problem peculiar to the Thomas keying system. In all probability, it can be corrected by bending the leaves of the key switches. Details are contained in Chapter 8 of the recently-released Howard W. Sams book, "Electronic Organ Handbook."

FM Radio Field

(Continued from page 29)

of the Standard Coil tuner (Fig. 4B) illustrates how AFC can be applied to the autodyne converter. Certain types of semiconductor diodes, when reverse-biased, will act as variable capacitors. (The necessary bias in the circuit of Fig. 4B is supplied by a positive voltage fed to the diode cathode.) A change in the potential applied across the diode terminals will cause a corresponding change in capacitance; thus, if the diode is connected in series with the oscillator tank, a variable AFC voltage can be employed to control the oscillator frequency.

Although popular, these one-tube tuners are not universally used in FM table radios. For example, Zenith's current models have a 6BJ6 pentode RF amplifier, and use the two separate sections of a 12AT7 as oscillator and mixer on both FM and AM. The Blonder-Tongue Model R-20 (FM only) uses a 12BA6 followed by a 12AT7.

Sarkes Tarzian's Model 723-502 table radio employs the pentode section of a 19CL8A as an RF stage and the triode section as an autodyne converter. Another out-of-the-ordinary feature of the latter receiver is the DC "stacking" of the converter and the first IF stage across the B+ supply (Fig. 5)—an arrangement often seen in the first and second video IF's of TV sets, but seldom in radios.

IF Circuits

The majority of other FM table radios use two 12BA6 pentodes as transformer-coupled IF amplifiers. In most AM-FM combination units, 455-kc IF transformers for the AM signal are connected in series with some of the 10.7-mc FM-IF transformers—thus allowing at least the second IF stage to function on both bands.

Unlike most high-fidelity FM tuners, small table radios do not ordinarily have extra IF stages designed specifically as limiters. However, the regular IF amplifiers of these receivers are generally fed a rather low plate voltage of 85 to 95 volts, which causes these stages to accomplish some limiting as well as amplification of the signal.

Furthermore, many of these units

have no AVC system at all; the IF stages are deliberately overloaded by strong input signals in order to clip off noise and keep the IF output-signal amplitude relatively constant.

Where AVC is provided in a combination AM-FM unit, the AVC line may be grounded in the FM position of the selector switch; or delayed AVC may be employed, as it is in TV tuners.

Detector

The ratio-detector circuit is predominant in small FM radios because it has better noise-limiting characteristics than the discriminator. However, certain receivers do use a discriminator circuit, preceded by a third IF or limiter stage. The quadrature-grid or "gated-beam" detector, now almost universally used in TV sound circuits, has not made much headway in the FM radio field—although one receiver, the above-mentioned Sarkes Tarzian model, does use a 12BN6 gated-beam detector.

Servicing

In FM table models, as in other radios, signal injection is a speedy and effective method of localizing trouble. However, the techniques are different from those generally used in AM receivers, although not necessarily more difficult to apply. It is not really necessary to use a frequency-modulated signal generator for testing, since a certain amount of AM can be passed through even a ratio detector—provided the input-signal level is low enough to avoid limiting action in the IF stages. Consequently, an AM signal generator covering the 10.7-

"Well, if you don't pay that bill by tomorrow, I'm afraid I'll have to take drastic measures . . . and rest assured, this is no idle threat. Of course, you realize there's nothing personal in this, Mother."

mc IF and the 88-108 mc RF band can be used to advantage.

In order to introduce signals of sufficiently low strength, it is often desirable *not* to couple the generator directly to the RF or IF circuit being tested. Because of the high frequencies and high-gain circuits involved, it is often possible to *radiate* adequate signals into the various stages for troubleshooting purposes. The easiest way of doing this does not even require removal of the chassis from the cabinet. Simply remove or retract the tube shields, tune the generator to 10.7 mc, set it up for a strong RF output, and place the RF output connector against the glass envelopes of the second IF, first IF, and converter tubes in succession. You should be able to hear an audio tone from the speaker, increasing in volume as you move back toward the converter. A little practice will enable you to set the generator controls for best results. Of course, you should use a shielded RF cable with a small tip in order to pinpoint the radiation to a small area. Connecting the generator directly to the various grid and plate leads is also possible if the signal level can be kept low enough to prevent overloading.

