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SEPTEMBER 1957

Radio-Electronics

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HUGO GERNSBACK, Editor

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•

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•

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•

Build-it-Yourself
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(See page 46)

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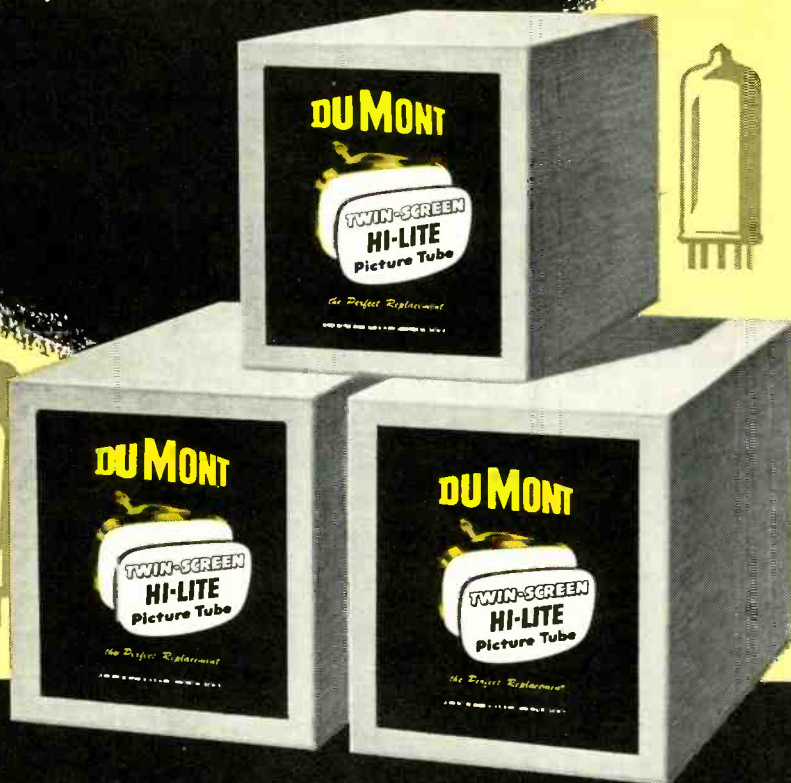
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The Heathkit ignition analyzer is being adjusted to show up the spark on four cylinders by Allan Riley, while model Barbara Dixon watches with considerable interest.

Color original by the Lattimer Studios, South Bend, Ind.

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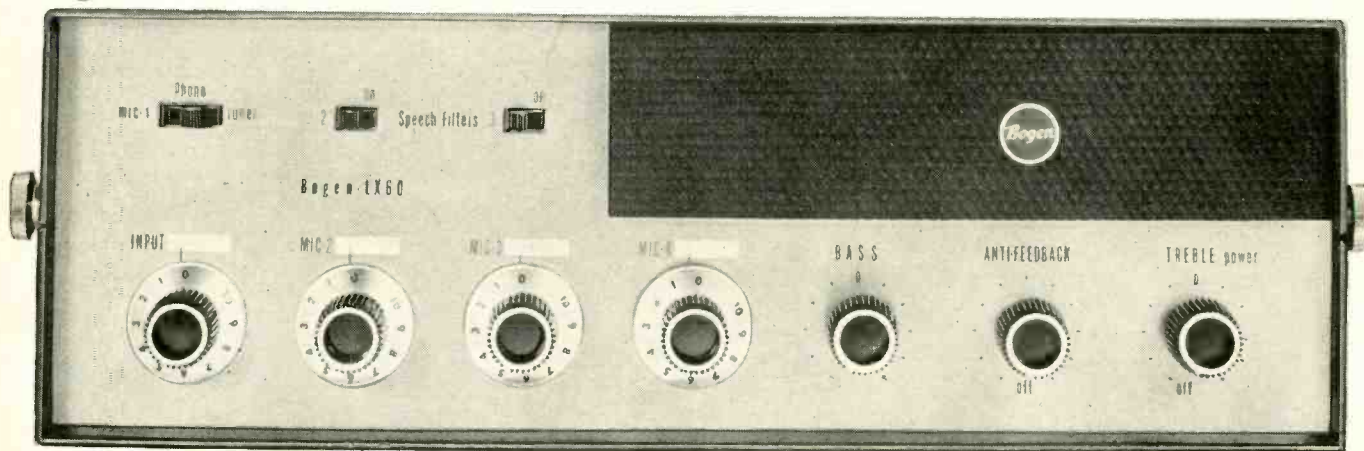
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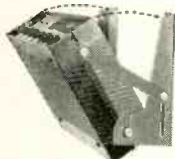
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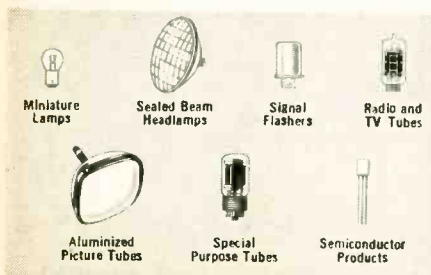


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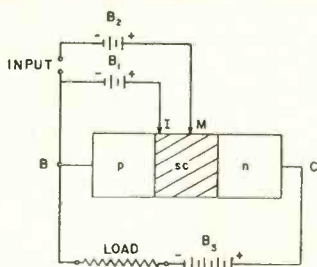


News Briefs



SPACISTOR, a new semiconductor amplifier that resembles a vacuum tube rather than a transistor, was announced at a recent New York City press conference by Raytheon. The Spacistor is a reverse-biased p-n junction (negative voltage applied to the p section and positive to the n section) so selected in regard to composition and geometry that the voltage across it (B_3) can be relatively high (in the order of 100).

