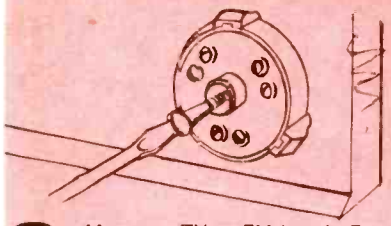
AUGUST, 1959 35 CENTS

PF REPORTER®

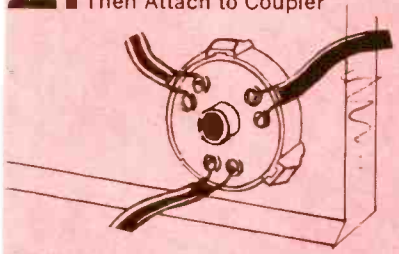
Including Electronic Servicing

This Month's Highlights

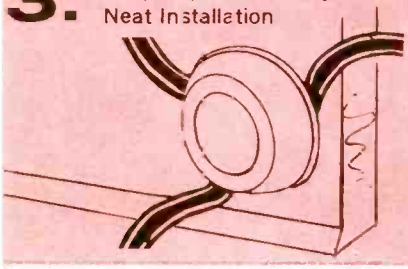
1. Fasten Coupler to Wall or Mast

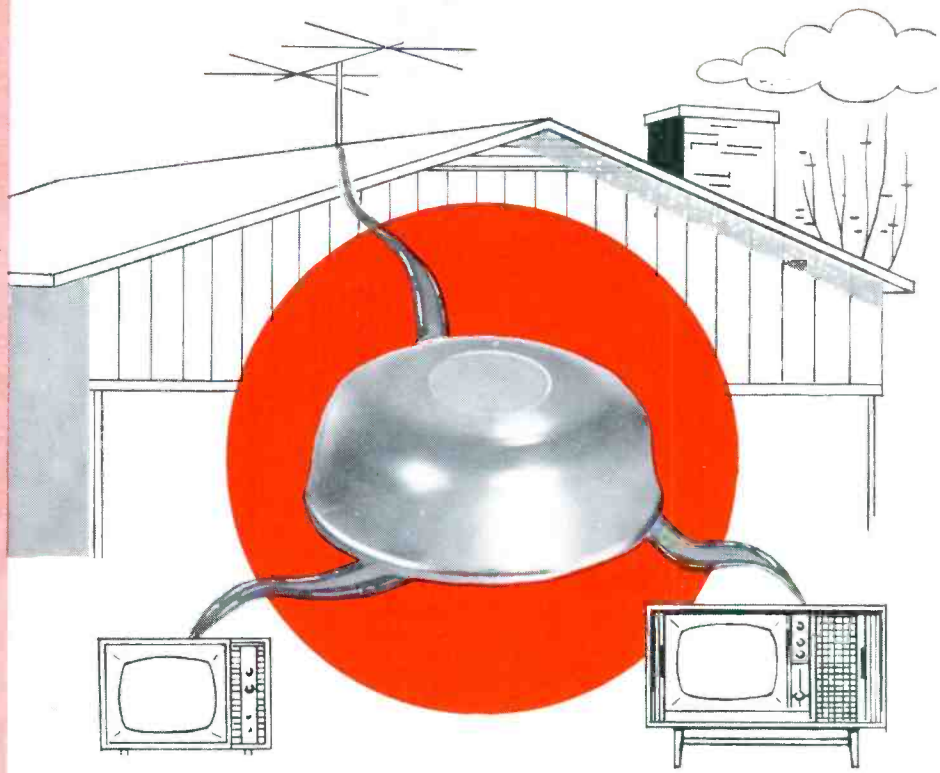


2. Measure TV or FM Leads Exactly, Then Attach to Coupler



3. Snap Cap On For Easy, Neat Installation

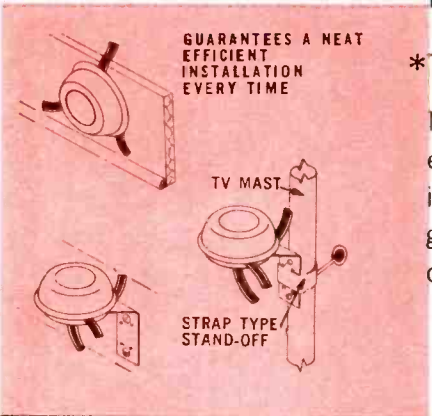




NEWLY DEVELOPED*

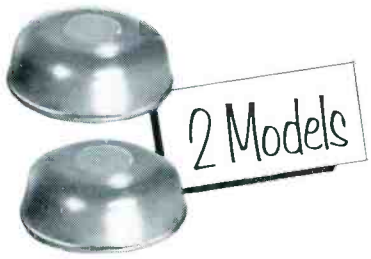
2-SET COUPLER

THAT GOES ON FAST AND EASY!



*This coupler is mounted **BEFORE** leads are attached.

Now at last you can get 2-Set TV or FM Couplers engineered for highest efficiency and easier, neater installations. They're designed for mounting against a wall or on a mast before attaching leads, eliminating guesswork and messy connections. Couple two TV or two FM sets, or one of each . . . enjoy greater signal strength on both!

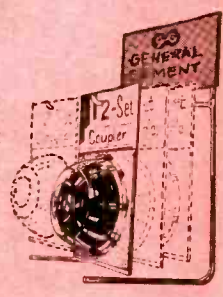


STANDARD model will couple any two sets to one antenna. Perfect match without interference. For most receiving areas.

No. 8917 — List $2.50

LOW LOSS model is similar to Standard, except it is designed and engineered specifically for fringe areas.

No. 8919 — List $3.50



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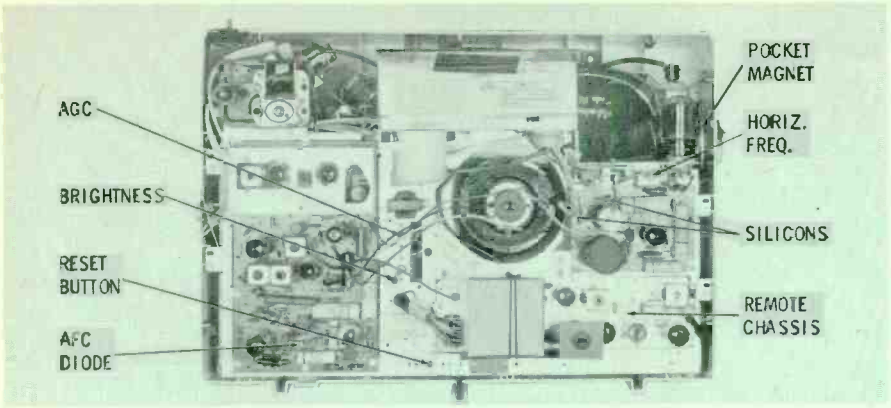
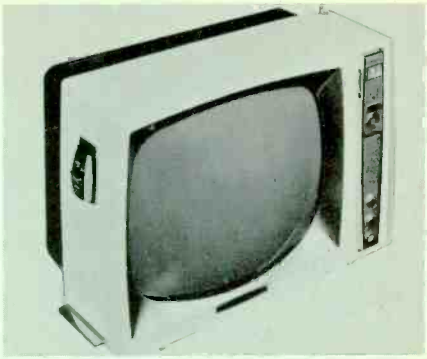
Main Plant: ROCKFORD, ILLINOIS, U.S.A.

Admiral





Admiral Model PS 17F22 Chassis 15B3

This new 17" portable features wireless remote control, plus a front push-bar for power tuning. To clean the safety glass, both chassis and picture tube must be removed.

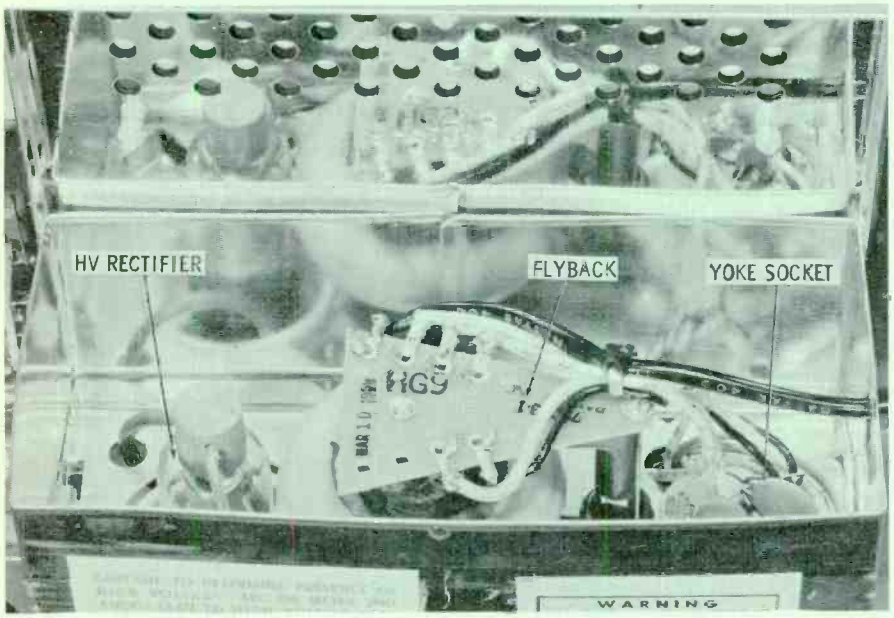
The silicon rectifiers powering the "hot" chassis are soldered to the smaller of two printed boards employed. Without the remote transmitter in its storage place, you might wonder about the device attached inside the cabinet near the horizontal output tube. Actually, it is a magnet to hold the remote unit in a pocket-like indentation on the outside of the cabinet. The reset button is used to restore power to the set should the AC circuit breaker open. An 8-ohm, 12-watt surge-limiting resistor is connected in series with this protection circuit, and is located on the wiring side of the chassis.

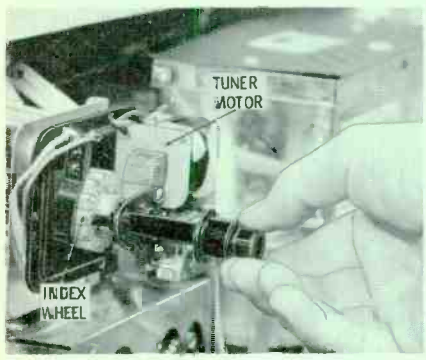
Lifting up the top lid of the high-voltage cage, you'll find a 1G3GT rectifier and a side-mounted flyback transformer. When called to service this set, check your caddy for a 2ER5/GG RF amplifier, 3DK6 video IF, and 10DE7 vertical sweep tube. Although you won't find a width, drive, or horizontal-linearity adjustment employed in this chassis, you will find height and vertical linearity controls, which are accessible through the hollow shafts of the contrast and vertical-hold controls on the front.

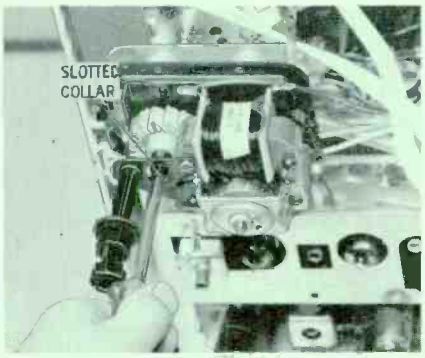
To set up the power tuner for automatic channel selection, you merely push in on the index knob and turn slightly clockwise. If the tuner skips, insert a 3/16" screwdriver blade into the hollow collar of the tuner shaft as shown, and turn to the desired channel number. Push in on the index knob and make a half turn counterclockwise until a stop is felt.

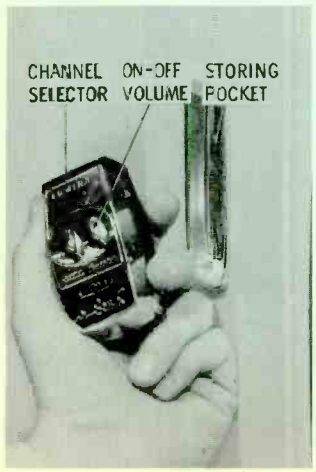
The hand unit for the *Son-R* remote control enables the operator to select channels, turn the set off and on, and vary the volume level in three steps. For proper control of volume, the manual control must be preset for a maximum desired level.

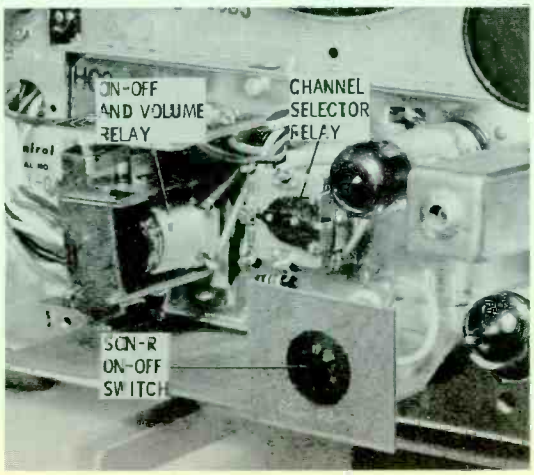
The remote amplifier chassis is positioned across the lower right section of the main chassis and employs a 12AX7, 6AV6, 6U8A, and 6BJ8. The TV may be operated without the remote chassis by connecting a jumper between pins 1, 10, and 11 of the remote socket, and another between pins 5, 9, and 12.

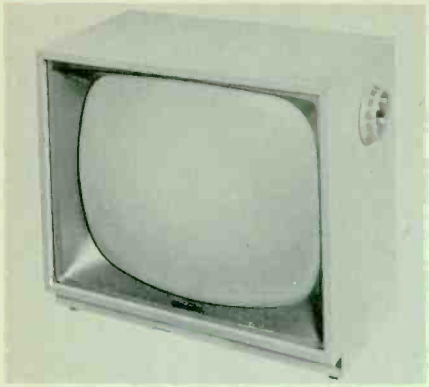












Muntz Model 21LTS

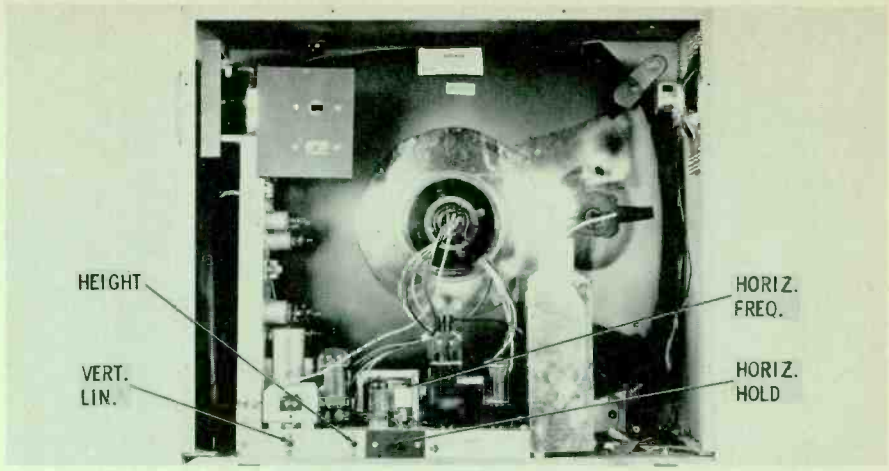
This new 21" table model features an all-metal cabinet, 110° picture tube, and operating controls all grouped within the channel selector knob on the side of the cabinet.

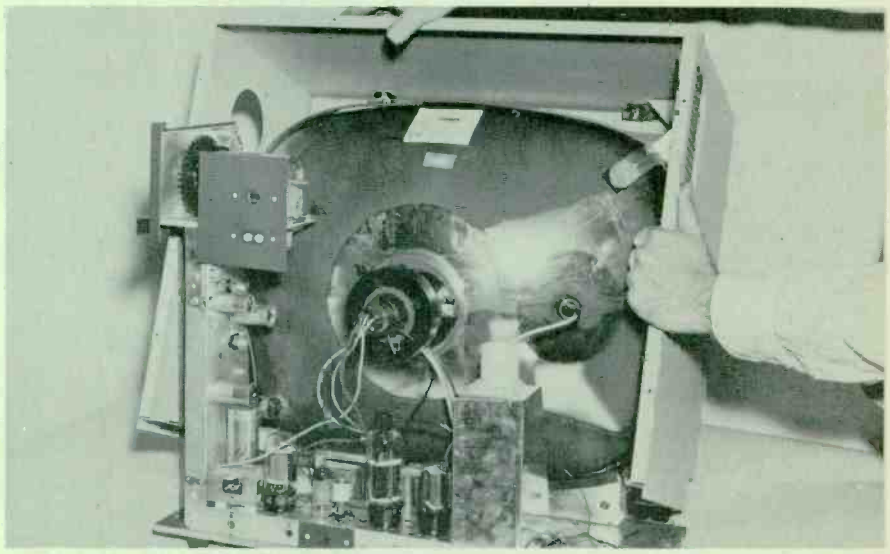
Since the physical layout of the chassis forms sort of a "J" pattern in the cabinet, one can see why the manufacturer refers to it as their "J" series. The chassis is conventionally wired and powered by a single silicon rectifier. Only four service adjustments are shown on the rear of the chassis because the set is designed so that width, drive, and horizontal linearity are not required. In addition to the CRT and high-voltage rectifier, the "hot" chassis employs only ten series-string tubes—a 2CY5 RF amp, 6CG8 converter, 3BZ6 video IF, 5BW8 video/sound/AFC, 6BA8A video out/sync. 6AW8A sound IF/audio out, 12AV5GA vertical, 6CG7 horizontal oscillator, 25DN6 horizontal output, and 19AU4GTA damper. It's interesting to note that the pentode section of the 5BW8 is used as both a video IF and a reflex amplifier for the first sound-IF stage.

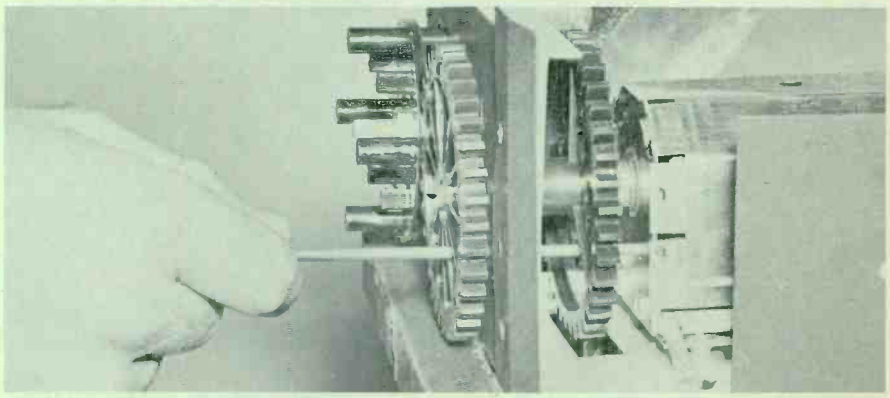
To clean the safety glass and screen on this particular set, the cabinet must be removed from the picture tube-and-chassis assembly as shown. This is accomplished by removing the control knob assembly, the Phillips screw on the side of the cabinet, and the four bolts holding the chassis mounting board at the bottom. After unsoldering the speaker leads, lift the cabinet up and off the chassis assembly. Be very careful not to twist the cabinet frame, since the resultant strain may cause the safety glass to shatter.

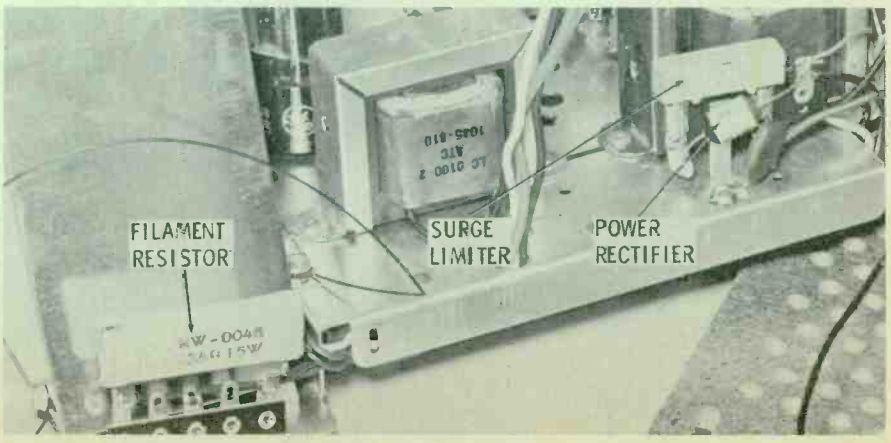
To touch up the oscillator adjustment on the *Hot-Rod* tuner, the cabinet must be removed. Special holes are provided in the plastic gears on the front of the tuner so that adjustment can be made as pictured.

On the front side of the chassis you'll find a power rectifier, surge limiter and filament-dropping resistor. The silicon rectifier is a 500-ma unit with soldered leads, while the surge limiter protecting the rectifier circuit is a 5-ohm plug-in type fusible resistor. The series-filament resistor located directly behind the high-voltage cage is rated at 36 ohms—15 watts.

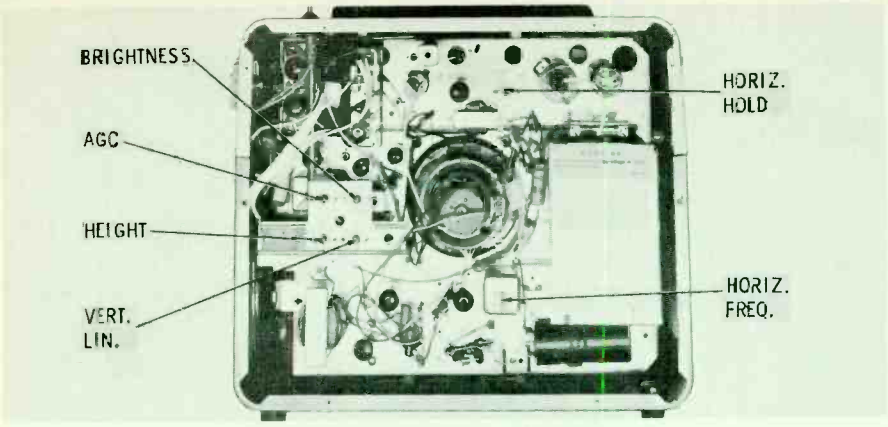


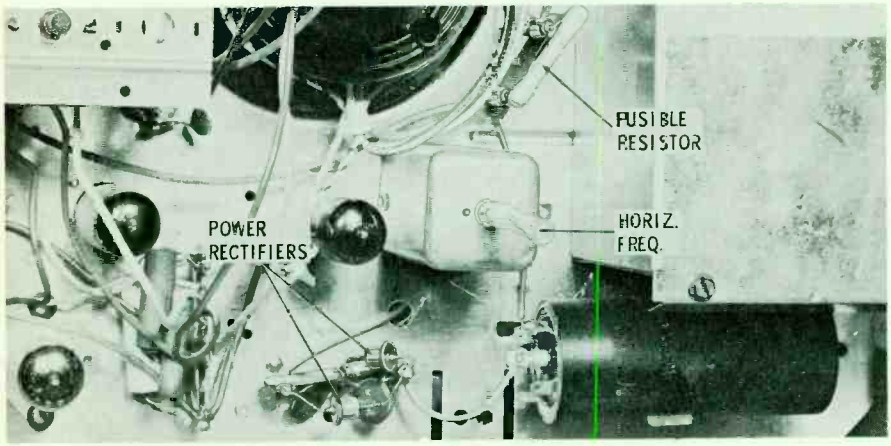


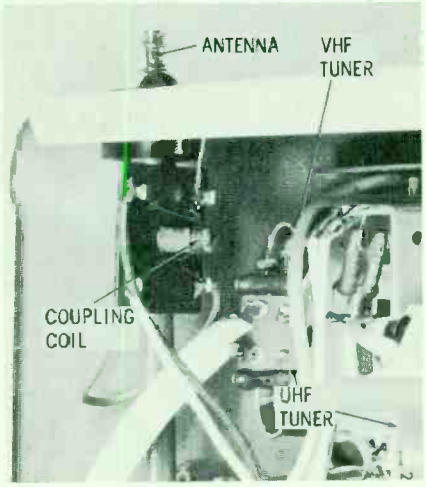


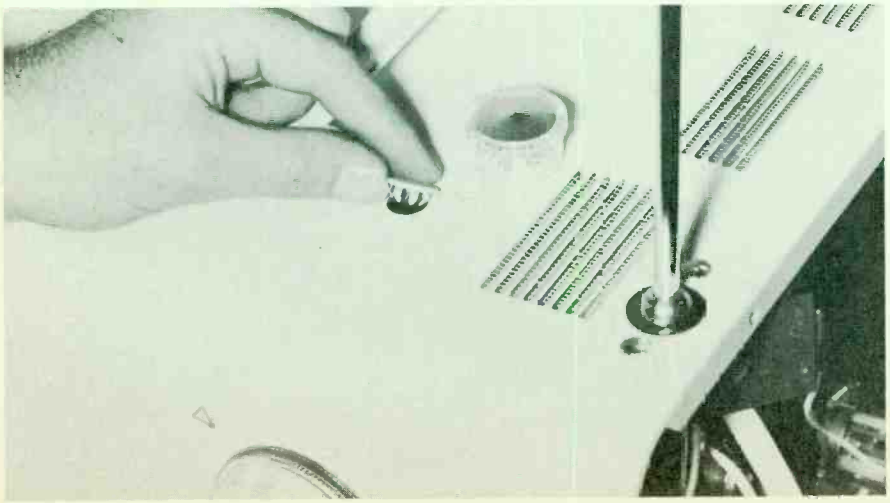


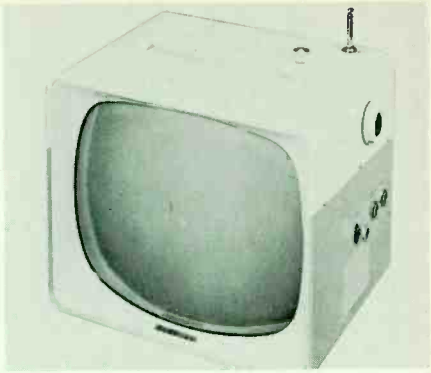
Trav-ler











Trav-Ler Model 1770U Chassis 750-19

You'll recognize this 17" portable by its two-tone metal cabinet, UHF tuning knob on top, and additional controls on one side. It also features a bar-like carrying handle and built-in telescoping antenna.

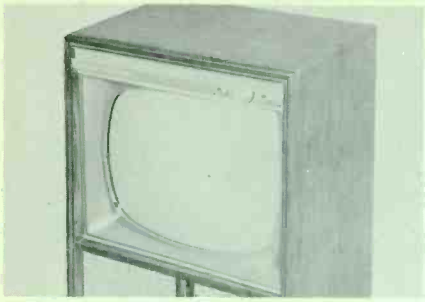
With the back off, you'll find a vertical chassis driving a 17BZP4 110° picture tube and 4" PM speaker. The chassis is "hot," and an isolation transformer should be used when operating it outside the cabinet. Although the receiver is fairly compact, no printed wiring is employed and all tubes can be easily reached. In the series-string lineup you'll find a 2BN4 and 5CG8 in the VHF tuner and a 12DB5 used as the vertical multivibrator.

Two silicon power rectifiers are soldered to a terminal board at the bottom center of the chassis. This voltage-doubler supply is protected by a plug-in fusible resistor (5.6 ohms-7 watts) positioned just left of the high-voltage cage.

As pointed out in the photograph, a special *surgistor* is mounted on top of the high-voltage cage. Appearing as a thin wire-wound resistor, the unit is a time-delay device incorporated in the power line circuit to prevent excessive current surges when the set is first turned on. Incidentally, the door of the high-voltage cage, which is held by only one ¼" screw, slides down far enough to permit replacement of the 1B3GT rectifier without requiring removal of the chassis from the cabinet.

When you first examine the input circuit of the built-in antenna, you may wonder about the assembly mounted on a small insulating board at the top of the cabinet near the tuners. Actually, it's an antenna coupling coil composed of a few turns of wire around a powdered iron core. This tapped coil matches the single-ended antenna to the 300-ohm balanced input of the VHF tuner.

Oscillator slugs of the tuner are accessible after removal of the small metal cap or plug from the top of the cabinet as pictured. This adjustment requires a long narrow alignment tool. By the way, it might also save a little time if you know in advance that the chassis and picture tube must be removed in order to clean the safety glass and screen on this set.



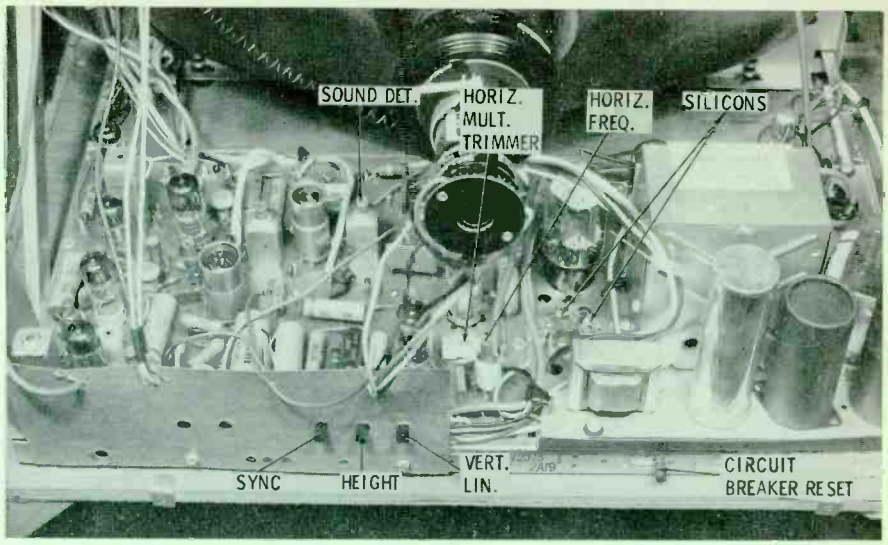
Westinghouse Model H21K272 Chassis V2375-1

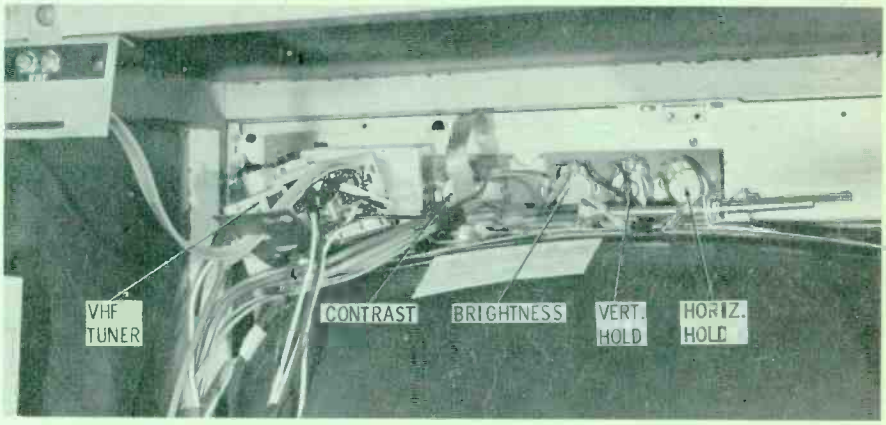
This vertical 21" console with both 8" and 5" speakers in a recessed sound chamber is one of the new *Wheaton* series. Operating controls, including volume with push-pull on/off, channel selector, and contrast, are positioned at the top front corner of the cabinet. Brightness, vertical hold, and horizontal hold are located near the center of the cabinet, up under the top trim strip.

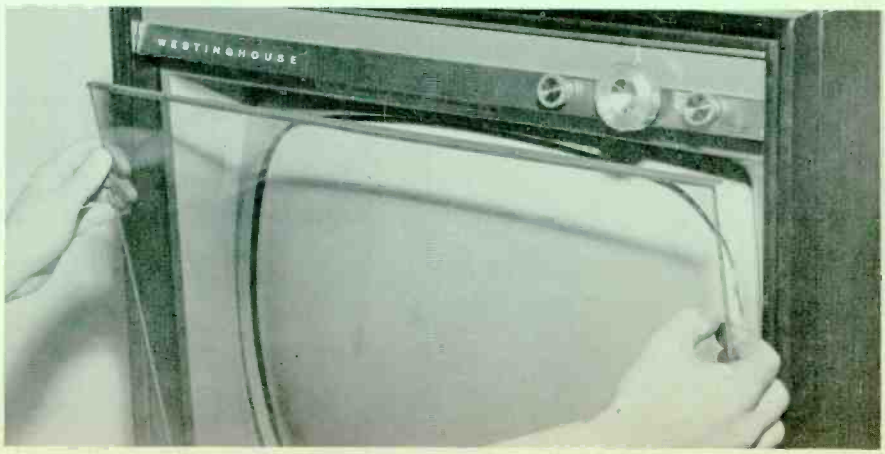
With series-filament tubes and two silicon rectifiers, the chassis is basically a horizontal style employing one large printed-wiring board. Although the yoke is not supported by a direct brace of any kind, the entire chassis (including tuner, controls, and picture tube) is one complete assembly, and may be removed from the cabinet as such. Among the service adjustments on the back of the set is one labeled SYNC. This is a stability control to improve synchronization in areas with high noise levels. Although no control is provided, AGC may also be varied by removing a special jumper from across the grid resistor of the keyer tube. The horizontal multivibrator trimmer, located on top of the printed board near the horizontal frequency adjustment, is a variable capacitor with a range of from 19 to 160 mmf. This component, under certain conditions, is adjusted to obtain a zero potential on a special test point in the grid circuit of the multivibrator.

A small VHF tuner (employing 2CY5 and 5AT8 tubes) and all front operating controls are mounted to a chassis brace above the picture tube. Tuner oscillator adjustments are accessible after removing the channel selector and fine tuning knobs. You'll find that oscillator coils for all channels except 2 and 7 are series-connected, and utilize a single slug for tuning each pair (3 and 4, 5 and 6, etc.). By turning the selector knob to the desired channel, the proper oscillator slug will always appear in the adjustment hole on the front of the tuner.

To clean the safety glass on this model, take out the three ¼" hex-head screws holding the glass retainer at the top. To remove this strip, it may be necessary to gently pry one end loose as shown in the photograph. After the top of the glass is free, tilt outward and lift up. When replacing the glass, make sure the rubber strip is in place across the top edge of the glass.







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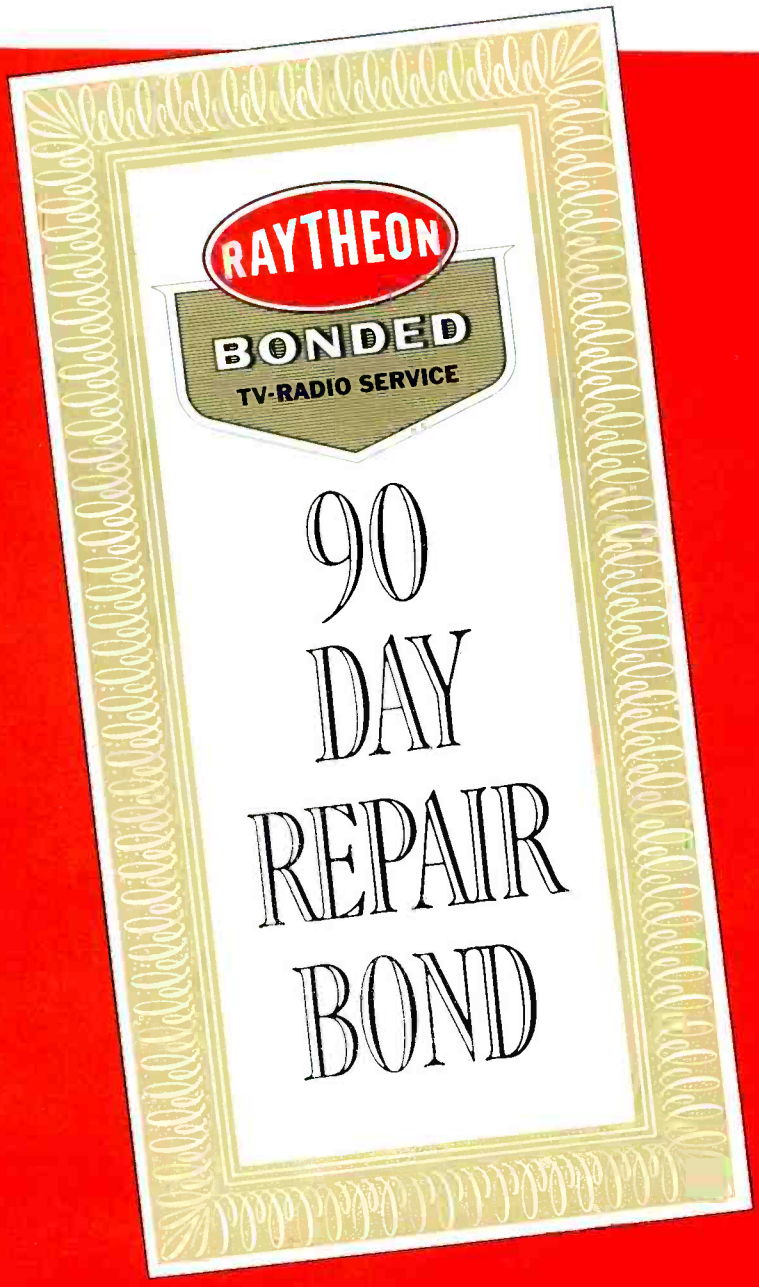

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Guide and Look!

It's a dynamic year-round consumer build-up, with local impact!

Every month of the year Raytheon runs powerful ads selling Bonded TV-Radio Service in all 51 regional editions of TV Guide. What's more, there's a full two-page spread in LOOK Magazine! And all these ads feature the names and addresses of Raytheon Bonded Dealers! Ask your Raytheon distributor how *you* can get your name listed. There's never been an ad campaign like this, and it's for Raytheon Bonded Service Dealers—*only!*

PLUS...

LOOK 28,000,000 READERS

RAYTHEON BONDED TV-RADIO SERVICE

These TV Service Technicians Guarantee All Work at Fair Prices

LOUISVILLE
HARBOR TV REPAIR
20 State St. LO 6-5483
JORDON'S RADIO-TV
123 Bellaire Place, SR 7-5627
ANDERSON TV RADIO
36 Woody Lane TE 6-8925
STANDARD TELEVISION
29 West St. LO 9-8263
CATLIN'S TV RADIO
298 Ivy Place HI 7-9273
MODERN TELEVISION
Center Shopping Can. LO 6-2345

LEXINGTON
MIKE'S TV-RADIO
28 East State St. LE 6-4856
TRIPLE T REPAIR
298 N. Center St. HI 8-7563
LEXINGTON TV SERVICE
29 State St. LE 6-2378

OWENSBORO
BERT'S TELEVISION
28 Main St. OW 9-3278
HILL TV SERVICE
29 Hill St. TE 7-2378

EVANSVILLE
BENNENT TELEVISION
7 Whitefish Road NA 9 4578
McCURRY A-1 TV SERVICE
27 North Main St. KI 8-4637
NOBLE RADIO & TV
29-45 Saturna St. LO 9-6452
HARVEY RADIO REPAIR
74 East Chester Road KI 8-7564
GEORGE'S TELEVISION
2 N. Village Road GL 8-4657
W. R. TV REPAIR
2764 Center St. WE 8-5649
PUCKETT TELEVISION
43 South Ave. DE 4-8567

DANVILLE
BENNENT TELEVISION
7 Whitefish Road NA 9-4578
McCURRY A-1 TV SERVICE
27 North Main St. KI 8-4637
NOBLE RADIO & TV
29 45 Saturna St. LO 9-6452
HARVEY RADIO REPAIR
74 East Chester Road KI 8-7564
GEORGE'S TELEVISION
2 N. Village Road GL 8-4657
W. R. TV REPAIR
2764 Center St. WE 8-5649
PUCKETT TELEVISION
43 South Ave. DE 4-8567

FRANKFORT
ART'S TELEVISION
28 North Main AL 6-5478
LYNCH TV SERVICE
35-67 Ketchum St. HE 9-8746

MIDDLESBORO
HARBOR TV REPAIR
20 State St. LO 6-5483
JORDON'S RADIO-TV
123 Bellaire Place, SR 7-5627
ANDERSON TV RADIO
36 Woody Lane TE 6-8925
STANDARD TELEVISION
29 West St. LO 9-8263
CATLIN'S TV RADIO
298 Ivy Place HI 7-9273
MODERN TELEVISION
Center Shopping Can. LO 6-2345

MADISONVILLE
MIKE'S TV-RADIO
28 East State St. LE 6-4856
TRIPLE T REPAIR
298 N. Center St. HI 8-7563
LEXINGTON TV SERVICE
29 State St. LE 6-2378

NEW ALBANY
ART'S TELEVISION
28 North Main AL 8-5478
LYNCH TV SERVICE
35-67 Ketchum St. HE 9-5746

RICHMOND
BERT'S TELEVISION
28 Main St. OW 9-3278
HILL TV SERVICE
29 Hill St. TE 7-2378

ASHLAND
HARBOR TV REPAIR
20 States St. LO 6-5483
JORDON'S RADIO-TV
123 Bellaire Place, SR 7-5627
ANDERSON TV RADIO
36 Woody Lane TE 6-8925
STANDARD TELEVISION
29 West St. LO 9-8263
CATLIN'S TV-RADIO
298 Ivy Place HI 7-9273
MODERN TELEVISION
Center Shopping Can. LO 6-2345

RAYSVILLE
BENNENT TELEVISION
7 Whitefish Road NA 9 4578
McCURRY A-1 TV SERVICE
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W. R. TV REPAIR
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PUCKETT TELEVISION
43 South Ave. DE 4-8567

GLASGOW
MIKE'S TV-RADIO
28 East State St. LE 6-4856
TRIPLE T REPAIR
298 N. Center St. HI 8-7563
LEXINGTON TV SERVICE
29 State St. LE 6-2378

COVINGTON
BERT'S TELEVISION
28 Main St. OW 9 3278
HILL TV SERVICE
29 Hill St. TE 7-2378

WINCHESTER
ART'S TELEVISION
28 North Main AL 8-5478
LYNCH TV SERVICE
35-67 Ketchum St. HE 9-5746

RAYTHEON

Now...Free 90-day Repair Bond

from your Raytheon BONDED TV Service Dealer

Now there's an important difference in television service! The next time your set gets in a jam, call a Raytheon Bonded TV Technician. You'll not only get expert service—you'll get a free 90-day written bond, backed by Raytheon, world-famous manufacturer devoted exclusively to electronics.