Simplified generator units such as pencil-type "injectors" are excellent for signal-tracing the audio section, and are usually adequate for checking continuity through the IF's; however, it is not usually possible to adjust their output accurately enough for stage gain to be checked.

Naturally, if you have a sweep generator that can be tuned to 10.7 mc, its FM output is ideal for obtaining maximum accuracy in signal-tracing.

Alignment

Touching up the RF-IF alignment is highly advisable after you have finished repairing an FM radio. Many customers will expect even the humble table model to perform like "hi-fi," so the unit should be given a chance to do its best. Balancing the detector will minimize distortion in the audio, and peaking the RF-IF slugs will help the radio to separate stations clearly and to reject noise.

The quick, simple alignment method using an unmodulated RF generator and a VTVM is ordinarily adequate for small FM radios. The detector - transformer secondary is adjusted for zero output from the detector at 10.7 mc, and all other adjustments are peaked for maximum voltage across the detector at the same frequency. Many, but not all, radios have double-tuned IF cans. Most of the one-tube tuners have trimmers in the oscillator and RF plate circuits, which may be adjusted as needed to improve sensitivity and tracking.

Of course, the sweep method of alignment gives more exact results, if you are properly set up for it. Certain types of troubles, such as a "lopsided" detector response or RF-IF regeneration, are much easier to handle with a sweep generator and scope.

Auto Radios and Converters

FM receiving equipment for automobiles is just now entering the volume-production stage. The customers for these units are "pioneers" who need expert technical advice on getting the most satisfaction out of their purchases. FM reception in cars is definitely practical, but we must understand *how* and *why* it is different from AM reception.

A special antenna is usually not needed, since the existing AM whip antenna can operate as a quarter-wave (resonant) device at 88-108 mc when retracted to a length of slightly over 30″.

Especially in heavy traffic or in built-up areas of cities, the auto FM installation receives a constantly changing pattern of signal reflections. While these would cause intolerable ghosts in TV, they do not produce any noticeable distortion of FM sound. Their chief effect is a rapid raising and lowering of RF signal strength. In metropolitan areas, this seldom creates a problem, since even the signal "nulls" resulting from out-of-phase wave reflections are usually strong enough to provide adequate output from the radio. The use of very effective limiter circuits serves to keep the audio level practically constant in spite of wide fluctuations in RF field strength.

As the car is driven away from the FM transmitter, a point is eventually reached where the signal during "nulls" is not strong enough to rise above the background noise level. "Picket-fencing," an effect in which the sound is broken up by signal fluctuations, then occurs. If you're familiar with the way a TV set behaves when the signal is disturbed by airplane flutter, you already know what "picket-fencing" is like. By the time this symptom appears, the car is out near the limits of the station's fringe area—so it's time to tune in another station if one is available. Unfortunately, the country isn't completely blanketed by FM radio signals, and sizable "white" areas will be found in less thickly populated regions. (Customers must be prepared to accept this fact.)

FM auto radios are highly sensitive, and make the most of available signals, but competition from electrical noise can become a serious problem in obtaining clear reception on weak stations. To add to the difficulty, much of the interference generated by the car's ignition system falls in the same frequency band as the FM radio signals; therefore, effective suppression of this noise is extremely important.

Conventional suppressor capacitors are often ineffective on FM because they have too much inductance. To get around this problem, special coaxial-type units are available for bypassing various points in the ignition system to ground. Besides the usual suppression measures, it is sometimes necessary in stubborn cases to bypass the battery lead of the ignition coil, and also to bond the ground terminal of the battery directly to the car body as well as to the engine block.

Typical Circuits

Several manufacturers have marketed *converters* which receive, amplify, and detect the FM radio signal. The recovered audio is then used to modulate an 800-kc oscillator which feeds its output to the antenna jack of the regular AM receiver. From this point, the signal is handled exactly like a conventional AM input. The only connections needed for attaching the converter are a 12-volt DC power lead and an antenna cable.