Thus there is a voltage drop and a space-charge region throughout the space between the base and collector (B and C in the diagram). Other elec-



trodes (the injector I and modulator M) are so positioned and biased that, while positive to the base, they are negative with respect to the space-charge region at the point of attachment. (Batteries B_1 and B_2 are less than 10 volts.) I is a pressure contact which emits electrons into the Spacistor. Emission is limited by the space charge, as in a vacuum tube. Modulator M is an alloyed contact containing p-type material. It thus forms a p-n junction, and due to its negative bias draws negligible current. Voltages applied to M do affect the space charge and thus vary the amount of current from I. M also has an effect on the space charge, somewhat analogous to that of the screen grid in a tetrode tube, making injector I bias practically independent of the B_3 voltage.

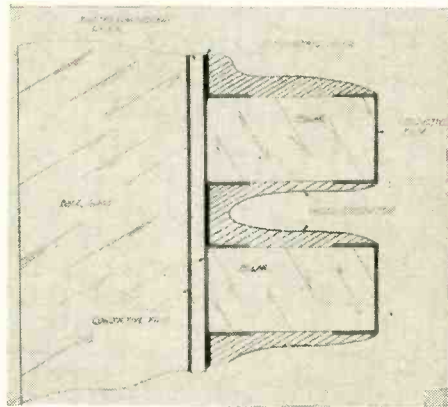
The input and output impedances of the Spacistor are extremely high—30 megohms or more. Transconductance of present Spacistors is still below that of good vacuum tubes though researchers expect to attain considerably better values. Due to the small output capacitance ($1 \mu\mu\text{f}$ or less is feasible) it is expected that spacistors may be constructed to work at frequencies higher than 1,000 mc.

PANELESCENT DISPLAY lamp which produces glowing figures of any form—or even moving images—when scanned by a light or electron beam from the rear was demonstrated recently by Sylvania. It is expected to have wide

uses in air traffic control, radar, instrumentation, education and advertising.

The device operates on the principle of the Sylvania Panelescent lamp, described in the March issue of RADIO-ELECTRONICS (page 15). An electroluminescent material is sandwiched between two conductive films or plates. When alternating current is applied to the conductors, the material glows.

A base plate of glass acts as the face of the display in the Sylvatron image tube. Over the glass is spread a conductive layer which forms one of the ac terminals (see illustration). The luminescent material is the next layer, and another transparent conducting film is applied over it. The image-producing array, consisting of rows of glass columns, is placed on this film. Tops and bottoms of the columns (which are a little less than $1/32$ inch square and $1/16$ inch high) are also coated with a conductive film and the sides with a photoconductive substance. Another piece of glass with a conducting surface (or, as in the illustration, a wire mesh) is placed on the tops of the columns, to form the other ac terminal.



When a dot of light is focused on the top of one of the columns, the light shining through the glass makes the photoconductive material next to it a conductor, carrying the voltage of the top (or rear) terminal to the conductive layer at the bottom of the column and making that area of the luminescent material glow. With proper voltage and frequency, the light from the small area keeps the photoconductive material active and the light continues. It may be erased by turning off the current or may be made self-extinguishing by selecting proper voltages and frequencies. Spillover from activated dots to surrounding areas is controlled by applying attenuating strips of black glass between the columns.

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NEWS BRIEFS (Continued)

Lettered signs, radar and maplike displays and even a small moving picture (produced by infra-red projection against the back of a small Sylvatron screen) were demonstrated. Asked about television possibilities, Sylvania executives pointed to the little movie to prove by its rudimentary quality that flat-screen TV was still a long way off. They did not deny, however, that "three or four years and a few million dollars" might make a difference in the picture.

ULTRASONIC LIGHT modulator described at a national convention on military electronics held at the Sheraton Park Hotel in Washington, D. C., consists basically of an ultrasonic cell (a crystal transducer similar to quartz) between two lenses. Light passing through is controlled when a signal is applied, by using optical defraction and piezo-effect principles.

L. Levi, laboratory manager of Fairchild Controls Corp., where the instrument was developed, said that the ultrasonic modulator was more complex but does a better job than the cathode-ray tube because its dynamic range is much greater.

The device can also be used for video recording. The photographic method is more efficient than magnetic tape as more can be recorded on the same amount of tape.