It's the TV service idea that set owners have wanted for years. This written bond guarantees all repair work, including all replaced parts, for 90 days.

Every Raytheon Bonded Technician has been selected on his record. He's proved himself in skill, experience, and integrity. He has complete service facilities. He charges fair prices, and always gives an itemized bill that lists all repairs and replacement parts. Best of all, he uses first quality, factory-warranted Raytheon electronic tubes.

Look for the emblem of your local Raytheon Bonded TV Technician, in store signs, advertisements, and the Yellow Pages. *Idea:* Cut out the listing on the right, and place in your phone book! It's your key to fast, dependable, *bonded* TV repairs and carefree viewing.

RAYTHEON DISTRIBUTOR PRODUCTS DIVISION · WESTWOOD, MASS.

RADIO
Stars of TELEVISION
MOVIES

remind customers in your town to look for your name in TV GUIDE *and* LOOK!

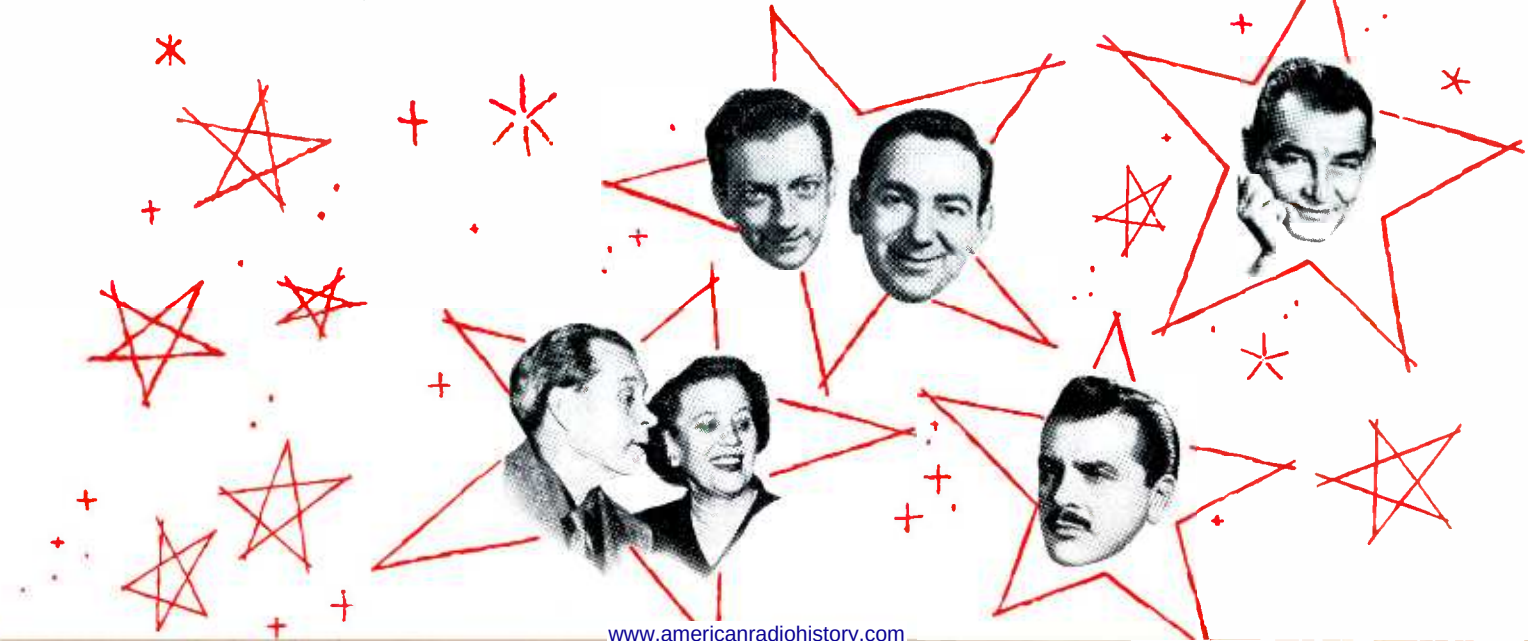
They're on famous NBC

RAYTHEON
BONDED
TV-RADIO SERVICE

Starring such personalities as

★ FIBBER McGEE & MOLLY ★ ED "Archie" GARDNER
★ ERNIE KOVACS ★ BOB & RAY
★ AND MANY OTHER STARS

. . . ALL working for you, round-the-clock, throughout the weekend.



MONITOR

weekend Radio Spectacular

All weekend long they sell the RAYTHEON Bonded Service Program for you!

It's a weekend-long show lasting from 8 p.m. Friday through 12 midnight Sunday. About once every 15 minutes throughout the weekend on Monitor, more than 10,000,000 radio listeners are told about the Raytheon Bonded TV-Radio Repair Service, the 90-day Repair Bond, and—You! Never before has such a concentrated barrage of sales messages been presented to the public Listeners are told to look for the bonded seal in your windows, to look for your name and address in TV Guide and LOOK.

Think of it! Stars like: Ed "Archie" Gardner, Bob & Ray, Fibber McGee & Molly, Ernie Kovacs, and many others, working for you on your local NBC radio station —and Raytheon foots the bill!

Here's how you can cash in.....

Tune up for Profits

with the NEW

RAYTHEON BONDED TV-RADIO SERVICE

Let every TV and Radio set owner know that you're Headquarters for this sensational program!

Here's all the advertising and promotional material you need for your own...

Local, Hi-Impact Merchandising Program

You get everything you need to tell 'em and sell 'em! Yours *free* when you sign up as a RAYTHEON BONDED SERVICE DEALER . . . identification materials, publicity, newspaper mat ads, radio and TV spot commercial scripts, window displays, the impressive, official Raytheon Bonded Certificate—and more.

All these sales-tested merchandising materials come to you in the Bonded Dealer's Merchandising Kit. These colorful advertising and promotion pieces are tailored to your needs. Each is an eye-catching, sales-building device to build your business and profits. Only Raytheon gives you this complete individualized package.

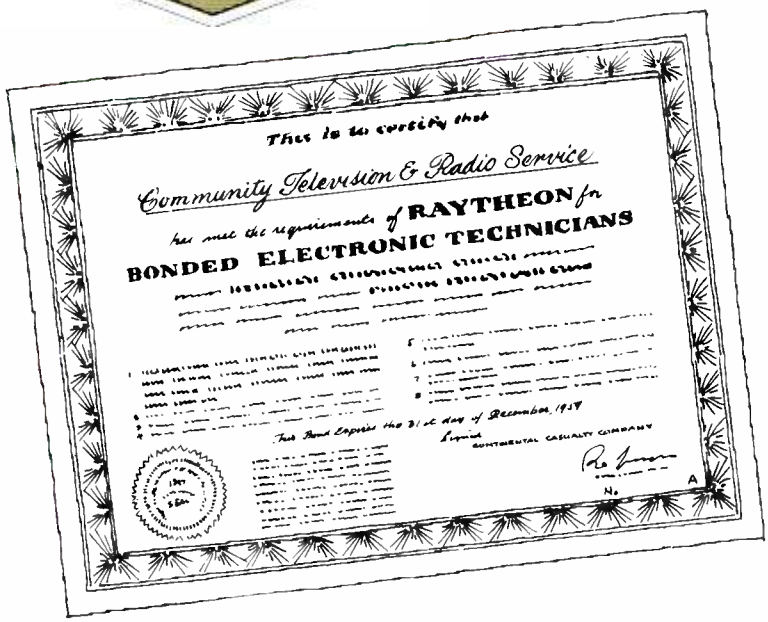
FREE Merchandising Kit

Free Merchandising

gives you everything you

RAYTHEON BONDED TV-RADIO SERVICE

Yours free, when you sign up as a Raytheon Bonded Dealer. It's a complete advertising and promotion program tailored to your needs!



Bonded Dealer Certificate (SPQ 7202)

Certifies that you are a qualified Raytheon Bonded Service Dealer. Prominently displays your name. It's a handsome two-color, 11″ x 14″ certificate . . . comes in a glassine case ready for framing. Lets all who come into your place of business know that they can count on you for reliable repair service. Even has the Code of Ethics which builds customer's confidence.

Identification Card (SPQ 7225)

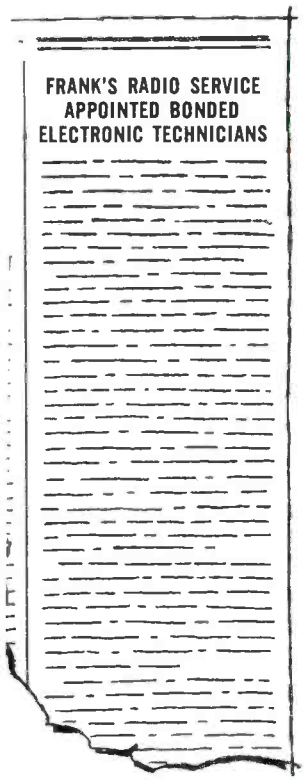
Official pocket-sized card identifies you as a Bonded Service Dealer. Wherever you call, customers will see by your card that they can depend on you as a qualified TV-radio serviceman whose work is backed by the exclusive Raytheon Bond. The handy pocket pass goes wherever you go—ready for instant use.

Creed Display for Counter or Window (SPQ 7201)

This eye-catching display will let all who pass by know that you subscribe to the Raytheon Code of Ethics. They'll know that you use top-quality Raytheon tubes and replacement parts . . . charge fair prices . . . guarantee all TV-radio repair work for full 90 days. It's a brilliant full-color display, varnished to retain its beauty. Built-in easel for easy setup anywhere.

Kit . . .

need to be HQ for this profitable program!



Publicity Release (SPQ 7232)

Announces your appointment as a Raytheon Bonded Service Dealer. It's important news for your community. All you do is send this announcement to your local paper with your name and address. Professionally written, it gives all the details that interest prospective customers . . . tells them that you are a selected, qualified service dealer . . . tells them about your 90-day guarantee, backed by bond.

Newspaper Ad Mats

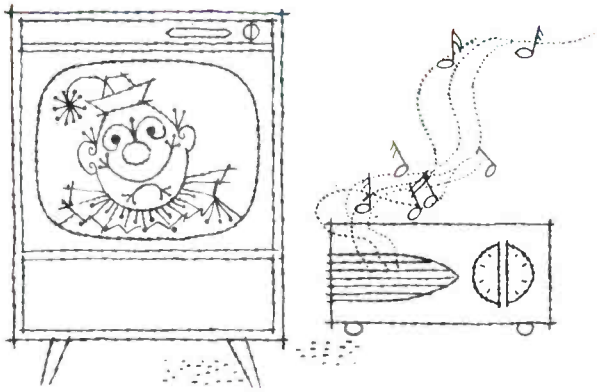
(SPQ 7266, SPQ 7267, SPQ 7268, DLQ 7000)

They're sure to be read! They tell the facts of the Raytheon Bonded Program . . . tell everyone that you're the man to see for bonded TV-Radio repair service. And, only you can cash in on these dramatic advertisements. You get them "all set" ready to run.

YOU ALSO GET FREE

1. **One hundred 90-day Customer Bonds.**
   (Additional quantities available through your Raytheon distributor.)
2. **Business Builder Book (SPQ 7044).**
3. **Samples of Direct Mail Postcards.**
4. **Samples of Business Aids**
   Letterheads • Billheads
   Envelopes • Calling Cards
   Job Repair Tickets
   Pressure-sensitive Repair Stickers
5. **And a selection of lithographed displays with window streamers.**

PLUS...



Radio-TV Spot Commercial Scripts (SPQ 7233, 7238)

Just right to reach customers at home, in car or out-of-doors. You have a choice of 15-second or one-minute spots for both TV and radio. These highly listenable spots tell your prospects that you're Headquarters for the Raytheon Bonded Repair Service. Best of all, with them you can cover prospects round-the-clock.

Window Decal (DLQ 7001)

Easy to apply, this striking red and gold decal identifies your place of business to all who pass by. Lets them all know that you have been selected as the Raytheon Bonded TV-Radio Repair Service . . . invites customers to come in and see you day and night.

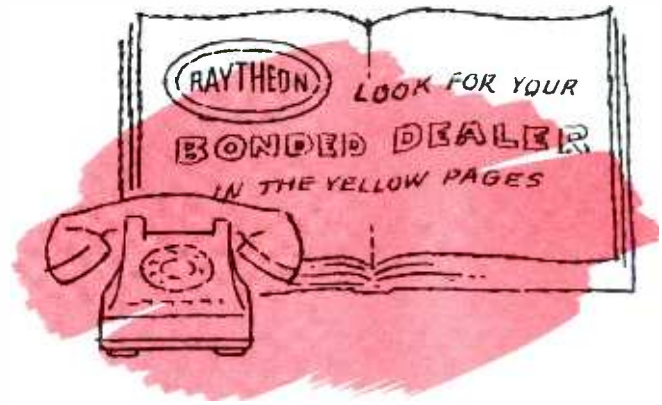
RAYTHEON
BONDED
TV-RADIO SERVICE

Your Distributor backs you with

Your local Raytheon Tube Distributor is ready to pitch in with prompt service and merchandising

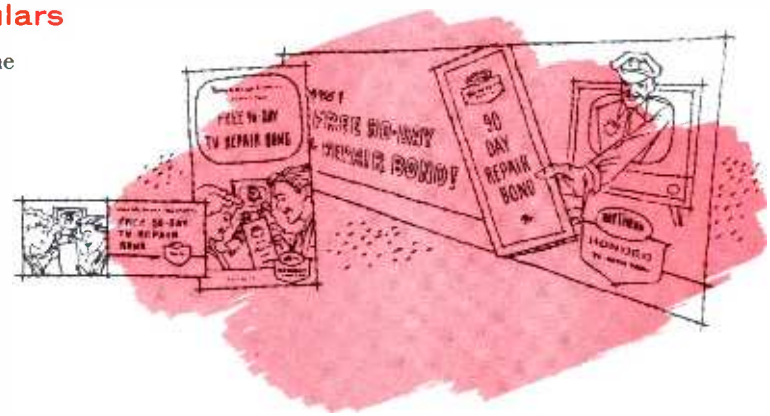
Your Name in Your Local Classified Telephone Book

Your name and address can be listed under the special Raytheon Bonded TV-Radio section in the Yellow Pages of the telephone book in your community. You get additional value from this deal because the telephone company carries on its own program of popularizing the Yellow Pages. Just about everyone checks the Yellow Pages for service when in need. Here's your opportunity to cash in on their reading habits.



Your Name on Outdoor Spectaculars

Colorful, eye-catching outdoor billboards in prime shopping areas . . . car and bus cards—all part of the Raytheon Bonded Service Program. And, you can have your name displayed prominently. Call your Raytheon Distributor for details on how you can have your name on these sure-fire sales builders.



"Welcome Wagon" Working for You

Gives the "Glad Hand" to new residents in town—as they arrive. Gives you exclusive representation as the Raytheon Bonded Service Dealer. Each new resident gets a gift in your name—you get a head start towards their service business. You also get names and addresses of new homeowners for follow-up action. "Welcome Wagon" is the nationally recognized "ice-breaker" for new business.

AIDS like these!

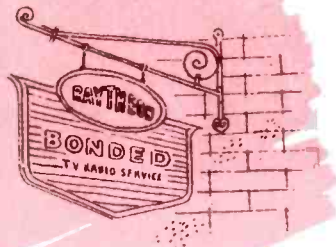
cooperation. See him soon for profitable deals exclusive for Bonded Dealers only!

Eye-Catching Window Valance

Smartly designed in red and gold, this colorful valance will really dress up your place of business . . . will give your storefront a whole new look. It sparks up your windows, makes your entire place of business more attractive.

Outdoor Sign

Finished in colorful metal—and featuring the Raytheon Bonded Service Dealer seal. Eye-catching sign identifies your store as headquarters for the Raytheon Bonded Repair Service to all who walk or drive by. Ready for fast, easy installation on side of building, on store front or in parking area.

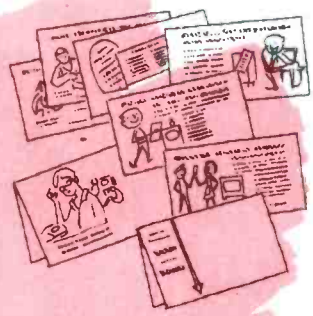


Truck Identification

Large, impressive Bonded Dealer decal, easy to apply to side of car or service truck. Weather-resistant, it will really dress up your vehicles . . . it's a traveling advertisement for your services! What's more, it identifies you as the Raytheon Bonded Service Dealer.

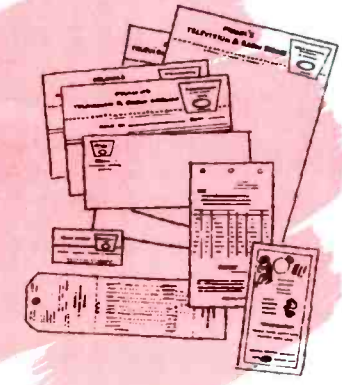
Direct Mail

One of the most economical methods for developing service business. You get a complete campaign that sells the bonded dealer guarantee . . . features your name and address. The informative, colorful, tested sales builders—available with or without your imprint.



Business & Shop Aids

A complete series of professionally designed printed materials . . . business cards . . . letterheads . . . billheads . . . job repair tags . . . reminder stickers for repeat business. Everything you need to get full benefits from the Raytheon Bonded Dealer Program. CHECK FREE SAMPLES THAT YOU GET WITH YOUR ORIGINAL KIT.



And, Coming Soon:

- RAYTHEON BONDED DEALER PUBLICATION
- BONDED DEALER AWARD PROGRAM
- TECHNICAL ADVISORY SERVICE
- INDUSTRIAL SERVICE REFERRAL PLAN

A *complete* program ready to go to work for you ▶

You can put this powerful bond to work building customer confidence on every call

Illustration is one-half actual size

Remember . . . your customers will see and learn about this bond throughout the year in

- TV GUIDE
- LOOK
- NBC MONITOR
- NEWSPAPER ADS
- OUTDOOR POSTERS
- CAR CARDS

RAYTHEON BONDED TV-RADIO SERVICE

Sign up!

Clip . . . Fill in and Mail Coupon Today!

Join today! The RAYTHEON BONDED DEALER PROGRAM is *the* outstanding profit plan for *independent* dealers like you. There are no dues! No fees! No gimmicks! It's open to recognized local, independent service dealers who believe in serving the public with top-quality materials . . . skilled services . . . fair prices.

Your efforts will be backed by the Raytheon Bond . . . National Advertising . . . Local Promotions . . . the *FREE* Bonded Dealer Merchandising Kit . . . Display Materials . . the best Distributor Service in the Industry . . . new bigger and better PROFITS!

All you do to join is cut out the form below, fill in, check off the materials you desire and mail to RAYTHEON. Raytheon will notify your sponsoring Raytheon Tube Distributor who will arrange all the details. If you are accepted as a Bonded Dealer, your distributor will work with you to see that you get *all* the benefits of the Raytheon Bonded Dealer Program.

That's all there is to it! It's easy—but best of all it's profitable—sign up today and cash in on this dynamic, exclusive profit program!

Send this form in today →

MAIL TO:

Mr. William Grey
RAYTHEON
55 Chapel St.
Newton 58,
Mass.

Cut along dotted lines

YES—I'm interested in taking full advantage of the nationally advertised Raytheon Bonded Dealer Program. I understand that there are no dues or fees involved, and that this program is limited to full-time, independent TV-Radio service dealers.

Check which you want:

- ☐ *FREE Merchandising Kit*
- ☐ *My name listed in TV Guide and LOOK*
- ☐ *Yellow Page listing*
- ☐ *Store identification*
- ☐ *Truck decal*
- ☐ *Direct Mail material*
- ☐ *Business Aids*
- ☐ _____

FIRM NAME: _____

BUSINESS ADDRESS: _____

CITY: _____ *ZONE:* _____ *STATE:* _____

TELEPHONE NO.: _____

YOUR SIGNATURE & TITLE: _____

Mail to Mr. William Grey, Raytheon, 55 Chapel St., Newton 58, Mass.

This is the program you've asked for...

- builds customer confidence and repeat business for you
- puts your name before your prospects through year-round local and national advertising

- gives you the *exclusive* use of an official *90-day repair bond* for each customer
- backs you with full-time promotional support.

Sign up NOW... to build for the future!

DISTRIBUTOR PRODUCTS DIVISION RAYTHEON
55 CHAPEL STREET • NEWTON 58, MASS.

PRINTED IN U.S.A. DLQ 7C04

GET more! DO more! MAKE more!

PROFIT PROFESSIONALLY ON EVERY CALL WITH

NEW B&K LOW-COST PROFESSIONAL Model 550 DYNA-QUIK

DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

Model 550

NET $119.95

Every service-technician now can easily check tubes the B&K professional way! Only with a *genuine dynamic mutual conductance tube tester* can you make a complete and accurate test under the actual dynamic operating conditions of the TV set. The compact new "550" is not just an emission checker. *It completely checks more tubes faster*—with laboratory accuracy. And the cost is so amazingly low, it pays its way over and over again! Take a tip from thousands of professional servicemen—*use B&K Dyna-Quik*. There is nothing like it.

Get More for Your Money

—IN SPEED, ACCURACY, AND VALUE

Save Customers

—SAVE CALL-BACKS, SAVE COST

Sell More Tubes

—MAKE MORE MONEY PER CALL

MODEL 550 DYNA-QUIK TUBE TESTER

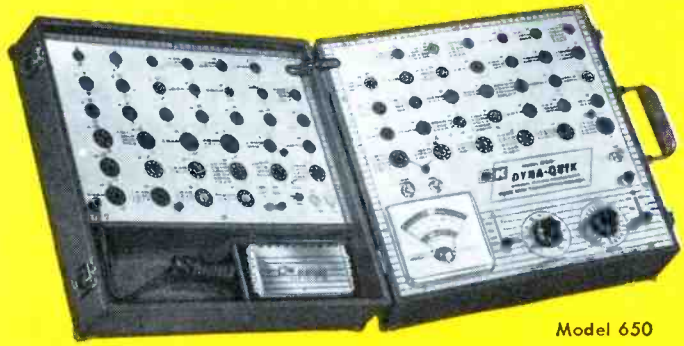
Tests Each Section of Dual-Section Tubes Separately

Great new value in professional quick-check at small cost. Provides **more** tube sockets to test **more** tubes faster. Accurately checks most of the TV and radio tubes usually encountered in everyday service work. Tests each section of dual-section tubes separately. **Measures true dynamic mutual conductance.** Checks tubes for shorts, grid emission, gas content, and leakage. Completely tests each tube in seconds, checks average TV set in a few minutes, in home or shop. One switch tests everything. Fast, convenient reference listings on socket panel. Patented circuit provides automatic line voltage compensation. 7-pin and 9-pin straighteners on panel. Handsome, luggage-type carrying case. Net, **$119.95**

MODEL 650 DELUXE DYNA-QUIK

Today's Finest Portable Tube and Transistor Tester

Accurately checks over 99% of the tubes most widely used in television receivers, plus popular home and portable radio tubes. Tests over 600 tube types. Lists over 125 most popular tube types, with settings, on socket panels for maximum operating speed. Complete listing in fast, index-type selector. **Measures true dynamic mutual conductance.** Tests each section of multiple tubes separately for GM, Shorts, Grid Emission, Gas Content and Life. Includes 16 spare sockets and ample filament voltages for future new tube types. **Transistor Section** checks transistors, diodes, and selenium rectifiers. Luggage-type carrying case. Net, **$169.95**



Model 650

B&K

B & K MANUFACTURING CO.

3726 N. Southport Ave. • Chicago 13, Illinois

Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

See Your Distributor or Send Now for Bulletin ST24-R

DIFILM®

BLACK BEAUTY®
CAPACITORS
BEAT HEAT AND HUMIDITY

New DIFILM Black Beauty Capacitors lead the way in tubulars! The operating temperature range of these new capacitors goes up to 105 C (221 F) *without voltage derating.* Capacitance tolerance is held to ± 10 %.*

• The new dual dielectric used in DIFILM Capacitors combines the proven long life of paper capacitors with the effective moisture resistance of polyester plastic film capacitors . . . to give you performance that can't be beat.

• Here's the kind of performance you can expect from DIFILM: very high insulation resistance, low power factor, moderate capacitance change with temperature, excellent retrace under temperature cycling, and superior long-term stability . . . *all at regular prices!*

• This high performance is fully protected by HCX®, an exclusive Sprague hydrocarbon material which impregnates the windings, filling all voids and pinholes before it polymerizes. The result is a solid rock-hard capacitor section. These capacitors are further protected by an outer molding of humidity-resistant, non-flammable phenolic.

For complete technical information on DIFILM Black Beauty Capacitors, write for Bulletin M-759 to Sprague Products Company, 105 Marshall St., North Adams, Mass.

*From .001 μF up

The major capacitor improvements come from

SPRAGUE®
world's largest capacitor manufacturer

SPRAGUE RESEARCH IS CONSTANTLY PRODUCING NEW AND BETTER CAPACITORS FOR YOU

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general manager
Mal Parks, Jr.

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associate editors
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Clifford 3-6441

Eastern

Cliff Landis
Corning Glass Building,
717 Fifth Ave., New York 22, N. Y.
MUrray Hill 8-6350

Western

The Maurice A. Kimball Co., Inc.
2550 Beverly Blvd., Los Angeles 57, Calif.
Dunkirk 8-6178; and 681 Market Street,
San Francisco 5, Calif. Exbrook 2-3365

Address all correspondence relating to circulation and editorial to PF REPORTER, 2201 East 46th Street, Indianapolis 6, Indiana

AUDITED PAID CIRCULATION ABC

PHOTOFACT **PF REPORTER**®

including Electronic Servicing

VOLUME 9, No. 8 AUGUST, 1959

CONTENTS

ABOUT THE COVER

Nobody with any sense at all would go out of his way to pick on a bumblebee—but what do you do when one picks on you? Anyone got an idea that will get our cover serviceman out of this uncompromising situation without sacrificing his tender nose?

For TV Technicians

RCA PRESENTS

A New Volt-Ohm-Milliammeter

...special ranges for transistor applications!

RCA WV-38A VOM

ONLY $43.95*

Also available as a KIT... only $29.95* Easiest-to-assemble ever!

(includes batteries, cable and probe with slip-on alligator clip, ground lead and clip)

*User Price (Optional)

WV-38A SPECIFICATIONS

Input Resistance	• 20,000 ohms per volt on DC 5,000 ohms per volt on AC
Accuracy (full scale)	• ±3% DC, ±5% AC
Regular Scales	• 2.5, 10, 50, 250, 1000, 5000 volts, AC and DC • 50 μa, 1, 10, 100, 500 ma, 10 amps (DC)
Extra Scales	• 250 mv. and 1 volt (dc)
Frequency Response	• AC—flat from 10 cycles to 50 Kc (usable response at 500 Kc)
Ohms	• 3 ranges: Rxl—(0-2,000 ohms), Rx100 (0-200,000 ohms), Rx10,000 (0-20,000,000 ohms)
Dimensions	• W. 5¼", H. 6⅞", D. 3⅛"

EXCLUSIVE! Extra 1-volt and 0.25-volt (250 mv) dc ranges for servicing transistor equipment!

EXCLUSIVE! New handle clips accommodate probes and test leads for extra carrying convenience!

You'll do a more professional servicing job with this highly accurate, versatile and stable VOM—a world-beater from the world leader in electronics!

Never so many valuable features packed into a VOM!—Ohms-divider network fuse-protected. Easy-to-read scales! Extra-large 5¼-inch meter. Polarity reversal switch. Improved frequency response. Full-wave bridge rectifier. Less circuit loading. Standard dbm ranges. PLUS—modern styling—it's an instrument you'll be proud to "show off" in the home or the shop!

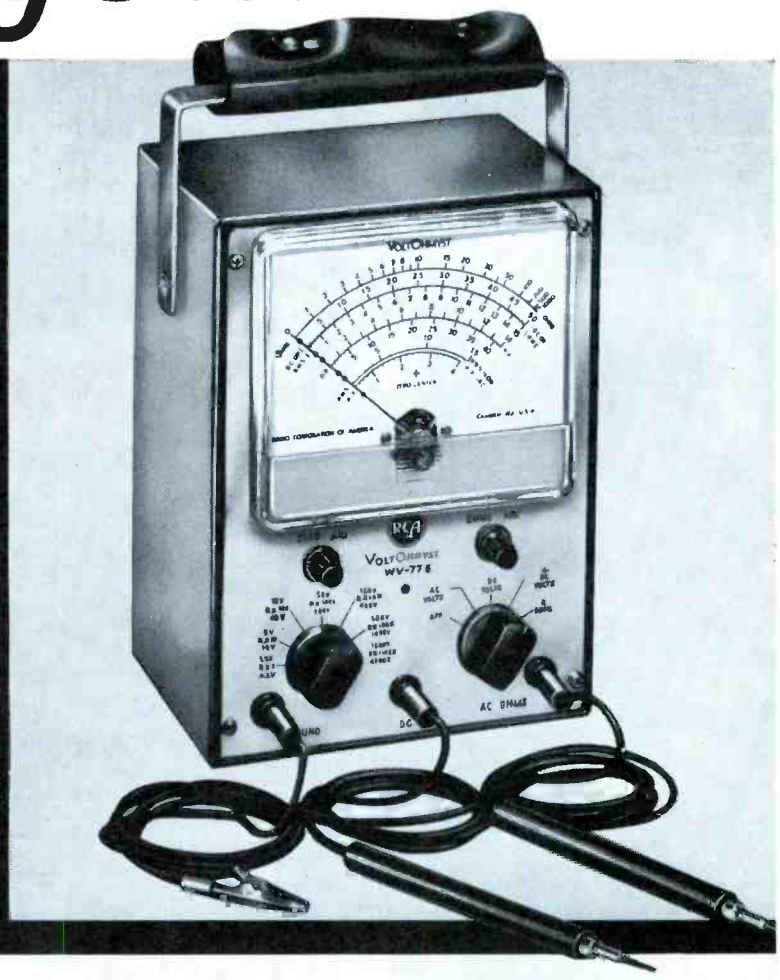
See it at your local RCA Test Equipment Distributor!

on the go...

RCA PRESENTS

A New VoltOhmyst

... with additional scales for accurate low-voltage measurement



RCA WV-77E VoltOhmyst **ONLY $49.95***

(includes test probes and leads, and ground clip and lead)

RCA WV-77E(K) VoltOhmyst Kit only $29.95*
Easiest-to-assemble ever!
*User Price (Optional)

FREE—New Booklet, "Servicing Is Easy with an RCA VoltOhmyst" offered with the purchase of a WV-77E or WV-77E(K) ($1.00 value).

SPECIFICATIONS

Measures:

DC Volts—0.02 volt to 1500 volts in 7 overlapping ranges

AC Volts (RMS)—0.1 volt to 1500 volts in 7 overlapping ranges

AC Volts (peak-to-peak)—0.2 volt to 4000 volts in 7 overlapping ranges

Resistance—from 0.2 ohm to 1000 megohms in 7 overlapping ranges. Zero-center indication for discriminator alignment

Accuracy—±3% of full scale on dc ranges; ±5% of full scale on ac ranges

Frequency Response—flat within ±5%, from 40 cycles to 5 Mc on the 1.5, 5, and 15-volt rms ranges and the 4, 14 and 40-volt peak-to-peak ranges

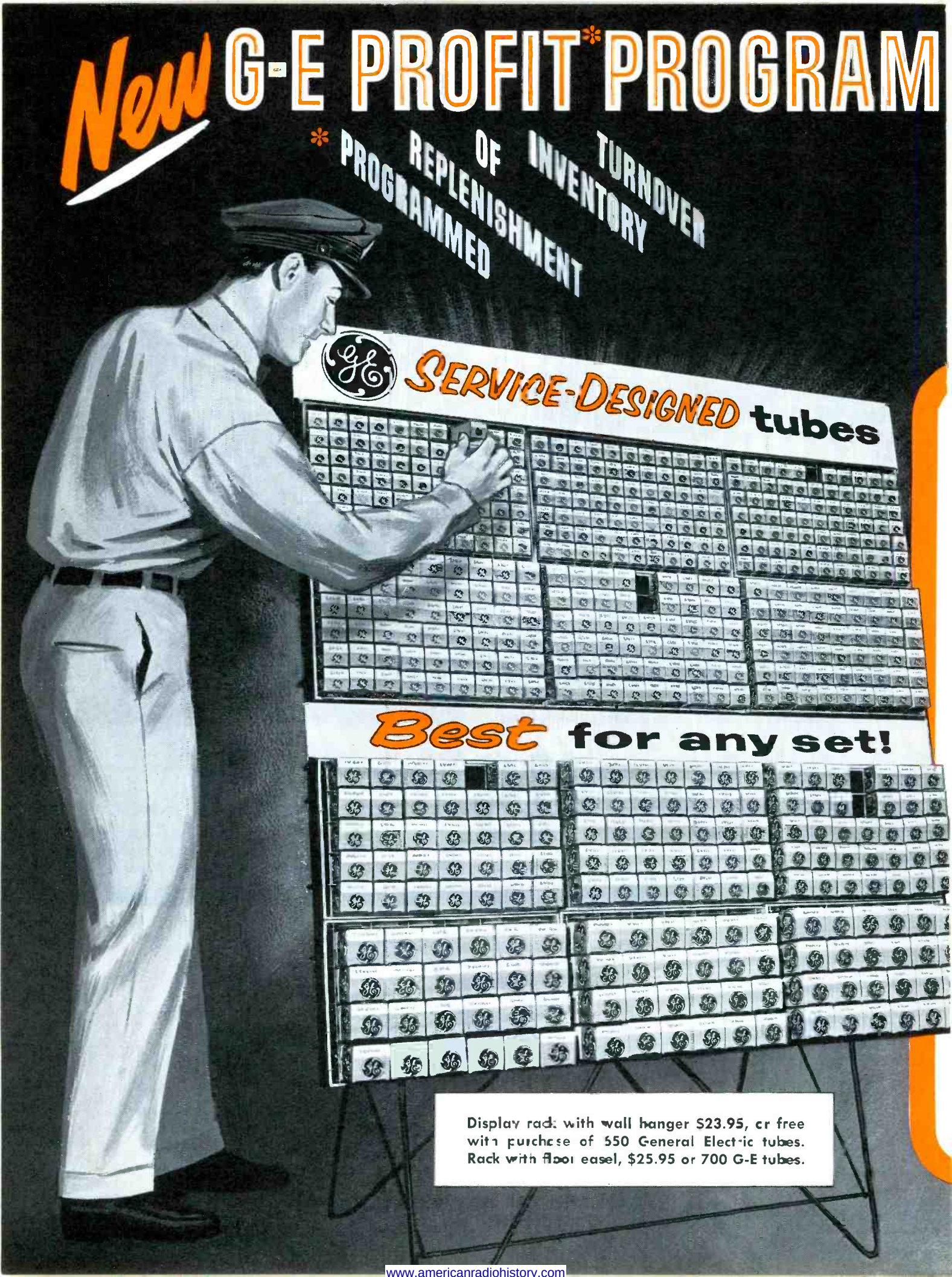
DC Input Resistance—standard 11 megohms (1 megohm resistor in probe)

Prove it to yourself! Here's a VTVM you can use almost anywhere —in the home, shop, or factory—combining flexibility, accuracy, and dependability!
Look what you get—ohms-divider network protected by fuse—ultra-slim probes and flexible leads for getting into those tight spots—leads, probes, and power cord can be stored in sleeve attached to handle for increased portability—separate scales for 1½ volts rms and 4 volts peak-to-peak maintain instrument accuracy on low ac measurements—all lettering on front panel acid-etched to last the life of the unit!
The RCA WV-77E VoltOhmyst is available "off-the-shelf" from your local RCA Test Equipment Distributor. See it, try it—bet you buy it!

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

New G-E PROFIT* PROGRAM

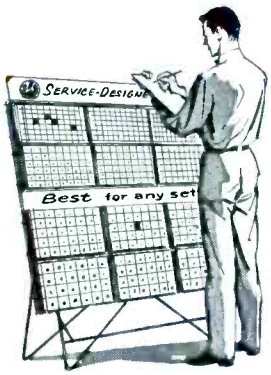
* TURNOVER OF INVENTORY REPLENISHMENT PROGRAMMED



Display rack with wall hanger $23.95, or free with purchase of 550 General Electric tubes. Rack with floor easel, $25.95 or 700 G-E tubes.

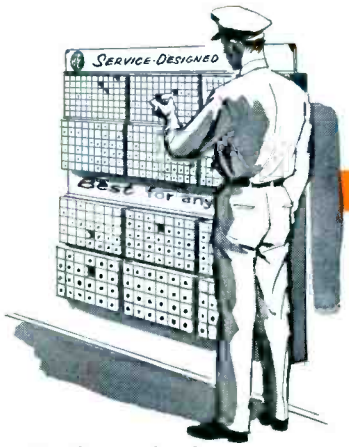
Streamlines Your Tube Sales for Fast Turnover, Top Volume!

Missing cartons show what tube types you should reorder.



Your tube inventory can easily be checked at a glance.

A second display will accommodate additional supply of tubes.



Rack can be hung on a wall if floor space is not available.

A General Electric "first"...that sells more tubes, saves record-keeping, *provides the tubes you need when you need them!* This is G.E.'s new PROFIT* Program, packaged for you in the finest, most complete tube display rack ever offered to TV technicians.

See (left) how easy it is to select types... how stock rotation is assured by orderly tube removal and replacement! Note the Display's ample dimensions—44″ high plus 16″ for easel base; 40½″ wide—providing plenty of space for a scientifically planned tube inventory!

If you invite customer self-service, the Display is ideal for that purpose. Also, your stock of tubes can be checked visually at any time. Missing cartons tell you what types to reorder, and how many, since the type numbers of all tubes taken out can be recorded in back. Book-keeping is virtually eliminated.

Over-stocking and tube shortages: both are banned by the Balanced Inventory feature. Your tube dollars work harder than ever before. See your nearby G-E tube distributor today about General Electric's Service-Designed Tube Display with brand-new, built-in inventory control! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

2-111-222

Letters to the EDITOR

Dear Editor:

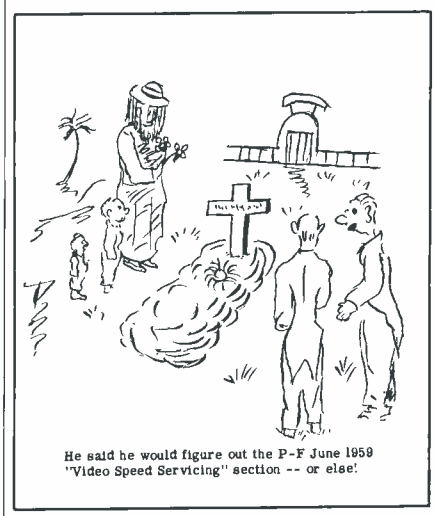
The July article "P's and Q's of Transistors" was very well done. There is one point, however, that we feel should be further clarified. On page 64, 1,000 ohms is given as the lowest figure for the forward resistance of audio power transistors (using the R x 100 ohmmeter scale). While this is essentially true of low power (small) audio units, high power types such as those used in the output stages of auto radios have considerably less forward resistance—down to 50 ohms on the R x 1 scale (with the unit disconnected from the circuit and at room temperature).