The Gonset converter, introduced a couple of years ago, is an example of this design. Another unit built along similar lines is the Granco

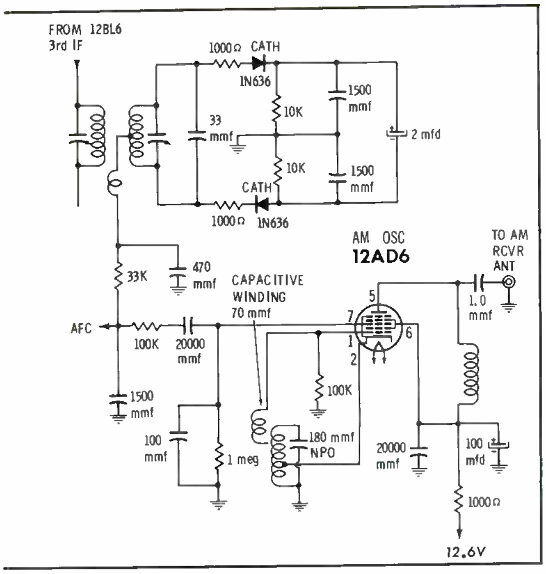


Fig. 6. Output of Granco FM Car Converter is an AM signal at 800 kc.

Model ARC-60, which has just reached the market. Its five tubes are of the "hybrid" type, with 12-volt plate supply. The tuner employs an ECC86 dual triode as a grounded-grid RF amplifier and autodyne converter. A semiconductor diode applies AFC to the converter section. (Note: The heaters of the ECC86 and the first IF tube —a Type QM956—are wired in series across the 12-volt supply.) Following the three-stage IF strip is a ratio detector using two 1N636 crystal diodes (Fig. 6), which feeds its output to a 12AD6 for conversion into an amplitude-modulated signal in the 800-kc range. Still another recently-introduced converter, the Automatic Model FM-61, has circuits basically similar to those in the Granco unit, but with a number of different features such as a 12AL5 discriminator.

The AM-FM switches used in converters generally include provisions for feed-through of AM signals to the main auto radio. When a converter is installed, the antenna trimmer on the AM radio should be readjusted to take into account the capacitance change due to the added switching circuitry and added cable length.

A different approach to auto FM reception is to provide a completely separate radio for this function. Motorola's FM-900 receiver shares only the antenna and speakers with an existing AM radio.

The tubes in the FM-900 do not receive plate voltage directly from the 12-volt supply; instead, a 108-volt DC plate potential is developed by a small, separate inverter/rectifier chassis which includes a 2N176 transistor as a power oscillator. Two more 2N176's are found in the push-pull audio output stage. The tuner uses the popular 12DT8 tube, with a semiconductor-diode AFC circuit that includes a neon-bulb voltage regulator to compensate for normal variations in supply voltage. Two 12AU6 IF stages, each with 100-volt plate voltage, are followed by two more 12AU6's operating as limiters with 54 and 70 volts on their respective plates. A 12AL5 ratio detector feeds its output to a two-stage audio driver circuit employing both halves of a 12AU7—which in turn feeds the transistorized output stage. Delayed AVC voltage is developed across an RC grid-leak network in the grid circuit of the first limiter, and is fed back to the RF amplifier. (A similar feature is also used in converter-type units to minimize the problem of signal fluctuations in auto installations.)

The speaker circuit of the FM-900 contains a built-in fader potentiometer, plus provisions for connecting both front and rear speakers. In addition, the circuit can be wired so that either or both of the speakers can be used on AM or FM at the flick of a switch—more evidence that convenience of operation has been one of the foremost aims in designing FM auto receivers. ▲

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5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: 75,046.

(Signed) MAL PARKS, JR., Bus. Mgr.
Sworn to and subscribed before me
this 28 day of September, 1960
(Seal) Marian F. Newman, Notary Public

PRODUCT report

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

Christmas-Tree Fuses (41V)

Ready for the holiday season, **Littelfuse** is offering a special fuse caddy containing replacements for the Type 8AG, 5-amp fuses used to protect strings of Christmas-tree lights. (The fuse holders are located in the AC line plug.) Dealer cost for the caddy (including 90 fuses, packaged in 18 metal boxes of 5 each) is $3.13; the fuses are priced for resale at 29c per box.