WORLD SERIES IN COLOR TV was announced by Ford C. Frick, commissioner of baseball. Two or more games of the 1957 series will be telecast in color by NBC-TV, he said. Present arrangements call for all games played in the American League city to be broadcast in color. If American and National League cities are so located as to allow traveling time for NBC's mobile color unit, it is possible that some or all of the games at the National League city will also be shown in color.

MICROWAVE DANGER to human health is being studied by the Air Force. Col. George M. Knauf, a surgeon at the Rome Air Development Center in Rome, N.Y., told the American Medical Association that a program to set up safety standards for high-power microwave transmissions has been started. Four universities have been awarded contracts to study the problem.

Among the important aspects under study is whether the only effect on the human body is that of heating, or whether there may be other effects. It has been suggested that molecules in the human body may resonate at certain microwave frequencies and that their structure may be altered thereby.

Some firms already have a safety code for operating microwave equipment. Bell Telephone Labs follows a standard established by the Naval Medical Research Institute, Bethesda, Md. The institute found that power density of 25 mw per square centimeter causes a body temperature rise of 1°. The Bell code requires workers to be

(Continued on page 14)

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*James S. Glen, Jr.
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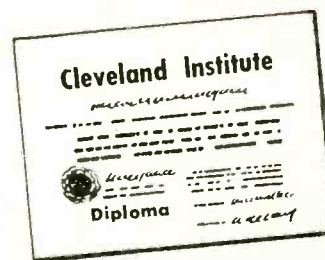
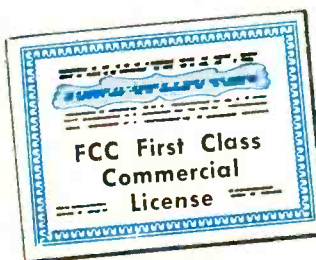


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International Telephone & Telegraph Co.
Mohawk Airlines
Motorola
North American Aviation, Inc.
Northwest Airlines
Philco
RCA
Ryan Aeronautical Co.
TWA
Union Switch & Signal Co.
United Airlines
Western Electric Co.
Westinghouse Electric Co.

*(Plus Many Others)



Every Cleveland Institute graduate gets this proof of his Technical Qualifications

Accredited by National Home Study Council

Cleveland Institute of Radio Electronics

Desk RE-9, 4900 Euclid Ave., Cleveland, Ohio

Please send Free Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- | | |
|---|---|
| <input type="checkbox"/> Military | <input type="checkbox"/> Broadcasting |
| <input type="checkbox"/> Radio-TV Servicing | <input type="checkbox"/> Home Experimenting |
| <input type="checkbox"/> Manufacturing | <input type="checkbox"/> Telephone Company |
| <input type="checkbox"/> Amateur Radio | <input type="checkbox"/> Other |

In what kind of work are you now engaged?

In what branch of Electronics are you interested?

Name Age.....

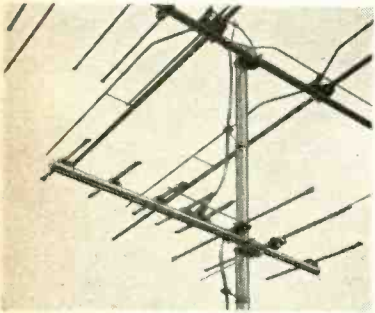
Address

City Zone..... State.....

Special Tuition Rates to Members of Armed Forces Desk RE-9

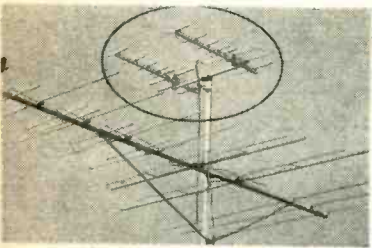
WHAT'S **NEW** FROM

Now...2 Ways to Add UHF to Your Fringe Area Color'ceptor



Here's something really new!

A UHF antenna (Winegard Mod. GG-1) that connects in series with the same lead used for the VHF Color'ceptor. No couplers... no loss... no interaction. Perfect results every time! Can be oriented independently from CL-4 or CL-4X. Same general features as on GG-2 shown below. Completely gold anodized. Only \$7.95.



New UHF Colinear Yagis Model GG-2 mounted with CL-4X Color'ceptor

High gain UHF antenna has 4 col. driven elements, 10 directors, 6 reflectors. Pin point directivity. No minor lobes. Flat frequency response. Can be stacked up to 16 bays for up to 21 db gain. Completely gold anodized. Can be ordered factory peaked to favor your channels. Only \$14.95.

NEWS NOTE: Color'ceptor, the favorite fringe area antenna of professional installers everywhere, is now even better! —NEW TDM insulators. Low loss, unbreakable—NEW special alloy plus extra reinforcing used in reflectors. Four times more durable—NEW sunfast gold finish. Permanently anodized.

... NEW ... SUPER *twilight**

FOR THE TWILIGHT* TV AREA

Biggest Advance Yet In Antenna Design!

Something new and wonderful has happened to antennas! Now you get the "whole ball of wax"... mast, lead-in, Antenna, mount... everything factory-assembled—factory-engineered into one simple, integral unit!