We would appreciate your bringing this to the attention of your readers, since it will be quite a serious and expensive matter if POWER transistors are tested and replaced on the basis of the information given in PF REPORTER.

W. C. CALDWELL

Delco Radio Div.
Kokomo, Indiana

An excellent point! We overlooked it because the article was prepared with portable-radio servicing in mind.—Ed.



W. H. KOEHLER

Missoula, Mont.

Dear Editor:

I've just received the June issue and noted the item in the *Letters to the Editor* column where the *Troubleshooter* excuses his mistakes by saying he is testing his readers. Well, that explanation is as good as any.

However, I wonder if you are also testing the readers with the scrambled-up versions of *Video Speed Servicing* in the same issue?

W. P. LOVINGGOOD

Maplewood, La.

Dear Editor:

Re—Video Speed Servicing June, 1959
Section Affected—Both.
Symptoms—Confusion.
What To Do—Cut diagrams on lines; attach Zenith diagrams to Zenith diagnoses and RCA ditto to ditto with Scotch tape.
Cause—SNAFU

NORMAN D. SLATER

Ogdensburg, N. Y.

Dear Editor:

Just for the record, this is the first serious mistake I've found in this magazine since I've been a subscriber. It pleases me to find out after all these years that you're human, too.

HOWARD E. SANTEE

Kalamazoo, Mich.

Dere Editerer:

I allus thut RCA und Zenith twenrnt su mutch diffrunt us yuh mak out but then I um jest wun uf thu dumberer wunes wat reid yur maggotzene.

Hoppin yuh mak thissun ought quikkerin i ded yer slo speederin paigez fur Jun.

GESS WHOU

Denver, Colo.

Dear Editor:

It was sure fun unscrambling the *Video Speed Servicing* sheets in the June issue. Keeps a guy on the alert. Was this accidental or intentional?

K. D. WRIGHT

Cheswick, Pa.

Dear Editor:

The June *Video Speed Servicing* appears to be "out of sync." All the diagrams are 180° out of phase with the printed matter! I would like a corrected reprint if possible, as I keep these sheets on file and consider them very handy service aids.

ROY C. BASSETT

Topeka, Kansas

No excuses this time; we're not claiming that the scrambled diagrams were a test of readership. Had we any lingering doubts over the "rating" of the Video Speed Servicing feature, they were removed when the letters on the Editor's desk reached eye level. And error it was —a genuine hand-engraved, diamond-studded, 24-karat snafu!

As mentioned in this column last month, we've prepared corrected reprints which may be had simply for the asking.

We really appreciated the good-natured, understanding tone of most of your letters. Knowing we have so few soreheads among our readers, we'll try harder than ever to please you!—Ed.

Dear Editor:

Lately I've noticed quite a few articles (not in your book) about part-timers in the radio and television repair business. These part-time servicemen are said to be taking away business from established shops by charging lower prices, operating after the regular shops are closed, and

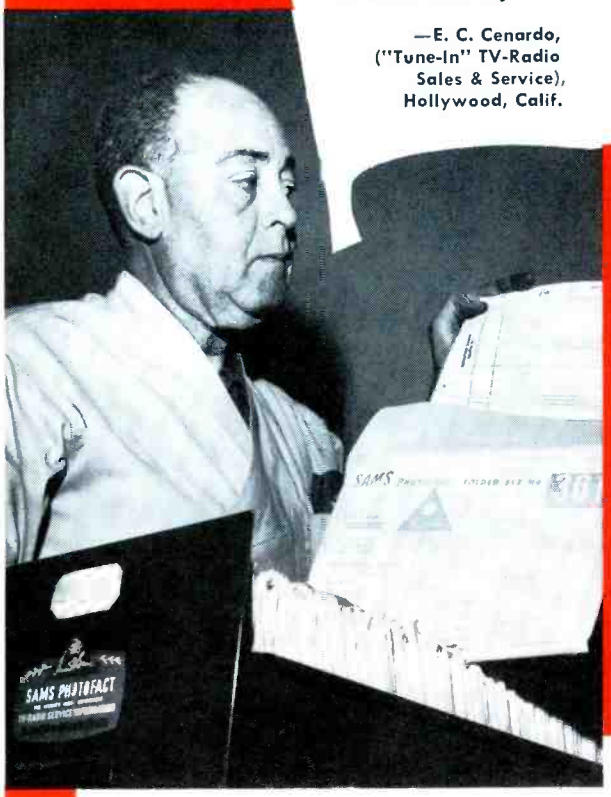
• *Please turn to page 36*

ownership of a PHOTOFACT SERVICE DATA LIBRARY SPELLS SUCCESS FOR SERVICE TECHNICIANS

here's actual proof from the men who know

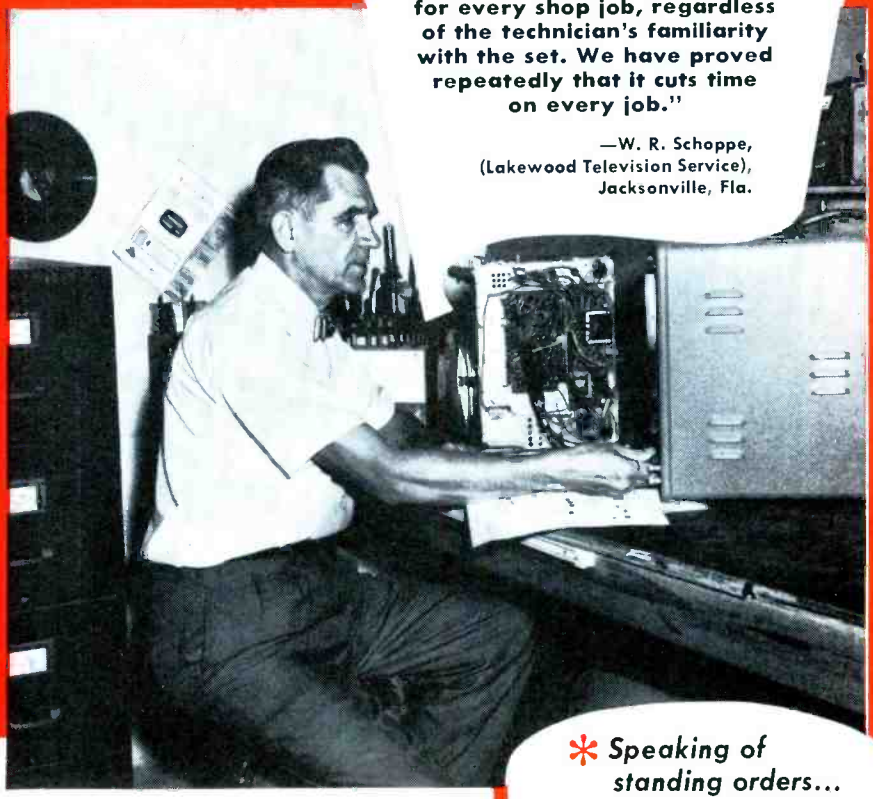
"PHOTOFACTS are a tremendous aid to a service technician in that they save hours of unnecessary work."

—E. C. Cenardo,
("Tune-In" TV-Radio Sales & Service),
Hollywood, Calif.



"It is impossible to do business without PHOTOFACT. It is a standing order* in our shop to pull PHOTOFACT from the file for every shop job, regardless of the technician's familiarity with the set. We have proved repeatedly that it cuts time on every job."

—W. R. Schoppe,
(Lakewood Television Service),
Jacksonville, Fla.



HERE'S MORE PROOF...FROM COAST-TO-COAST

"PHOTOFACTS mean so much to my business that would not think of operating for any length of time without them."
—James G. Haynes
Leitchfield, Ky.

"The PHOTOFACTS that I have purchased on the Easy-Buy plan have been paying for themselves each month."
—Donald Johnson
Hector, Minn.

"PHOTOFACT means faster service to my customers, and more sets through my shop, which means more profit to me."
—Frank J. Schumacher
Hillsboro, Ore.

"I would be lost without SAMS PHOTOFACT. PHOTOFACT has become a part of servicing."
—Joseph S. Musil
Stamford, Texas

"PHOTOFACT means quicker and more efficient service to the customer."
—Wesley F. Scott
Logansport, Ind.

"Would not be without my PHOTOFACTS. Their return in time saved on servicing, pays for their cost many times over."
—E. R. Hayes
Clemson, S. Car.

(These are just a few of the hundreds of "Success w th PHOTOFACT" letters in our files)

* *Speaking of standing orders...*

you'll find the truly successful Service Technicians are those who stay ahead because they're on a Standing Order Subscription with their Distributors to receive all new PHOTOFACTS as released monthly...

For Standing Order Subscription and Easy-Buy Plan details, see your Sams Distributor today, or write to Howard W. Sams...

NEW EASY-BUY PLAN!

It's the money-saving way to build your complete profit-making PHOTOFACT Library!

NO INTEREST—NO CARRYING CHARGE—AS LITTLE AS $10 DOWN

FREE! Valuable steel file cabinets given to PHOTOFACT monthly subscribers and Library purchasers.

Valuable booklet shows you how PHOTOFACT boosts your profit-capacity

FREE

Send for it!

HOWARD W. SAMS & CO., INC.
2201 E. 46th St., Indianapolis 6, Ind.

☐ Send me Free booklet "Your Guide To Maximum Profits"
☐ I'm a Service Technician: ☐ full-time; ☐ part-time

My Distributor is:_____

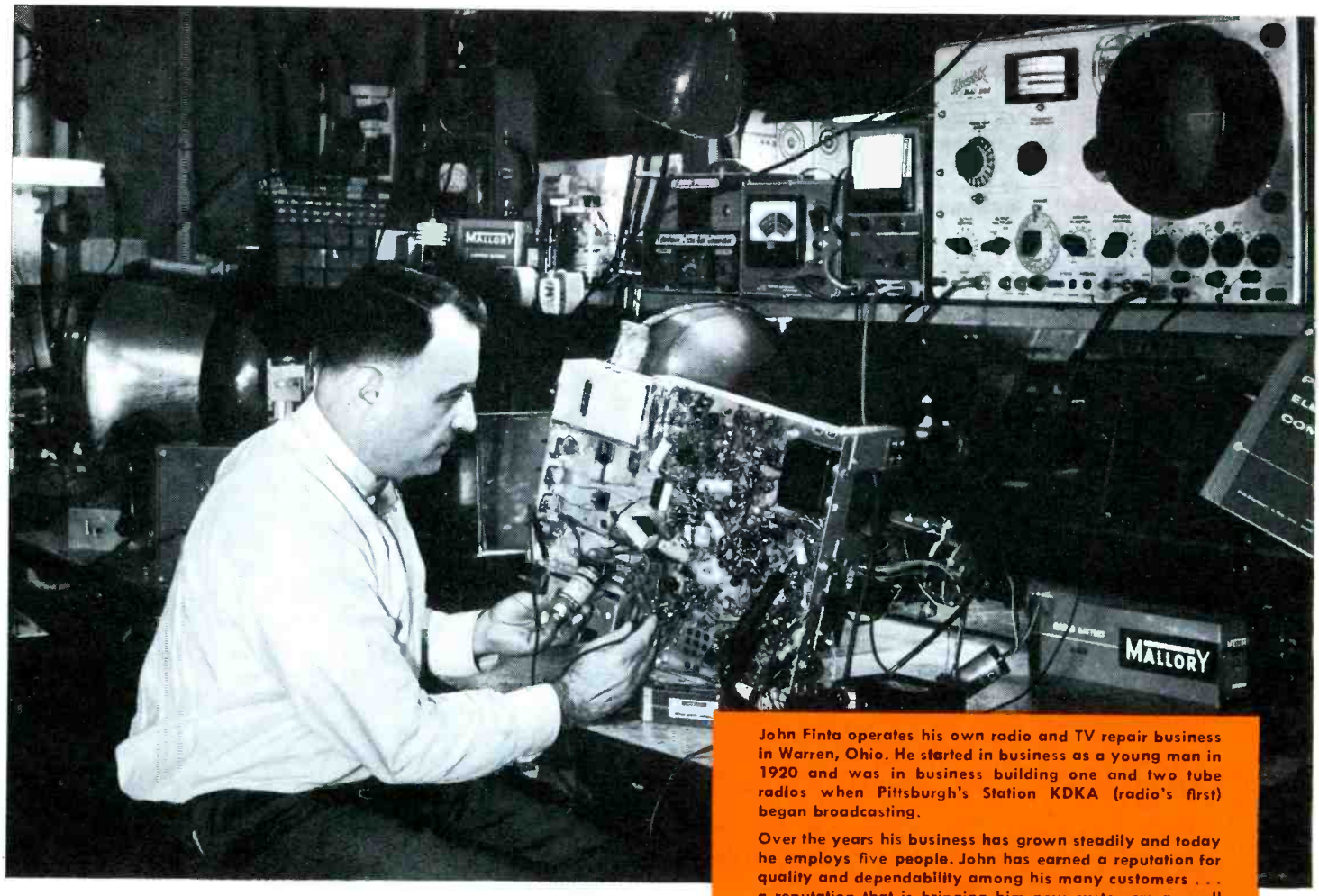
Shop Name_____

Attn._____

Address_____

City_____ Zone_____ State_____

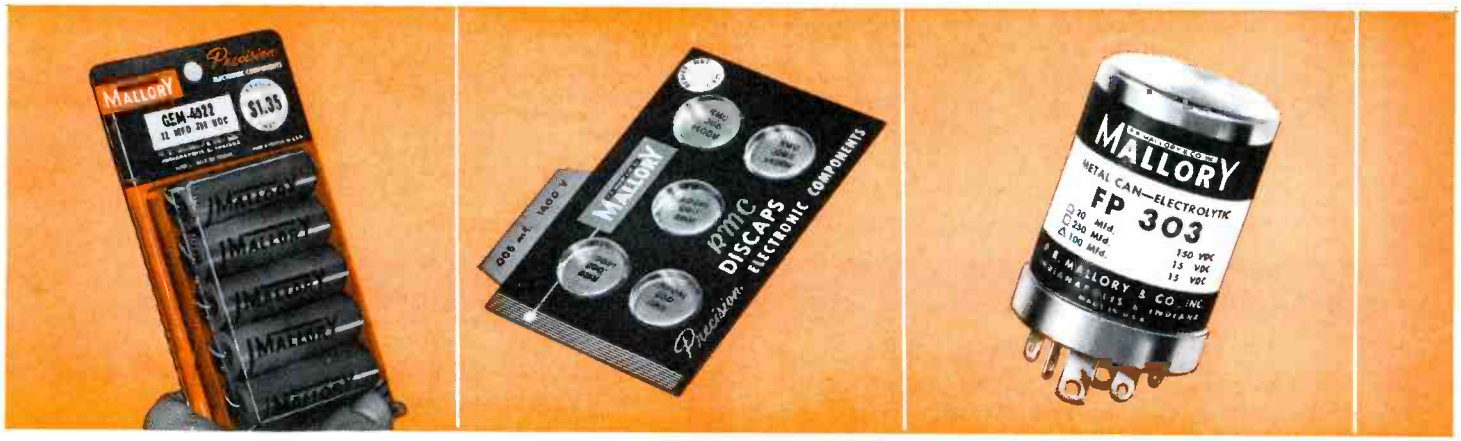
Service Technician John Finta Says...



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

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

Cut Call-Backs with These Quality Mallory



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

RMC Discaps®—are a product of the world's largest producer of ceramic disc capacitors. Long the original equipment standard, Mallory RMC Discaps are now available for replacement. They come in a handy 3" x 5" file card package . . . easy to stock, simple to use.

FP Electrolytics—The Mallory FP—the original 85°C capacitor—now has improved shock-resistant construction and leakproof seal. Its etched cathode construction—standard in all FP's—assures hum-free performance. High ripple current ratings fit the toughest filter circuits.

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

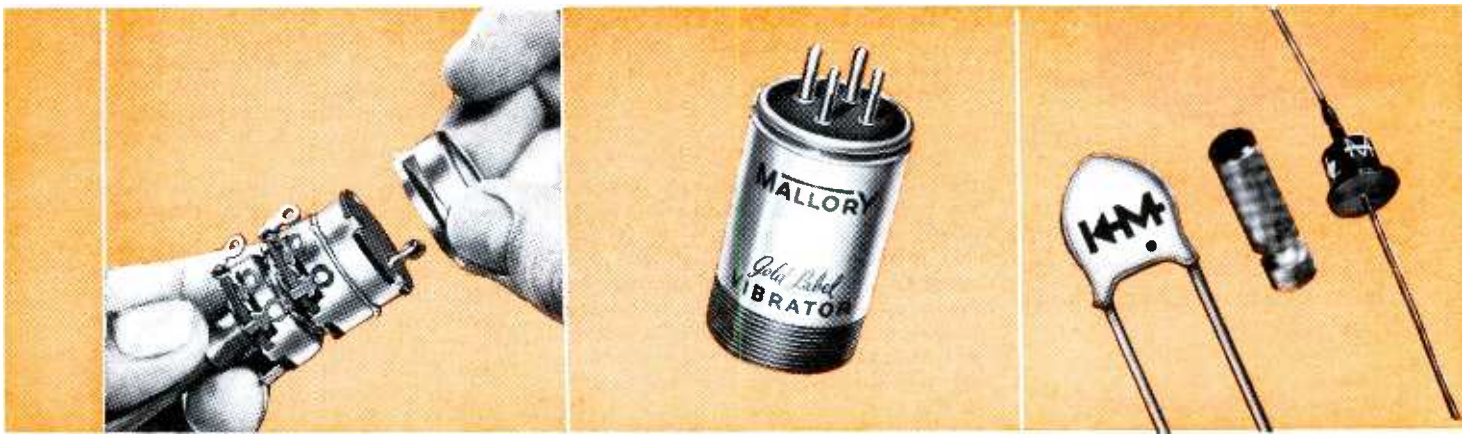
“Nothing gets under your skin more—or eats into your profits deeper—than time consuming, expensive call-backs. But, there’s one sure way to stop them: use only quality replacements.

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

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

P.R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

Products...



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

Gold Label* Vibrators—On critical auto radio servicing, use the Mallory Gold Label Vibrator. It gives longer, trouble-free service life. Mallory Gold Label Vibrators feature Mallory exclusive buttonless contact design.

**Trade Mark*

Silicon Rectifiers—New Mallory design gives far longer life, lower forward voltage drop, and reverse leakage current than conventional types . . . exceed the requirements of military humidity tests. In convenient kits for replacement of selenium rectifiers in radio and TV.

Letters

(Continued from page 32)

(in some cases) putting in parts which are not needed. In at least one instance, they are referred to as "night crawlers."

These articles disturbed me for awhile, but not any more. I have contacted all the full-time shops in my town (four in all), and every one of them started in as part-timers or else operated from their homes.

True, part-time service people do take away some of the work from the established shops. Here are some of the reasons why customers leave one shop and look for another TV man: Slow service, sometimes two or three days; sloppy dress; "That other TV man was arrogant and treated me like a numbskull;" "He left a mess on my clean floor;" "The other man put in three or four tubes and still my set does not work;" and so it goes on and on. Please do not put too much blame on the part-timer if he takes some of the customers away from another shop.

I am now a part-timer, but I hope to have a shop of my own some day. Then maybe I'll cuss about part-timers.

E. A. FERGUSON

Snohomish, Wash.

You may find carping comments about "night crawlers" in other publications but not in ours.

In our opinion, it makes little difference if a man operates full or part-time, providing only that he practices sound business principles, and works toward giving his customers full value and improving his technical skills.—Ed.

Dear Editor:

Right after I entered my subscription to PF REPORTER, I had on my bench a Capehart CX-88 set with a width problem. That evening, I started reading my latest copy of that "Grand Old Book," and right before my eyes was an article on the CX-88 which told what to do if proper width could not be obtained. I feel that this one article fully paid for my subscription for the next two years.

DOUGLAS E. BENNETT

Ferndale, Mich.

Naturally.—Ed.

Dear Editor:

You have the best magazine in the business, but I sure miss the statistics you used to publish. I would like to know how many sets are being sold this year compared with last year, how many CRT's and receiving tubes are being sold, and such business. It sure is nice to know what John Doe is buying; this knowledge is useful as a yardstick for your future service and selling programs.

E. D. LAMB

Tacoma, Wash.

Here are some recent statistics gathered by the Electronic Industries Association:

Only 4.9 million black-and-white TV sets were produced during 1958. This figure is quite a drop from the 6.4 million sets built in '57. Total number of TV's in use at the end of 1958 was estimated at 49.7 million. At the same time, approximately 96 million home radios, 47 million auto radios, and 29.9 million phonographs were in use.

In the first three months of 1959, the staggering total of 2,240,451 picture tubes were sold as replacements for existing units. Some 104,146,000 receiving tubes were also sold during the same period.

Any other readers agree with Mr. Lamb?—Ed.

Dear Editor:

We used to hear a lot about pay TV, but suddenly we hear no more. Is it shelved? If not, what is its present status —are we going to get it or not?

JERRY BECCIA

Waterbury, Conn.

Pay TV isn't dead, but it's suffered many discouragements in the past year. About the only successful enterprise has been big-screen closed-circuit TV, such as was used to show the recent Patterson-Johansson fight in movie theaters of various cities.

The wired pay-TV system in Bartlesville, Okla., so greatly publicized a year or so ago, has quietly starved to death. Ambitious plans to wire up Los Angeles for toll-televising Dodger games have run into snags, too.

Besides generally unfavorable public opinion, the biggest barrier standing in the way of pay TV is a hostile atmosphere in Washington. Congress has rather grudgingly okayed the FCC's proposals for allowing tests of "one pay-TV system per market—one market per system," but the test conditions are very strict. For one thing, the promoters of pay-TV setups themselves must bear the heavy financial burdens of conducting the tests, with considerable risk of losing these investments. Having been told in effect to "put up or shut up," many pay-TV interests have chosen to do the latter for the time being, but word has it that some are planning to go full steam ahead.—Ed.

Dear Editor:

I find PF REPORTER to be the best reference guide for information when working on tough troubles. Even have a special book shelf at my bench for same.

A. B. WALTHER

Malverne, N. Y.

We're flattered to know our magazine has such a place of honor.—Ed.

Dear Editor:

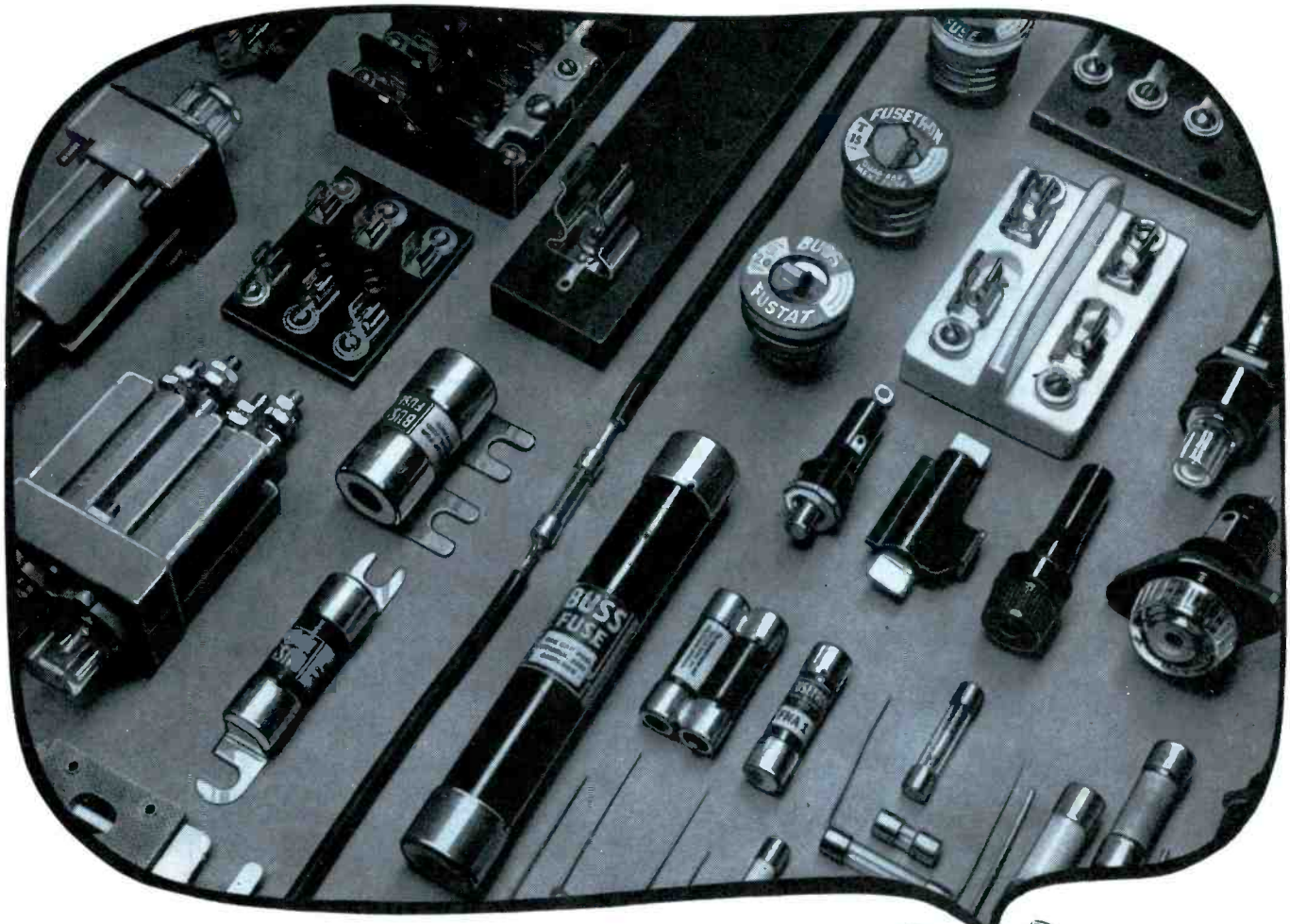
My congratulations to the U.S. Post Office for finally getting my copy of PF REPORTER to me in reasonably good shape. Usually, when it arrives on a rainy day, I have to iron it (after it's been on the line to dry) in order to read it.

J. M. PORACKY

Canton, Ohio

When we introduce our special tropical edition, printed on waterproof Mylar, we'll put you on the mailing list.

Meanwhile, we'll try and talk the weatherman into arranging things so your copy will be delivered on a clear day.—Ed.



To Assure You Safe, Trouble-Free Electrical Protection

every BUSS Fuse is electronically tested!

Before a BUSS or FUSETRON fuse ever leaves the plant, it must meet our high quality control standards.

Each fuse is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

Thus . . . by selling and installing BUSS and FUSETRON fuses you have one more way to help safeguard your reputation for service and reliability.

Complete Line For All Your Fuse Needs

Single-element fuses for circuits where quick-blowing is needed.

Single-element fuses for normal circuit protection.

Dual-element, slow-blowing fuses for circuits where harmless current surges occur.

Indicating fuses where signals must be given when fuses open.

BUSS fuses range in size from 1/500 amperes up — and there's a companion BUSS line of fuse clips, blocks and holders.

Your customers Know and prefer BUSS fuses

The ready acceptance of BUSS fuses is built on the millions upon millions of BUSS fuses used in homes and industry over the past 44 years. When you furnish BUSS, your customers instantly recognize that you are providing them with the finest electrical protection possible.

For more information, write for BUSS bulletin SFB.

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

859

BUSS fuses are made to protect - not to blow, needlessly.

BUSS makes a complete line of fuses for home, farm, commercial, electronic, electrical, automotive and industrial use.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS
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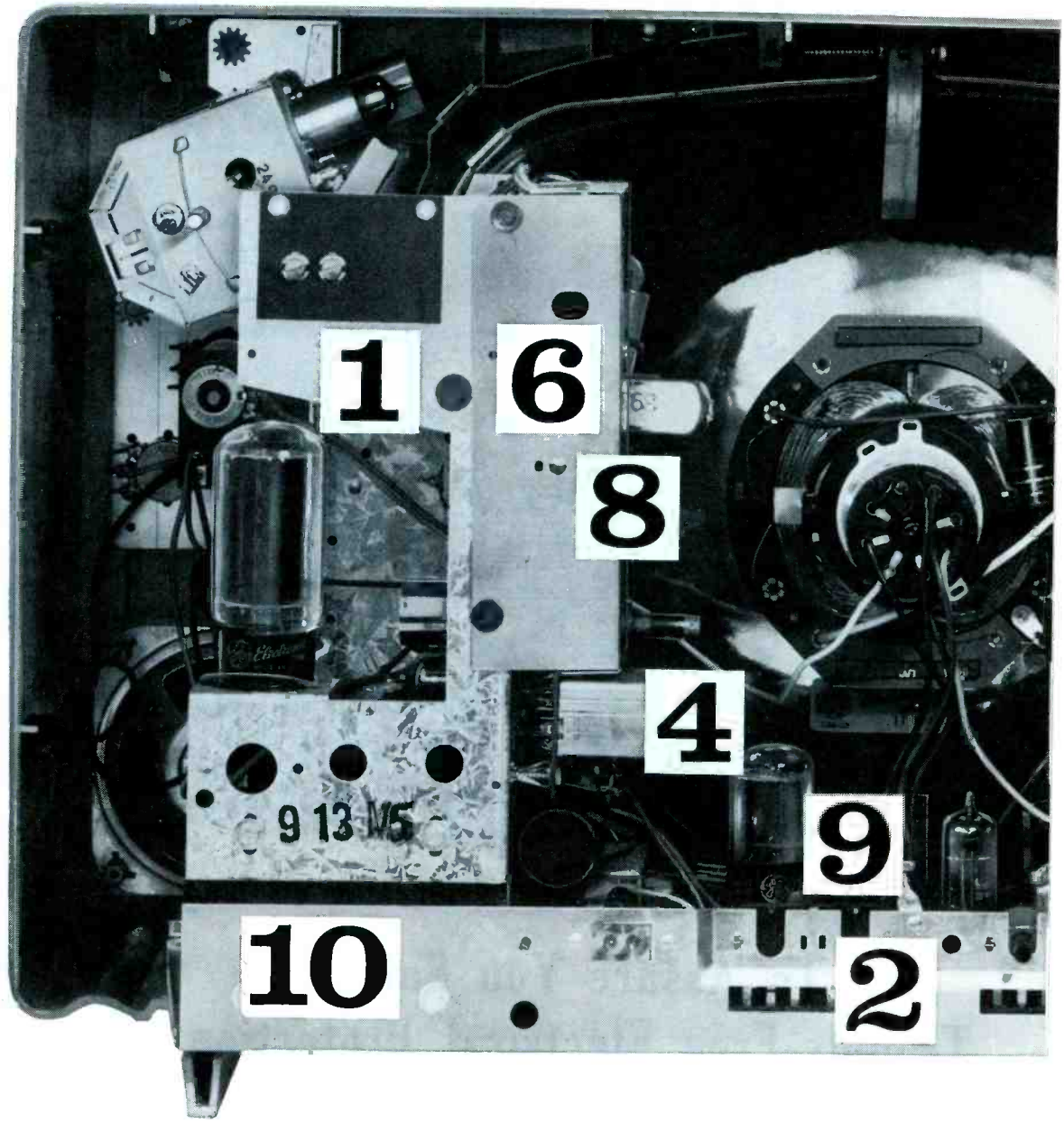


Now all 1960 General Electric TV sets have wonderful "Designer" TV serviceability! This means that in at least 9 out of 10 repairs you need not pull the chassis *or* the picture tube.

It's much simpler to circuit trace or replace parts, get at the key check points. Tubes are directly replaceable. And all fuses are accessible.

This leads to a higher home completion rate. Result: greater productivity. You make more calls.

Attribute this to Precision Etched Circuitry—another contribution to General Electric quality and performance.

Another thing you'll like: You can get at both sides of the printed board *while the chassis is still in the cabinet.* And the painted schematic gives you a "road map" to follow—a great time-saver in a situation where time means money.

Is it any wonder that service men are discovering that General Electric makes not only the finest sets in television—but the easiest-to-service sets, too! General Electric Company, Television Receiver Department, Syracuse, New York.

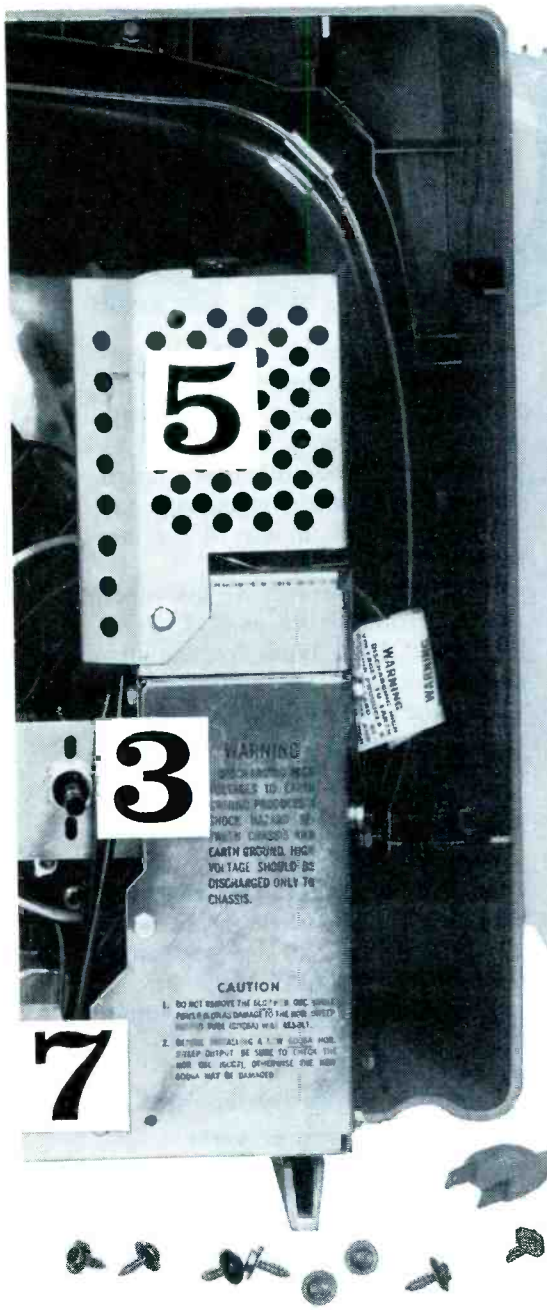
1. Both line and high-voltage fuses are readily accessible and replaceable.

2. Vertical linearity and height controls easily reached without removing back.

3. Width switch to adjust picture width to line voltage—accessible without removing back.

4. Video detector shield easily removable, and video detector may be unsoldered from circuit without removing chassis or picture tube.

5. All tubes are service designed and accessible. Tapered tube pins and special sockets insure easy



NOW! DO 9 OUT OF 10 REPAIRS WITH-OUT PULLING CHASSIS OR PIX TUBE ON ANY '60 GENERAL ELECTRIC TV SET!

removal and positive contact.

6. Both sides of the printed board may be reached without removing chassis or picture tube.

7. Horizontal hold control can be adjusted very easily without removing the back.

8. Precision Etched Circuitry has a painted connection diagram on component side of the board for easy circuit tracing.

9. All components are mounted on only *one* side of Precision Etched Circuitry boards.

10. Power transformer on *all* models.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Manager, Product Service
General Electric Company
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P.O. Box 1122, Syracuse, New York

Please send me a *free* copy of:
FACTS ABOUT PRINTED CIRCUITRY.

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Address_____

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PR-8

Let's talk about VERTICAL

Besides such well-known defects as dead oscillator, inadequate sweep, poor linearity and loss of sync, the practicing serviceman must also combat such troubles as vertical bounce, poor interlace and distorted sweep. These troubles are found in both steady-state and intermittent conditions. All are discussed in this article—some treated as specific case histories and some described in a more general vein.

The circuits in Figs. 1 through 5 are representative of the different basic vertical sweep systems used in TV receivers. Each has some design individualities worthy of discussion. In Fig. 1, for example, the sawtooth-forming network (C1 and R1) is on the amplifier side of the coupling capacitor; it can be on either side, but is generally found in the oscillator plate circuit. In Fig. 2, amplifier plate voltage is applied midway between the two vertical-yoke windings. More often than not, it is applied to the output transformer rather than to the yoke; this circuit is shown merely to indicate the variation. Fig. 3 shows an auto-transformer used in a blocking-oscillator hookup. Take note, however, that this doesn't change circuit operation at all. The circuit in Fig. 4 uses the linearity adjustment to control bias voltage on the grid of the amplifier, rather than the more common method of varying cathode voltage. The circuit in Fig. 5 employs a triode-connected pentode for the output amplifier, whereas quite frequently this stage is operated as a pentode. The different design characteristics just pointed out may be interchanged in any of the circuits.

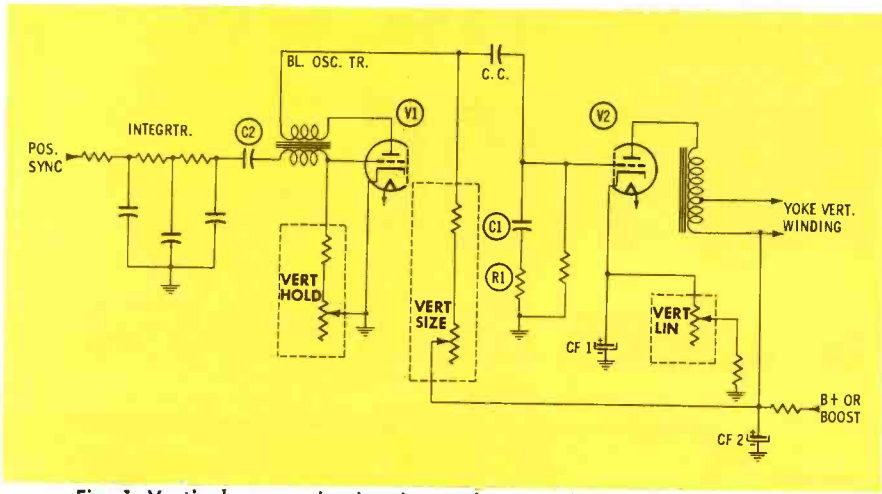


Fig. 1. Vertical-sweep circuit using a plate-coupled blocking oscillator.

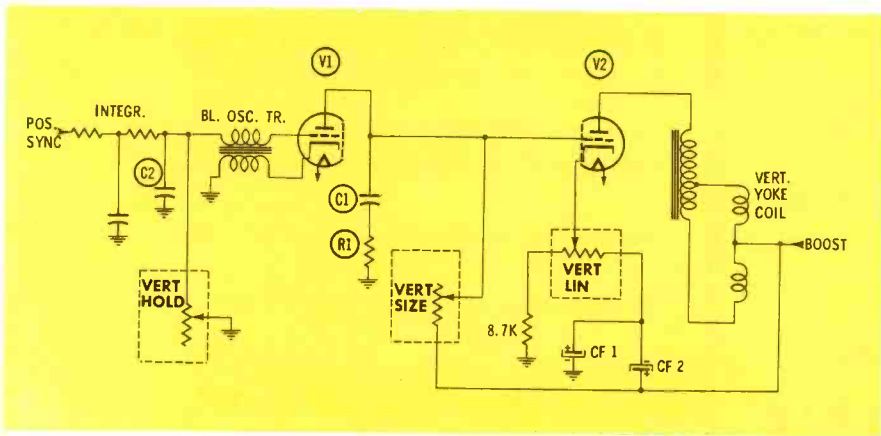


Fig. 2. Vertical-sweep circuit using a cathode-coupled blocking oscillator.

In Figs. 1 through 4, the tubes are dual triodes such as SN7, CG7, BL7, and BH7 types, or the dissimilar double triodes like the CS7, CM7, or DE7 types developed especially for the vertical-sweep systems used most recently. The dissimilar double triodes contain a medium-mu low-power section and a section capable of power amplification. The circuit in Fig. 5 usually employs a dual triode such as a 12AU7 or 6SN7 for the oscillator, and a 6W6 or 6AQ5, either triode or pentode-connected, for the output stage.