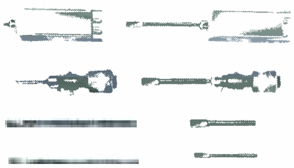
Reference Voltage Source (42V)

The eight outputs of the **Mallory** "Voltage Reference Battery" are 1.35, 2.70, 4.05, 5.40, 6.75, 8.10, 9.45, and 10.80 volts —all accurate within ±½% throughout the life of the unit (normally at least three years). This mercury battery is useful as a reference source in instrument calibration, voltage measurement, thermistor bridges, bias circuits, pH testing, and other applications requiring a stable low-voltage DC output. Price is $39.50, including carrying case.

Lamp-Magnifier Combination (43V)

The **Swing-O-Lite** "Inspector" features a 5"-diameter magnifying glass with 13" focus, surrounded by a 22-watt ring-type fluorescent lamp. Three different sizes, with free-swiveling arms reaching 24", 33", and 45", are respectively priced at $33, $34.50, and $36. Optional accessories include a convenience outlet in the base, a higher-power magnifying lens, and special colors besides standard grey, brown, or desert tan.

Repairs for Tuning Studs (44V)

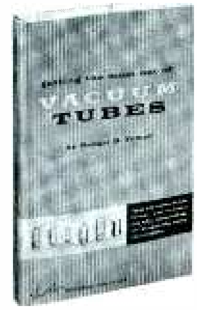


When you find the slotted tip broken off the threaded adjustment stud of a width or horizontal linearity coil, horizontal oscillator transformer, IF can, etc., attaching a **Superex** Model A.G.C. Repair Shaft will provide a convenient means of rotating the stud—thereby eliminating the need for replacing the coil. A repair shaft assortment, priced at 79c, contains both 4-40 and 6-32 sizes in six lengths.

Yoke Loosener (45V)

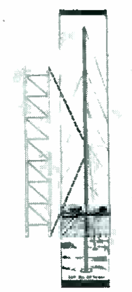
A spray application of **Walsco** "Ez-Off Frozen Yoke Remover" will free a deflection yoke which has become stuck to the neck of a TV picture tube. After the solvent has been allowed to penetrate the windings for a few minutes, the yoke can be slipped off with only slight pressure. This chemical (Catalog No. 215-03) is priced at 99c per aerosol spray can.

Book on Tube Usage (46V)



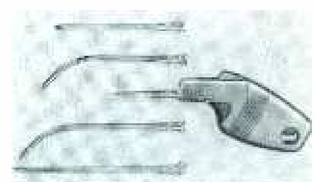
"Getting the Most Out of Vacuum Tubes"—a new book written by Bud Tomer and published by **Howard W. Sams & Co., Inc.**—describes and classifies various types of tube failures, points out possible causes, and suggests ways of lengthening tube life by proper application and maintenance. The author also explains why so many different tube types are in use, goes into detail about the capabilities and limitations of tube testers, and answers the question, "Can a tube's future life span be predicted?"

Heavy-Duty Communication Tower (47V)



The **Rohn** No. 55 communication antenna tower can be erected to a maximum height of 450', allowing for a wind load of 30 lbs. per sq. ft., and an antenna size of approximately 12 sq. ft. Sections 10' long, which fit together with sleeve joints, have an 18½" equilateral-triangle cross-section and electrically-welded "zig-zag" bracing. The entire section is hot-dipped galvanized after fabrication.

Solder Feeder (48V)



The "Kormat" wire-solder dispensing tool, manufactured by **International Electronic Research Corp.,** eliminates the acid and oil contamination of solder joints which sometimes occurs when solder is hand-held. The probe tip is fastened to the body of the dispenser with a bayonet connector to permit quick interchange of various straight and curved tips for different jobs. Enough solder to last many hours is wound on a spool inside the handle. The unit is priced at $5.95, complete with one standard-style tip.

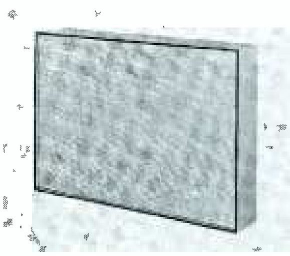
Sound Projector (49V)

Designed for use in churches, hotel lobbies, and other locations where an attractive appearance is important, the **Atlas** DC-5 "DeCor" sound projector has an exterior finish of brushed natural aluminum. The bell can be swiveled both horizontally and vertically. A 5" cone speaker provides low-level sound reinforcement with low-frequency response extending down to 120 cps. Suggested retail price is $22.00.