- NO loose parts to assemble
- NO wires to strip

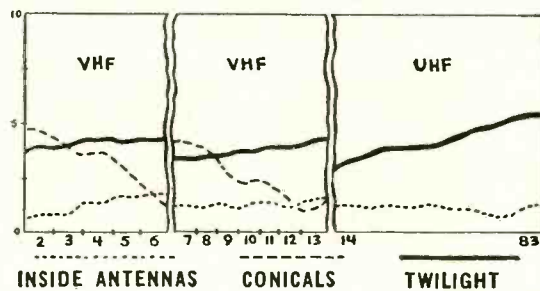
Just take your Twilight out of the box... pop it open... put it up as easy as driving 3 nails... it's as simple as that!

Now you can make a complete installation (in most cases without even getting on the roof) in no more time than it takes to pull a TV chassis for repair! Twilight is so easy... it's a breeze to install.

Engineered for results... styled to sell... as new and modern as today!

SENSITIVITY COMPARISON CHART

Note extremely linear frequency response of Twilight



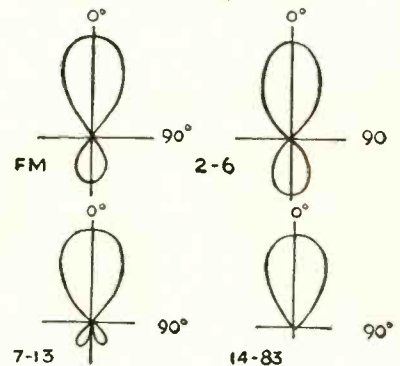
INSIDE ANTENNAS CONICALS TWILIGHT



LOOK AT THESE ALL NEW EXCLUSIVE ENGINEERING INNOVATIONS

- 1 **UNIVERSAL MOUNT*** goes up in minutes... super-sturdy... eliminates ugly guy wires, chimney brackets... fits all surfaces, flat, sloping and vertical.
- 2 **SPECIAL DRIVE FASTENERS** go in like nails, hold like screws... special gaskets seal roof automatically.
- 3 **SNAP-OUT MAST CLAMP**... automatic, self-aligning. No tools.
- 4 **SERIES-FED UHF** new intermixed design. No loss, no interaction, one lead-in. Can't become obsolete. And at no extra cost!
- 5 **ELECTRO-LENS HIGH GAIN DIRECTOR SYSTEM** for ultra linear frequency response and no ghost-catching minor lobes on any channel.
- 6 **DUAL "T" MATCHED DRIVEN ELEMENTS**... end-fire phased. Accurate 300 ohm impedance match.
- 7 **PERMANENT NON-CORROSIVE ANODIZED FINISH** in Sunfast Gold, Twilight Blue or Starbrite Silver... looks better, sells faster... makes all other antennas look as old-fashioned and out-of-date as they really are.

Horizontal Directivity Patterns



*Patent Pending

NEW PEEK-A-BOO PACKAGE

Makes beautiful display... lets customer see merchandise without opening carton... has complete sales story pitched to your customers on back of carton.



Winegard Co.

Winegard

COMPACT... POWERFUL!



**WINEGARD
TWILIGHT, MOD. TL-283**
All Channels 2-83 plus FM
Color or Black and White

All aluminum construction... can't stain roof. The Twilight* installation includes: antenna with mast, lead-in wire and set terminal clip attached; universal mounting base with special drive fasteners, roof-sealing gaskets and stand-off insulators. Antenna width: 87"—Height including mount 53". Net wt.: 4½ lbs., Shpg. wt.: 6 lbs. Can be mailed parcel post.

You can buy Twilight two ways: complete installation, Mod. TL-283, list \$29.95; Twilight head only with standard mast clamp, Mod. 283, list \$19.95.

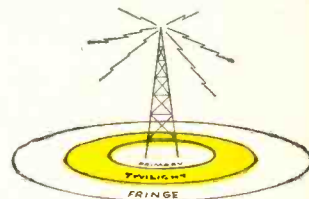
Note:

50 ft. heavy 80-mil
300 ohm lead-in wire
with set terminal clip.

**NEW
Sunfast
Gold
Anodized**

**Absolutely
Nothing
Else
To Buy**

THIS IS THE TWILIGHT AREA



The "in-between" Twilight area (5 to 35 miles) presents reception problems all its own. Most set owners living within its boundaries have been enjoying neither the finest TV reception nor the poorest.

Because the Twilight area has many of the reception difficulties of both the fringe and primary areas, almost every type of antenna from rabbit ears to large arrays is used here. None of which were actually designed with the Twilight area's actual requirements in mind.