Size and Linearity Troubles

Inadequate sweep or vertical size with normal linearity is the result of an inadequate yoke field, and may be traced to a defective output transformer, weak output tube, low supply voltage to the circuit, or any other abnormality that reduces deflection power to the yoke. Loss of capacity in the filters associated with the circuit should be suspected when the lack of size is accompanied by poor linearity, a symptom which can only be attributed to distortion in the shape of the sawtooth yoke current.

Poor linearity with the bottom half of the raster shortened is a condition that often stems from a less-than-normal charge being assumed by the sawtooth-forming capacitor. The cause may be leakage in the capacitor (C1 in Figs. 1 through 5), an increase in the resistance of R1 or the oscillator plate-load circuit, or slight leakage in CC, the capacitor that couples the signal

SWEEP SYSTEMS

. . . and pin down all those hard-to-trace trouble symptoms to specific sections and components—by Allan F. Kinckiner.

to the output amplifier. Note that word "slight." If this leakage is significant, it will cause foldover at the bottom of the raster. Any of these defects will lower the voltage to which the sawtooth capacitor can charge. Actually, this may reduce raster size linearly; however, adjustment of the linearity control will cause the top to appear normal, giving the impression that only the bottom half has reduced in size.

Poor linearity with the top half of the raster shortened is generally due to a fault in the amplifier circuit —the usual causes being too much bias on the tube, an open cathode-bypass capacitor, or insufficient voltage at the plate.

Poor linearity with bunching of the topmost raster lines (first 8 or 10 of those visible) is most often found in sets employing one of the blocking-oscillator circuits. The bunching effect is caused by improper retrace, which is often due to excessive residual magnetism of the oscillator-transformer core. If previous checks have definitely isolated the defect to the transformer, shunting the primary winding with a 10 to 20K-ohm resistor will probably eliminate the trouble. If it does, a replacement transformer should be tried. In some instances (because of original design defect or compounded circuit aging), even a new transformer won't eliminate the bunching, and you'll have to resort to the shunt resistor anyway.

Poor linearity, with bunching of raster lines at both top and bottom and the center of the raster spread out, has been found in sets where filter CF2 (Figs. 1 through 5) was open or had lost capacity. In these cases, it is often possible to attain adequate sweep, but circular images will be more square than round. Generally, an open CF2 filter is accompanied by other noticeable

• *Please turn to page 78*

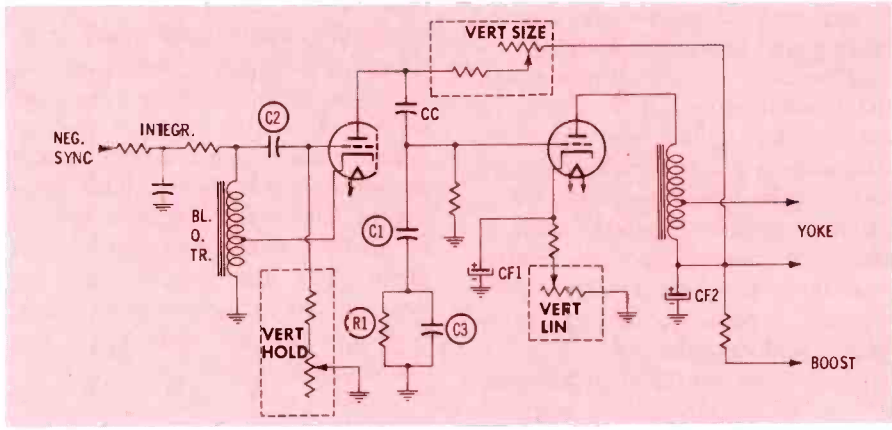


Fig. 3. Blocking oscillator circuit which uses a tapped transformer.

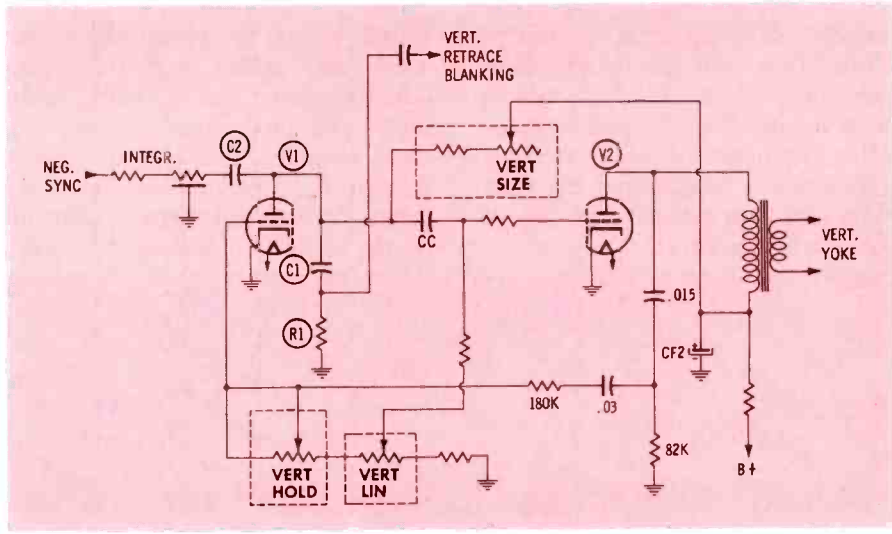


Fig. 4. Dual triode used as both multivibrator and output amplifier.

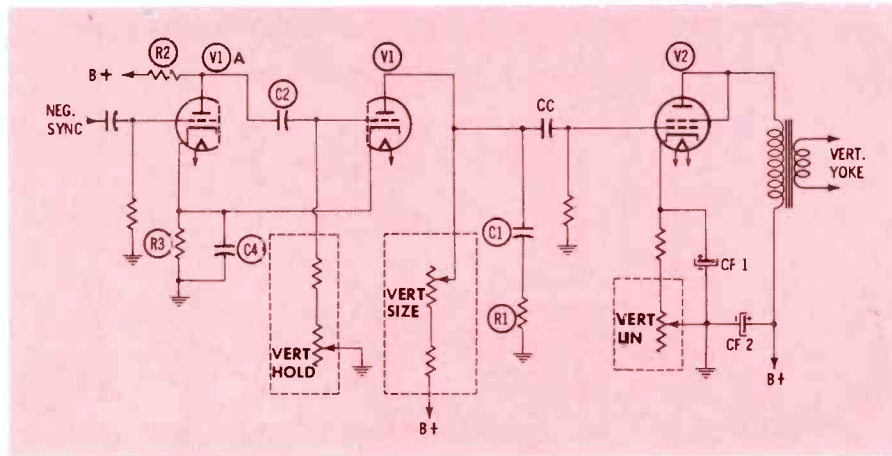


Fig. 5. Cathode-coupled multivibrator with separate tube in the output stage.

How to choose and use MICROPHONES

Microphones are used wherever sound must be converted to electrical signals—with PA systems, both indoors and out, in tape and disc recording, and in communications systems such as amateur, commercial, and broadcasting. In selecting a mike for a particular use, the audio technician has a tremendously wide variety from which to choose. The ultimate choice depends upon a number of microphone characteristics. Among these are directivity, impedance, sensitivity, frequency response, and ruggedness.

In this, and the October column, we will thoroughly discuss each of these characteristics. Then we will consider the advantages and disadvantages of each type of microphone, plus any special problems concerning usage. An audio system is no better than the microphone which originates the signal, so some consideration in choosing the right mike, and then using it correctly, is well worth the effort.

Characteristics

While price is not actually a characteristic, there is no doubt that it is an important factor in the selection of a mike for a particular use. While microphone prices vary from several dollars to several hundred dollars, many high quality mikes are available in the medium price ranges, and these are adequate for all except the most exacting requirements. The primary difference between mikes in various price ranges is the extent and linearity of frequency response.

Directivity

Some microphones can handle sound waves from any direction. These are called non-directional, omnidirectional, or polydirectional mikes, all three terms having the same meaning. This type of pickup pattern is illustrated in Fig. 1A, where "X" indicates the placement of the mike. In this arrangement, adequate pickup is obtained from any point within a given radius.

Another type of directional pattern is shown in Fig. 1B. This is a bidirectional pattern, meaning that the unit can pick up sounds from two general directions. Adequate pickup can be obtained from any point within either of two circular areas of specified radius. Minimum response occurs for sounds originating in directions along a common tangent to the circles.

The other general type of pickup pattern is that shown in Fig. 1C, where only one side of the mike is sensitive to sound pickup. This is called a unidirectional pattern because pickup can occur from only the one direction. It is also known as a cardioid pattern because of its similarity to the shape of a heart. In some units, this pattern is obtained by using two separate mike elements in a single case — a dynamic and a ribbon, for example. Single unit cardioids achieve this pickup pattern by virtue of the mike housing design.

It is possible to obtain other patterns which are combinations of the basic ones. One such example is shown in Fig. 1D, where a bidirectional pattern is altered to provide greater pickup in one direction than in the other. Most mikes have a fixed pattern; others have patterns which can be altered with the flick of a switch.

Differential microphones are directional, but have an additional feature in that the distance between the sound source and the mike affects the pickup. Normally, these units are designed for adequate pickup close to the mike while rejecting sounds originating farther away, even in the same direction.

Virtually all microphones tend to become more directional as signal frequency increases. Best results along these lines are obtained when the physical size of the mike is small

• *Please turn to page 81*

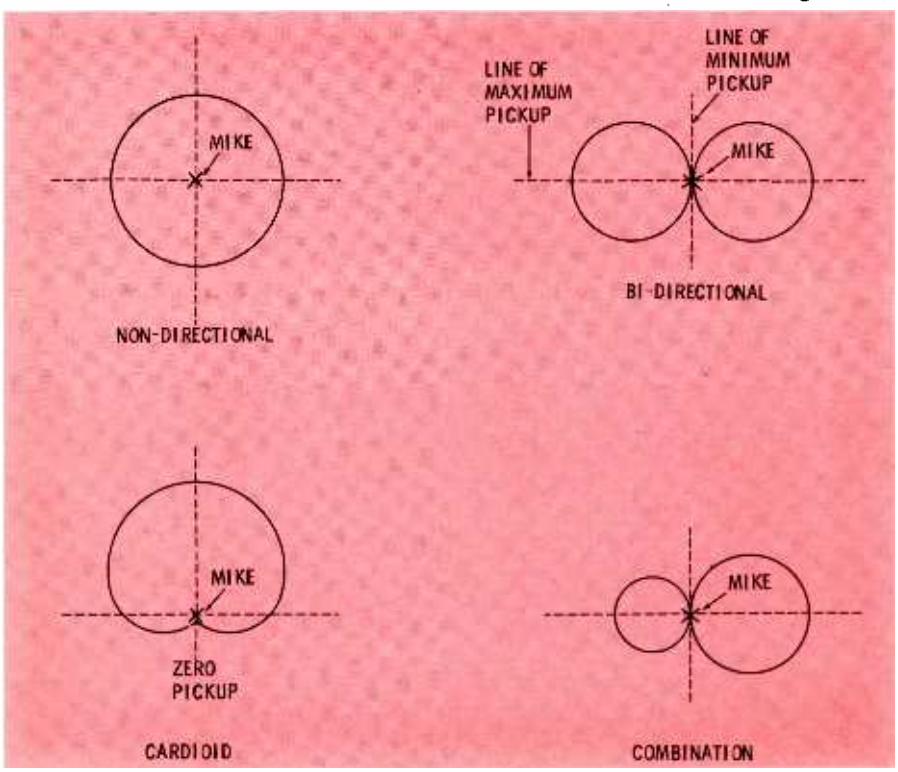


Fig. 1. The four standard microphone directional patterns in common use.

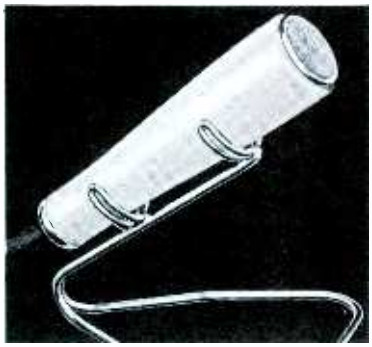
Altec-Lansing 661—dynamic
Frequency response: 30-15,000 cps
Output level: -55 db
Output impedance: 30-50, 150-250, 20K
Pickup pattern: omnidirectional

Astatic Model M-322-S—crystal
Frequency response: 30-15,000 cps
Output level: -54 db
Output impedance: high
Pickup pattern: nondirectional

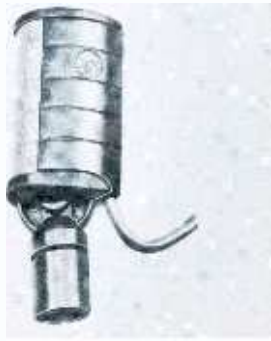
RCA Model BK-6B—dynamic
Frequency response: 80-12,000 cps
Output level: -67 db
Output impedance: 30, 150, or 250 ohms
Pickup pattern: semidirectional

Sonotone Model CM-10—ceramic
Frequency response: 50-13,000 cps
Output level: -62 db
Output impedance: high
Pickup pattern: omnidirectional

American Microphone Model D22—dynamic
Frequency response: 50-12,000 cps
Output level: -55 db on high Z
Output impedance: high or low
Pickup pattern: omnidirectional



Duotone Model MIC 39-1—crystal
Frequency response: 50-10,000 cps
Output level: -62 db
Output impedance: high
Pickup pattern: omnidirectional



RCA Model SK-45B—dynamic
Frequency response: 70-12,000 cps
Output level: -56 db
Output impedance: 150, 250, or 15K
Pickup pattern: semidirectional

Telex Model BOW-11—dynamic
Frequency response: 300-5,000 cps
Output level: -52 db
Output impedance: 25 ohms
Pickup pattern: unidirectional

American Microphone X203—crystal
Frequency response: 100-7,000 cps
Output level: -55 db
Output impedance: high
Pickup pattern: omnidirectional

Electro-Voice Model 664—dynamic
Frequency response: 40-15,000 cps
Output level: -55 db
Output impedance: 150 ohms or high
Pickup pattern: cardioid

Shure Model 101C—carbon
Frequency response: 300-4,000 cps
Output level: 5 db below 1v @ 100 mb
Output impedance: 50-100 ohms
Pickup pattern: semidirectional

Turner Model 80—crystal
Frequency response: 80-7,000 cps
Output level: -54 db
Output impedance: 25,000 ohms
Pickup pattern: nondirectional

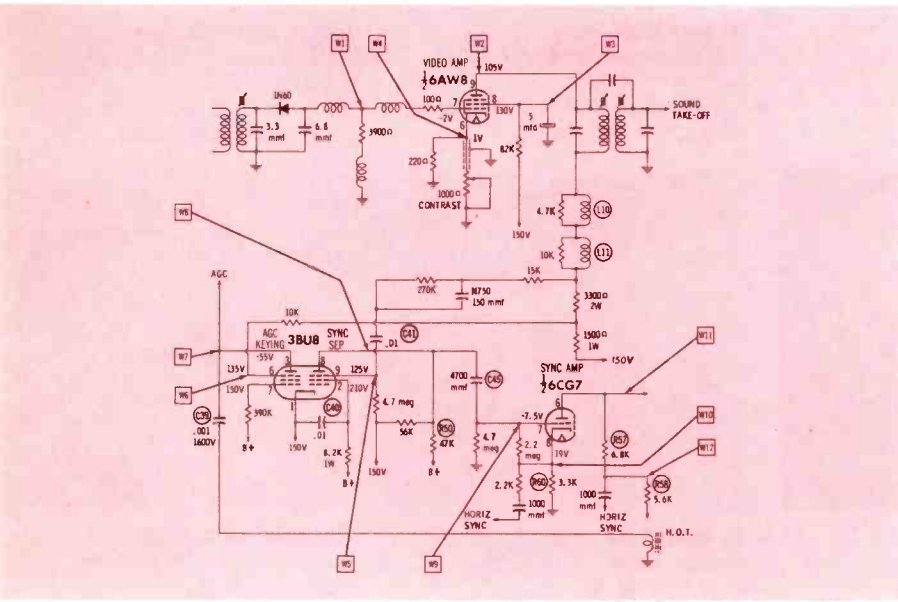
Astatic Model 77—dynamic
Frequency response: 30-15,000 cps
Output level: -52 db
Output impedance: 30-50, 150-250, 40K
Pickup pattern: cardioid

Electro-Voice Model 927—crystal
Frequency response: 60-8,000 cps
Output level: -50 db
Output impedance: high
Pickup pattern: omnidirectional

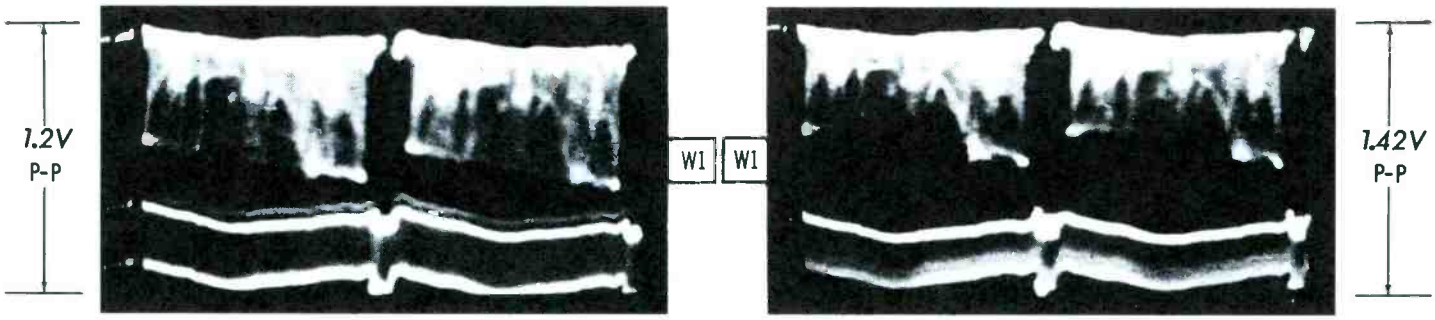
Shure Model 737A—crystal
Frequency response: 60-10,000 cps
Output level: -53 db
Output impedance: high
Pickup pattern: cardioid

Turner Model 200D—dynamic
Frequency response: 60-13,000 cps
Output level: -53 db
Output impedance: high
Pickup pattern: nondirectional

SCOPING MODERN TV CIRCUITS

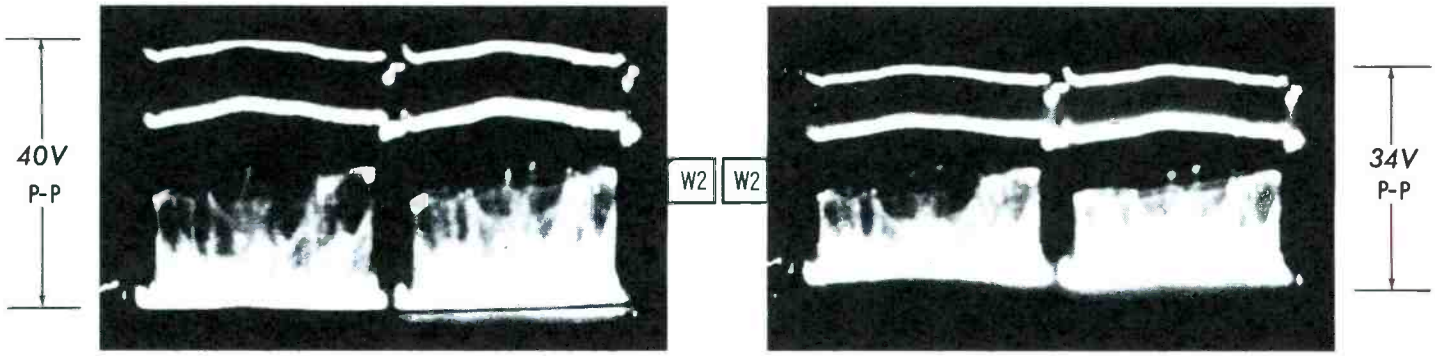


Because sync separation, noise cancellation, and AGC keying are all accomplished with the modern -BU8 circuit, troubleshooting may seem somewhat complex. Actually, it's quite simple when you use a scope and know what to look for. A study of the waveforms presented here will make analysis of this circuit a lot easier. We powered our set with 117-volts AC and clamped the AGC line at a level that provided a detector output of 1.2 volts p-p. The contrast control was adjusted for a 40-volt signal at the video amplifier plate. (These facts are given to help you duplicate the signal amplitudes for trouble analysis work.)



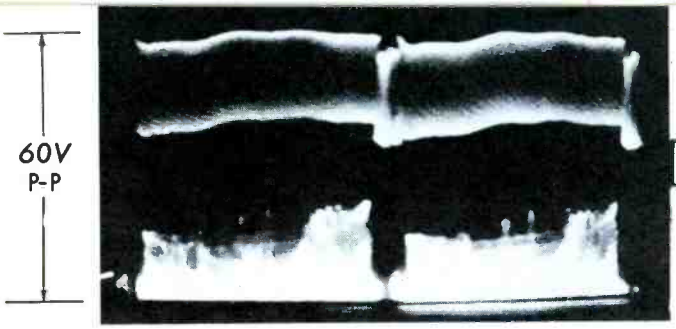
W1 gives an indication of RF-IF circuit performance. Insufficient amplitude indicates loss of gain or excessive AGC bias. Hum modulation is usually caused by heater-to-cathode leakage in one or more of the RF-IF tubes, or by poor filtering of the B+ lines to these stages.

At first glance, appearance of this signal seems to be normal, but note the greater separation between video and sync information (using a standard test pattern signal), plus the excessive overall amplitude. These symptoms are the result of grid current, caused by a defective video tube.



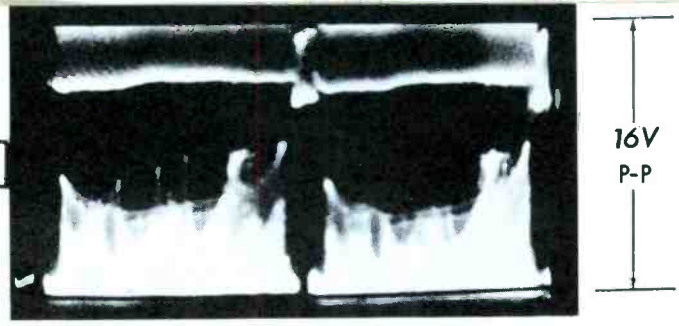
The amplitude of W2 depends on the contrast control setting. Insufficient amplitude can be attributed to a weak video amplifier, excessive stage bias, or low plate-supply voltage. The initial symptom is insufficient picture contrast at normal control settings.

Signal amplitude is reduced by degeneration when the screen bypass capacitor opens. With this defect, picture details usually appear somewhat smeared. This is indicated, to some degree, by the run-together appearance of the video portion of this waveform.



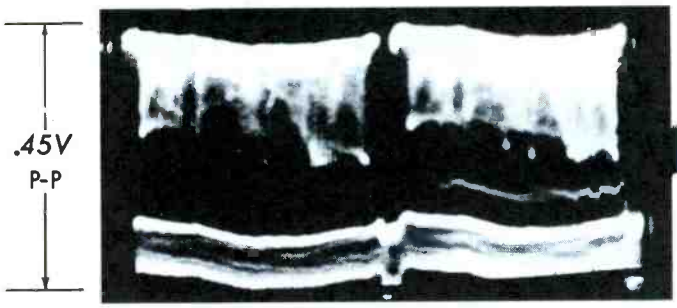
W2

Excessive W2 signal amplitude accompanied by picture smear and loss of fine detail can usually be traced to an open peaking coil. In this case, L11 opened and left the 10K-ohm shunt resistor as part of the plate load; thus, low-frequency response was increased, while high frequencies were attenuated.



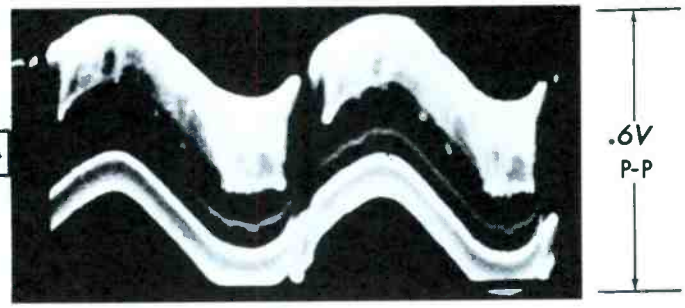
W3

Under normal conditions, W3 has an amplitude of less than one volt, indicating that the screen-bypass capacitor is doing its job. This waveform was taken with the bypass capacitor disconnected, and shows the degenerative signal (having the same phase as the plate signal) developed across the screen-dropping resistor.



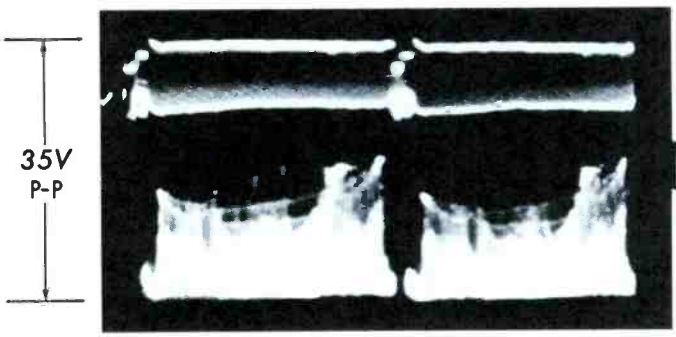
W4

With an unbypassed cathode circuit, W4 indicates the degenerative signal developed for the purpose of reducing distortion, particularly at low frequencies. Amplitude, of course, is directly proportional to cathode resistance.



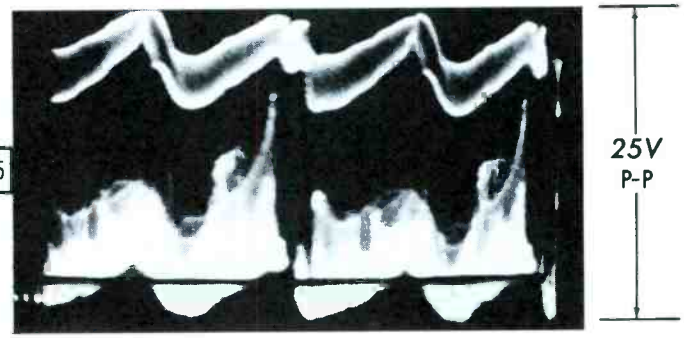
W4

Heater-to-cathode leakage in the video-amplifier tube is easily pinpointed by the appearance of hum modulation in W4. Don't be fooled, however, since an ungrounded scope return lead will introduce the same symptom.



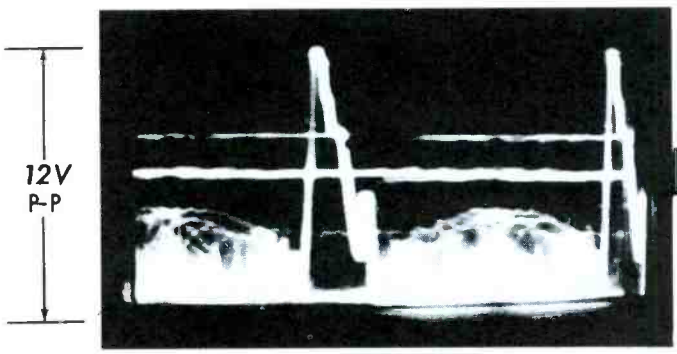
W5

W5 looks very much like W2, except for a slight reduction in amplitude. Circuit impedance at this point is quite high, and in addition to using a low-capacitance probe, you'll probably have to connect the ground lead of your scope to the low side of the grid resistor to obtain a viewable signal.



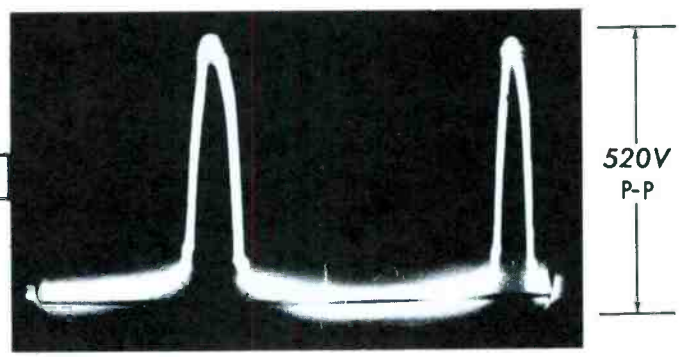
W5

Here's what W5 looks like when C41 is leaky. The degree of sync trouble will vary from picture jitter to complete loss of sync. Since a DC voltage measurement at the grid would not be indicative of leakage, you'll have to resort to use of your ohmmeter or capacitor checker to test the coupling capacitor in this case.



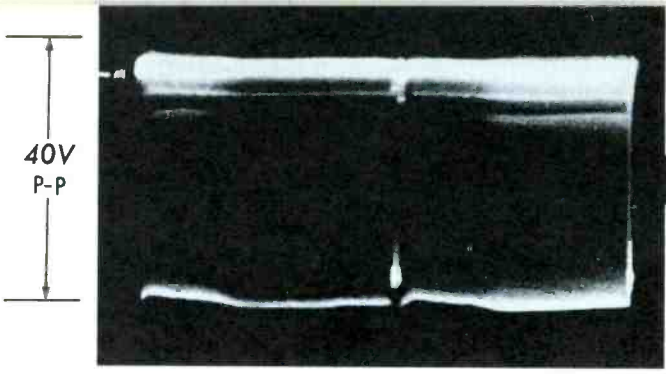
W6

The input of the AGC keyer receives this signal from the video-output circuit. The amplitude of the horizontal-sync pulse automatically adjusts the conduction level of the stage. Greater amplitude results in the development of more AGC voltage.



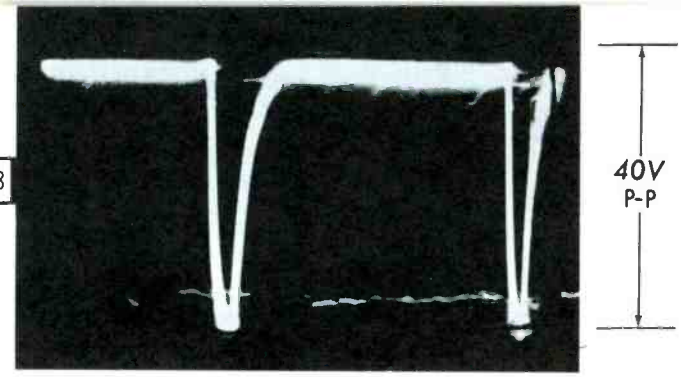
W7

W7 shows the AGC-keying pulse received from the flyback transformer. It must be in phase with W6 for proper AGC action. A gassy horizontal-output tube can delay this pulse just enough to cause trouble; replacing it may save pulling the chassis.



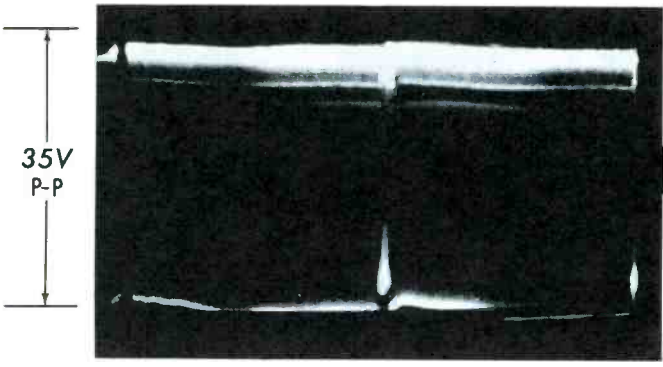
W8

W8



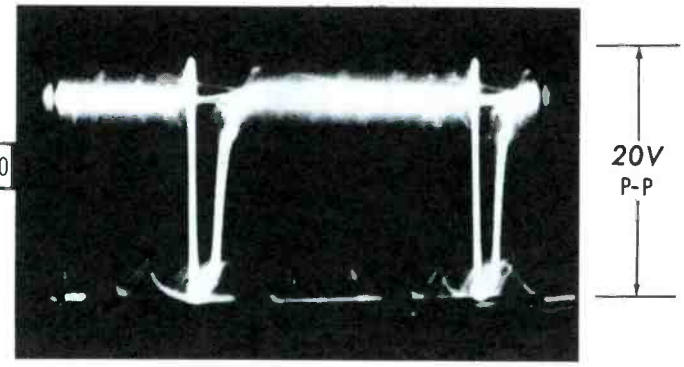
W8, the output of the sync separator, contains no video information—only horizontal and vertical sync pulses. This is the way the signal should look with a scope sweep frequency of 30 cps.

With the scope sweep synchronized at 7,875 cps, W8 takes on this appearance (a clear-cut view of what the horizontal sync pulses should look like) at the output of the sync separator.



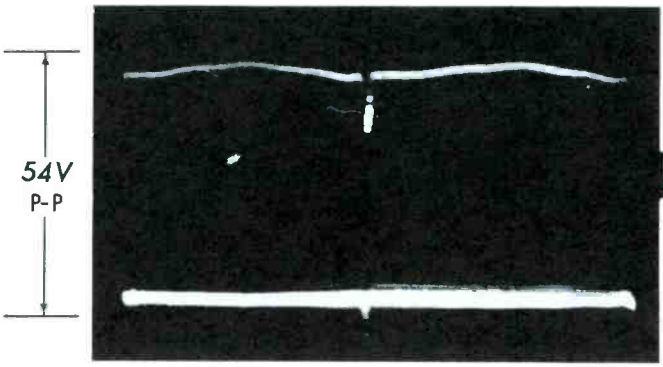
W9

W10



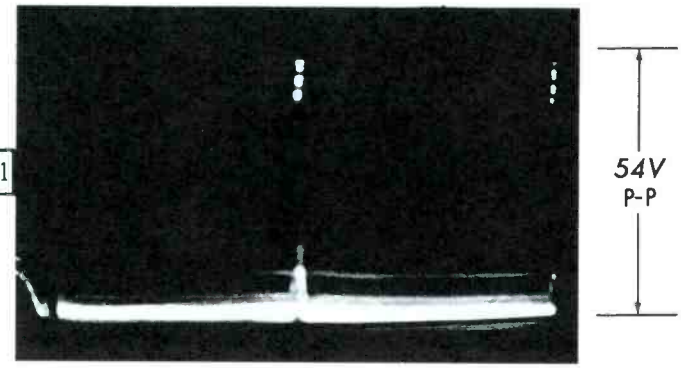
W9, the signal at the grid of the sync amplifier, is identical to W8, except for a slight loss in amplitude. Leakage of C43 reduces the signal further, and sync becomes a little touchy, especially in noisy or weak-signal areas.

Horizontal sync pulses for one-half the dual-diode AFC circuit are delivered from the 6CG7 in cathode-follower style, developing across R60, the cathode-load resistor. Amplitude is important to proper horizontal AFC action.



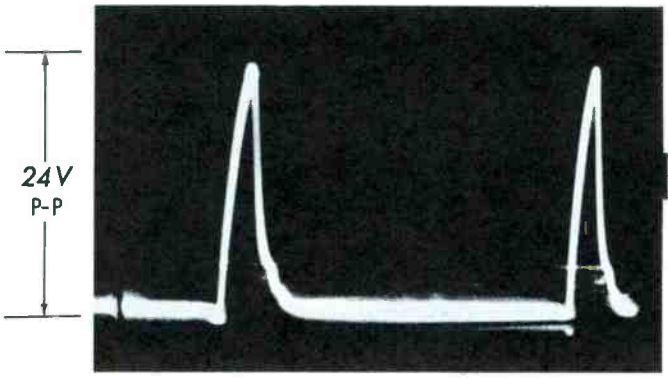
W11

W11



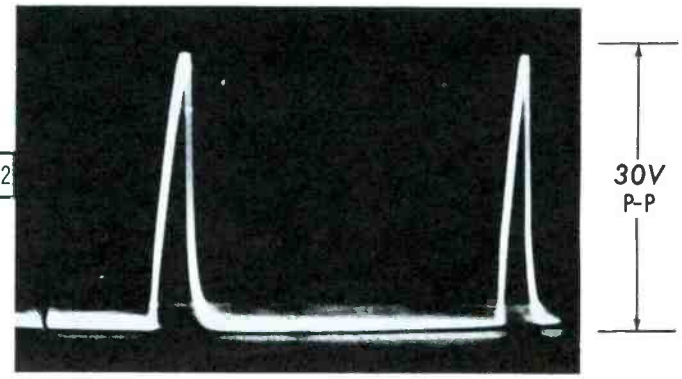
Here's the 6CG7 plate signal at 30 cps. Note that the signal has been increased about one and a half times, and it now has sufficient amplitude to drive the vertical integrator. Signal reduction results in intermittent flopover.

Slight leakage in C43 increases the amplitude of W11, accentuating vertical pulses more than horizontal. An early symptom is picture bounce or jitter, and the need for periodic readjustment of the vertical-hold control.



W12

W12



Amplified horizontal sync pulses are taken in proper proportion to drive the other half of the dual-diode AFC circuit from the junction of R57 and R58. If improper AFC action is noted, check the amplitudes of W10 and W12.

Leakage in C43 increases the amplitude of W12. It also causes the pulse to become narrower, which can result in horizontal-AFC troubles. Normal appearance of W10 and W12 is a fair indication that the sync stages are okay.

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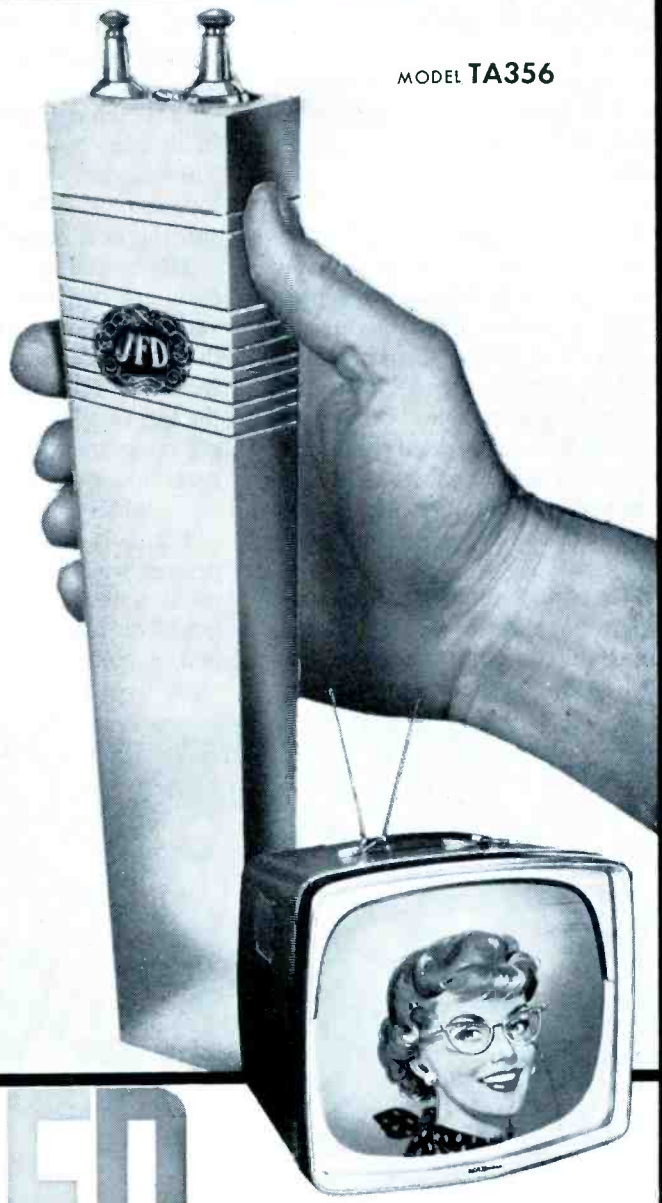

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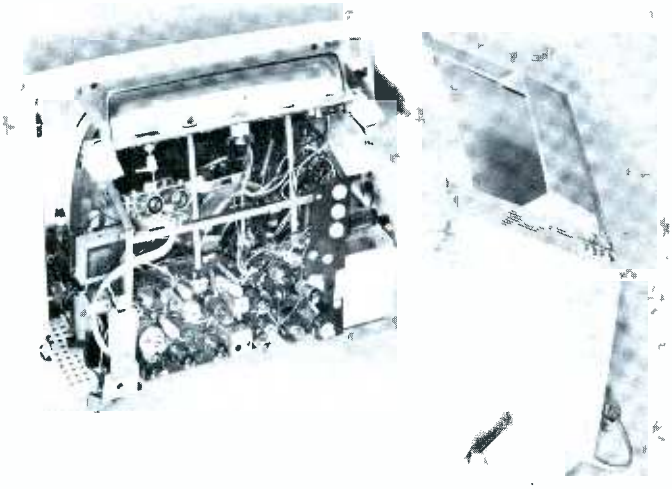

Fig. 1. When the rear cover of the *dualette* has been removed, most of the chassis is exposed.