New Panel for Tube Testers (50V)

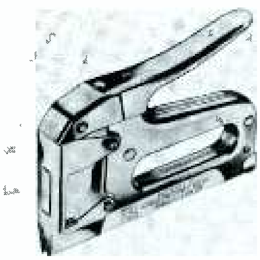
To enable **B & K** multiple-socket tube testers to check a greater number of tube types, the manufacturer has designed a Model 610 Test Panel which can be installed to provide expanded testing facilities for radio-TV tubes, hybrid auto-radio types, popular European designs, and most industrial tubes. The unit comes in three versions, for use with the Model 500, 550, and 650 tube testers, respectively. Net price is $49.95.

Wall-Mounted Speaker (51V)



3" deep, 12" high, and 18" wide, the **Utah** PT-2 extension-speaker baffle contains a 6" x 9" inverted speaker, a 3" x 5" tweeter, and a bass-relief port. A choice of blonde or mahogany finish is offered, and "S" hooks for wall mounting are furnished. Over-all impedance is 8 ohms; power-handling capacity is 8 watts; retail price is $32.50.

Staple Gun (52V)

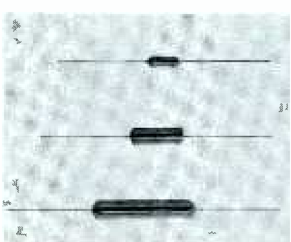


The tapered striking edge of the **Arrow** T-25 staple gun enables it to drive staples in tight places such as corners and narrow grooves. This gun uses a new type of round-top staple which fits snugly over low-voltage wires and cables without mashing the insulation. Staples of two different leg sizes, 7/16" and 9/16", are accepted by the same machine.

Component Substitution Box (53V)

The **Mercury** Model 500 "Component Substitutor" (price: $29.95) offers 10 values of capacitance from 100 mmf to .5 mfd, plus 10 electrolytics from 4 to 330 mfd; 20 values of resistance ranging from 33 ohms to 10 megohms; a power resistor, continuously variable up to 5000 ohms; and continuously variable bias voltages up to ±15 volts. Substitutes are also furnished for crystal diodes and power rectifiers with ratings up to 55 ma.

Wire-Wound Resistors (54V)



Axial-lead "Greenohm V" power resistors, in which the conventional terminal lugs have been omitted to save space, are newly available from **Clarostat.** There are three series, the VC3D, VC5E, and VC10F, with power ratings of 3, 5, and 10 watts (in that order). Standard resistance tolerance is ±5% for values of 1 ohm or higher, and ±10% for values under 1 ohm.

Surge Protectors (55V)

Damaging current surges, which occur when equipment is first turned on, are limited with the **ATR** "Electronic Tube Protector." Unit is available in two types — Model 250 (shown; $3.95) for plugging directly into an AC wall outlet, and Model 300 (with extension cord; $4.95) for mounting anywhere up to 6′ away from the outlet. Both are fuse-protected and can be used with 100- to 300-watt loads.

Component Price Information (56V)

A new edition of "Dave Rice's Official Pricing Digest" (Vol. 4, No. 1) has been announced by **Electronic Publishing Co.** List or suggested retail prices are given for more than 63,000 components; also provided is a table of national and regional average TV service charges. The 300-page book is corner-punched so it can be suspended from a cord; its 3¾" x 9 13/16" size also makes it suitable for carrying in tube caddy or toolbox. Price is $2.50 per copy.

INDEX TO ADVERTISERS

November, 1960

Latest Jackson Tube Test Data

MODEL 648

Tube Type	Fil	D.	E	Plate Test
6FY5	6.3	A123	A57	17 XZ
9EF6	9.4	123	456	26 W
15EW6	15	AC1234	567'	45 XZ
17EW8	17	123	A45	15 XZ
		127	A89	15 XZ
34GD5	35.	C123	467	55 VW

SUPPLEMENTS LATEST ROLL CHART 648 23C

MODEL 598

A	B.	C.	Fil. Cont.	D.	E	F	G
6.3	3YZ		4	5	2		50
9.4	2Y		7	3	5	4	21
15.	3Y		4	5		6	60
17	4		5	1	2Z		55
	4			6	7Z		55
35.	3Z	2	4	7	5	6	33