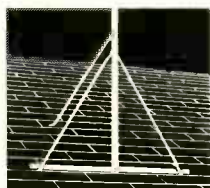
An extensive survey made by the Winegard Company in the Twilight areas of some of our larger cities brought to light these amazing facts:

- 42% of the TV owners were not really satisfied with their reception
- 72% of these dissatisfied TV viewers were using set-top antennas
- 53% didn't like antennas on top of their set
- 34% said set-top antennas were too difficult to adjust
- 49% thought outside antennas were too big and unsightly
- 34% thought outside antennas were too susceptible to corrosion-stained roofs... and were ruined by weather
- 49% of all set owners questioned were willing to spend up to \$30.00 for a TV antenna that would overcome all these objections. 7% would spend up to \$60.00

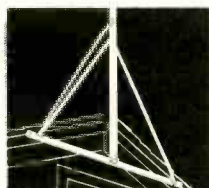
With the above information, Winegard engineers went to work to produce the first antenna designed specifically for the needs and wants of TV set owners in the Twilight area.

We call this new electronic masterpiece... appropriately enough... the Twilight!

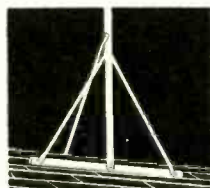
Twilight Mounts on ANY Surface—Sloping, Flat, Vertical



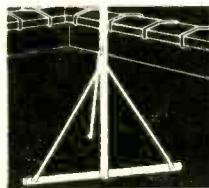
Side of roof



End of roof



Peak of roof



Flat or trailer

SELL THE LINE THAT HELPS YOU SELL!

As Adverised in **LIFE** The Saturday Evening **POST** Better Homes & Gardens

List price established nationally in Life magazine at \$29.95. Extra long discount structure so you can allow trade-ins or free installation if you wish... and still make your normal profit.

Mr. Dealer:
See Your Winegard Distributor and

Mail Coupon Today!

WINEGARD CO., Dept. RE-9
3000 Scotten Blvd., Burlington, Iowa

- Complete information on Twilight plus sales aids.
- Other Winegard Do-It-Yourself antennas and kits as low as \$14.95.
- Complete information on high powered Color'ceptor.

Dealer Firm Name.....
Address.....
City.....State.....

This CHANGER tops wow and flutter standards for broadcast turntables



Thorens CD-43 record changer

"Under almost all conditions the unit was better than the NARTB specification for broadcast reproducing turntables."

That's what C. J. LeBel of the Audio Instrument Company, an independent testing lab, says about wow and flutter in the Thorens CD-43 record changer.

Mr. LeBel tested three sample changers picked at random from our warehouse stock. Here are the actual test figures for the *worst* of these three units:

Serial No.	Line Voltage	Speed RPM	No. Discs on turntable	Wow + Flutter (%)	
				RMS	Peak
71185	120	33½	1	0.2	0.25
			10	0.15	0.20
		78	1	0.06	0.1
			10	0.04	0.08
		45	1	0.1	0.15

Note that only one measurement lies slightly outside the NARTB standards limit of 0.2% peak wow. All other measurements on this changer were within NARTB peak limits. Note too that *all* the RMS measurements (prescribed by American Standards Association and believed to be a more accurate index to subjective effect) are well below this value. And, of course, these outstanding results apply also to the Thorens manual player, audiomatic player, and transcription turntable since they all use the same precision motor.

Now all Thorens units are covered by a 1-year guarantee. This new guarantee plus tests like the above are your insurance that you are getting the best record changer money can buy when you select a Thorens—whether it's for yourself or for your customers. See the Thorens CD-43 at your dealer's today. 7.7

FREE! Send for booklet "Hi-Fi and Your Budget" to Thorens Company, Dept. E9.7, New Hyde Park, N. Y. Don't forget to include *your* name and address.

THORENS SWISS MADE PRODUCTS

MUSIC BOXES • HI-FI COMPONENTS • SPRING-POWERED SHAVERS • LIGHTERS

NEWS BRIEFS (Continued)

kept out of areas where power density exceeds 4% of this total. The Army has a safety standard of .01 watt per sq cm.

(This problem was discussed—with special reference to high-powered radar transmitters—and some precautions suggested, in Hugo Gernsback's editorial in the August, 1953, issue of RADIO-ELECTRONICS.)

Calendar of Events

SEPTEMBER 1957

12th General Assembly of the International Scientific Radio Union, Aug. 22-Sept. 5, National Bureau of Standards, Boulder, Colo.

British National Radio & Television Exhibition, Aug. 28-Sept. 7, Earls Court, London, England.

ARRL National Convention, Aug. 30-Sept. 1, Palmer House, Chicago.

Conference and Exhibit on Magnetic Amplifiers, Sept. 4-6, Hotel Penn Sheraton, Pittsburgh, Pa.

Cincinnati High-Fidelity Music Show, Sept. 6-8, Sheraton-Gibson Hotel, Cincinnati, Ohio.

Instrument-Automation Conference and Exhibit, Sept. 9-13, Cleveland Public Auditorium, Cleveland, Ohio.

High-Fidelity Show sponsored by International Sight & Sound Exposition, Sept. 13-15, Palmer House, Chicago. (RADIO-ELECTRONICS will exhibit in Room 746.)

Heart of America Chapter of The Representatives Distributor Conference, Sept. 15-19, Excelsior Springs, Mo.