BENCH SERVICING NEW SETS

by Thomas A. Lesh

You'll like the wrap-around rear cover of the Sylvania *dualette* portable (Chassis 1-543-1) shown in Fig. 1. When the cabinet back is removed, most of the chassis is plainly exposed to view. Several other manufacturers have also introduced slim portables with various types of contoured rear covers, so the conventional "chassis-in-a-box" concept of TV-set design is evidently giving way to some fresh new ideas. This is an encouraging trend from the standpoint of service, because it means less time wasted on disassembly when such jobs as tube replacement, IF alignment, or voltage and waveform checking are being performed.

Most of the signal circuits in the *dualette* are on a single printed-wiring board mounted almost vertically (with a slight inward tilt) across the back of the chassis. This panel is practically identical to the top section of the double-decker "S-110" chassis which has been used in all other Sylvania sets since 1957. The only important change is a relocation of the service controls to suit the new mounting arrangement.

Horizontal and vertical sweep circuits are conventionally wired on a vertical panel, which is located on the right side of the chassis as seen from the rear. A similar panel on the left side supports the power-supply components, including a pair of germanium rectifiers wired as a voltage doubler.

Fig. 2 is a closeup of part of the printed-wiring board. Note the unusual construction of the horizontal hold control; the inner end of the plastic control knob is formed into a hexagonal rod which extends into the horizontal frequency coil and turns the slug.

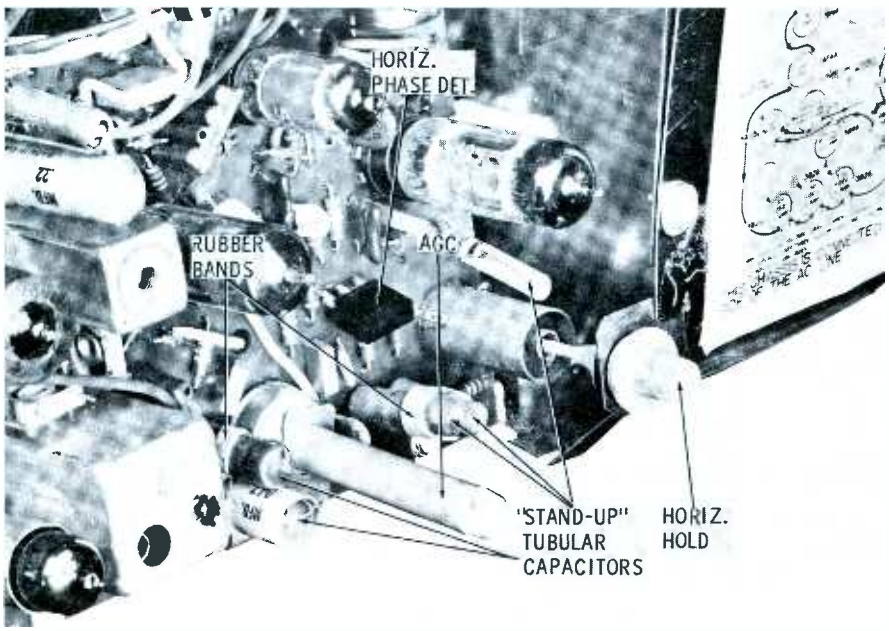

Fig. 2. Details of printed-wiring board. Note plug-in phase-detector diode.

Take a close look at Fig. 2 to find out what *can* and what *can't* be serviced from the exposed side of the wiring board. Unshielded tubes can be temporarily plugged into socket adapters to permit measurement of voltages, resistances and waveforms on the various tube pins. Where a captive shield prevents use of an adapter, it's still possible to obtain readings by touching the test prod to the tube-socket lugs at the point where they pass through the board. This can be done more easily if the tip of the prod is bent slightly.

The dual selenium diode in the horizontal phase-detector stage is a plug-in type and can be replaced as easily as a tube. The quickest method of replacing a defective resistor or ceramic capacitor is to crush it and use the remaining lead stubs as connecting points for the new component. Unfortunately, this handy repair technique is not usable with paper tubular capacitors (which are mounted at right angles to the board), or with inductors. These components are flush with the board to insure rigid mounting. (In Fig. 2, note that some pairs of capacitors have even been secured together with rubber bands to minimize vibration!) To reach the leads of such components for unsoldering, further chassis disassembly is required.

Wait—don't separate the printed-wiring board from the rest of the chassis. There's a much easier way to reach the underside of the board. The whole chassis assembly can be quickly separated from the picture

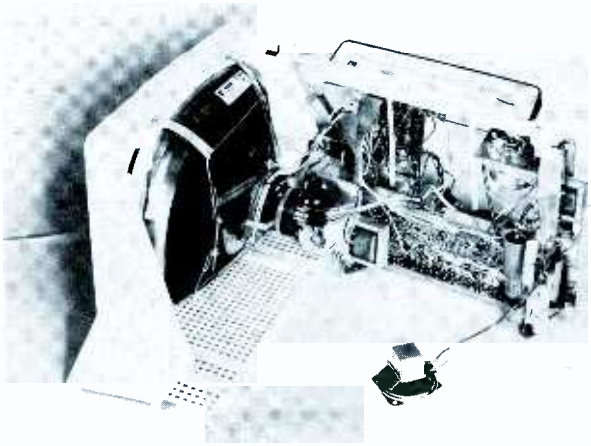

Fig. 3. Receiver can be operated in this position.

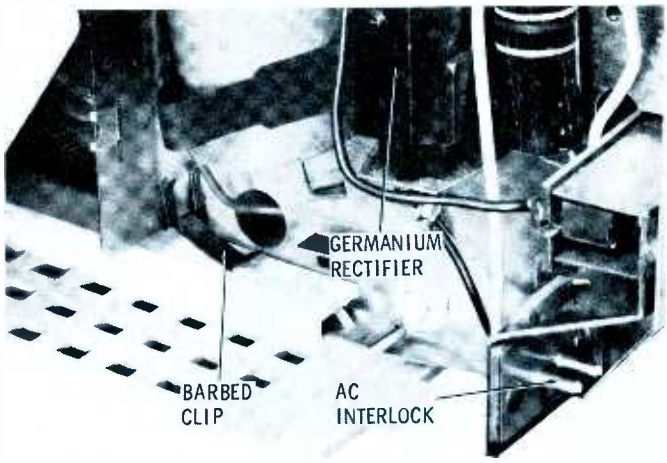

Fig. 5. Lift up on spring clip when pulling chassis.

tube and the rest of the cabinet, thus enabling you to reach the front side of the chassis (see Fig. 3). The control panel and carrying handle stay with the chassis, so you *never have to remove any knobs* from this receiver, except when replacing the associated controls. The set can be operated when arranged as in Fig. 3, thereby giving easy access to the sweep circuits—if you have a 110° CRT base-socket extension. The speaker (or speakers) can be removed from the front wall of the cabinet by pushing down on a spring clip and lifting out the speaker.

Chassis removal is a snap, once you understand how it's done; but there are a couple of "hitches" to baffle the uninitiated. This should discourage all but the most determined do-it-yourselfers from fooling around with the inner reaches of the chassis. For one thing, although only two screws are used to fasten the chassis assembly to the cabinet front, they are of a type you've probably never seen before. As illustrated in Fig. 4, they're Holt-head screws—a cross-slot type with grooves which deepen toward the outside rim. (These small black screws are visible in the far corners of the top control panel in Fig. 1.) If you don't have a Holt-type driver —and this is a safe bet—Sylvania suggests filing a shallow, concave V notch in the bit of one of your spare blade-type screwdrivers. This modified tool will enable you to extract the special screws.

Why were these odd screws used? They're strictly a safety device; according to Sylvania, they are necessary to qualify the *dualette* for the UL label. The idea is to prevent the average set owner from unwittingly taking out the main chassis screws and thus exposing himself to high-voltage shocks or serious breakage.

When the Holt-head screws have been removed, and the CRT socket and speaker leads have been unplugged, you're almost ready to pull the chassis; but it is still held in place by a small spring clip (Fig. 5) located behind the AC interlock near the bottom left corner of the chassis. This clip has a barbed edge which digs into the soft plastic cabinet and anchors the chassis. Lift up on the clip to disengage the barb so that you can slide the chassis backward. If you want to separate the chassis completely from the front section of the cabinet, unplug the yoke and high-voltage leads.

Picture Tube

The 17DKP4 cathode-ray tube in the *dualette* is a new 110° type with a neck about 2" shorter than in previous 110° tubes. The reduction in neck length has been made possible by a change in electron-gun design and adoption of a new feature called *tripotential focus*. This arrangement is much simpler than it sounds; it mainly involves repositioning the focus anode in the gun structure. In conventional types of electrostatically-focused picture tubes, the high-voltage anode (the one connected to the internal aquadag coating of the tube) consists of two sections, and the focusing anode straddles the gap between the halves as shown in Fig. 6A. This type of gun might be said to have *bipotential* focusing because only two electrical potentials (those on the focusing and high-voltage anodes) play a part in producing the electrostatic field which focuses the electron beam. In the new gun, a one-piece high-voltage anode is employed, and the

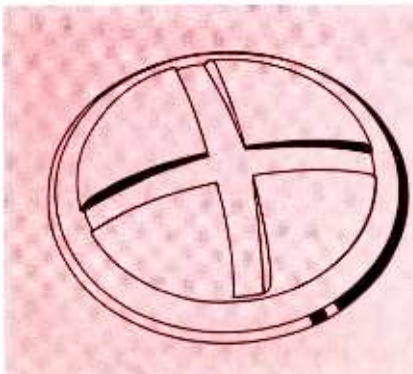

Fig. 4. Holt-head screw design.

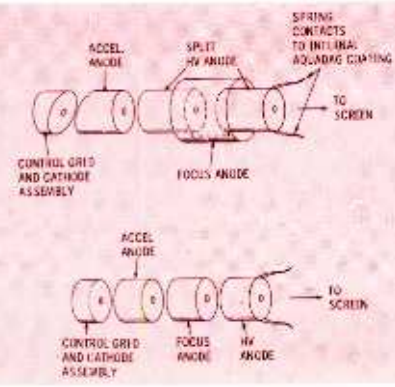

Fig. 6. Structure of CRT electron guns.

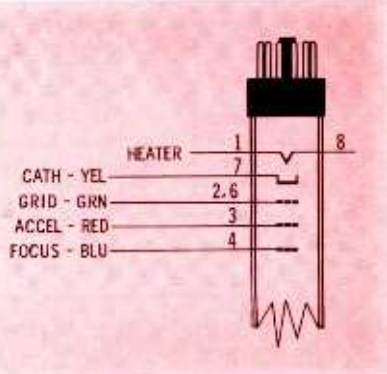

Fig. 7. Base connections of a 17DKP4.

focusing electrode is located between this anode and the accelerating anode (Fig. 6B). In this case electrodes at *three* different potentials are present in the focusing region. Although not drawn exactly to scale, Fig. 6B gives some idea of the saving in gun length made possible by the tripotential system.

A potentiometer is included in the focus circuit of the *dualette* to provide a range of focus-anode potentials from zero to +660 volts. Some readjustment of this control is advisable whenever a considerable change is made in the brightness-control setting—say at least 90° rotation.

Voltage for the accelerating anode is derived from boost B+ in the usual manner. It fluctuates from about 500 to 540 volts according to the brightness setting, but focus-spot adjustment has little (if any) effect upon accelerating potential.

Like most other picture tubes, the 17DKP4 receives a composite video signal at its cathode and a vertical retrace-blanking signal at the control grid. Base-pin connections are indicated in Fig. 7. Notice something? An important step has been taken toward standardizing 110° bases. The new CRT has a flexible-pin base instead of the rigid-pin "shell base" which has been used in previous Sylvania 110° tubes.

The color code for the base leads is given in Fig. 7 to help you locate test points for the various CRT elements. Merely trace each lead to its source on the chassis; they're all in sight.

Noise-Limiter Circuit

An interesting circuit feature of the *dualette* is a new method of obtaining an input signal for the noise-limiter grid (pin 1) of the 3CS6 sync separator. In previous versions of this circuit, an arrangement has been used in which a low-amplitude signal is tapped off at the output side of the video detector. If strong pulses of noise interference appear in this signal, they tend to drive the noise-limiter grid momentarily into cutoff. This interrupts the conduction of the sync separator and prevents noise from appearing in the output signal of the stage.

To improve noise-limiter operation, Sylvania has moved the noise-limiter takeoff point *ahead* of the detector—to the plate circuit of the third video IF stage (Fig. 8). Noise pulses strong enough to require cancellation have a greater amplitude than the modulated IF signal envelope, and this enables them to produce the desired cutoff effect when a sample of the IF signal is applied to the noise-limiter grid of the 3CS6.

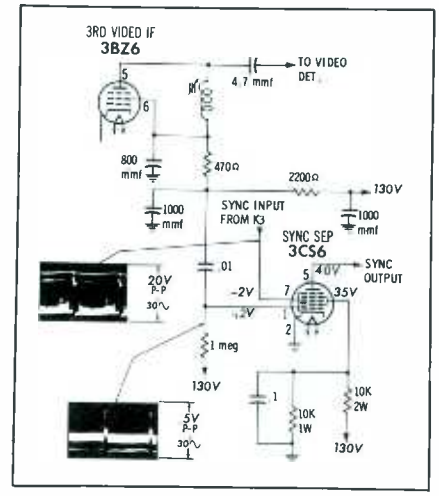

Fig. 3. Receiver can be operated in this position using CRT base extension.

Except for the few points mentioned, the *dualette* is electrically very similar to other 110° sets made by the same manufacturer. If you have serviced any Sylvania receivers with chassis numbers of 1-537-1 or higher, it won't take you long to get acquainted with the new 1-543-1. ▲

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NOTES on test equipment

by Les Deane

DC Power in a Small Package

The instrument shown in use in Fig. 1 is a new transistorized power and bias supply by EICO of Long Island, New York. Designated as the Model 1020, it affords many applications in powering low-current devices such as transistor radios, hearing aids, preamplifiers, etc. as well as supplying bias potentials for both transistor and tube circuits.

Using two transistors for voltage regulation, the output of the supply is well filtered and therefore ideally suited for powering ripple-sensitive transistorized equipment. The unit comes complete (less test leads) in either kit or factory-wired form.

Specifications are:

1. Power Requirements—110/120 volts, 50/60 cps; power consumption variable with load; DC circuits protected by front panel fuse.
2. DC Output—continuously variable in two ranges from 0 to 6 volts and from 0 to 30 volts, range switch provided on front panel; maximum load currents of 300 ma at 24 to 30 VDC, 200 ma at 12 to 24 VDC, and 150 ma at 0 to 12 VDC; AC ripple 1/200 of 1% at full load.
3. Panel Features—DC voltmeter with two scales of 0 to 6 volts and 0 to 30 volts; neon lamp provided as ON-OFF indicator.
4. Size and Weight—5" x 4" x 5½", 4½ lbs.

Since low-current supplies like the Model 1020 are of more value to the serviceman today than ever before, I thought I might obtain one of the wired versions, examine it, and let you know what I felt the instrument had to offer.

Looking over its physical structure, you'll find that the unit is housed in a sturdy steel case with aluminum carrying handle. Because of its compact design, the unit should require little space on any service bench. After I removed eight Phillips-head screws from the edges of the case, I found the entire top section lifts off of an "L"-shaped front panel and base section. All chassis components are mounted to this "L" frame as pictured in Fig. 2. You can see that the two power transistors employed for voltage regulation are located at the top of a vertical metal bracket, which also serves as a heat sink. Most of the other components are placed either on the front panel or between terminal strips attached to the vertical bracket. A power transformer and pair of silicon rectifiers, however, are positioned behind the bracket and are not visible in Fig. 2.

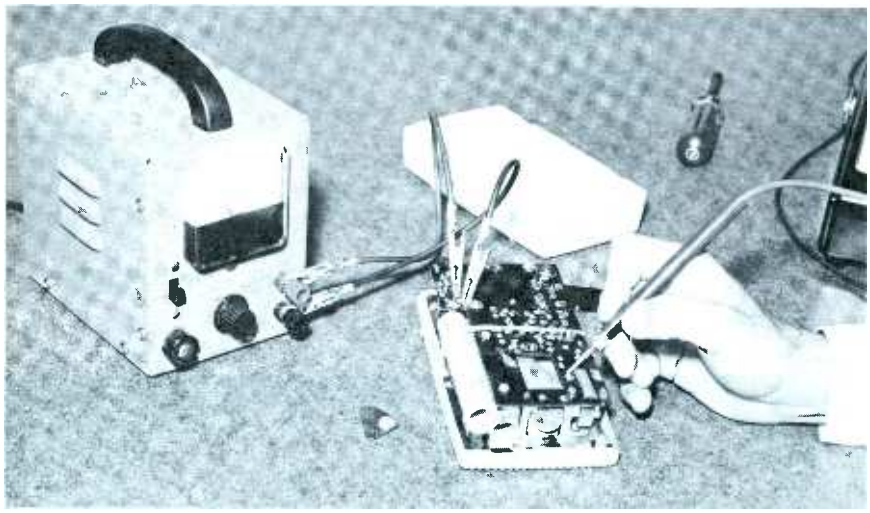


Fig. 1. With a maximum output of 30 volts, EICO's new supply features a dual-range voltmeter. Here, the unit is shown powering a pocket-size transistor radio.

I have presented a complete schematic of the Model 1020 in Fig. 3 so that you will better understand the transistorized circuit of this particular supply. The AC input to the instrument is converted to DC by the full-wave rectifying action of power transformer T1 and silicon diodes M1 and M2. Input filter capacitor C2 smoothes out much of the initial AC ripple, but final filtering and regulation centers around the transistor networks.

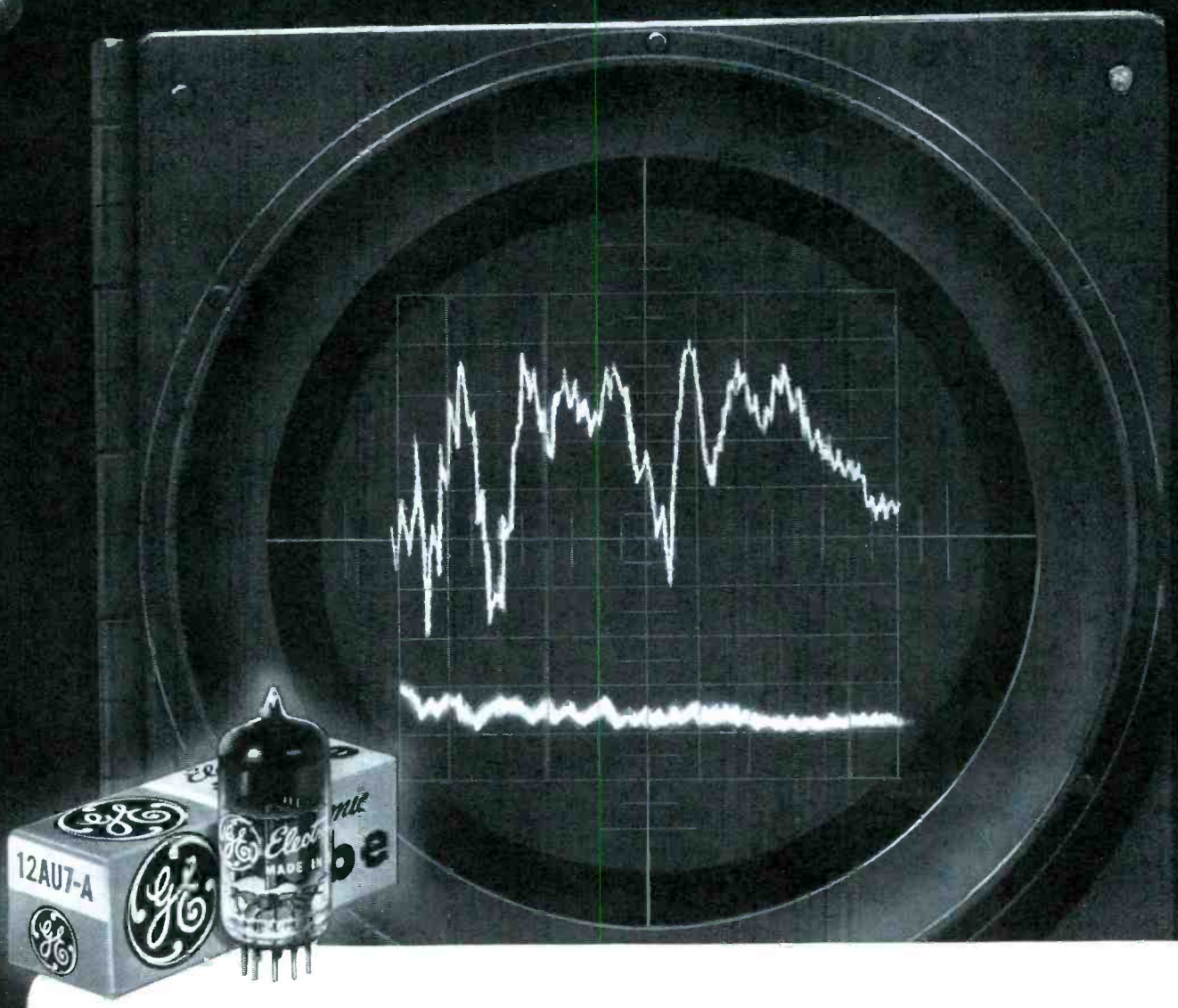
The two PNP transistors are effectively connected in series across the full rectified voltage. Ganged controls R1A and R1B regulate collector and base potentials, which in turn control emitter current and thus total output voltage. Capacitors C3 and C4 act as bias filters for the base circuit of each transistor, and thereby limit voltage variations on the sensitive base elements. The transistors are biased so that small voltage variations or ripple in their collector circuits will not produce a noticeable change in their emitter currents. Any hum-producing ripple that might get by this smoothing network is further reduced by output filter C5.

To protect the instrument and the transistors against current overloads, a ½-amp slow-blow fuse is placed in the negative center-tap return of the power transformer. Notice, however, that the neon ON indicator in the primary circuit will remain lit even if this fuse blows.

The DC voltmeter, in series with either a dropping resistor or the range switch (depending on the position of the latter), is connected directly across the output terminals of the supply. With range switch M5 in its 6-volt position, resistor R9 is shorted out, and full-scale reading of the meter becomes 6 volts. With the switch in the 30-volt position, R9 is connected in series with the meter resistance, and full-scale deflection now represents 30 volts.

I made use of the EICO supply by powering several battery-op-

• *Please turn to page 89*



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Bottom scope trace shows Service-Designed Tube's low-microphonic performance compared with ordinary 12AU7-A (top).

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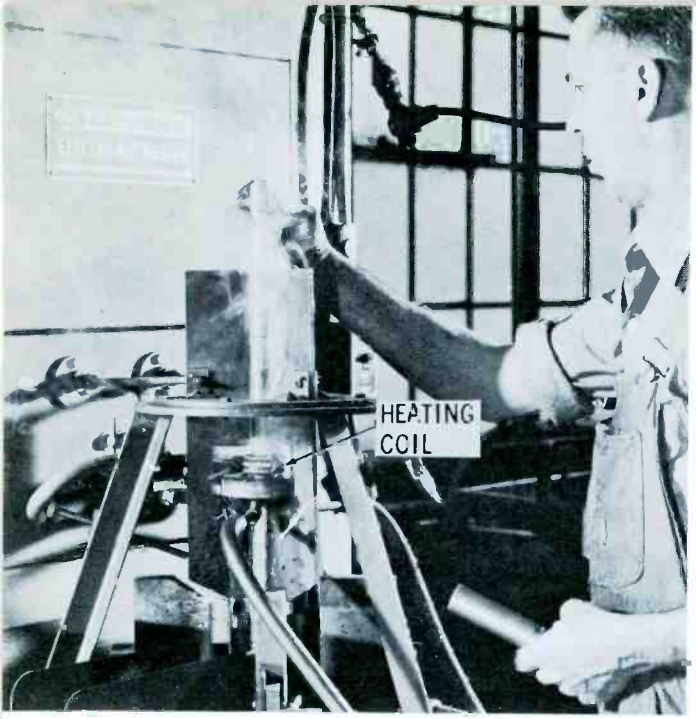


SERVICING INDUSTRIAL ELECTRONICS

PART 16—BY MELVIN WHITMER

INDUCTION HEATING APPLICATIONS

Fig. 1. This heater is used for case-hardening king pins.

In Part 15 (May issue), dielectric heating was described as a process for applying heat to non-conductive materials. Application of RF power for heating conductive materials is called *induction heating*. The methods of applying power to both non-conductive (dielectric) and conductive materials are so similar that in many applications the same electronic heater can be used. The changes required are in the methods for coupling power to the item to be heated. Non-conductive materials must be coupled to the power source as if they were the insulation in a capacitor, while a conductive material must be considered as a shorted, single-turn secondary coil of a transformer. The power source drives the primary coil and, in accordance with the turns-ratio, power is coupled to the secondary in the form of high current at low voltage.

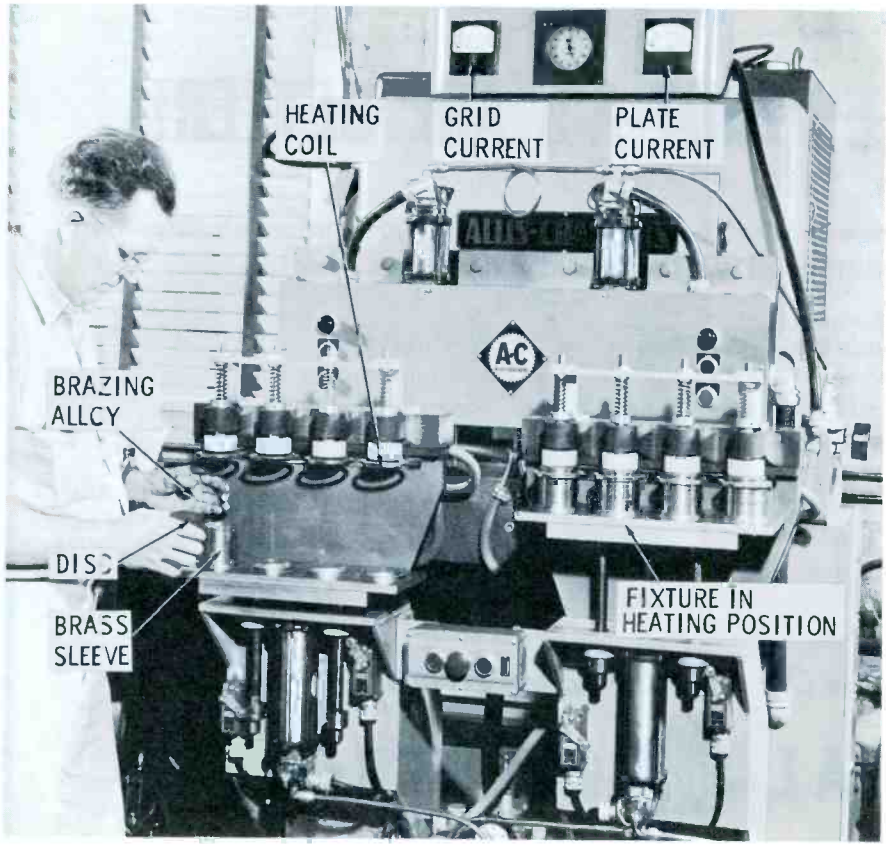


Fig. 2. Four pieces are brazed in this induction heater in only 23 seconds.

The main source of heat in the induction heating process is the circulating current induced in the work. If you have ever accidentally produced a short in the filament line from a transformer, the heat produced by high current at low voltage may have impressed you, particularly if the charred filament wire had to be replaced. Primary heating is, therefore, due to high current, while magnetic properties and generator frequency contribute to the exact heating characteristics.

Magnetic Materials

Conductive material which is also magnetic can be electronically heated to a specific temperature in less time than non-magnetic material. The additional heat results because of the magnetic property of metal, which involves molecular orientation. Each molecule tends to line up with the applied magnetic field. With RF power applied, the magnetic field reverses direction rapidly, and the molecules are in constant motion. Heat is thus produced in magnetic metal by both circulating current and molecular motion.

As a magnetic metal is heated, a loss of magnetic properties occurs. The temperature at which all magnetic properties are eliminated is

• *Please turn to page 85*

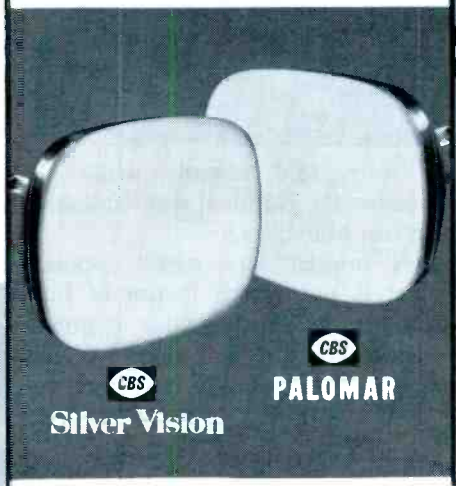
New Developments from CBS Electronics

Matched Pairs for Higher Fidelity

Typical of premium-performance CBS receiving tubes are these audio output tubes. Their critical audio characteristics are matched to help minimize harmonic distortion in push-pull amplifiers. The 6BQ5, 6V6GT, 5881 and 6550 matched pairs reduce distortion even below that attainable by controls for balancing plate currents.

Professional 55 Stereo Cartridge

This is the professional's version of the popular Columbia CD. Designed for transcription turntables, it uses a .5-mil diamond stylus, and features superior linearity . . . separation . . . needle-point impedance . . . low mass . . . freedom from hum and distortion . . . output level . . . ruggedness. Includes 4 plug-in equalizing networks. Another fine Columbia audio component.



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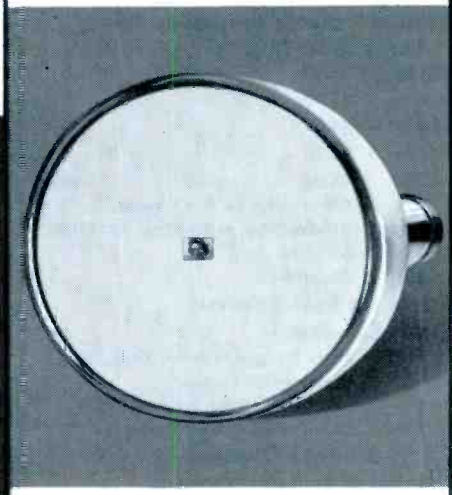
A CBS original! Sell your customer whichever he wants: premium-performance CBS Silver Vision or budget-priced CBS Palomar. Either is easy to sell because of top brand prestige. Either stays sold because of top performance in its field. Recommend these dependable national-brand CBS picture tubes with confidence.



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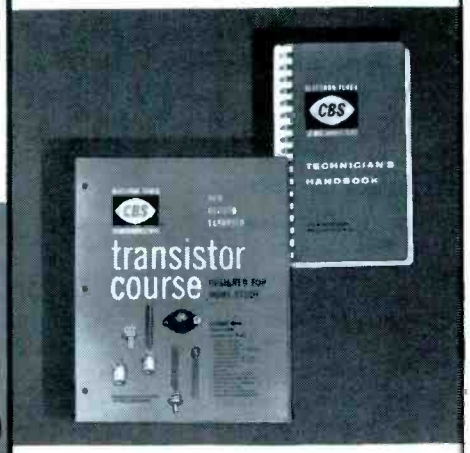
New UHR tubes offer still another addition to CBS industrial tubes . . . most inclusive line in the industry. They can compress into 1/20 square inch all detail on the face of a 21-inch picture tube. They make practical many advanced military and industrial applications requiring resolution beyond the capabilities of the unaided human eye.

New Semiconductor Lines

Drawing on its experience in NPN switching transistors and PNP power transistors, CBS Electronics now adds a comprehensive group of NPN power transistors for use in complementary circuits. Its line of NPN switching transistors has been more than doubled to meet increasing demands by computer manufacturers.



Revised Transistor Course and Technician's Handbook

Expanded CBS Transistor Home-Study Course (still only $25.00) makes it easy to learn about transistors by making practical transistor devices from readily available parts. Opens up advancement opportunities. 1959 Technician's Handbook, designed for the technician, is compact, handy, modern. Its 550 pages include receiving, picture, special tubes and semiconductors . . . only $1.85. See both at your distributor's.

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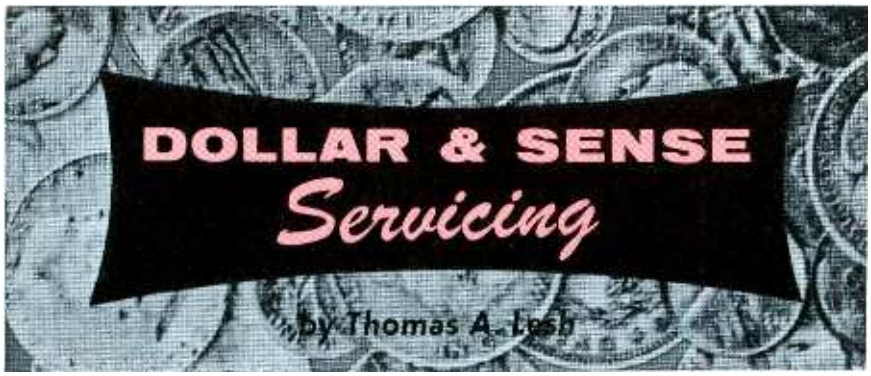


Breach of Promise. "Women *are* appreciative of common, ordinary courtesy. Of course, they're literal-minded too. And that's why, when you tell them you'll be there on Monday, they expect you on Monday!" Miss Willie Mae Rogers, director of the Good Housekeeping Institute, said recently while addressing the National Association of Service Managers.

A broken service-call appointment is not just a matter of hurt feelings, as though your feminine customer had been "stood up" on a date. She generally has more important things to do than stay home all day waiting for you to show up. These days, it's even quite probable that she's holding down a job and must take time off to let the TV man into the house.

So, in spite of your own tight schedule, you should do everything in your power to be on time for firm appointments you've made. In case you're unavoidably delayed, phone ahead and explain the situation; the customer will be much less ruffled by the time you arrive.

To rescue yourself from being a slave to a timetable all day, make a point of being a little vague about your arrival time when you are first arranging the call. This will help you to spot the customers who are not too fussy about punctuality. If some people want a definite time for an appointment, let them ask for it; then make a big hit with them by showing up at the proper time.

Service Survey. Have you ever wondered what the public thinks of your profession? Valuable insight into this question is provided by an impartial survey, completed just recently, which includes information on sets owned by 375 Detroit families and how they feel about TV service. To gather the data, fifteen students from Wayne State University, directed by Dr. H. Webster Johnson, visited a random sampling of homes in 15 areas of metropolitan Detroit. While the percentage figures they obtained may not reflect national averages, they are indicative of consumer thinking on several points of particular interest to the professional service technician. Here are the results:

Facts on Service Calls

Last time set was repaired:

46.7%	Last year (1958)
30.7%	First 4 months of 1959
13.2%	Not since Jan. 1, 1958
9.3%	Never
0.1%	Don't know

Service agency called:

43.2%	Local repair shop
16.3%	"Free-lance" serviceman
11.2%	Store of purchase
11.2%	Immediate family
10.1%	Factory agency
8.0%	Other

Method of choosing service agency:

33.9%	Recommended by friend
22.5%	Located in neighborhood
21.9%	Recommended by dealer
9.4%	Yellow Pages
1.5%	Mail advertising
10.8%	Other or none

Nature of service performed:

32.2%	Removed set from home
91.3%	Completed work promptly
84.8%	Replaced tubes
32.1%	Replaced other parts
12.6%	Don't know about other parts
88.1%	Dealt honestly
94.3%	Acted courteously

Opinion of price charged:

84%	About right
11.3%	Too high
3.1%	Too low
1.6%	Don't know

Home-call charge considered fair:

2.1%	Under $3
22.9%	$3.00
1.6%	$3.50
25.6%	$4.00
24.2%	$5.00
0.5%	$6.00
21.8%	Other price or don't know

General satisfaction with past service:

83.5%	Satisfied
16.5%	Dissatisfied

Facts on Self-Service Tube Checkers:

30.9%	Have bought tubes at drugstore, supermarket, etc.
35.8%	Have used self-service checkers
60.7%	Users satisfied with checkers

Facts on Sets Owned

Number of sets per family:

75.8%	1
23.7%	2
0.5%	3

Kinds of sets owned:

56.2%	Console
25.4%	Table
9.3%	Portable
9.1%	Combination

Average hours used per day:

10.7%	0-2
50.8%	2-5
35.7%	5-10
2.8%	Over 10

Sets under warranty: 15.5%

Sets under service contract: 10.7%

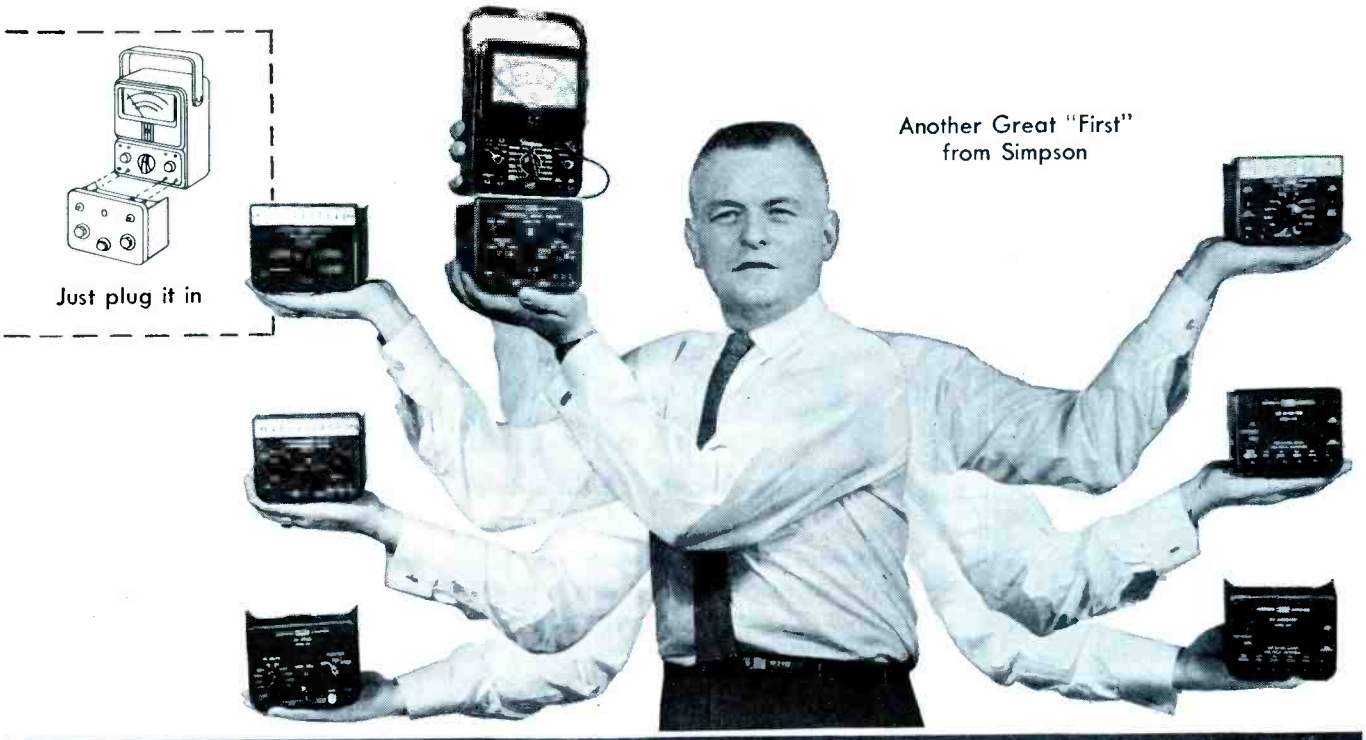
$ & ¢

Pay Now—Pay Later. If you sell long-term service contracts and collect payment in advance, when are you supposed to pay income tax on your receipts? The Bureau of Internal Revenue has held the position that such money should be treated as taxable income for the calendar year when collected—whether or not the work contracted for is actually performed in that year. This policy can put a businessman out on a limb every now and then, the ups and downs of business being what they are. Suppose a dealer sells a flock of one-year service contracts in the fall, and they result in very few calls until year's end. With relatively high income and low outgo, he has a healthy tax bill to pay the following spring.