SUPPLEMENTS LATEST ROLL CHART 598 2

MODEL 658

Tube Type	Sec	Heater	Circuit H-K	Circuit P-G	Plate	Grid Test	Heater Current
6FY5	T	6.4J	123	a57	17R	10WY•	
9EF6	P	10.6F	123	456	21Q	80VY•	A18 6L Z600
15EW6	P	18 6D	1247	ac356	60S	10WY•	
17EW8	T	18 6L	123	a45	19Q	20WY•	
	T	"	127	a89	"	20WY•	
34GD5	P	38.E	123	467	35R	70VY•	

SUPPLEMENTS LATEST ROLL CHART 658 3

CATALOG AND LITERATURE SERVICE

ANTENNAS & ACCESSORIES

1V. *JFD — 1960 Exact-Replacement Antenna Guide for Portable and Toteable TV sets* (20 pages), compiled and edited by Howard W. Sams & Co., Inc. Gives TV receiver model number, manufacturer's antenna part number, and model number of corresponding JFD exact-replacement antenna. Also Form 940 dealer catalog illustrating and describing 1960 line of natural silver and gold anodized *Hi-Fi* TV antennas, mounts, masts, and accessories. *See ad page 19.*

2V. *JERROLD*—"Products For Better Televiewing," a 12-page catalog of home TV reception aids, TV distribution systems, antenna system test equipment and accessories. *See ad 2nd cover.*

3V. *ROHN* — New folder describing complete line of antenna towers and allied accessories; also descriptive literature on heavy-duty communications towers. *See ad page 21.*

4V. *WINEGARD* — Descriptive catalog on new A-400 distribution amplifier, including a schematic and specifications for the unit. *See ad page 46.*

AUDIO & HI-FI

5V. *ATR* — Literature on *Universal Inverters,* ideal for operating standard 110-volt AC public-address systems in mobile applications. *See ad page 12.*

6V. *DUOTONE* — "How-to-" booklet on identifying and replacing phono needles; wall chart of replacement-needle data; needle identification and replacement catalog to bona fide dealers and repairmen. *See ad page 58.*

7V. *ERCONA* — Illustrated brochure and price list on *Mark III Reslo* studio-type ribbon microphones featuring replaceable ribbon cartridges.

8V. *SONOTONE* — New cost sheet covering all products; specification sheet with color illustration of CM-17 *Flex-Mike* for language labs; new catalog sheet on 9T series of ceramic stereo cartridges. *See ad page 75.*

9V. *SWITCHCRAFT* — New-product bulletin No. 101 on ultra-miniature *Micro-Jax* for use as phone jacks on transistor radios. *See ad page 80.*

10V. *TELEX* — Literature on stereo and monophonic headsets and accessories for communications, educational, and entertainment use; also catalog sheets and hook-up information on under-pillow speakers. *See ad page 56.*

COMPONENTS

11V. *CORNELL-DUBILIER* — Substitution cross-index of twist-prong capacitors, listing recommended C-D replacements for Aerovox, Mallory, Pyramid, Sangamo, and Sprague types.

12V. *SPRAGUE* — Distributor Stock Catalog C-613 on line of capacitors, resistors, printed-circuit networks, and test equipment. *See ad page 10.*

FUSES

13V. *BUSSMANN* — 24-page booklet giving detailed information on complete line of *BUSS* and *FUSETRON Small Dimension* fuses and fuse holders — the ones most used in protecting electronic equipment. *See ad page 35.*

14V. *LITTELFUSE* — Information on caddy of fuses for Christmas-tree lights. *See ad 4th cover.*

PROMOTIONAL AIDS

15V. *SYLVANIA* — Booklet No. 1028, "Can Local Sylvania Advertising Really Help My Business?" with true case histories telling how other dealers have made money. Points the way for *every* service dealer to multiply business with local ads. *See ad page 27.*

SEMICONDUCTORS

16V. *CBS ELECTRONICS* — Reference Chart PF-384 for semiconductors, giving basic data on CBS transistors and diodes. *See ad page 25.*

SERVICE AIDS

17V. *CASTLE TUNER* — Leaflet describing fast overhauling service on television tuners of all makes and models. *See ad page 50.*

18V. *INJECTORALL* — 1960 catalog of electronic chemicals.