Institute of High Fidelity Manufacturers Show, Sept. 17-21, Morrison Hotel, Chicago, Ill. (RADIO-ELECTRONICS will exhibit in Room 606.)

RETMA Symposium on Numerical Control Systems for Machine Tools, Sept. 17-18, Ambassador Hotel, Los Angeles, Calif.

Industrial Electronics Symposium, Sept. 24-25, Morrison Hotel, Chicago.

Society of Motion Picture & Television Engineers Convention, Oct. 6-11, Hotel Statler, New York.

National Electronics Conference, Oct. 7-9, Hotel Sherman, Chicago.

New York High-Fidelity Show, Oct. 7-12, New York Trade Show Bldg., New York, N. Y. (Annual Convention of the Audio Engineering Society will be held in conjunction with the Show from Oct. 9-12.) (RADIO-ELECTRONICS will exhibit in Room 526.)

Canadian IRE Show, Oct. 16-18, Automotive Bldg., Exhibition Park, Toronto, Ont., Canada.

High Fidelity Show, Oct. 18-20, McAllister Hotel, Miami, Fla.

Fall Hi-Fi Festival, Oct. 26-27, Kansas Conservatory of Music, Kansas City, Mo. Technical Conference of IRE Professional Group on Electron Devices, Oct. 31-Nov. 1, Shoreham Hotel, Washington, D. C.

TWO NEW TV STATIONS, both Western, started programming since we last reported:

KGEZ-TV, Kalispell, Mont.....9

KPLO-TV, Reliance, S.D.....6

WBLN, Bloomington, Ill., channel 15, closed down.

There were four changes in call letters:

WBOY-TV, Clarksburg, W. V.....12
(formerly WBLK-TV)

WVUE, Wilmington, Del.....12
(formerly WPFH)

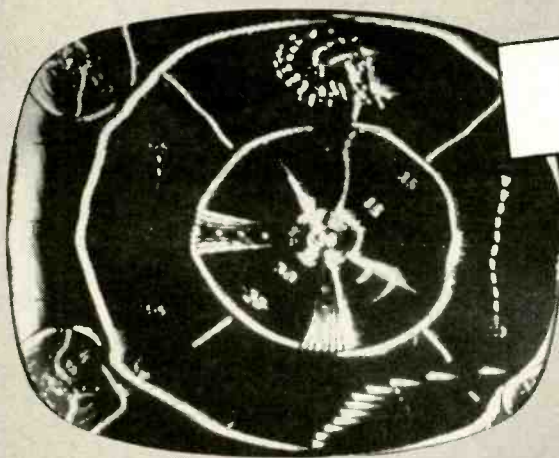
KCTV, San Angelo, Tex.....8
(formerly KTXL-TV)

KSBY-TV, San Luis Obispo, Calif.6
(formerly KVEC-TV)

WFIE-TV, Evansville, Ind., resumed activities on channel 14 on July 3 after quitting channel 62 on July 1.

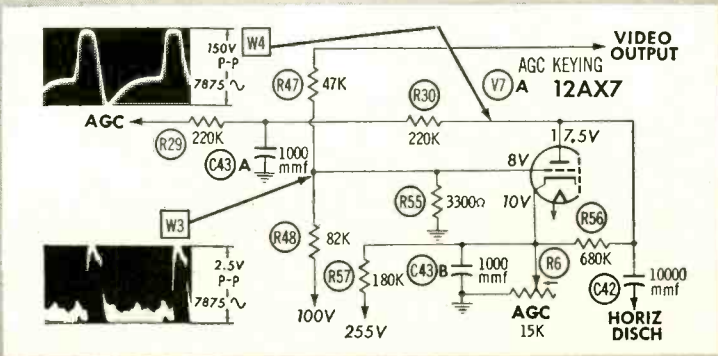
These developments change our figures to 502 operating U.S. stations (411 vhf and 91 uhf), 25 of which are noncommercial (6 uhf). END

how long would it take you to solve this service problem?



SYMPTOM:
Negative Picture

(Based on an actual case history taken from the Howard W. Sams book "TV Servicing Guide")



PHOTOFACT helps you lick problems like this in just minutes for only *2 1/2¢ per model!

Let's take a look at this problem: A negative picture such as illustrated is the result of a lack of proper AGC voltage—causing one or more stages in the tuner, IF, video detector or video amplifier stages to be over-driven. Look for the following possible causes:

1. AGC control (R6) improperly adjusted
2. Defective keyer (V7A) in AGC circuit
3. Defective RF, mixer, or video IF tubes
4. Defective video detector tube or crystal
5. Defective video amplifier tube
6. Defective coupling capacitor (C42)
7. Defective component in AGC line

With the applicable PHOTOFACT Folder at your fingertips, you trouble-shoot and solve this problem in minutes. Here's how:

First check the AGC control for possible misadjustment as per instructions in "Servicing In The Field" notes which you'll find in every PHOTOFACT Folder. (You'll easily find the AGC control location on the Tube Placement Chart.)