Somebody has squawked about this problem—and the U.S. Court of Appeals has listened. In a decision this year (Bressner Radio Inc. vs. Commissioner of Internal Revenue), this court upheld the right of a New York City radio store to defer part of its income-tax payments on contract fees until such time as these fees "ripen into taxable income"—that is, until paid-for services are actually rendered.

If this decision holds promise of tax savings for you, better have your tax consultant check into it.

New Simpson "Add-A-Testers"



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Ico Range: 0-100 ua
Ico Accuracy: ±1%, with 260 ±3% (F.S.)

DC VTVM, Model 651 ..... $32.95
Voltage Ranges: 0-.5/1.0/2.5/5.0/10/25/50/100/250/500
Accuracy: ±1%, with 260 ±3% (F.S.)
Input Impedance: greater than 10 megs all ranges

TEMPERATURE TESTER, Model 652 ..... $38.95
Temperature Ranges: −50°F to +100°F, +100°F to +250°F
Accuracy: with 260 ±2° (nominal)
Three lead positions provided
Sensing Element: thermistor

AC AMMETER, Model 653 ..... $18.95
Ranges: 0-0.25/1/2.5/12.5/25 amps
Accuracy: ±1%, with 260 ±3% nominal
Frequency Range: 50 cycles to 3000 cycles

AUDIO WATTMETER, Model 654 ..... $18.95
Load Ranges: 4,8,16,600 ohms
Wattage: Continuous 25 watts (8,600 ohms)
50 watts (4,16 ohms)
Intermittent 50 watts (8,600 ohms)
100 watts (4,16 ohms)
Accuracy: ±5%, with 260 ±10% nominal
Direct reading scale from 17 microwatts to 100 watts

MICROVOLT ATTENUATOR, Model 655 ..... $18.95
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Frequency: DC to 20 KC
Accuracy: ±1db

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Checks all radio and hearing aid batteries up to 90 volts at the manufacturer's recommended load, or any external load.

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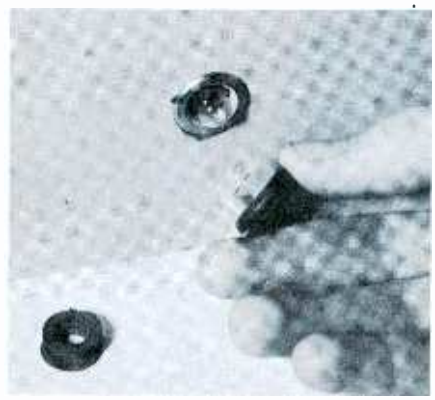
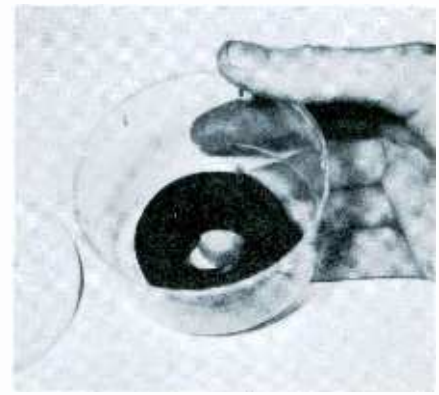
TIPS for TECHS



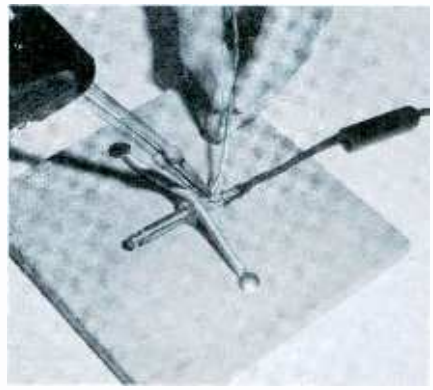
Grommet Removes Bulb Shield

Pilot lamp assemblies like the one shown have plastic screw-in bulb shields that are sometimes very difficult to remove. Should you have difficulty unscrewing one, you can get a better grip by slipping on a rubber grommet. Most pilot lamp wrenches won't fit the larger shields.



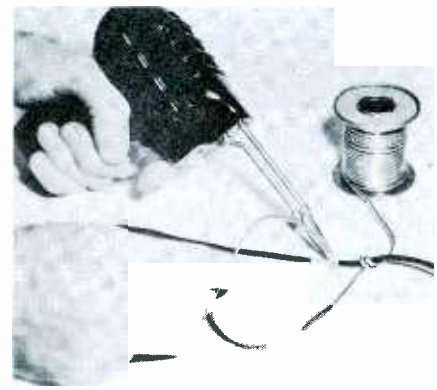
Container Preserves Tape

If a roll of friction or rubber tape is allowed to lay around in the open air, the adhesive will dry out and render the tape worthless. A plastic food container like the one shown makes a good airtight storage compartment that will keep your tape fresh for months.



Soldering and Testing Block

A block of plywood with a length of spring tacked to it acts as a "third hand" on the bench. Small parts that have to be held for testing or soldering are slipped under the spring as shown. This soldering and testing block is almost as useful as the soldering gun or diagonal cutters.



Solder Holds Wire

When you find it difficult (if not impossible) to hold a wire still while soldering or tinning it, wrap a loop of the solder around the wire and use it to hold the work as illustrated. This eliminates the need to clamp the work in a vise or to weight it down with tools.

Burned by Hot Tubes?

To avoid burning your wrist or hand on the hot bulb of a tube while trying to reach another one mounted nearby, carry along a spare tube puller in your kit and slip it down over any tube that may be in your way. If you don't happen to have a spare tube puller handy, an empty tube carton can be used.

Time-Saving Tool Stand

A clear glass tumbler makes a good holder for an assortment of alignment tools. You can see both ends of each tool and pick out the one needed at first glance. A moment or two saved on many such insignificant motions can, in time, result in more dollars in the pocketbook.

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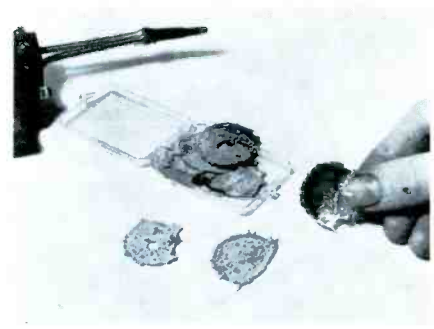
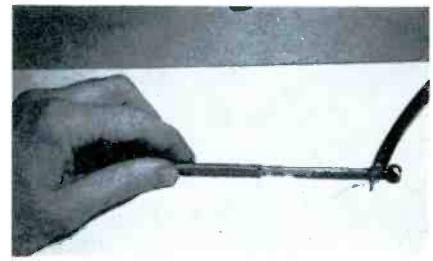


Use for Solder "Splatters"

When you have a tiny soldering job, which requires that as little heat be applied to the work as possible (soldering transistors and such), try this: Splatter several drops of solder from the tip of your iron or gun onto an old newspaper. When the splatters cool, peal them off and place in a small container. You'll find these ultra-thin pieces of solder will melt much more rapidly than ordinary wire solder, and thus require less heat.

Razor as Touch-Up Sander

A safety razor makes a good touch-up sander for marred radio and TV cabinets. By inserting some sandpaper in the blade holder, the slightly rounded head of the razor makes it easy to taper off the blemish before applying touch-up enamel, shellac or varnish.

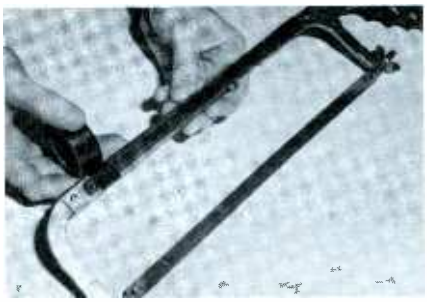


Wire-Stringing Needle

It's a cinch to string electrical, radio, TV or hi-fi wires and cables through walls and partitions when you use a round curtain rod as a "needle." The rods have a small eye at either end through which the wire can be easily threaded. Fully extended, they measure about a yard long.

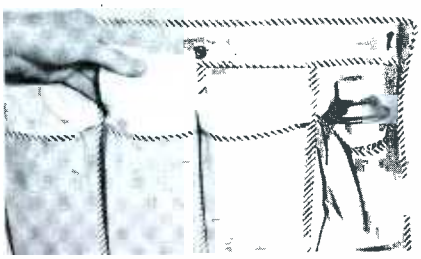
Soldering Pencil Maintenance

To keep a soldering pencil with interchangeable tip working at top efficiency, it's not only necessary to keep the tip cleaned and well tinned, but also the threaded heating-element shaft (see photo). This gives better heat conduction and also keeps the tip from "freezing" tightly in place. After the initial tinning, use only fine sandpaper or a wire brush on the heating element shaft. It is rather thin and will not withstand cleaning with a file.



Carry Extra Saw Blades

Let a couple of extra blades ride piggy-back on the frame of your hacksaw. Then, if one breaks while you're cutting a mast or doing other work away from the shop, you can always replace it right on the spot. Use electrician's tape to bind the spare blades to the frame.



Shoe Bag Stores Cloths

Most service shops keep several clean cloths around for dusting, cleaning, etc. A shoe bag tacked to the shop wall makes a neat and handy storage place for these cloths. The bag can be cut to fit into any space yo uhappen to have vacant, and the extra pockets can be used to hold cans of cleaning solvent.

QUICKER SERVICING

By Calvin C. Young, Jr.

Some Notes on Multivibrator Servicing

Even though the multivibrator-type oscillator is rather simple in operation, it can be quite troublesome at times. Take the experience I had with an Admiral 16RC1, for instance. In this set, a ringing coil is the only horizontal-frequency adjustment, and in order to synchronize the picture, the coil's adjustment slug had to be set at one end of its range. Even then, the picture had a tendency to tear and was unstable.

When oscillator tube and phase-detector diode substitution failed to cure the trouble, the chassis was taken to the shop. Because the picture would almost sync at the end setting of the frequency coil, I guessed that one of the components in the frequency - determining network (Fig. 1) had changed value. After checking the 47K-ohm resistor and finding it had the correct value, the 820-mmf capacitor was checked by substitution. This failed to improve operation, so the resistors in the plate and wave-shaping networks were checked. Failing to uncover any off-value units, I proceeded to check the 4700-mmf coupling capacitor to the output stage, and the 680-mmf sawtooth-forming capacitor by substitution. Again, this failed to cure the trouble. In desperation, the ringing coil and 3900-mmf capacitor were substituted — still no results.

Having failed to cure the trouble by guess and substitution, I came to my senses, sat down and put on the old thinking cap. A cathode-coupled multivibrator uses a combination of cathode and plate-to-grid coupling, and its frequency is mostly a function of the time required for the 820-mmf capacitor to discharge sufficiently to permit the second stage to conduct. The ringing-coil assembly is primarily a stabilizing network, and the circuit should operate even with the coil and capacitor shorted out—provided, of course, that all other components were within tolerance. At this point, I remembered that the input grid was essentially grounded for 15,750-cps signals, and that any correction voltage should vary around zero volts.

This thought process turned up a possible cause for the trouble not previously checked and eliminated, and the VTVM was now brought into play. A reading of several volts was obtained at the input grid of the multivibrator! The scope was now connected to this grid, with the result that a rather mean - looking signal—having both 60- and 15,750-cps components—appeared on the screen. Now, I was almost certain that the .047 bypass capacitor was open. As it so happened, replacement of this component cured the trouble.

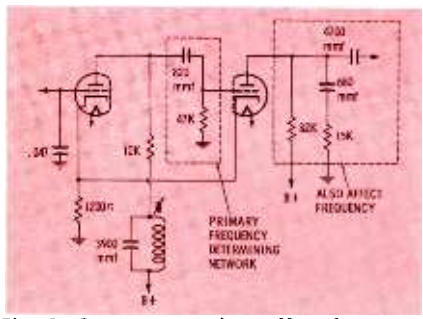


Fig. 1. Components that affect frequency in a basic horizontal multivibrator.

As a final check on circuit balance, the ringing coil assembly was shorted out. As predicted, circuit operation was stable. This was conclusive proof that the circuit was operating on frequency.

Let this little tale save you the extra hour it took me to find a fairly simple trouble. For maximum efficiency in troubleshooting multivibrator circuits, proceed as follows: (1) Short out ringing coil and note effect. If picture flops to right, oscillator is too fast; If picture flops to left, oscillator is too slow. (2) Check signal and voltage at input of multivibrator. Presence of signal indicates an open capacitor; appreciable voltage indicates circuit unbalance. (3) Check value of all resistors, especially the grid- and plate-load units. Replace any out of tolerance. (4) Check value of coupling capacitor between stages of the oscillator. If no tester is available, substitute with a duplicate (value and type) of the original. (5) Check value or substitute capacitors in coupling and wave-forming networks.

This system of testing presupposes that you have isolated the trouble to the oscillator and have eliminated the phase detector as a possible cause.

Horizontal Sync Stability

Small defects are often more difficult to locate and cure than large ones, I realized the other day after encountering a set using the circuit shown in Fig. 2. The customer complained that the picture shimmied and shook all over. When the initial home call substantiated this complaint, tubes were substituted in the tuner, video IF, video amplifier, AGC and sync circuits. In addition, the horizontal oscillator was also checked. When this failed to produce a cure, the chassis was pulled and taken to the shop. I fully ex-

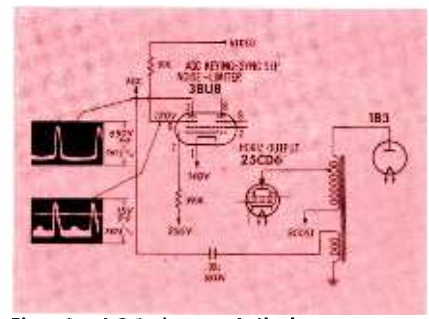


Fig. 2. AGC keyer failed to operate normally due to delayed plate pulse.

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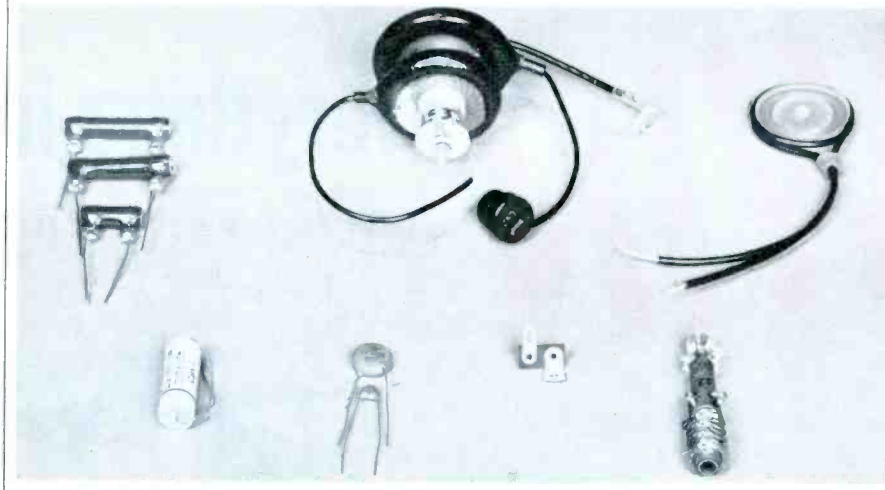


Fig. 3. Triad kit cures width and 6CD6 troubles in KCS68 and KCS81 sets.

pected to find that one of the AGC filter capacitors had opened up; however, as luck would have it, they all checked good. The next step was to check the 3BU8 circuit both for correct signals and voltages; all were normal. Because the set employed an AGC keying circuit (and this can be very troublesome at times), it was next on the list. Using a variable bias supply, the AGC line was clamped. This eliminated the shimmy, so I knew the AGC network was at fault—but where?

Since all the tubes in the tuner and video circuits that could affect AGC operation had already been replaced, and the voltages and signals at the keyer stage seemed normal, everything should be working fine—but it wasn't. There was only one thing that hadn't been checked—namely, the timing of the plate and grid pulses to the AGC keyer. I then reasoned that if the pulse to the plate of the keyer was either early or late due to a defect between the horizontal oscillator and AGC stage, the AGC output voltage would be low and sync trouble could result.

Since the horizontal-output tube hadn't been replaced and I remembered past AGC troubles being caused by gassy output tubes, the 25CD6 was replaced. The trouble was cured at last. Simple — but tough to find. Be on guard.

Sweep Trouble in RCA KCS-68 and KCS-81 Chassis

These direct-drive type horizontal-output circuits have been a real thorn in the side of most servicemen. The most frequent complaint is that the 6CD6 output tubes last only a very short time. If you've had one of these babies in the shop and have taken the time to measure tube currents, the reason for the rapid tube failure is no secret to you. 160 ma of cathode current just isn't conducive to long tube life. If you have followed the normal path and substituted every component in the circuit, including the flyback and yoke,

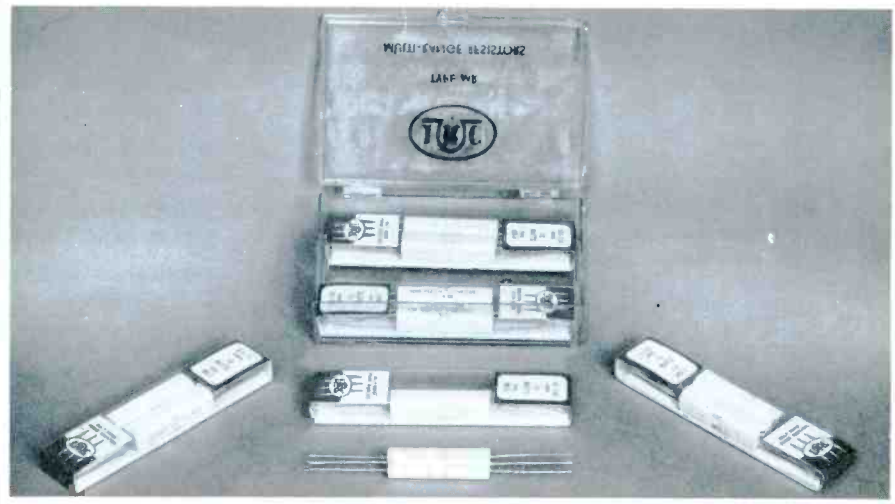


Fig. 4. IRC's 10-unit, 10-watt resistor kit replaces 203 values up to 50K.

without affecting the current to any great extent, you will at once appreciate the job Triad has done in developing their D-153 kit (Fig. 3) to cure these problems. The kit contains a new improved flyback, a new heavy-duty linearity coil, a new filament winding for the 1B3, three wire-wound resistors, three capacitors, and instructions for installation. In addition, there are complete instructions on how to adjust the new circuit for optimum width with minimum circuit current — about 100 to 110 ma with the modified circuit.

Power Resistors

If the high cost of maintaining a complete stock of power resistors has prevented you from stocking all of the standard values you might conceivably need, you will be interested to learn that IRC's type "MR" kit (Fig. 4) will enable you to replace any 10-watt resistor between .5 ohm and 50,000 ohms. This kit, with only 10 units (two of each of the five different types, permits two resistors within each range to be replaced. For example, the MR-1 unit has resistance values of 1, 2, 4, and 8 ohms, permitting resistors with values between .5 and 15 ohms to be duplicated. The MR-2 has sections with values of 10, 20, 40, and 80 ohms, permitting resistors with values between 5 and 150 ohms to be replaced. MR-3 has sections with values of 100, 200, 400, and 800 ohms to duplicate resistors with values between 50 and 1500 ohms. MR-4 has sections with values of 1,000, 2,000, 4,000, and 8,000 ohms to duplicate resistors with values between 500 and 15,000 ohms. The MR-5 unit has two sections of 10K ohms each and two sections of 15K ohms each to substitute for resistors between 3K and 50K ohms. Instructions packed with the kit tells how to duplicate 203 values within 10% tolerance. Types MR-1 through MR-4 will duplicate 47 values each and type MR-5, 15 values. In case you are wondering about size, each unit is about 1⅞" long by ½" square. The eight leads (two for each section of each unit) are 1½" long.

This handy kit should save you many unnecessary trips to the distributor, and thereby increase your productive (money-making) time.▲

db understanding THE DECIBEL

Here's your chance to tame this tricky maverick and make it work for you—by Jack Beever

In the course of talking to thousands of servicemen across the country, I ran across an astoundingly prevalent blank spot in their otherwise complex body of knowledge. This blank spot, which leaves them unable to properly evaluate the characteristics of many pieces of apparatus, is a lack of understanding of the decibel—what it is, and why it's used.

Just think of the many items having characteristics described in terms of decibels. Specifications for amplifiers, antennas, transmission lines, microphones, attenuators, speakers, speaker enclosures, TV set couplers, tap-off units, phono pickups, tape recorders, response curves, trap attenuations, cross-over networks, and hum levels usually include decibel measurements. If knowledge of the decibel is one of your working tools, you can interpret these ratings and be guided accordingly.

The decibel (db) may be used to measure voltage, current, or power. This article will concentrate on *voltage* db measurements, which are of greatest concern to the serviceman; but once you understand how to express voltage in terms of decibels, you'll find it easy to figure out what's meant by db of current or power.

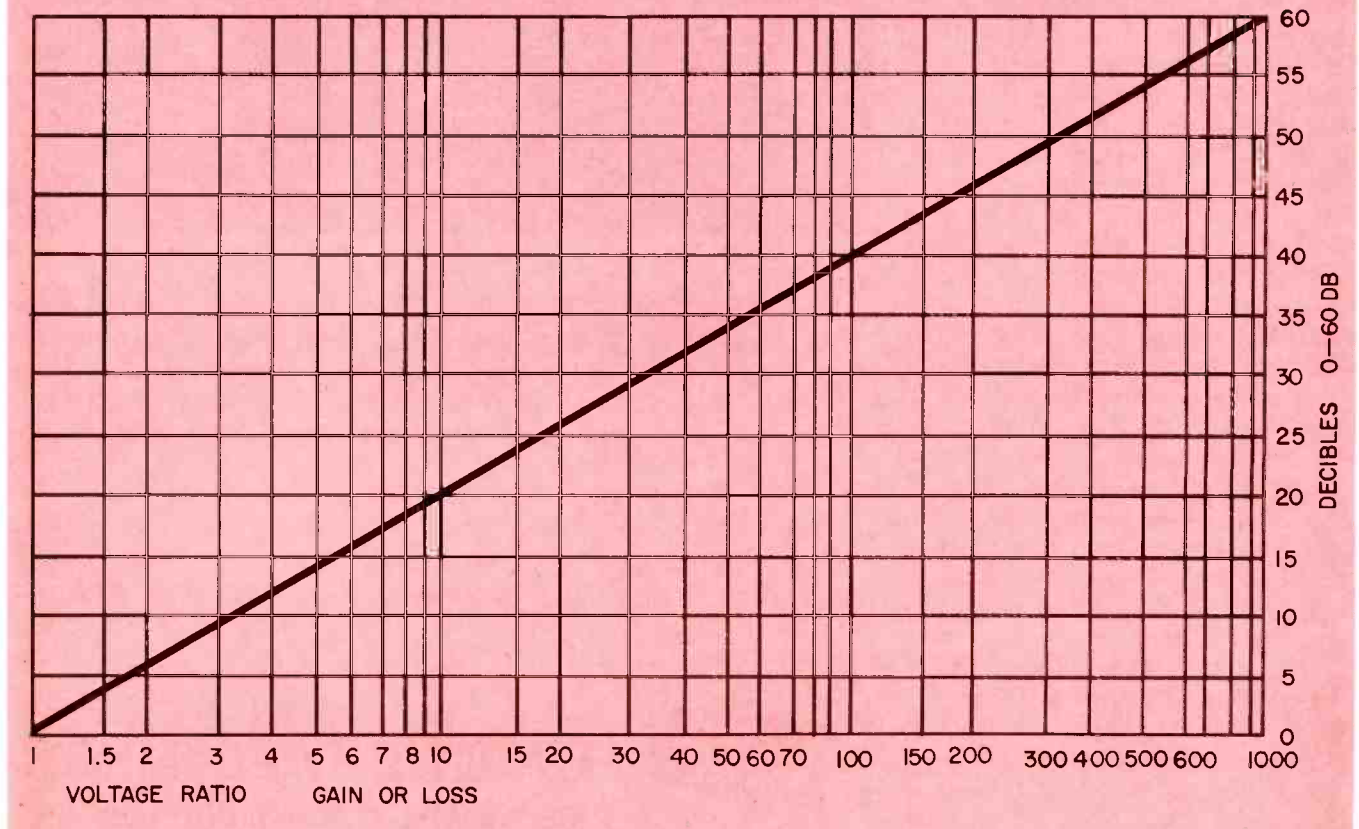
The most important thing to remember about decibel numbers is that they don't follow the rules of ordinary arithmetic. For example, 46 db is twice as great as 40 db, and 52 db is twice greater than 46 db! You see, a db figure doesn't say merely "how much" or "how many" (like the "10" in 10 dollars); instead, it says "how much *more*." Thus, it implies a comparison, just like the word "better." When a TV announcer says, "Our product tastes better," it makes you wonder "Better than what?" Similarly, the figure 6 db implies "two times as great as—" or "twice as much."

Another odd thing about the db is its nonlinear nature. Look at these examples:

6 db = 2x	20 db = 10x
10 db = 3.16x	30 db = 31.62x
12 db = 4x	40 db = 100x
18 db = 8x	60 db = 1000x

The expression "plus 10 db" means "multiplied by approximately 3." If the db figure is made twice as great (20), is the multiplication factor doubled? No! According to the table, it is more than tripled—from 3.16 to 10. Another doubling of the db figure, from 20 to 40, produces a tenfold increase in the multiplication factor, from 10 to 100. This strange behavior results from the way the db is derived. Although decibels are a little hard to comprehend at first, they greatly simplify all kinds of gain and loss calculations; thus, it's to your advantage to follow the reasoning behind the db. We'll start with the formula, but don't let it scare you. If you've read

Graph for converting voltage-ratio figures to db equivalents.



this far, you know enough to follow it through:

$$db = 20 \log_{10} \frac{E1}{E2}$$

Expressing it in English, the formula goes like this: The db is equal to twenty times the common logarithm (to the base 10) of the major (larger) voltage divided by the minor (smaller) voltage. Solving it goes like this: Suppose we have an amplifier with equal input and output impedances, and we want to find its voltage gain in db. The output voltage, which is larger than the input, will be the "major" voltage. Let's substitute some typical numerical values for E1 and E2 in the formula. If the output voltage is 100 and the input 10, then 100/10 = 10, and the formula is reduced to:

$$db = 20 \log_{10} 10.$$

Now we have to find the common logarithm of 10. This is what handicaps most TV technicians in trying to understand the decibel; they usually forget their logarithms soon after leaving school. Well, we only need a single fundamental principle anyway, so let's go on. The common log, or logarithm to the base 10, is a figure which may be written as an exponent—a little number located above and to the right of another number. (An example is the figure 2 in the expression 10^2.) The exponent indicates that the associated number is being "raised to a certain power—i.e., multiplied by itself a certain number of times. You're probably familiar with whole-number exponents such as "squares" and "cubes":

$10^2 = 10 \times 10 = 100$;

$10^3 = 10 \times 10 \times 10 = 1{,}000$.

The idea behind logarithms is that you can express any number in terms of "10 raised to a certain power." In other words, 10 multiplied by itself a certain number of times will equal the desired number. The numerical examples in the preceding paragraph contained logarithms! The exponent 2 is the log of 100 because $10^2 = 100$; likewise, 3 is the log of 1,000. Other numbers can be expressed logarithmically by using *fractional* exponents:

$10^{2.5328} = 341$; therefore,

$\log_{10} 341 = 2.5328$.

In our particular problem, we have to find $\log_{10} 10$, or the exponent by which the base 10 must be multiplied to get the number 10.

This one's easy—it equals 1. The formula now looks like this:

db = 20 x 1, and db (gain) = 20.

We have found that the amplifier's gain is 20 db. Of course, if we had obtained a fractional number like 18.5 when we divided E1 by E2, we'd need a log table to find the common log of 18.5. Since log tables are somewhat cumbersome to use, you may find the conversion graph given above a welcome device. To use the graph, merely divide the major voltage by the minor voltage. Then locate the corresponding number on the bottom of the chart, follow straight up until you intersect the heavy diagonal line, and look to the right edge of the chart for the db figure.

One of the most puzzling things about the db is zero db. Zero db isn't "nothing"—it's the same as saying "there's a relationship of one to one." In other words, no gain and no loss. It works out like this, and we can use the amplifier we had before, but now we find the input is 10 volts and the output 10 volts. Thus,

$$db = 20 \log_{10} \frac{E1}{E2}$$

$$= 20 \log_{10} \frac{10}{10}$$

$$= 20 \log_{10} 1.$$

The question now is, "What exponent will raise 1 to 10?" This is a funny one, the logic of which has escaped mathematicians. They only know it works like this:

$10^2 = 100$

$10^1 = 10$

$10^0 = 1$

$10^{-1} = 0.1$

We can see the sense behind the first, second and fourth expressions, but the third makes sense only because it fits and works. Let's put it into the formula:

db = 20 x 0; therefore, the amplifier's gain is zero db.

What we've been leading up to is this: When we say 6 db, we are referring to a figure which is twice as great as zero db. This naturally brings up the question, "What's zero db?" The answer: Zero db is anything you choose to make it! In audio, committees of engineers have agreed upon a standard value. In TV, zero db is assigned various values according to the particular application. In dealing with the antenna signal, for instance, we could

use 1,000 microvolts measured across 75 ohms of impedance.

No matter how good your intentions, the graph for db conversion won't always be handy; but there's a trick which will let you get a quick mental approximation of the ratio represented by almost any decibel number.

The trick is based on the fact that when you add db numbers together, you are actually multiplying, just as you do when you add exponents of 10. For example, 10^2 times $10^2 = 10^{2+2} = 10^4$ or 10,000. Similarly, if you subtract db numbers, you are dividing; as in 10^6 divided by $10^2 = 10^{6-2}$ or 10^4. Following this reasoning through, you need not know the values of all db numbers to be able to derive their values.

If you will commit to memory a few basic ones which can be added together to make the db number you need to know, you can find the gain (or loss) factor by multiplying the ratios of the known numbers.

Let's suppose you've memorized these three values ($\cong$ means "approximately equal to"):

3 db $\cong$ 1.4 x
6 db $\cong$ 2 x
20 db $\cong$ 10 x

Now, if you're asked what ratio is represented by 26 db, you can quickly figure that 26 equals 20 + 6. If 20 is ten times and 6 is two times, then 26 db equals 10 x 2 or 20 times. Similarly, suppose you need the ratio represented by 18 db. This is 6 + 6 + 6, and therefore means 2 x 2 x 2 or 8 times. Another one is 9 db, which would be 6 + 3 or 2 x 1.4, the equivalent of 2.8 times. Naturally, the more of these basic ratios you know, the quicker you can arrive at the ratio for a given number—and believe me, it does tend to make you look awfully intelligent. Imagine working out logarithms *mentally*! If you learn just those few used as examples in this article, you'll have it whipped. First thing you know, you'll be talking like a telephone engineer.

The only important phase we haven't discussed so far is decibels of loss. The difference here is that when talking of loss, we divide by the ratio instead of multiply.

Remember one thing more—if you know the uses and interpretation of the db, it can stand for (d)ollar (b)ills in your pocket! ▲

across the BENCH

by Stan Prentiss

Making Use of the DC Oscilloscope

For the past several months I've been promising more information on DC oscilloscope amplifiers and how to use them. So here it is!

The abbreviation "DC" means direct current—with no transformers or capacitors for signal coupling. The blocking capacitor in the input is short-circuited, and the plate of the first amplifier is connected directly to the grid of the second amplifier. Therefore, the DC component of the signal (down to zero cps) can be amplified along with the incoming AC signal.

Now, what does this suggest? Isn't what you really have a *visual* AC-DC voltmeter? One of the most valuable assets of a DC oscilloscope is that you may read the value of, and "see" both the signal and the DC voltage at the same time. This tells you whether or not your DC voltages are correct, and simultaneously shows you what is happening as the broadcast signal is amplified, detected, and separated for its eventual application to the deflection and video reproduction circuits. If your scope has been calibrated to show the AC signal in terms of peak-to-peak voltage values, you may obtain all troubleshooting information at one point with a single glance at the scope. With a little practice, this will make your job much easier.

Calibrating and Adjusting the Scope

If your scope sweeps linearly for at least 4" in the vertical plane (usually the height of the screen graticule on a 5" tube face), you're all set to do a thorough job of finding faults in television receivers or any other electronic equipment. Be sure, however, to use a low-capacitance probe beyond the video detector for isolation between the circuit you're investigating and the oscilloscope. My own scope is calibrated so that, with the vertical gain control wide open and a 10-to-1 LC probe in use, true peak-to-peak voltages are read at any convenient setting of the vertical step attenuator switch—i.e., voltages between 0 and 1 are read on the x1 step, voltages between 1 and 10 are read on the x10 step, voltages between 10 and 100 are read on the x100 step and voltages over 100 on the x1000 step. Removal of the 10-to-1 probe affects amplitude readings only in that the decimal point is moved one place to the right. You do, however, have to watch your step attenuator setting since excessive potentials applied to the usual service-type oscilloscope, even through the low-capacitance probe, will cause waveform clipping if the attenuator switch isn't set at a reasonable level.

DC amplifiers have only one particularly undesirable tendency, and that is *drift*. This drift is caused by the fact that vacuum-tube characteristics, B+ and bias voltages, and values of circuit components are subject to change. A fraction of a volt change in the input of DC amplifier is magnified to several volts change at the plate. In a scope, the operating point of the last amplifier can be shifted enough to throw the trace quite far away from the center of the CRT screen.

For this reason, scopes must have some sort of compensating control adjustment. Because it must produce no phase shift, this control (usually called a *balance control*) has to be a resistance. In the typical circuit shown in Fig. 1, balance control R16 proportions the plate volt-

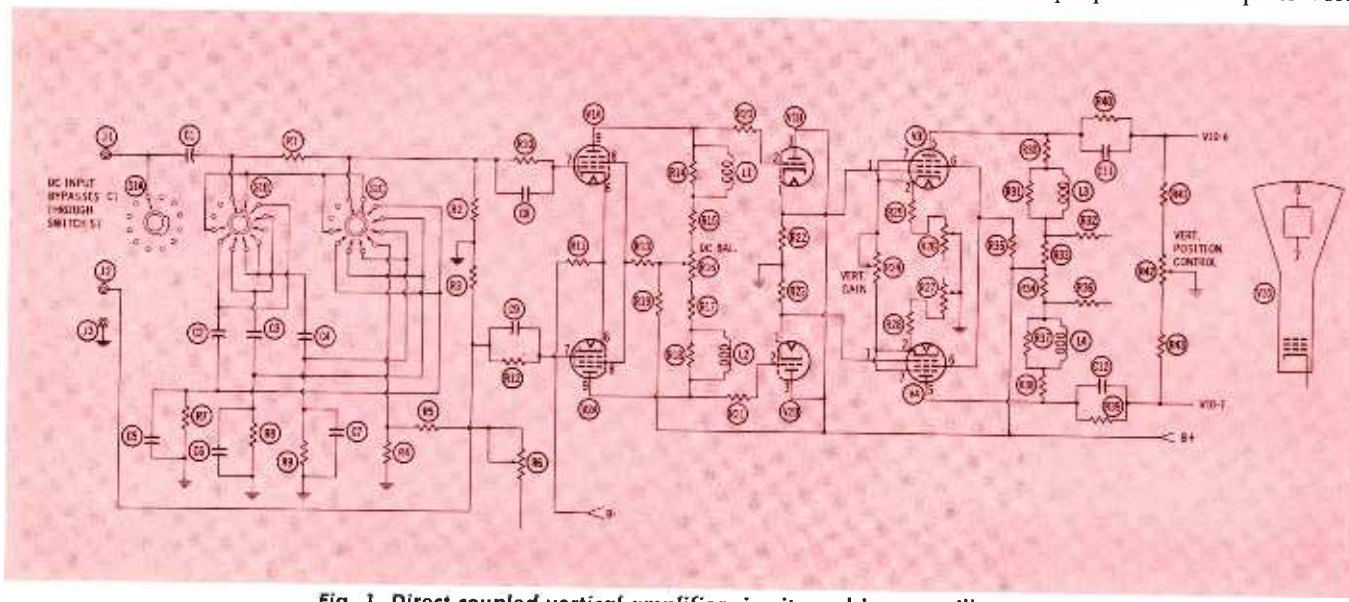


Fig. 1. Direct-coupled vertical-amplifier circuit used in an oscilloscope.

ages of the input push-pull amplifier V1.

DC Amplifier Circuit Description

The push-pull input feeds cathode followers V1B and V2B. Incoming signals are developed across identical cathode resistors R22 and R23 and fed to the grids of the output amplifiers. The plate outputs of V3 and V4 go to pins 6 and 7 of the CRT via frequency-compensating networks that include R40, C11, R31, and L3 in the V3 stage, and R39, C12, R37, and L4 in the V4 stage. The cathodes of V3 and V4 are connected to potentiometer R24, which is the vertical-gain control, and also to large, 2-watt current-limiting resistors to a ground path through bias potentiometers R26 and R27. These potentiometers must be adjusted so that there is between 1 and 2 volts of bias between the cathode and grid of each tube. The input of the oscilloscope is then short-circuited, and balance control R16 (between the plates of V1A and V2A) is adjusted to eliminate all up and down movement of the horizontal scan line. Beam trace will then remain in the center of the CRT when the vertical-gain control is rotated.

DC Amplifier Applications

Let's take a popular RCA KCS82 chassis and check its sync circuits using a DC scope at the more critical points. As you can see from the schematic in Fig. 2, the sync signal is taken from the plate of V7 and DC-coupled to the grid of the horizontal-sync separator. The same signal is also coupled to the grid of V6, the vertical-sync separator. Note that with DC coupling to V8, the grid voltage (even without the incoming AC signal added) measures 110 volts.

Now look at the grid waveform of the horizontal-sync separator (upper one in Fig. 3). It was taken with a horizontal scope sweep of 7,875 cps, and is approximately midway across the first major grid line above the center line or zero-reference level. With the scope calibrated and the vertical attenuator in the x100 position, we know that the DC level is about 100 volts (each minor division equals 20 volts), and that the waveform is riding mostly below this level. How-

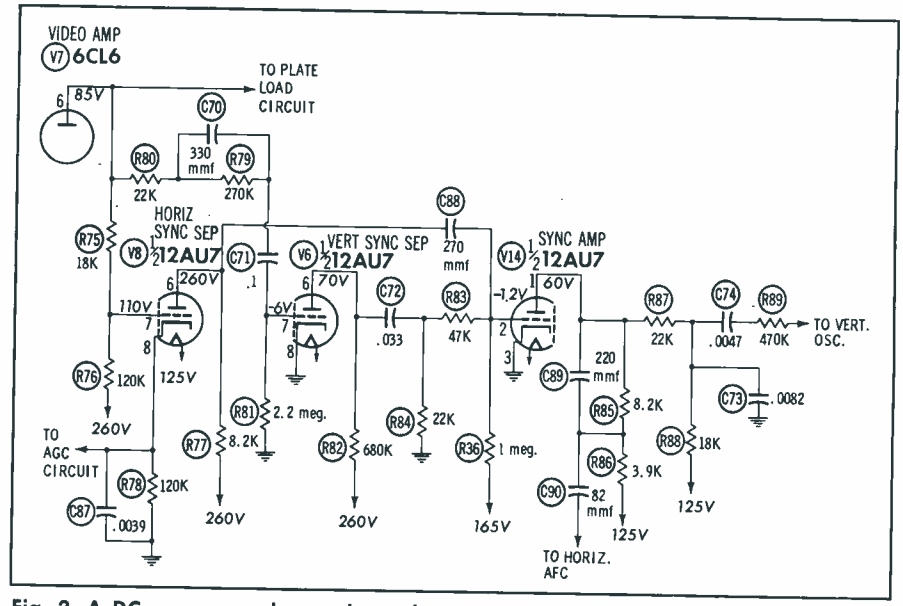


Fig. 2. A DC scope may be used to advantage in checking these RCA sync circuits.

ever, its peak approaches the 120-volt DC level. On the other hand, the signal at the grid of the vertical-sync separator, where all DC voltage is blocked, varies around the -6 volt level as shown in the lower waveform in Fig. 3 (taken with a 30-cps scope sweep). Under this condition, video information falls between the minus 50 and 90 volt levels, and the vertical-sync separator will pass only the sync pulses seen in the upper portion of the waveform. Referring again to Fig. 2, notice that DC cathode voltage of the horizontal-sync separator is 125 volts. The grid is, therefore, negative by 15 volts with respect to the cathode, and again, just as in the case of the vertical-sync separator, only the sync information above a certain level—about 100 volts in this instance—will be amplified and passed on to the sync amplifier.