19V. *PRECISION TV TUNER* — Information on repair and alignment service available for any type of TV tuner. *See ad page 70.*

20V. *SWING-O-LITE* — Flyer on *Inspector* bench light with built-in 5"-diameter magnifying glass surrounded by 22-watt shadow-free fluorescent tube and mounted on omnidirectional swivel arm. *See ad page 68.*

21V. *YEATS* — Information about dolly for delivering TV and hi-fi sets or appliances, and about padded TV, radio, and appliance covers. *See ad page 84.*

SPECIAL EQUIPMENT

22V. *ACME ELECTRIC* — Catalog 091-BL01 giving detailed information on automatic voltage stablizers and manual voltage adjustors for TV receivers and other electronic applications. *See ad page 87.*

23V. *DIALIGHT CORP.* — Brochures, "Lights That Enlighten" and "Datalites," describing a variety of applications for *Dialco* pilot lights as read-out indicators in data processing, instrumentation, and automation. Legend-bearing lights are presented, as well as *Data Strip* and *Data Matrix* multiple-light assemblies.

24V. *SCHOBER* — Catalog of electronic-organ kits; also descriptive sheet on AT-1 *Autotuner* and OT-1 *Organ Tester* for use in electronic organ maintenance.

TECHNICAL PUBLICATIONS

25V. *ELECTRONIC PUBLISHING* — Brochure describing all-new edition of *Dave Rice's Official Pricing Digest,* including list prices on over 63,000 components, plus national and regional average service charges. *See ad page 68.*

26V. *GERNSBACK*—Descriptions of Gernsback Library books. *See ad page 62.*

27V. *MOTOROLA* — Complete brochure describing Motorola Institute training course on two-way radio communications; sample lesson SA-7 on transistorized receiver circuits. *See ad page 66.*

28V. *RCA INSTITUTES* — Complete catalog of home-study training in radio and electronic fundamentals, TV servicing, automation, and transistors; also comprehensive electronic course selection at Resident Schools in New York City and Los Angeles. *See ad page 16.*

29V. *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics servicing. *See ads pages 76, 77, 80, 82.*

TELEVISION RECEIVERS

30V. *SETCHELL-CARLSON* — Attractive folder designed for distribution to customers, with photographs and descriptions of 11 basic models in current TV line — including combinations formed by adding some or all of the following plug-in components: AM radio, FM radio, phono, stereo amplifier, and remote stereo speaker cabinet. Plug-in principle is also used in series of separate stereo and monophonic hi-fi systems. *See ad page 18.*

TEST EQUIPMENT

31V. *B & K* — Bulletin AP16-R gives information on new Model 1076 *Television Analyst,* Models 1070 and A107 *Dyna-Sweep Circuit Analyzers,* Models 550, 650, 675, and new 685 *Dyna-Quik* dynamic mutual conductance tube testers, new Model 610 Test Panel, new Model 160 Transistor Tester, and Model 440 CRT rejuvenator-tester. *See ads pages 17, 51.*

32V. *ELECTRO PRODUCTS LABS* — Catalog sheet giving data on complete line of DC power supplies, including kits and regulated transistorized units.

33V. *HICKOK* — Folders describing Model 209A VTVM, plus line of tube testers, oscilloscopes, transistor testers, VOM's, and signal generators. *See ad page 53.*

34V. *MERCURY* — Master catalog on complete test-equipment line, plus information on new service aids.

35V. *SECO* — New 16-page booklet illustrating tube testers, dynamic transistor checker, two-way radio test set, and several time-saving service aids. *See ads pages 84, 85, 87.*

36V. *SENCORE* — New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter,* plus brochure on complete line of *time-saver* instruments. *See ads pages 14-15, 36, 37, 38, 39, 40, 41.*