Using the same chart, you will quickly locate and check the suspected tubes. Tubes and AGC adjustment okay?—then: Check waveforms W3 and W4 in the AGC Keying circuit and waveforms in the video circuit to isolate the faulty component. Example: A loss of signal waveform at W4 would indicate an open coupling capacitor (C42). Correct waveforms are always shown right on the PHOTOFACT Standard Notation Schematic.

Correct voltages, also shown on the Standard Notation Schematic, and resistances (in easy-to-read chart form) help you locate faulty components with speed. You'll find, too, how easy and fast it is to locate parts by means of the exclusive PHOTOFACT chassis photo views, with call-outs keyed to the schematic. And finally, you'll find the proper replacements for all components listed in the complete PHOTOFACT parts list.

It's no accident that over fourteen million PHOTOFACT Folder Sets are in use, helping thousands of Service Technicians do their work faster and more profitably every day. PHOTOFACT pays for itself because it automatically boosts your output and earnings.

Use the servicing method you prefer—checking of waveform, voltage or resistance—you'll find all the information you need at your finger-tips in PHOTOFACT.

For only *2 1/2¢ per model, PHOTOFACT helps you solve your service problems in just minutes—helps you service more sets and earn more daily!

*Based on the average number of models covered in a single set of PHOTOFACT Folders.



MONEY BACK GUARANTEE!

Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper PHOTOFACT Folder Set covering the receiver. Then use it on the actual repair. If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. **GET THE PROOF FOR YOURSELF—TRY PHOTOFACT NOW!**

FREE



FOR SERVICE TECHNICIANS ONLY

Fill out and mail coupon today for Free subscription to the Sams Photofact Index — your up-to-date guide to virtually any receiver model ever to come into your shop. Send coupon now.

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Improve your own music system with a superb new ESL cartridge and arm

ESL PROFESSIONAL SERIES ARM & CARTRIDGE

Breathtaking perfection of reproduction for the most critical broadcast, recording, and laboratory use is now made possible by this superlative reproducer. The ultimate in compromise-free design, plus matchless Danish hand craftsmanship. The precision machined, ball bearing arm fits this cartridge only.

Frequency response: 16-30,000+ cps • IM distortion: almost immeasurably small • Minimum compliance: 6.8×10^{-6} cm/dyne • Dynamic mass: .001 grams • Vertical force: 1-3 grams
Output impedance: 1.5 ohms • Minimum output voltage: 2.0 mV (1 kc at 10 cm/sec)

ESL-310 arm (15 $\frac{3}{4}$ ") without cartridge \$57

Diamond stylus: ESL-P1 (.001"), P2.5 (.0025"), P2.7 (.0027"), P3 (.003") \$49.50

Acknowledged as the world's finest



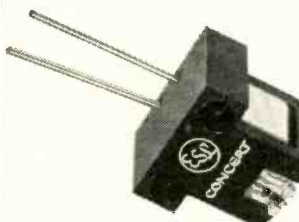
ESL CONCERT SERIES CARTRIDGE

The most advanced electronic technology and mechanical skills have devised this magnificent instrument which can improve the finest music reproducing systems. Used for quality control by leading record manufacturers. It greatly prolongs record and stylus life, and will fit any standard mounting arrangement.

Frequency response: 16-30,000+ cps • IM distortion: almost immeasurably small • Minimum compliance: 6.8×10^{-6} cm/dyne • Dynamic mass: .001 grams • Vertical force: 2-6 grams
Output impedance: 1.5 ohms • Minimum output voltage: 1.5 mV (1 kc at 10 cm/sec)

Diamond stylus: ESL-C1 (.001") or ESL-C3 (.003") \$35.95

For the audio connoisseur



ESL/BJ 'SUPER 90' TANGENTIAL ARM

Highly improved, studio model of the world-famous BJ tangential arm which overcomes tracking error, reduces distortion, and increases record life. Self-lubricating ball bearings insure friction-free movement; twin arms virtually cancel resonances. Complete with two plug-in heads accommodating almost all cartridges, including turnover and triple-play models. Counter-weights variable over 40-gram range. Calibrated pedestal permits instant selection of correct stylus overhang. Made in England under the personal supervision of its inventor.

ESL/BJ 'Super 90/12' (12 $\frac{1}{2}$ ") \$33 • ESL/BJ 'Super 90/16' (14") \$36.50

Overcomes tracking error



ESL TRANSFORMER ACCESSORIES

The ESL cartridge requires with some amplifiers a high quality ESL voltage step-up transformer (or ESL transistor amplifier): the 201 Series for low level magnetic inputs, 301 Series for low or high level magnetic inputs, or the 211 with insensitive amplifiers.