Grid voltage for sync amplifier V14 is a combined result of grid conduction and the B+ divider hookup of R36, R83, and R84. The composite signal of the vertical and horizontal sync-separator outputs appears at the grid of the sync amplifier as shown in Fig. 4 (30-cps sweep rate at top, 7,875 at bottom). Notice that even though V14 is called a sync amplifier, there is little gain afforded by this stage.

The composite sync signal at the plate of V14 travels in two directions. It is acted upon by the integrating network (R87, R88, R89, C73, and C74), and goes to the grid of the vertical multivibrator, the other half of V14. The integrating network filters and shapes it into a positive-going spike that will trigger the vertical multivibrator at the field rate of 60 cycles per second. The composite signal is also differentiated and filtered for use at the grid of the horizontal-AFC circuit in combination with the sawtooth feedback from the horizontal oscillator.

Between C89 and C90, the sync signal viewed at half the frame rate looks like the upper waveform in Fig. 5. The lower waveform in the same figure is the combined oscillator feedback and horizontal sync signal with a scope sweep of 7,875 cps. Observe that the upper waveform rides at 100 volts DC, whereas the positive peak of the lower waveform is at approximately -10 volts.

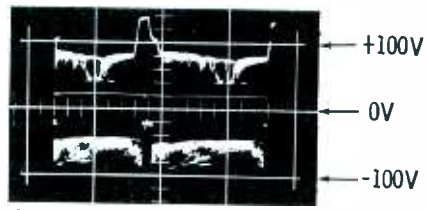


Fig. 3. Waveforms appearing at the sync-separator grids shows DC levels.

Skull Practice

As we said in the beginning, the DC oscilloscope is really an optical

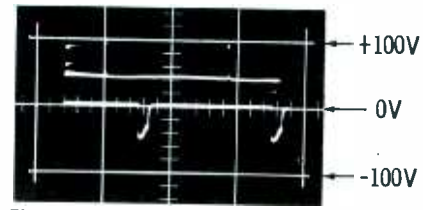


Fig. 4. Sync-amplifier plate and grid waveforms showing relative DC levels.

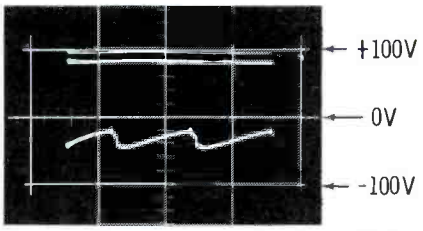


Fig. 5. Waveforms at junction of C89 and C90 and at grid of horizontal AFC.

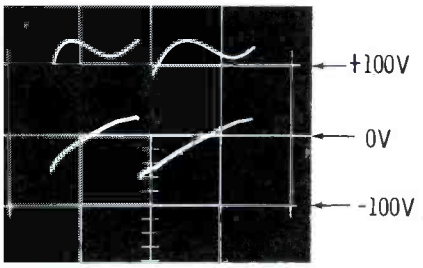


Fig. 6. Signal at grid of horizontal output tube shows DC conduction level.

AC and DC voltmeter. Consequently, you can make a quick measurement of DC voltages by merely touching your low-capacitance probe to the desired spot (use the higher vertical-attenuator ranges for best accuracy). You will also see the amount of ripple (pulsing DC) that is or is not being filtered properly. This is about the best way I know to instantly spot an open electrolytic capacitor. For instance, in the RCA chassis we've been dealing with, the power-supply ripple allowed is only 0.1 volt after filtering by both the input and output electrolytic capacitors and the choke. If you find excessive ripple, one of these filter components just isn't doing its job. To double check, switch over to the AC input momentarily to be sure that excessive DC isn't causing clipping in the scope amplifiers and obscuring some of the results. The input capacitor, of course, blocks DC and may result in a more accurate p-p reading.

Another excellent use for the DC scope is at the horizontal-output tube grid. In addition to noting whether or not the necessary sawtooth signal is arriving from the horizontal oscillator, you'll also be able to note the DC level at which the output tube will begin conduction (Fig. 6). In the upper half of Fig. 6, you can also see the general appearance of the waveform at terminal C of the oscillator transformer.

With a little practice, you'll be using DC amplifiers with the speed of an expert, and achieving really rapid repairs of difficult troubles.▲

THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

Unfreezing Yokes

Some time ago, I remember seeing something in PF REPORTER about the problem of separating a "frozen" yoke from the neck of the picture tube without damage to either component. I have recently encountered such a problem, and a search through back issues for help has proved fruitless.

ROBERT W. GREGWARE

Troy, N. Y.

We dealt briefly with this problem in "Replacing Defection Yokes." May, 1958 —but it's not too soon to touch on this subject again.

Anything's better than prying a yoke off by force, and we can recommend a couple of specific methods which are much safer. Unfortunately, we don't know of any foolproof method of freeing a yoke without damaging it, once the insulating varnish on the horizontal windings has become stuck to the neck of the CRT. Even if these windings don't develop short circuits during the removal process, you run the risk of a later breakdown because of damage to the insulation.

One useful technique is to run AC line current through all the yoke windings connected in series, using a 60-watt light bulb in series with the yoke to serve as a current-limiting device. The heat generated by a few seconds' application of current is usually enough to loosen the yoke from the CRT neck.

An alternate solution would be to tip up the set and drip a little varnish solvent onto the neck of the picture tube, where it will run down into the center hole of the yoke and soften the insulation.

No Fuzz Control

I have an RCA Chassis KCS47A with defective focus. This set has a permanent-magnet assembly which I tried adjusting with no success. High voltage at the CRT anode measures 12,000 volts, which is a little low. The original CRT checked very weak, so I replaced it; but that didn't improve the focus. After trying about everything else, I replaced the permanent magnet with an electromagnetic focus coil using a separate power supply. This corrected the trouble.

Before I purchase a new permanent-magnet assembly, I would like to know whether it's normal for magnets to lose their strength over the years or whether I am only overriding some other trouble by using an electromagnetic focus coil.

LOUIS R. LUCIANO

Salem, Mass.

Your application of the electromagnetic unit was quite well thought out and is a good test to make whenever you are dubious about the condition of a permanent-magnet focusing device. These definitely can lose much of their magnetism over a long period of time, especially if they have ever been dropped or otherwise mishandled.

Erasing Retrace Lines

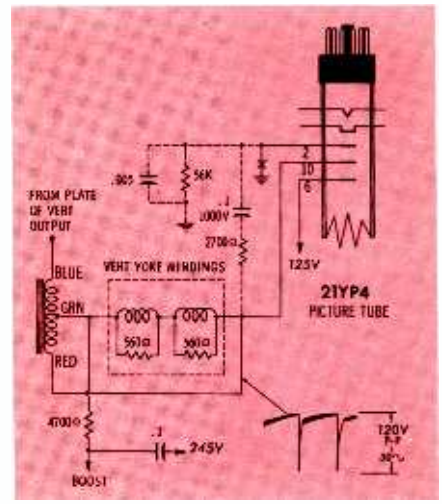
Would you help me design a vertical retrace-blanking circuit for a Fada Model 21L1? I have been using the article by Jesse Dines in the August, 1958 issue as a guide, but I'm having trouble applying the information to this set.

LAFON DARLAND

Harrodsburg, Ky.

The receiver in question already contains a simple, yet interesting, hookup which apparently suppresses retrace lines to some degree. As you trace the DC path from the boost B+ supply to the accelerating anode (pin 10) of the CRT, you'll notice it passes through the vertical yoke windings in parallel with the secondary of the vertical output transformer. In this way, negative-going 120-volt pulses are picked up and applied to the accelerating anode. Of course, these are unlikely to cut off beam current, but the momentary reduction in accelerating voltage evidently tends to defocus or weaken the electron beam during retrace.

Since the set is several years old, it would probably benefit from a more positive-acting type of blanking circuit. You can obtain the necessary signal from the vertical output transformer, although you will need a hookup slightly different from the examples suggested by Mr. Dines. In this particular set, the center tap of the autotransformer (green lead) is the "low" side of the secondary — because it's the point nearest the DC supply — and the bottom or red lead of the transformer is the "high" side of the secondary. Thus, the red-lead terminal is the correct source for the blanking pulses you need. To install the blanking network, unground the control grid of the CRT and add the components dotted-in on the schematic. This circuit is used in numerous Admiral receivers and should also work in your Fada. Component values may be juggled to some extent, but try to maintain negative-going pulses of about 50 volts p-p on the grid of the picture tube.



Picture Washout

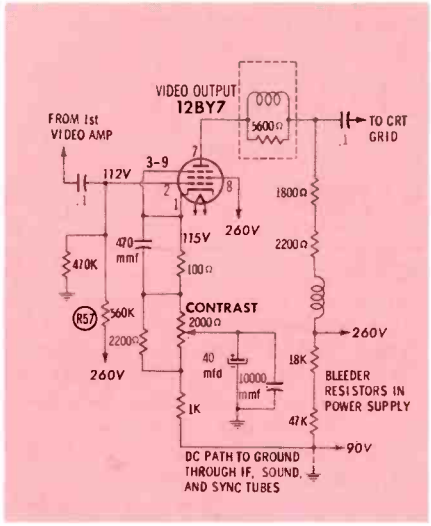
While looking for the cause of extremely poor contrast in a Stromberg-Carlson Model 21TM, we found abnormally low plate voltage on all four video IF's and the first video amplifier. These stages are all connected to the 90-volt branch of the B+ source, and we discovered that the supply voltage on this line was down to about 50 volts. Eventually, we located the reason for the trouble. R57 in the grid circuit of the 12BY7 video output tube had increased in value from 560K to 2 megohms, thus changing all the voltages in the output-tube circuit and indirectly affecting the 90-volt line.

WALSH TV & RADIO

Taunton, Mass.

Here's a good example of what can happen when a resistor in a voltage-divider network changes value. When the resistance of R57 increased, the voltage drop across it also increased. This caused the grid voltage of the 12BY7 to become less positive, thereby increasing the bias on the tube and reducing its plate current. Low contrast? Small wonder!

To understand why the 90-volt B+ line was also affected, refer to the schematic. The video output stage forms a relatively low-resistance shunt across part of the power-supply bleeder network — the portion which lies between the 90- and 260-volt B+ sources. (You've undoubtedly seen the audio output stage in many other TV sets wired between low and high B+ in a similar manner.) Let's take the total resistance between these two source points, place it in series with the total resistance between the 90-volt line



and ground, and treat this series combination as a voltage divider designed to provide 90 volts at the midpoint. The decrease in current through the 12BY7 had the same effect as an increase in resistance within the upper section of this voltage divider. Since there was no corresponding increase in the resistance of the lower section, the ratio between the two resistances was altered. A greater voltage drop then occurred across the upper section of the divider, and the potential at the midpoint became less than 90 volts.

Blanking Bar Anatomy

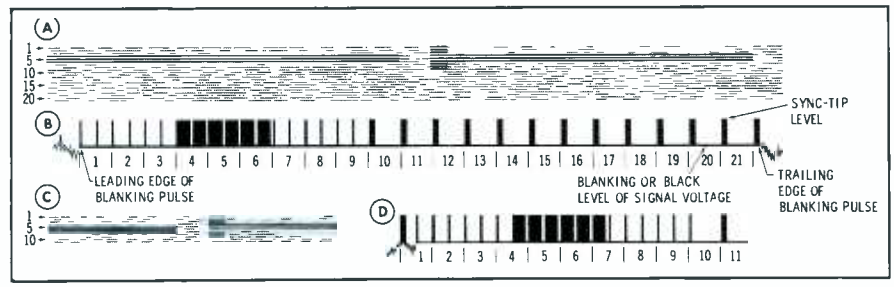
How about a picture of a vertical blanking bar with each portion of it clearly defined and described?

ELTON L. KENNEDY
Montoursville, Pa.

The best way to understand this bar is to compare it, line by line, with the signal which produces it — namely, the vertical blanking pulse in the composite video signal applied to the driven element of the picture tube.

The horizontal oscillator goes through 20 to 22 complete cycles during each vertical blanking pulse, so the bar on the screen will contain approximately 21 lines (see part A of drawing). At the end of each vertical frame of the picture, the leading edge of the blanking pulse arrives just as the electron beam reaches the right side of the screen. Almost immediately, a pulse occurs and triggers horizontal retrace. This is not an ordinary horizontal sync pulse, but the first of six special equalizing pulses which help maintain proper interlace. In part B of the drawing, note that these occur at twice the frequency of the regular horizontal sync pulses. Nos. 1, 3 and 5 trigger horizontal lines 1, 2 and 3 of the blanking bar. Pulses 2, 4 and 6 have no effect on sync, since they arrive in midline; however, they produce a small "blacker-than-black" pip in the composite video signal, which makes a visible dark spot in the first three lines of the bar.

Next comes the vertical sync pulse itself, which lasts throughout lines 4, 5



and 6. These three lines appear mostly black because the video-signal voltage stays at sync-tip level most of the time. Twice in each line, however, the signal voltage drops briefly to the blanking level to form notches or serrations. The second and fourth notches occur at the end of lines 4 and 5, and their steep, positive-going "trailing edge" serves to trigger the horizontal oscillator. Notches No. 1, 3 and 5 occur in mid-line and produce a visible gap in the center of the black area within the blanking bar.

Six more equalizing pulses follow closely behind the vertical sync pulse. Nos. 1, 3 and 5 trigger horizontal lines 7, 8 and 9, respectively. Trailing pulses 2, 4 and 6 occur in mid-line and appear as black spots on the screen.

Normal horizontal sync pulses occur at the end of lines 9 through 21. Between pulses, the video-signal voltage never varies from the blanking level; thus, the visible area in the lower part of the blanking bar is all the same shade.

After completing line 21 of the bar, the electron beam returns to the left side of the screen and begins tracing the next vertical field of the picture. The end of this field, and the beginning of the next blanking bar, occurs at an instant when the beam is centered horizontally on the screen. Parts C and D of the drawing show the first 11 lines of this next bar as well as the signal which generates it. Compare these with A and B; note that the equalizing pulses and serrations which previously occurred in mid-line will now arrive at the ends of the lines. This means that a different set of pulses synchronize the horizontal oscillator. However, the number and spacing of pulses just ahead of the vertical sync pulse are exactly the same as before; this is necessary to insure correct timing of the vertical oscillator.

When two fields are interlaced to produce a complete picture, the slightly dissimilar blanking bars A and C combine to produce a single 42-line bar having "blacker-than-black" signal elements in the first 18 lines.

Since the steep-sided sync and equalizing pulses are similar to a square-wave signal, the appearance of the darkest areas in the blanking bar give good clues to the frequency response of the video circuits. For example, weak high-frequency response causes an abnormally fuzzy or rounded appearance of the short black squares formed in lines 1-3 and 7-9; on the other hand, phase shift or poor gain at low frequencies will cause smearing of the long black bars in lines 4-6.

If the pattern at the top of the bar does not look very much darker than the rest of the bar under conditions of high picture brightness, this indicates an insufficient voltage difference between the blanking and sync-tip levels in the composite video signal. This symptom is often an important clue to trouble ahead of the video output stage which is affecting sync.

Since practical TV designs can't be expected to have perfect horizontal sync or flawless response to extremely low and high video frequencies, you can expect to see a certain amount of distortion in even a normal blanking bar. With a little practice, you should be able to judge whether or not a given bar looks reasonably satisfactory.

Hairy Capacitor

I recently had a Bendix Model KS-21E in the shop with a bad case of vertical rolling. After considerable troubleshooting, I finally located a 680-mmf ceramic capacitor with a scarred area on it (see

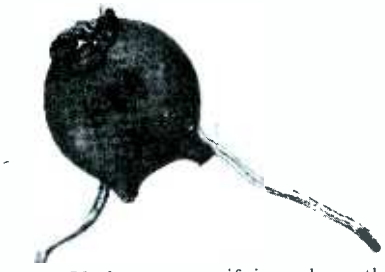


photo). Under a magnifying glass, this patch appeared to be covered with fine "whiskers." The trouble was cured by replacing the damaged component, which turned out to be a high-frequency bypass capacitor connected from the cathode of the audio output tube to ground. The bad spot was apparently produced by heat from a 150-ohm resistor mounted just above the capacitor; however, I couldn't find any charring or any other evidence of resistor overheating.

WILLIAM F. O'REGAN

Dorchester, Mass.

The capacitor grew "hair" when its plastic coating melted and became drawn out into tiny fibers. This strange formation may have been caused by an electrostatic attraction between components, or the capacitor may possibly have touched the resistor and then pulled away while the plastic was still soft.

A failure in the audio section of this set was able to affect vertical sync because the audio output tube is utilized as a voltage-dropping resistor in the power supply. The plate current of various other tubes, including the sync separator and sync phase inverter, must pass through the audio output pentode to reach the low-voltage rectifier. When this hookup is employed, the cathode of the output tube normally maintains a potential of about 135 volts and is regarded as a low B+ source point.

The 680-mmf capacitor probably developed leakage as a result of the heat injury, thereby lowering the cathode voltage of the audio output tube. This could easily reduce the plate potential on the sync stages and weaken their output signal to the point where you would lose control over vertical oscillator frequency.

Microbe Hunting, Anyone?

In an Admiral Chassis 7L1 transistorized portable radio (PHOTOFACT Set 375, Folder 6), capacitor C6 touching the rotor of the tuning capacitor during a portion of its rotation caused a noise similar to the "static" produced by dust or metal fragments between the plates. Moving C6 a fraction of an inch solved the problem. Easy—but not always obvious!

NORMAN D. SLATER

Ogdensburg, N. Y.

It's mighty easy to get into trouble when the components on these jam-packed little chassis start elbowing each other around. A good thorough physical examination under a magnifying glass should come ahead of any electrical tests on these chassis, except for basic battery-substitution and current-drain checks.

Vertical Sweep Systems

(Continued from page 41)

effects, such as bends in vertical lines or as a slightly-rounded keystone raster with the bottom narrower than the top.

Poor linearity with bunching somewhere around the middle of the raster is probably the most difficult linearity problem to cure. Sometimes (but not often enough), this symptom can be corrected by judicious selection of a replacement amplifier tube. This trouble is prevalent in sets using low plate-resistance tubes such as the 6S4, and results from a "knee" in the tube's operating curve. (A more detailed discussion appeared in "Keeping Up With Vertical Sweep Systems," January, 1958 PF REPORTER.) If tube replacement fails to eliminate the trouble, you'll have to resort to more unusual techniques. For instance, you may find that increasing the gap in the transformer core by insertion of paper shims will help.

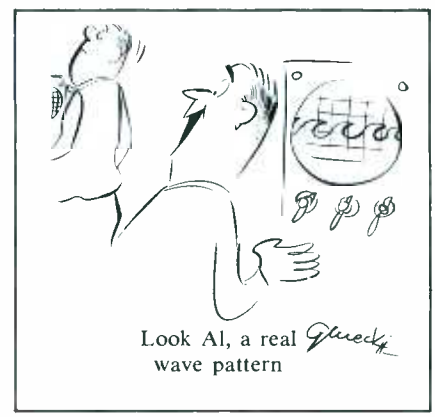
For sets using the circuit in Fig. 2, the same trouble can sometimes be eliminated by decreasing the value of the large fixed-value cathode resistor (8.7K ohms in Fig. 2); a 7K-ohm substitute cured several sets for me.

If none of these suggestions work, try adding a 20K-ohm resistor in series with a .05-mfd capacitor between the grid of the vertical amplifier and one side of the yoke winding. This addition is very much like a neutralizing network used on triodes in higher frequency applications.

Intermittent Troubles

When any of the previously-discussed troubles occur intermittently or only after the set has warmed up, it is natural to suspect a part capable of producing similar trouble in a steady state. For example, leakage in C1 often develops when the set heats up, causing the bottom half of the raster to shorten. Thus, the same defect causes the same symptom; however, this time it's thermally-induced.

Some intermittents can be more difficult. Take for instance the case involving a Westinghouse V-2313, which employs a circuit similar to the one in Fig. 5. The set produced a good picture with a full raster at first, but in a few minutes vertical sweep decreased to about half size with acceptable linearity. Barely turning the linearity control resulted in full deflection, so the control was replaced. The set operated normally for a full day before being returned to the customer. Three days later the same condition developed again; replacement of the 12BH7 seemed to be all that was needed. One week later, another complaint for the same trouble caused the set to be brought in again. This time the intermittent condition was so touchy that even application of the VTVM probe would remove or create the fault. With the scope, however, the large signal across filter capacitor CF1 indicated that it was opening



Look Al, a real Gleeck wave pattern

intermittently. After replacing this filter and bench-checking the set for several days, we knew that at last the fault had been corrected.

In servicing intermittent troubles, it is often more expedient to seek clues that generally accompany a condition, and change the components which would logically cause the trouble, rather than to change parts indiscriminately.

Slowness in reaching full deflection is another oftimes puzzling condition found in vertical sweep systems. The cause is often the same as the one we found in the case of an Emerson employing a 6W6 amplifier and 6SN7 oscillator in the circuit hookup of Fig. 5. The complaint was that it took several minutes for the picture to reach full vertical size. The set was turned on and each voltage in the circuit, even the filament, was monitored to determine if any change occurred in step with the increasing size. No specific clues were obtained. Next, a scope was used in the same type of monitoring procedure; again, nothing was learned. This monitoring takes a lot more time than it does to tell about it, since each point must be checked for the period it takes the set to reach normal operation. Power is then removed for a few minutes, and then applied again while another point is checked. This repetition eats up service time, and since it produced no results after a half-hour of testing the Emerson serviceman did what most others do with puzzlers—put it aside to look at it later.

Several service jobs later, the set was again placed on the firing line, but in the interim, the serviceman had been doing some speculating about this problem. He realized that in checking filament voltage he had measured from the hot side to chassis ground. On a hunch, he connected his VTVM leads directly across the tube pins. Now the fault became apparent. The reading across the 6W6 filament was only 5 volts; however, it increased in unison with vertical size. It was now obvious that the trouble was due to poor grounding of the other filament connection; the missing voltage was being dropped across a high-resistance solder joint.

Similar conditions have been found in quite a few sets, especially in those using 6W6, 6BL7 or 6AH4 tubes as vertical amplifiers. Recently, a series-filament G-E "MM" model, in which the 40-ohm filament-dropping resistor had increased to 70 ohms, presented the same condition. Why, with low filament voltages throughout the set, only the vertical section was affected, is one of those "unexplainables" that crop up in this business.

In the blocking-oscillator circuits of Figs. 1, 2, and 3, the components primarily responsible for maintaining correct frequency are C2 and the resistance of the vertical-hold network. In the multivibrator circuit of Fig. 4, the feedback network made up of the .015-mfd and .03-

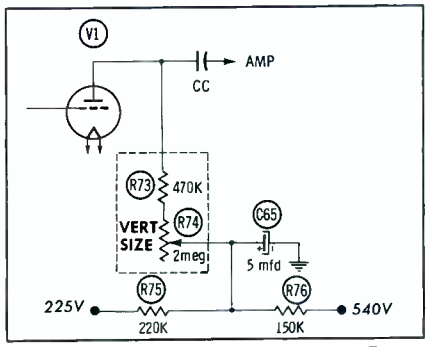


Fig. 6. Vertical overscan on an Emerson caused by open 5-mfd capacitor.

mfd capacitors, and the 180K and 82K resistors, are the principle frequency-determining components. In all of the circuits, the values of components in the integrator network also have some effect on the frequency of the circuit. If any of them are far off value or otherwise defective, the frequency shift can be great enough to prevent the hold control from locking in the picture. A shift in the value of C1 or peaking resistor R1 has to be fairly extensive before the frequency of the circuit is affected.

We had a prime case of frequency trouble the other day on a set (circuit similar to Fig. 3) which was brought in for intermittent rolling. A casual examination revealed that it had been recently worked on and that the parts in the integrator network as well as C2 had been replaced. While probing in the set, it was discovered that a slight pressure on C3 would cause the rolling. How the previous serviceman had missed this component is explained by the fact that it is mounted several inches away from the vertical-sweep system. Nevertheless, it is part of the sawtooth-forming network, and in this case a replacement capacitor cured the trouble.

When a 21" Tele King receiver was serviced for rolling on some programs, it was noted that lock-in was obtained with the hold control at one end of its range. When the set was tuned to a station that gave its identification in color, the picture began its slow roll. Before proceeding further with this aspect of the trouble, however, it was decided to make the repairs necessary to center the lock-in range.

The vertical system used the circuit shown in Fig. 1. First, timing capacitor C2 and the final capacitor of the integrator were changed with some improvement in vertical-hold control centering. Then, the control was cleaned and checked. When these legitimate service procedures made no improvement, we realized that the cause was either inherent in the original design of the circuit, or in the combined aging of components. Deciding to make a minor change, a 2-meg pot was connected in series with the hold control and adjusted to sync the picture. The resistance value at which the picture synchronized was found to be 1.5 megohms, and a fixed resistor of this value was installed in place of the original 1-megohm unit. The roll condition has never recurred to our knowledge.

The customer's complaint that the set had rolled "sometimes" might have been qualified to "rolls when station is transmitting in color," but the customer just didn't know that there is a very slight difference in color transmitting standards. As a matter of fact, he didn't even know the trouble occurred mainly during color transmissions, since his was a black and white set.

There is one other condition that happens often enough to warrant mention. Some receivers using the circuit in Fig. 1 apply a small positive voltage to the return end of the vertical-hold control. Trouble arises when dust in the control creates a high-resistance leakage path to ground and throws the circuit off frequency. Merely blowing out the control with compressed air is usually all that's required.

(Editor's note: We knew you could use a breather about now, so we'll save the other holf of this story for the September issue.)

Microphones

(Continued from page 42)

in comparison to the wavelengths of the signals to be handled. When the unit is large, adequate mike action cannot be obtained for high frequency signals from angles other than those encompassed by the front hemisphere.

The directional properties of various mikes can be used to great advantage in determining which one to use for a specific job. More will be said concerning this under the heading of mike placement in the next installment.

Impedance

Microphones are rated as to the impedance of the unit. Four main ratings are available: 50, 150, and 250 ohms, plus high impedance (sometimes called grid impedance). Generally, crystal and capacitor mikes are high impedance units; carbon, dynamic, and ribbon types are low impedance types, although some dynamic and ribbon types are equipped with an internal matching transformer for high-impedance applications.

To prevent undue loss of signal, and also some types of distortion, impedance of the microphone should match the input impedance of the amplifier. Most amplifiers have high impedance inputs, so a high impedance mike could be connected directly into the input grid circuit of the amplifier. Low impedance mikes require that a matching transformer (connected step-up) be used between them and the amplifier input.

Mike impedance also may cause problems when the mike must be operated at some distance from the amplifier, necessitating the use of a long connecting cable. For low impedance mikes, a much longer cable can be used.

An impedance matching transformer can be used at the mike if a high impedance mike is used with a long cable. Physically, this imposes no great problem because small compact units are available, designed to be connected directly into the line without being mounted. This is a disadvantage if another transformer is required to provide a match between the cable and the amplifier input. In most cases, therefore, it is simpler to use a low impedance mike whenever long cable runs are required.

Sensitivity

Sensitivity of a microphone is a ratio between signal output and sound input. Contrary to what we might expect, the most expensive mikes are not necessarily the most sensitive ones. They may be even less sensitive so that wider and more uniform frequency response can be achieved.

Microphone input consists of sound waves which exert a pressure on the moving element. This pressure is measured in dynes per square centimeter of area. The dyne is a unit of force, so the pressure unit indicates the force applied to each square centimeter of mike area. A dyne per square centimeter is also called a microbar, and it is this unit which is most often used in microphone ratings.

Mike sensitivity is normally expressed in terms of decibels of signal output compared to a zero decibel reference level. The outputs are always below the reference level, and the normal range of ratings varies from about —48 to —75 db. A

unit rated at —48 db gives more signal output (is more sensitive) than one rated at —75 db.

For low impedance mikes, power is important, so sensitivity is usually rated with either 1 or 6 milliwatts as reference. (One milliwatt is actually the zero VU reference level.) Output is measured with a sound input of 10 microbars, which is a level comparable to normal speech at a reasonable distance from the mike. Output of high impedance mikes is most often rated using a reference of one volt output with an input sound level of either 1 or 10 microbars.

Although these two ratings seem to be entirely different, the ratings are actually about the same when we consider the output of the low impedance mike on the high side of the matching transformer. If a mike is rated using an input of 10 microbars, its level is 20 db higher than for a 1 microbar sound input. For example, a mike rated at —58 db for 1 microbar would be rated at —38 db for 10 microbars.

Frequency Response

For the most exacting requirements, two frequency response characteristics are needed. The range must be wide enough to include most of the frequencies likely to be encountered, and the response should be linear over this range. In less expensive mikes, response peaks greatly reduce the quality of the output signal. A peak in the low frequency range gives a "booming" quality. If the peak occurs in the middle of the band, both low and high frequency responses are limited, giving a "hollow" type sound similar to that of a telephone receiver. When response peaks occur in the high frequency regions, an unnatural quality exists, certain parts of speech are over-accented, and any noise present is increased in amplitude.

When purchasing a mike, the type of response required is the first factor to consider. Music contains a much wider range of frequencies than speech, so if the mike is to be used in communications work, with a PA system, or in any application involving only speech, a limited response mike should be considered.

Non-directional mikes have essentially the same frequency response characteristics for all distances within range. Unidirectional and bidirectional types tend to emphasize the low frequencies when placed close to the sound source. This is particularly true of ribbon types; modern cardioids are relatively free of this proximity effect.

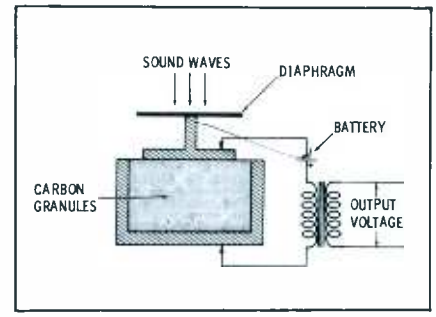


Fig. 4. Holt-head screw of type used to fasten *dualette* chassis to cabinet.

Carbon Microphones

The basic construction and hookup of a carbon mike is shown in Fig. 2. This type of unit does not generate a voltage as the other types do, but modulates a direct current in accordance with variations of the input sound waves. The battery acts as the voltage source, causing current to flow through the carbon granules and the primary of the output transformer. As long as the cur-

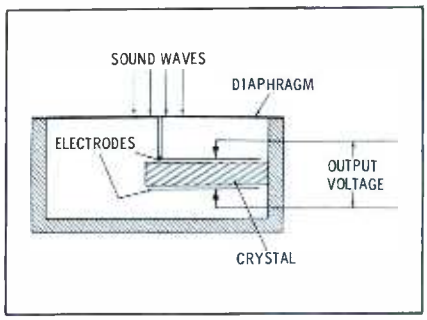


Fig. 3. Drawing illustrating construction and operation of a crystal mike.

rent remains constant, no voltage is induced into the transformer secondary; hence, there is no output. When sound waves strike the diaphragm, it vibrates, causing varying pressures on the carbon granules. As carbon compression increases, resistance decreases, and a larger current results. Less pressure on the carbon increases resistance because the granules spread farther apart; therefore, circuit current drops below normal. These changes are induced into the output circuit through the transformer. Working as a variable resistance, the carbon mike produces an output signal which is an electrical replica of the input sound waves.

The carbon mike has a number of advantages. It is rugged, develops higher ouput voltage than the other types, is simple in construction and operation, and can take considerable vibration without damage. In addition, it is inexpensive, and is not too easily affected by above average temperature or humidity.

However, its basis of operation limits its usefulness to certain fields. The carbon granules make only intermittent contact with each other, setting up small amounts of arcing between the granules. This causes hiss and noise as current flows through the circuit, a condition characteristic cf all carbon mikes. Minimum signal which can be handled is determined by the amount of hiss and noise.

Another disadvantage is that the carbon granules sometimes become too tightly packed. Packing can be caused by excessive current (caused by shouting into the mike), or excessive moisture. Packing limits the extent of granule movement, and greatly reduces the output voltage. Sometimes jarring of the mike loosens the granules, restoring normal operation. Compared to other types of mikes, the carbon unit has a very limited frequency response and a somewhat high distortion level. In addition, its response characteristics may vary from time to time, depending upon the position of the granules and the extent of packing.

The carbon mike requires a source of voltage, which can be considered a disadvantage, and it is essential that this voltage be pure DC. If the voltage were taken from a power supply, any ripple would modulate the mike current and cause hum in the output. Current is usually less than 100 ma, and most often the unit is designed for 6-volt input. An adjustable resistor can be connected in series to regulate the current, and a press-to-talk switch is sometimes connected in series to permit switching the mike on and off. It is a low impedance mike, and can be either transformer or resistance coupled into the grid circuit of the audio amplifier.

Its characteristics limit this type of mike to voice use only, so it should not be considered where music is involved. For mobile communications, in amateur radio, and

in some PA system applications, the carbon mike produces strong output for close-up voice work. Its ruggedness is a definite advantage for uses where severe jarring or vibration is often encountered. The mike element itself is non-directional, except that in many cases it is mounted in a case to discriminate against noise and signal interference.

Crystal Microphones

The basic elements of a crystal microphone are shown in Fig. 3. Sound waves cause the diaphragm to move back and forth, and the crystal bends with the movement. Due to the piezoelectric properties of the crystal (usually Rochelle salt), a voltage which varies with the intensity of the sound waves is produced. This voltage is taken from the electrodes which also serve to hold the crystal.

The crystal mike produces a high output, although not as high as the carbon type. It is fairly rugged and can be designed for wide response and low distortion. It requires no source of voltage and, being a high impedance unit, can be connected directly into the grid circuit of the audio amplifier. Crystal mikes are relatively inexpensive, ranging from a few dollars up to around forty dollars, and are of the type usually supplied with tape and disc recorders. With these advantages it has many applications in amateur and commercial radio, PA systems, recording, and some broadcast work.

Although the frequency range of crystal mikes is good, there are often response peaks to contend with. In addition, the crystals pick up moisture quite easily, which tends to limit both sensitivity and response. This also means that response and sensitivity change from time to time. These disadvantages rule out its use in professional recording and broadcast work and in places where high temperature or humidity is encountered.

Crystals will not operate above about 120° F. For this reason, the use of crystal mikes with mobile radios is limited because of the high temperatures inside vehicles during the summer. Crystal mikes are reasonably rugged but can become damaged from shock.

They are high impedance units, and therefore the allowable length of mike cable is limited. If an excessively long line is necessary, a preamp with low impedance output can be used at the microphone; however, it is more advisable to use a low-impedance dynamic unit. At the amplifier or preamp, the crystal mike should be terminated in at least one megohm, otherwise the low frequency response may drop off too much. Voltage should never be applied to the crystal; even the low voltage of an ohmmeter could damage it.

The more recently developed ceramic microphones overcome some of the disadvantages of the crystal mikes. The ceramic type is not as susceptible to heat and moisture, and inherently gives better frequency response. Sensitivity of ceramic types is about 5 to 8 db less than crystal units, but this disadvantage can easily be overcome by additional amplification.

In the concluding part of this discussion, we'll have more to say about ceramic, as well as dynamic, ribbon, and capacitor mikes, plus some general hints on the use of mikes to obtain best results. ▲

Industrial Electronics

(Continued from page 54)

called the *Curie* temperature of the metal. The rate of temperature rise changes sharply as the metal is heated above the *Curie* temperature. This sudden change is reflected back to the power oscillator as a decrease in load, and the work temperature then rises more slowly above this point unless the coupling is increased.

Surface Heating

In contrast to dielectric heating, which produces an even heat throughout the work, induction heating may heat only the surface metal. The depth of heat penetration into the work is controlled largely by the frequency of the applied power; i.e., depth of penetration decreases as frequency increases. This characteristic is used to harden surfaces of king pins without making them brittle. Fig. 1 shows a workman feeding king pins into an automatically controlled heat-timing and quench fixture. A high-frequency electronic heater supplies the RF power. Since the pins are made of steel, both circulating current and molecular motion generate the surface heat. As a result of uneven heating, the king pin becomes progressively softer from the outside to the inside. The central metal provides the toughness for shocks while the hard outer surface resists wear.

Brazing

Brazing is a method of joining metal parts by using an alloy which, when heated with the parts, melts and then forms a bond when allowed to cool. Soldering is a low temperature (350°F to 600°F) form of brazing which uses a joining alloy of lead and tin, or lead and silver.

"We had to put in a few parts . . . "

Soldering by induction heating aids in fabricating electrolytic cans, terminal strips, etc. The metals which can be joined by soldering are copper, copper alloys, steel alloys, nickel, nickel alloys, and clad or plated aluminum.

A cleaning and protective chemical (flux) prevents oxidation and dissolves dirt during the heating process. Zinc, aluminum, and ammonium clorides are the most active fluxes and are commonly used in paste form; however, they leave a residue which is corrosive, conductive, and hygroscopic (attracts moisture from the air). In electrical applications, these properties cause trouble. The solution to this problem is to use a resin flux which leaves a harmless residue. Resin flux is less active than other types, however, and when used for heating applications, greater care must be exercised in precleaning and handling operations. A recently developed *H-series* soldering flux is more active and vaporizes during the heating process, leaving an insignificant residue.

High-temperature brazing provides a bond comparable to weld-

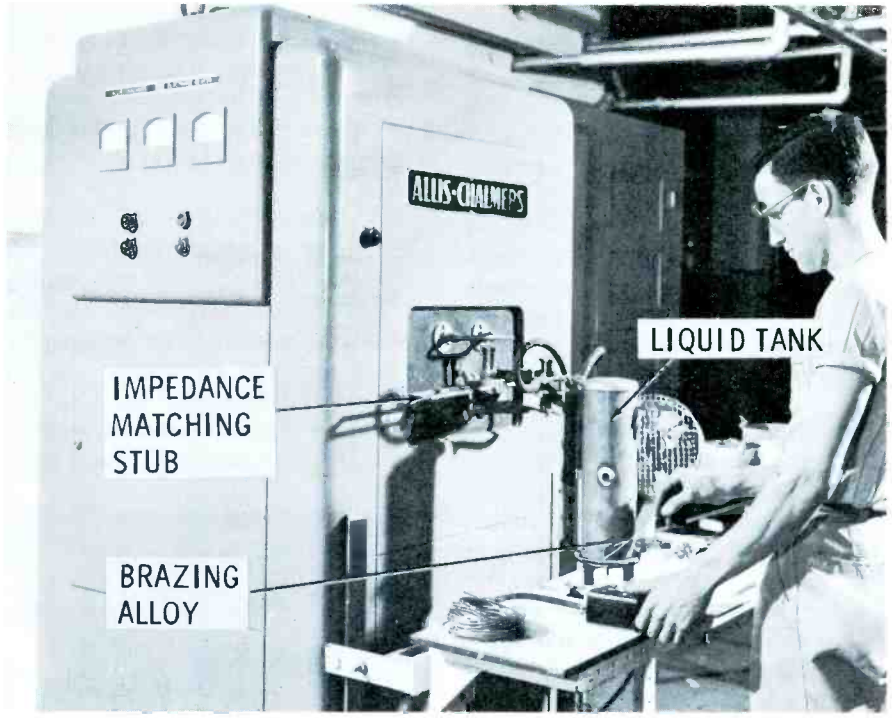


Fig. 3. No shock hazard exists here because the coil is only a few volts positive.

ing. Joining alloys for brazing are copper and silver; copper, silver, and zinc; silver and maganese; and copper. These alloys melt at temperatures ranging from 1125°F to 1980°F. Fluoride or alkali salts are generally used as brazing fluxes, although special fluxes may be required in difficult jobs.

Fig. 2 shows two fixture platforms holding four items each. One fixture is set up while the other brings the work up to the heating coils. Discs (in the operator's right hand) are being placed on brass sleeves (in the fixture) with thin rings of joining alloy (in the left hand) in between. The disc and sleeve are coated with brazing flux at the contact areas, and the application of low-frequency power provides deep heat penetration.

Another brazing operation is demonstrated in Fig. 3. The ends of a compressor tank are brazed to the center piece in one-third the time required by older, hand-torch methods. Joining alloy is added by the operator in this application because complete, airtight sealing is required. No shock hazard is present because the work coil is only 2 to 10 volts above ground.

Frequency Selection

Electronic heater frequency is selected after considering the heating properties desired. At 300 kc/second, metal is uniformly heated. Power is easily coupled to large pieces of work at this frequency; however, as the size of the work decreases so does the coupling efficiency. The highest frequency which still results in uniform heating increases as work size decreases. Although the depth of penetration

Fig. 4. This 10-kw heater seals lens in instrument case using 300-kc RF power.