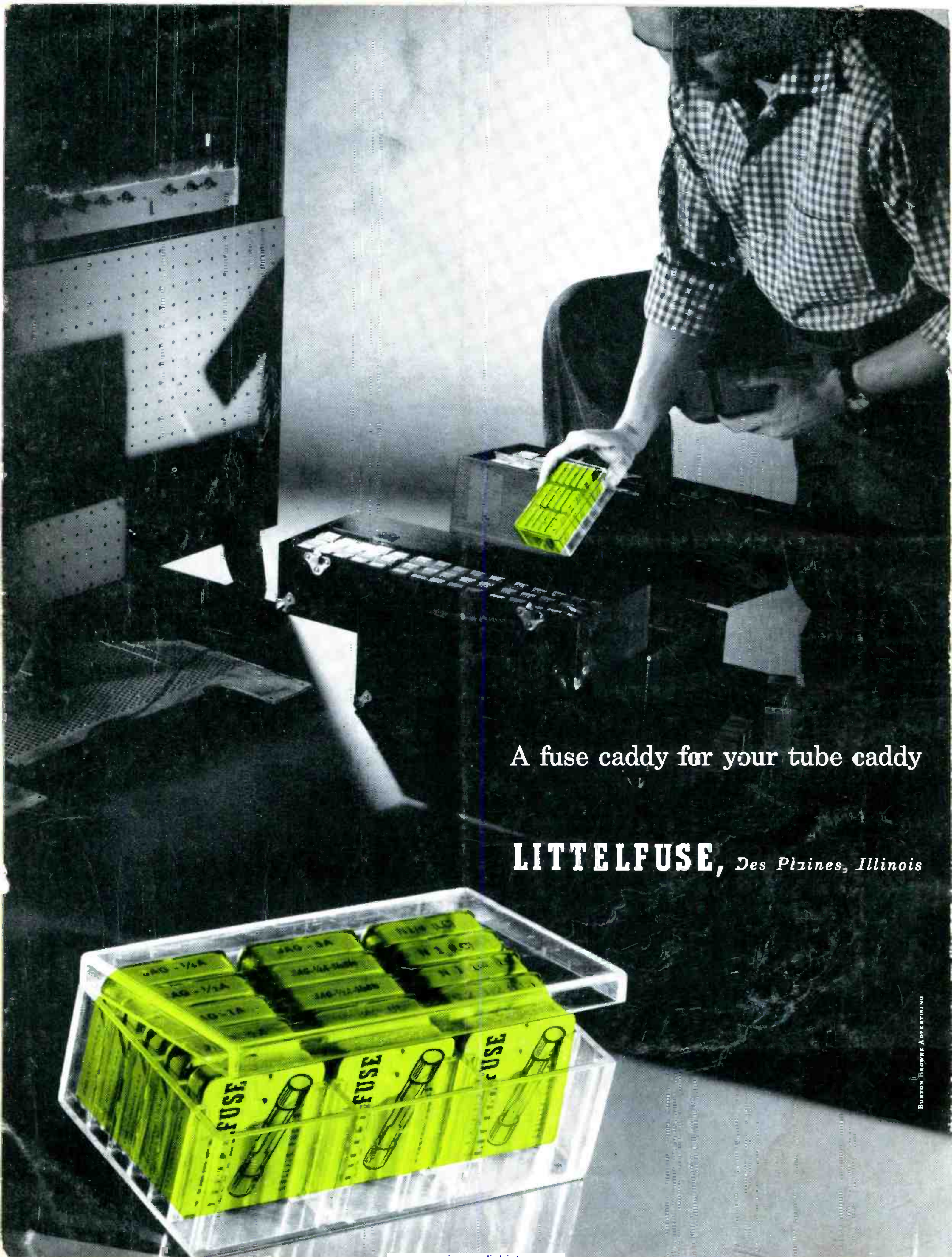
37V. *SIMPSON* — *Brochure* describing VOM's, DC VTVM, color-bar generator, and many other types of radio and TV test equipment. *See ad page 78.*

TOOLS

38V. *BERNS* — Data on 3-in-1 picture-tube repair tool, *Audio Pin-Plug Crimper,* and *Ion* adjustable beam bender. *See ads pages 58, 64.*

39V. *L.I. ELECTRO-LABS* — Catalog sheet on the Model A-1000 *Solder-Pen,* a 30-watt pencil-type soldering iron. When not in use, the removable handle fits over the tip, thus allowing the iron to be carried around while still hot.

40V. *VACO* — New 8-page catalog on specialty tools, entitled "Choose Your Cards," illustrating 34 different carded displays of tools. *See ad page 72.*


A fuse caddy for your tube caddy
LITTELFUSE, Des Plaines, Illinois
BURTON BROWNE ADVERTISING