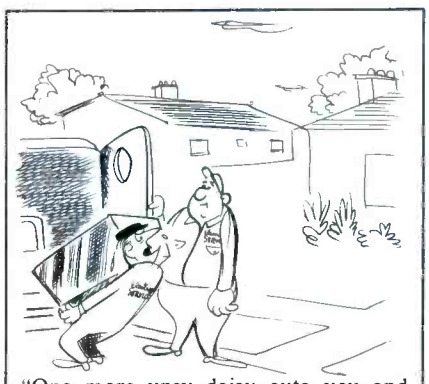
Fig. 5. Electronic heater used for case-hardening transmission-gear teeth.

Fig. 6. Heat is used to anneal gears to make them tough and wear-resistant.

is inversely proportional to frequency, smaller pieces can be heated uniformly at higher frequencies because they have smaller diameters.

Depth of penetration is constant for a given frequency and size of work; thus, a penetration of one-thousandth of an inch means that a solid circular work piece whose diameter is two-thousandths of an inch is heated uniformly, whereas work pieces with larger diameters are surface heated to a depth of one-thousandth of an inch only. Because coupling efficiency increases with frequency, and depth of penetration varies inversely with frequency, the highest possible frequency is usually selected. When a dielectric material is also present in the work-coil field, a frequency below the optimum may be chosen to reduce the heating effect on the dielectric.

In Fig. 4, the lens in an aircraft instrument is being permanently sealed in a brass tube by induction heating. Low frequency (300 kc) prevents the lens from being heated



"One more upsy daisy outa you and I'll bust you one!"

by dielectric effects. The selectiveness of frequency with relation to the heating effect is responsible for many industrial feats. For instance, the glass face of a metal cathode ray tube is fused to the metal cone by high-frequency electronic heating. These applications show that RF frequencies cannot be sharply defined as pertaining to dielectric or induction heating only. At 100 kc/second, heating is primarily by induction, while 100-mc RF is generally useful only for dielectric heating. Within these bounds there is a gradual shift of application from one form of heating to the other.

Work Coils

The matching impedance may be perfect, the frequency may be properly selected, and still the work will not be heated satisfactorily. Work material must be heated uniformly throughout a certain area before induction heating has any meaning. Shaping the work coil to fit the job is a start, but the induced field distribution will dictate the coupling provisions for specific areas. For instance, Fig. 5 shows the work coil used in hardening the teeth on a tractor transmission gear. The teeth surfaces must be hard, but at the same time penetration must be limited to a fraction of an inch. The coil is located around the circumference of the gear, and high-frequency power is applied. The table platform raises and lowers the gears to place them inside the coil. A quenching liquid is sprayed on the gear as it reaches the desired temperature. The gear is not finished with its heat treatment when the teeth are hardened. The center of the gear is heated using the work coil shown in Fig. 6. Low-frequency power is used to get deep penetration, and a single-turn work coil provides proper coupling. The gear is cooled slowly and evenly, annealing the center metal of the gear to relieve stresses which could later cause the gear to break.

The coupling coil of Fig. 6 is a link between the oscillator tank coil; it acts as a primary while the work is used as a secondary. Link-coupling similar to this is common in transmitter interstages where inductive coupling is required. The link forms a low-voltage, high-current transmission line, actually coupling

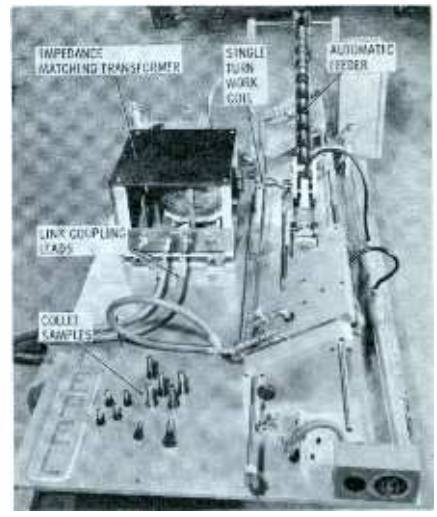
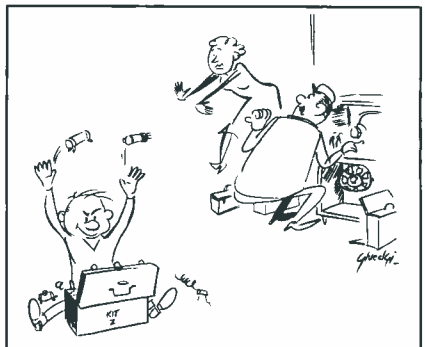


Fig. 7. Link-coupling permits the heater to be placed in a remote position.

two physically separated transformers. Dual transformer coupling by means of a link is further illustrated in Fig. 7. Two lines are identified as the link between the final transformer and the electronic heater. With this insulated link, the work table can be located away from the electronic heater without arc-over or shock-hazard problems. Collets are surface-heated and quenched in an automatic cycle, thereby providing a hard, wear-resistant surface and a tough body.

Proper work coil design enables heat treatment of manufactured items ranging in size from sewing needles to generator arbors for hydroelectric generators. Work coil shapes may be made to fit all types of contour parts encountered in brazing. Power may be concentrated by the work coil on a single area of a part so that the desired area is heated to the melting point while the unheated areas of the part may be touched with bare hands.

In the next installment, we'll discuss the circuits used in electronic heaters. ▲



"Don't worry, ma'am—it's just my decoy kit—I use it to keep the kids occupied."

(Continued from page 52)

erated radios in the lab, and although the instrument is limited to certain load currents, I noted that these limitations could be ignored as far as portable transistor radios are concerned. Due to the excellent filtering and voltage-regulating features, I also found that the radios functioned without any interferring AC hum or buzz.

There are a number of applications for a small power supply such as the Model 1020 over and above those you'd normally expect. One that I used, for example, is choosing a correct bias potential for filament circuits in audio amplifiers and preamplifiers to minimize hum which could otherwise seriously affect fidelity. By biasing the AC filament circuit with a DC voltage slightly above or below its normal ground return, amplifier hum originating from this source can often be reduced. This condition usually stems from a heater-to-cathode difference in DC potential on one or more of the amplifier tubes.

To determine the right voltage for this application, I merely connected the positive terminal of the supply directly to the isolated filament circuit or, after removing its ground return, to the center tap of the filament winding on the power transformer. The negative terminal goes to chassis ground. I then adjusted the output voltage until minimum hum conditions were achieved. Reversing bias polarity by switching the power supply leads, I repeated the procedure and noted which polarity produced best results.

Since it's often difficult to ascertain slight variations by ear, I pre-

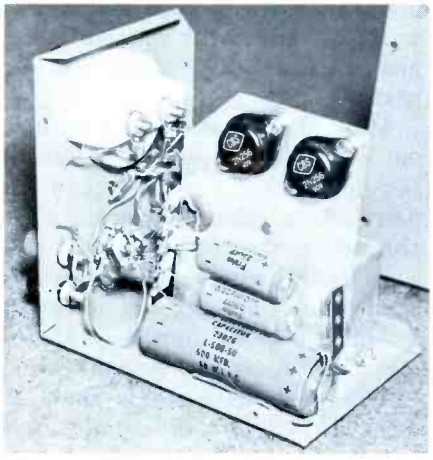


Fig. 2. The Model 1020, using two transistor regulators, is small in size.

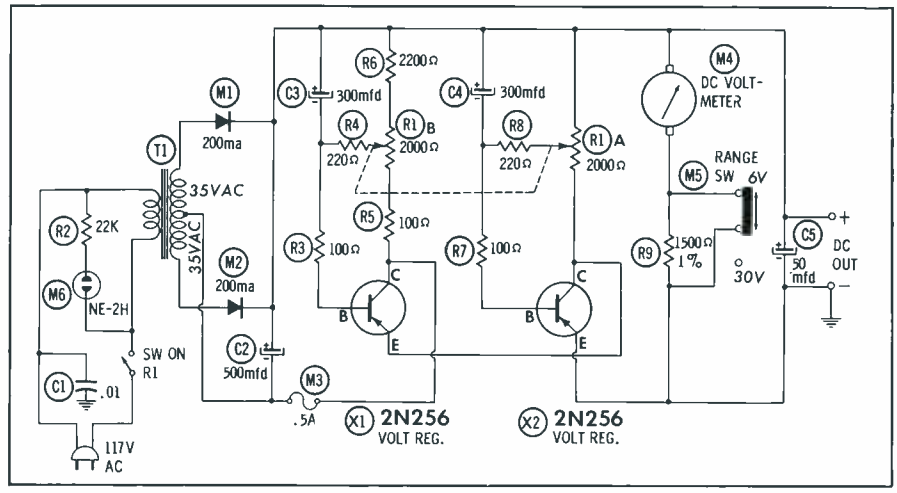


Fig. 3. Circuitry of the Model 1020, revealing the application of transistors.

fer to use an oscilloscope to monitor hum voltage. Incidentally, circuits that develop AC filament voltage with respect to chassis ground must be rewired as an isolated network before this DC biasing trick can be used.

After employing the variable DC supply to determine the correct polarity and voltage value, you can then obtain the needed bias from other circuits in the equipment and make a permanent modification. A few examples of hum-reducing circuits using fixed values are shown in Fig. 4.

A Report on the "VoltOhmyst"

RCA is currently marketing a vacuum-tube voltmeter that is available as either a kit or factory-wired instrument. Pictured in Fig. 5, the Model WV-77E features a plastic holder on its carrying handle to store test leads and power cord for compact portability.

Specifications are:

1. Power Requirements—105/125 volts, 50/60 cps; power consumption approx. 5 watts; one self-contained 1.5-volt battery; ON indicator provided on front panel.
2. AC Voltmeter—rms ranges from 0 to 1.5, 5, 15, 50, 150, 500, and 1500 volts, separate scale for 0 to 1.5 volts; peak-to-peak ranges from 0 to 4, 14, 140, 400, 1400, and 4,000 volts, separate scale for 0 to 4 volts; frequency response ± ½ db from 20 cps to 500 kc on all ranges up to 400 volts p-p; accuracy ± 5% of full-scale deflection.
3. DC Voltmeter—ranges from 0 to 1.5, 5, 15, 50, 150, 500, and 1500 volts; input impedance 11 megohms with probe and cable; accuracy ± 3% of full-scale deflection; zero center-scale indication provided.
4. Ohmmeter—ranges of R x 1, 10, 100, 1,000, 10K, 100K, and 1 meg; center scale 10; ohms circuit protected by ½-amp fuse; zero- and ohms-adjust controls on front panel.
5. Size and Weight—8" x 5⅝" x 4½"; approx 4 lbs.

I know that many of you are interested in building your own test equipment whenever possible, so I made it a point to obtain a kit version of this RCA VTVM and built it here in our own lab.

The kit instrument is identified as Model WV-77E(K) and comes complete with tubes, test leads, and even solder. Aside from a complete parts list and schematic, I was supplied with a large instruction chart which included about a dozen drawings and over 150 detailed steps to lead me by the hand through the entire construction and calibration of the instrument. Don't let the number of assembly steps scare you, for most of them are only a short sentence representing one simple operation. Don't try to hurry through, however; allow yourself ample time to digest the instructions and complete each step before going to the next.

Most of the parts are assembled on a printed-wiring board about two-thirds the size of the front panel. As a guide in placing components on the board, I found that a symbol number for each part is printed in white ink (in its exact location) on the opposite side of the board from the etched wiring. Naturally, it takes a few hours to build the kit, but no special tools or exceptional "know-how" is necessary.

The power supply of the instrument employs a transformer and single selenium rectifier. A 6AL5 functions as a full-wave rectifier for AC inputs, while a 12AU7A is used in a push-pull balanced DC bridge having a 400-ua meter movement in its plate circuit. The meter face is fairly large and easy to read with its AC and DC scales color coded to match colored voltage markings on the range selector. The function selector (also on the front panel) has both positive and negative positions for DC measurements.

I find that servicemen interested in building kit-type equipment are usually more concerned with final calibration procedures than with the more familiar mechanical and elec-

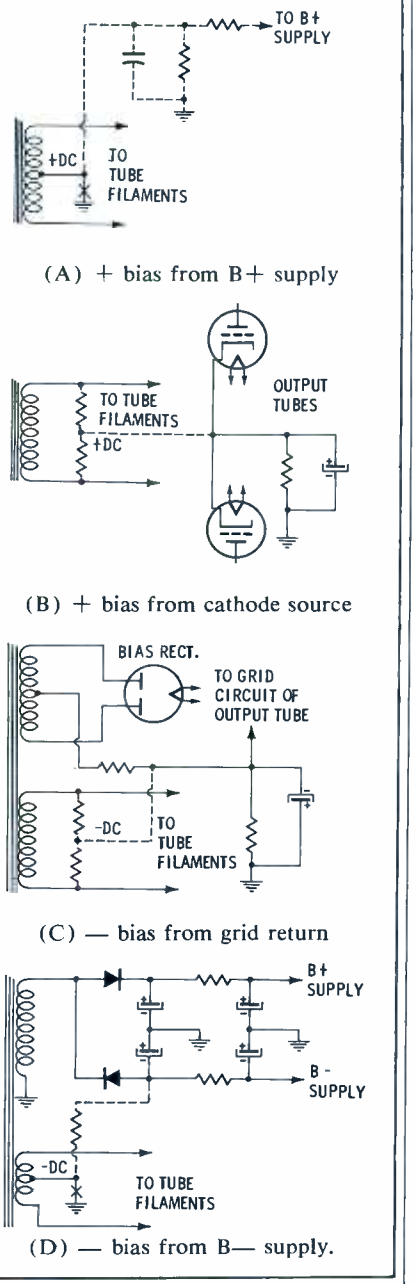


Fig. 4. Typical filament circuits.

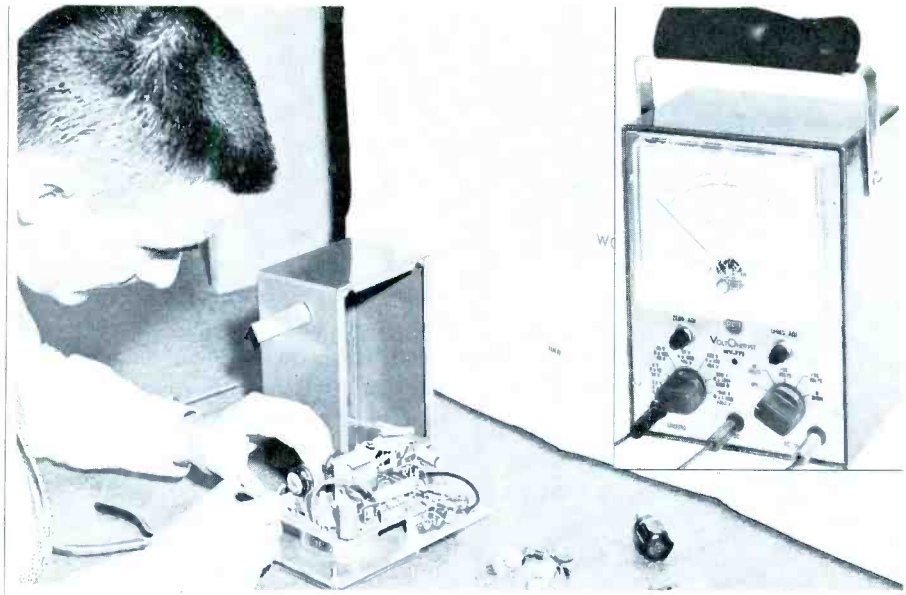


Fig. 5. RCA's new VTVM comes wired or as an easy-to-build kit. It measures DC or rms volts up to 1500V, p-p signals to 4,000V, and resistances to 1,000 megohms.

tronical construction steps involved. For this reason, I will describe some of the final touches for this VTVM kit before it can be placed in reliable and profitable service.

Before mounting the chassis in its metal case, I checked to see that the knife-edged meter needle pointed to "0" with the function switch in its OFF position. It didn't quite make it, so I adjusted the plastic screw head on the front of the meter until the pointer lined up with the zero mark at the left edge of the scale. Following instructions, I supported the front chassis panel in its normal upright operating position and inserted the AC plug into a 117-volt outlet. I then set the function switch to +DC VOLTS and placed the range selector to its 1-5-volt position.

After about a 15-minute warm-up period, I proceeded with the DC calibration and plugged in the red and black test leads to the DC and ground jacks, respectively. Connecting the tip of the DC probe (which contains a 1-megohm isolating resistor) to the clip end of the ground lead, I zeroed the meter by manipulating the ZERO ADJ. control on the front panel. I then disconnected the DC probe from ground and touched it to the positive terminal of the instrument's 1-5-volt battery.

The final step was to adjust the DC calibration control, which is the center potentiometer of a three-section unit mounted to the printed-wiring board (see Fig. 6). This control, located in the plate circuit of the 12AU7 dual-triode, is used to balance the DC meter bridge. While holding the probe on the battery terminal, I adjusted it until the meter needle read beyond full-scale deflection—or to the recommended position shown in Fig. 7.

After completing these DC touch-ups, I also calibrated the instrument's AC and ohms circuits by two simple procedures involving the 117-volt source and the ohms adjustment on the front panel. ▲

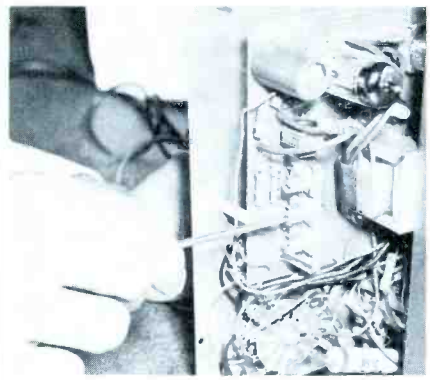


Fig. 6. Do-it-yourself adjustment of the WV-77E(K) includes DC calibration.

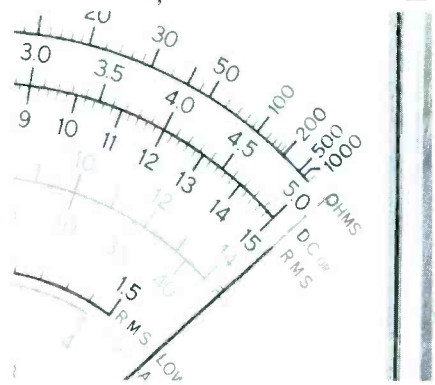
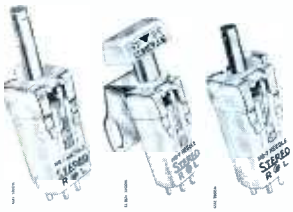


Fig. 7. Close-up of meter shows correct position of pointer for DC calibration.

PRODUCT report

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

Stereo Cartridges (38G)

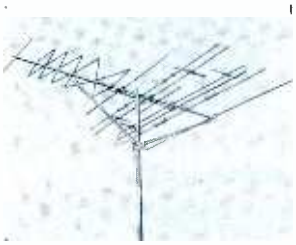


Three new Astatic high-output stereo cartridges, Models 70TS, 74TS and 76TS-TB, differ from each other in mounting arrangements but have identical performance characteristics as follows: Output 2 volts, frequency response 50-10,000 cps, channel separation 20 db, and stylus pressure 10 gm. All use Astatic needles N8-7 and N8-3.

Wire Dispenser (39G)

The interlocking-type construction of Alpha *dispens-Aracks* makes it easy to fasten several of these wire-dispensing units together side-by-side, back-to-back, or in vertical stacks to provide increased storage capacity. For convenience in measuring lead lengths, an 8" ruler is printed along the top edge of the rack.

Fringe-Area Antenna (40G)



Two driven dipoles (one folded *Satellite Sleeve* and one straight rod) are used in the latest-type JFD *Power-Helix* antenna for fringe areas. List price of the basic model, PX911, is $35; a gold-anodized aluminum version (AX911) is $42.50; and two-bay stacked arrays are available at $72.50 (regular finish) or $87.50 (anodized).

Tuner Cleaner (41G)

Accessories included with each 8-oz. aerosol spray can of Chemtronics *Tun-o-lube* tuner cleaner are a flexible plastic *Spray Aid* (for directing the spray into hard-to-reach places) and a wall-mounting bracket which grasps the lip of the can. The cleaning fluid is a non-flammable formula which includes a contact lubricant. Price is $1.98 per can.

Oval Speaker (42G)

Quam Model 48A2 is a 4" x 8" speaker which replaces original equipment in numerous recent models of auto radios as well as in certain RCA and Sylvania radio and TV sets. Power-handling capability is rated at 4.5 watts, magnet weight is 1.4 oz., over-all depth is 2 3/16", and list price is $6.95.

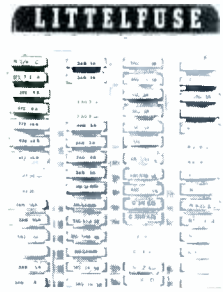
Soldering Irons (43G)

Interchangeable ceramic heating elements are used with the SIDCO *Kiss'n Cool* soldering-iron handle. Some have permanently-attached soldering tips, while others are fitted with detachable 1/8"-diameter tiplets. Both series of elements are available in several ratings within the range of 25 to 50 watts.

Non-Polarized Electrolytics (44G)

Tubular, non-polarized electrolytic capacitors, Illinois Type IHTAC, are designed for use in crossover networks in high-power audio equipment. These units have "flat" characteristics over the frequency range from 30 cps to 15 kc. Several values are available—for example, 75 or 50 mfd at 25 VAC and 4 mfd at 12 VAC.

Fuse Rack (45G)



The *Fusemaster*, a clear plastic wall rack with 60 "slide-in" compartments for fuse boxes, is now available from Littelfuse. All the compartments are labeled with various fuse-type numbers to help the service dealer set up a complete, orderly inventory. A supply of blank, adhesive-backed paper strips is also provided for the dealer's convenience in modifying the labeling system to suit his needs.

Resistor Assortments (46G)

IRC *Handy-Paks* of carbon composition resistors are supplied in a number of ingeniously-packaged assortments, such as the *Resist-O-Caddy* folding plastic pouch ($14.40), the *Resist-O-Pedia* loose-leaf binder ($46.80 or $55.44, depending on contents), and the *Resist-O-Chest* metal file box ($24.48 or $55.44).

High-Compliance Cartridge (47G)

The *Professional 55* version of the Columbia CD stereo cartridge is intended for use with transcription turntables. Special features include a small (0.5-mil) diamond stylus and a very low tracking force of 1.5 grams. Two pairs of miniaturized, plug-in equalizing networks (for both low- and high-level inputs) are supplied with each cartridge.

New Tubes in Stock (48G)

Latest additions to the Raytheon line of replacement radio-TV tubes are the following: 3CY5 tetrode RF amplifier, 6DT5 vertical-output pentode, 6EH8 triode/pentode oscillator-mixer, 6J6A twin-triode oscillator-mixer for 450-ma series-string circuits, 9AU7 dual triode for 450-ma circuits, 9BR7 dual-diode/triode for sync and horizontal AFC stages, and 12AZ7A dual-triode amplifier.

Three-Channel Stereo (49G)

Electro-Voice has developed a system whereby left and right-channel stereo signals can be matrixed together and fed to a third, centrally-located speaker to create a "three-channel stereo" effect. The system includes a complete three-channel setup comprising a pair of four-way *Patrician 700* speaker systems (each with 30" bass reproducer), a Model XT-1 mixer transformer (shown), and a three-way *Stereon 200* center-channel unit.

Transistorized Power Supply (50G)

For operating mobile radio receivers and transmitters from a 12-volt battery source, the Webster Electric Model 2D11 transistorized power converter furnishes dual outputs of 500 VDC at 150 ma and 250 VDC at 80 ma. Continuous operation is permissible up to 104° F; "two minutes on—three off" operation at 122° F. Maximum battery drain is 15 amps. The unit measures 4¾" x 4" x 8" and weighs 3½ lb.

Radial-Lead Capacitors (51G)

Arco-Elmenco *dp* capacitors, with a combination *Mylar* and paper dielectric, are about half as large as conventional tubular capacitors. The outer coating, formed by dipping into phenolic resin, is much more humidity-resistant than molded coatings. Ratings permit reliable continuous operation at full rated voltage up to 110° C. Packed in transparent *5-Pak* bags, values available are .001 to .25 mfd at 600V and .001 to .05 mfd at 1,600V.

Stylus Pressure Indicator (52G)

Tracking force may be measured with the Clevite "Walco" *Microgram Stylus Pressure Gauge*, using the following procedure: Place the gauge on the turntable, rest the stylus on the broad end of the gauge, and place the counterweight on the slender end of the gauge to achieve a balance. Read stylus pressure directly in grams. Retail price is $1.50.

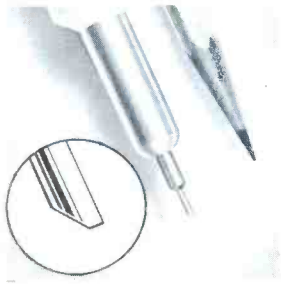
Audio Test Record (53G)

To aid servicemen in testing hi-fi equipment, Audiotex (division of GC-Textron) has introduced an unbreakable *Audiotester* LP record. One side features a recording of a metronome (for balancing stereo channels) and other test signals for pickup alignment, channel separation, frequency response, RIAA equalization, and turntable rumble. On the other side are several monophonic tests. List price is $4.98.

TV Twin Lead (54G)

Belden *Permohm* antenna lead is designed for low signal loss under adverse conditions such as exposure to ice, smog or salt spray. The twin conductors are encased in a solid polyethylene ribbon and then embedded in a thick casing of foamed polyethylene. 50′, 75′, and 100′ hanks, 500′ cartons and 1000′ spools are available.

Tiny Soldering Tip (55G)



Want a *real* pencil-type soldering tip? The Ungar Type PL340 *Micro-Needle Tiplet*, with an outside diameter of 3/64" and a length of ¾", is designed for extremely delicate jobs such as soldering miniature components and tiny eyelets to printed wiring boards. The bevel-edged tip, made of iron-clad, nickel-plated copper, fits Heating Units No. 4045, 1235 and 535.

5-Watt Controls (56G)

Discovery of an improved type of insulation has enabled Centralab to expand its line of WW and WN Series *Radiohm* wirewound controls. Formerly available only in resistances up to 25K ohms, these miniaturized 5-watt units are now being made in values up to 100K ohms. All controls in both series have linear taper.

Compact Stereo Speaker System (57G)

The Pilot PSV-1 *Stereo Voice* unit consists of two 3" tweeters, two 6" midrange speakers, and a 12" woofer inside a 25¾" x 14¼" x 12" cabinet which can be mounted either horizontally or vertically. The 3" and 6" speakers are arranged for wide sound dispersion. By means of an external control, they can be repositioned as needed for best stereo effect. Weight of the unit is 45 lb.; price is $139.50.

Tape Sales-Service Package (58G)

The *Two-Way Profit Pack* offered to service dealers at $44.40 (the price of the tape alone) by ORRadio includes 12 assorted 7" reels of *Irish* tape, a wall banner for the dealer to use in advertising his tape-recorder servicing business, and a 208-page recorder-service manual prepared especially for ORRadio by Howard W. Sams. This book includes detailed schematics, exploded views, and trouble charts for several of the most popular recorders.

Receiving Tubes (59G)

Sylvania has announced five new tube types for the radio-TV replacement market: 6AF3 damper diode, 6- and 12DT8 dual triodes for FM radio front ends, 6ES5 diode/triode RF amplifier for television tuners, and 12DY8 tetrode/triode for auto radios.

INDEX TO ADVERTISERS

August, 1959

TUBE TYPE	MODEL 648 FIL.	D.	CIRCUIT SEC.	A.	E.	PLATE TEST	MODEL 49 B.	C.	D.	MODEL 115/715/561 FIL.	X.	PLATE	CATH. SHORTS	E.	YZ
2ER5	2.5	A237	P	2.5	AC456*	95WX	3	1X	2s6	2.5	3	25	7	30	2JMS
3ER5	3.0	A237	P	3.0	AC456*	95WX	3	1X	256	3.0	3	25	7	30	2JMS
6ER5	6.3	A237	P	6.3	AC456*	95WX	3	1X	256	6.3	3	25	7	30	2JMS
6ES5	6.3	A234	P	6.3	567	34YZ	-	-	89	6.3	-	22	7	12	2JMOR
6FM8	6.3	129	T	6.3	A67	23XZ	4	-	2X,	6.3	-	30	7	48	7OQ
		124	D	6.3	8	65X	4	-	6X.			33	3		3Q
		123	D	6.3	5	65X	4	-				33	1	48	4Q

Latest Chart Form 648-21, 115/715/561-11, 49-5

ANTENNA SYSTEMS

1G. AMPHENOL-BORG — Catalog sheet on new *Marine Core* twin-lead which has up to 93% less signal loss than other types when submerged. *See ad page 60.*

2G. JERROLD—16-page booklet on the amplified TV-FM Home System shows how to obtain optimum TV and FM reception using a number of outlets throughout the home. *See ad page 69.*

AUDIO & HI-FI

3G. KAAR—Brochures entitled "An Explanation of Repeater Operation in the Mobile Services," and "FCC Rules and Regulations, Effective September 11, 1958 . . . an interpretation."

4G. PICKERING — Service File of helpful, informative data on audio and hi-fi. *See ad page 68.*

5G. QUAM-NICHOLS—New 8-page catalog gives detailed specifications on 121 speakers and 27 audio transformers, including many new replacement units for transistor-radio and hi-fi units. *See ad page 80.*

CAPACITORS

6G. CORNELL-DUBILIER—24-page Substitution Cross Index, listing over 3,525 twist-prong and tubular-electrolytic replacements. *See ad page 65.*

7G. ILLINOIS CONDENSER — Literature on all types of capacitors, including radio, TV, motor-start, Philco-flash, miniature, subminiature, military, computer, paper, audio-crossover network, and tantalum. *See ad page 87.*

8G. P. R. MALLORY—Form 9-165, new capacitor catalog. *See ad pages 34-35.*

9G. SPRAGUE—M-773 *Difilm* Mylar-Paper capacitor catalog sheet. *See ad page 26.*

CARTRIDGES & NEEDLES

10G. CLEVITE-WALCO — 36-page 1959 needle and accessories catalog with complete cross-reference and needle-identification data.

11G. ELECTRO-VOICE — Bulletin No. 267, featuring new totally-compatible stereo cartridges. Offers two series—the *Magneramic* for magnetic inputs and the standard ceramic for ceramic inputs.

12G. JENSEN INDUSTRIES — 1960 Wall-chart, form J-100; also, new dealer stock control and cartridge cross-reference guide, form DL-157. *See ad page 91.*

COILS & TRANSFORMERS

13G. J. W. MILLER — Data sheets on the latest radio and TV replacement coils. *See ad page 51.*

14G. TRIAD—New general replacement catalog, TR-60; also new TV replacement guide, TV-60. *See ad page 84.*

FUSES

15G. BUSSMANN—Completely new television fuse chart describing proper fuses to use, how they are mounted, and which circuit they protect. *See ad page 37.*

MOVIES

16G. SENCORE—Learn all about 22-minute slide-film and when free showing will be held in your area.

SERVICE AIDS

17G. CHEMTRONICS — Flyers describing complete line of electronic servicing chemicals, including *No-Arc* hi-voltage insulator.

18G. E-Z-HOOK—Convenient reference sheet titled, "How to Build the Five Most Useful Scope Probes," with schematics, mechanical component layouts, etc. *See ad page 86.*

SPECIAL EQUIPMENT

19G. ATR—New KARADIO catalog sheet describes auto radio sets for both imported and compact American cars. *See ad page 32.*

20G. BULLDOG — Form EH-100, descriptive folder and prices on *Electrostrip*. *See ad page 78.*

21G. SOLA — Flyer describing the *TeleVolt* line-voltage regulator for TV sets, radios, hi-fi amplifiers, and tape recorders.

TECHNICAL PUBLICATIONS

22G. CBS ELECTRONICS—"Servicing Transistor Equipment," the latest issue of *Tech Tips* by Bud Tomer. *See ad page 55.*

23G. HOWARD W. SAMS—Descriptive literature on all Howard W. Sams publications covering servicing of radio, TV, hi-fi, etc. Includes data on latest books, "Tape Recorder Manual, Vol. 4," "Television Antenna Handbook," "101 Ways to Use Your Signal Generator," and the new and completely revised edition of PHOTOFACT Television Course." *See ads pages 33, 76, 90.*

TEST EQUIPMENT

24G. B & K—Bulletin ST21-R gives helpful information on new point-to-point signal-injection technique with Model 1075 *TV Analyst*; other bulletins describe *Dyna-Quik* Models 500B, 650, and automatic 675 portable dynamic mutual-conductance tube and transistor tester, plus Model 400 CRT cathode-rejuvenator tester. *See ad page 25.*

25G. DOSS—Information on the latest in test equipment, including the *Pioneer* 250 Horizontal Systems *Quantalyst*. *See ad page 58.*

26G. EICO—20-page 1959 2-color catalog describes 65 models of professional test instruments, hi-fi, and "ham" gear in both kit and factory-wired form. Shows how to save 50%. *See ad page 50.*

27G. JACKSON — Data sheets describing Models 598 and 658 low-cost dynamic tube testers. *See ads pages 82, 96.*

28G. RCA—Pocket-sized folders on the WV-38A(K) volt-ohm-milliammeter and WO-33A(K) super-portable oscilloscope kits. *See ads pages 28-29, 3rd cover.*

29G. SECO — Literature describing the new Model 100 dynamic transistor checker and Model 78 grid-circuit and tube-merit tester; also 8-page 2-color folder on company's other equipment, plus servicing information. *See ad page 77.*

30G. SERVICE INSTRUMENTS — Catalog sheet describing the new Model HG-104 harmonic generator, which simultaneously produces RF, IF and audio signals for quickly isolating transistor-radio troubles. *See ads pages 79, 81, 83, 85.*

31G. VIS-U-ALL — New 4-page catalog on complete line of "Business-Building Test Equipment" for service dealers. *See ad page 64.*

TOOLS

32G. BERNS—Data on the 3-in-1 picture tube repair tool that crimps pin and element lead to make a solid electrical connection; can also be used as screwdriver and channel selector. *See ad page 90.*

33G. HUNTER — Catalog on subminiature tools for printed board work, etc. *See ad page 91.*

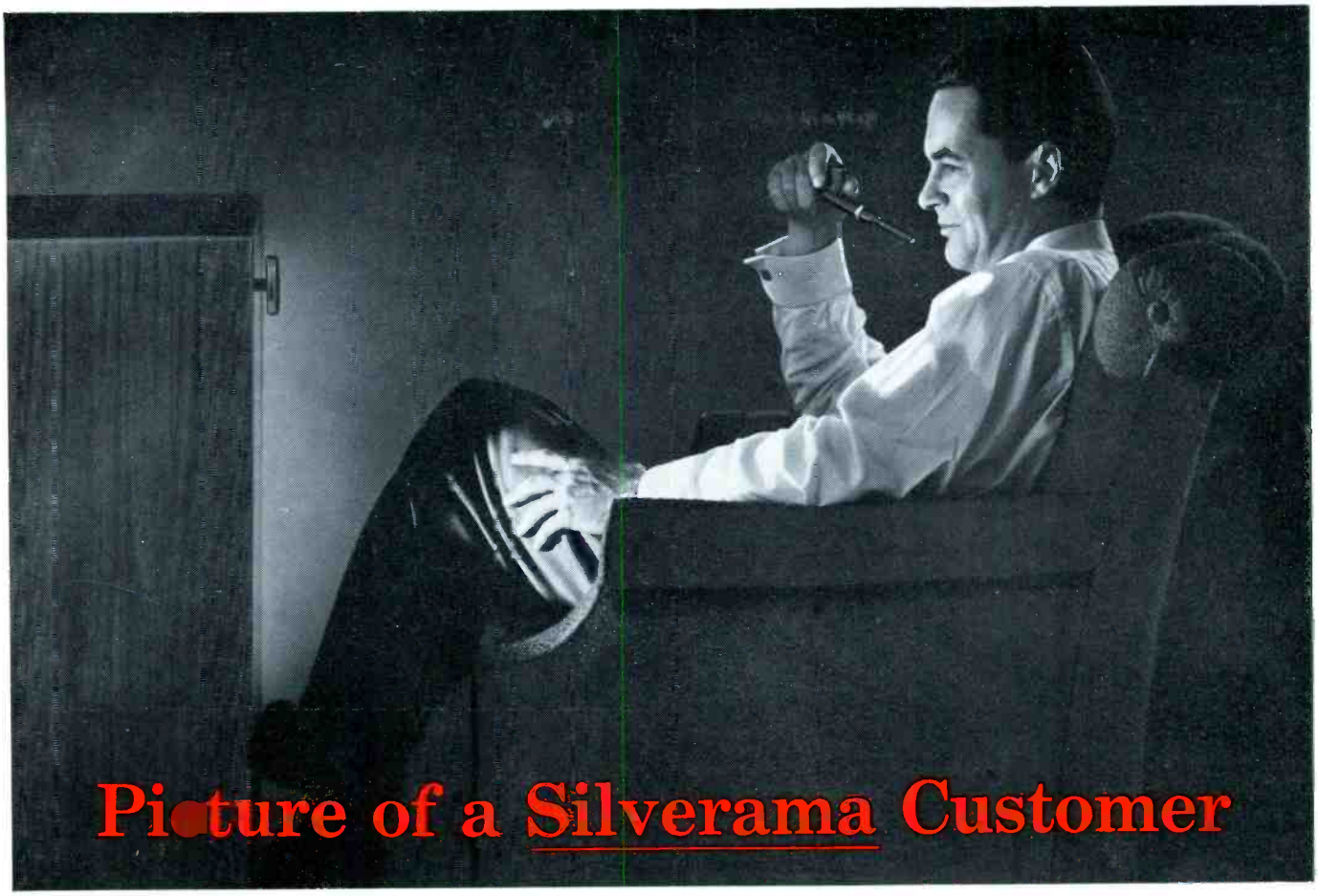
34G. XCELITE—Latest catalog sheet on line of serviceman-designed tools, listing various types of screwdrivers, nutdrivers, pliers, and cutters. *See ad page 89.*

TUBES

35G. AMPEREX — 12-page catalog plus detailed data sheets on line of premium-quality frame-grid tubes designed for use in exacting applications. *See ad page 72.*

36G. TUNG-SOL—Pocket price list with July 1st suggested retail prices for approximately 1000 receiving and picture tube types; also, order form and catalog sheet for newly-published "Tube Base Connections" and "Tube Characteristics" books. *See ad page 59.*

37G. WESTINGHOUSE — Entry blanks for "Winner Takes All" contest which offers $50,000 in prizes. *See ad page 63.*



Picture of a Silverama Customer

This man needed a replacement picture tube for his TV set—and he wanted the best. So his TV technician installed an RCA Silverama—the premium picture tube made of all-new glass and all-new parts. It's the finest picture available today—just right for the customer who expects top quality and top performance.

Sell RCA Silverama with the assurance that you're delivering a completely new tube—a premium product that can command a premium price and premium profits for *you!*

★ ★ ★ ★ ★

Is your customer budget minded? Offer him an RCA Monogram—factory-rebuilt by RCA to dependable quality standards. There's no finer rebuilt made—just right for the customer whose primary consideration is price.

Sell RCA Monogram with assurance—your customers will get satisfactory performance—and you will have fewer call-backs.

Remember...

- RCA picture tubes—warranted for one full year and fit virtually every make and model TV set.
- RCA picture tubes—backed by a brand name you can sell with confidence.
- RCA picture tubes—pre-sold by an extensive and continuing national advertising campaign.

GET THE FULL DETAILS FROM YOUR AUTHORIZED RCA DISTRIBUTOR TODAY!

RCA®

RADIO CORPORATION OF AMERICA

Electron Tube Division *Harrison, N. J.*

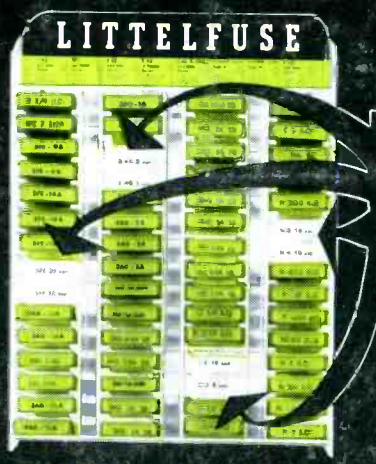
dealer-serviceman's fuse rack . . .

. . .for wall mounting

most needed

most wanted

. . . the FUSEMASTER!



dealer-serviceman's fuse requirements at a glance