ESL-201 Shielded, unmounted transformer; 1:11 voltage step-up \$7.50

ESL-201M An ESL-201, mounted and wired for plug-in connection \$11

ESL-201F Same as 201M, plus supersonic filter and switch \$15

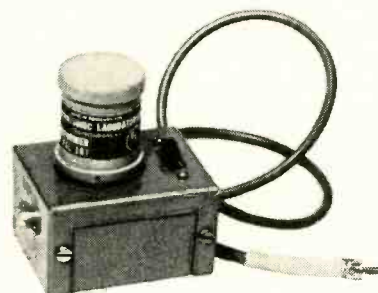
ESL-301 Shielded, unmounted transformer; 1:30 voltage step-up \$9

ESL-301M An ESL-301, mounted and wired for plug-in connection \$12.50

ESL-301F Same as 301M, plus supersonic filter and switch \$16.50

ESL-211 Shielded, unmounted transformer; 1:244 voltage step-up \$6.25

For flexibility of application



ESL-201F ESL-301F



FOR LISTENING AT ITS BEST

Electro-Sonic Laboratories, Inc.

Dept. E • 35-54 Thirty-sixth St • Long Island City 6, N.Y.

Additional information available
free upon request to ESL

Electronics Boom Seen

Need For Television Technicians To Rise

Industry Warned About Shortage Of Trained Men

TV SALES SET NEW RECORD

Sylvania Head Expects Huge Electronic Gains

Transistor Radios Developed

RCA HEAD PREDICTS SALES BOOM FOR COLOR TV SETS

VETERANS - - NON-VETERANS

Get Into The Field That's Making Headlines



I. C. Lane, B.S., M.A.
President, Radio-Television Training Association,
Executive Director, Pierce School of Radio & Television.

All over the nation the Television-Radio-Electronics industry is making News — News that means opportunity for YOU. You can cash in on the headlines.

I WILL TRAIN YOU AT HOME FOR A TOP-PAY JOB IN TELEVISION

I will prepare you for a spot in America's fastest-growing industry. You can become a trained technician in your spare time without giving up your present job or social life. No experience needed.

LEARN BY DOING

As part of your training I give you the equipment you need to set up your own home laboratory and prepare

for a top-pay job or set up your own business. You build and keep a TELEVISION RECEIVER designed and engineered to take any size picture tube up to 21-inch. (10-inch tube furnished. Slight extra cost for larger sizes.) . . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied, including all tubes.

STUDY NEWEST DEVELOPMENTS

My training covers all the latest developments in the fast-growing Television-Radio-Electronics industry. You learn about FM — RADAR — COLOR TV — TRANSISTORS — PRINTED CIRCUITS, etc.

CHOOSE FROM FOUR COMPLETE COURSES covering all phases of Radio, FM and TV

1. Radio, FM and Television Technician Course—no previous experience needed.
2. FM-TV Technician Course—previous training or experience in radio required.
3. TV Studio Technician Course—advanced course for trained men.
4. Color TV Technician Course—Includes latest color TV circuits.

EXTRA TRAINING IN NEW YORK CITY AT NO EXTRA COST!

After you finish your home study training in Course 1 or 2 you can have two weeks, 50 hours, of intensive Lab work on modern electronic equipment at our associate resident school, Pierce School of Radio & Television. THIS EXTRA TRAINING IS YOURS AT NO EXTRA COST WHATSOEVER!

FCC COACHING COURSE

Important for BETTER-PAY JCBS requiring FCC license! You get this training AT NO EXTRA COST! Top TV jobs go to FCC-licensed technicians.

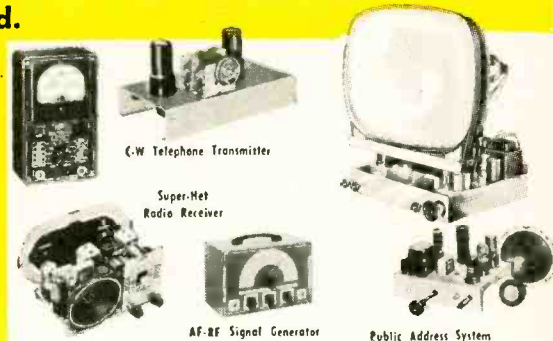
VETERANS

My School fully approved to train Veterans under new Korean G. I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

Radio-Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veteran Training



Sylvania Now Sponsoring RTTA's Color TV Technician Course
One of the nation's largest electronics manufacturers and marketers, Sylvania Electric Products, Inc., in its continuing effort to cooperate with independent service dealers is now sponsoring the RTTA Color Television Technician Course. The Color Television Technician Course is being made available to authorized Sylvania Dealers throughout the 48 states who are interested in expanding their knowledge and experience in Color TV servicing.

FREE HOW TO MAKE MONEY IN TV
FREE I'll send you my new 40-page book, "How to Make Money in Television-Radio-Electronics," a Free sample lesson, and other literature showing how and where you can get a top-pay job in Television.

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lane, President
RTTA
Dept. RE-9D, 52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Send me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make TOP MONEY IN TELEVISION. I understand I am under no obligation.

(PLEASE PRINT PLAINLY)

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

- Color TV Tech. Course
- Radio-FM-TV Technician Course
- FM-TV Technician Course
- TV Studio Technician Course

VETERANS!
Write discharge date

NO OBLIGATION!

Correspondence



DO-IT-YOURSELFER'S VIEW

Dear Editor:

The hobbyist has absorbed huge quantities of war surplus junk, cheap tubes, do-it-yourself-kits; bought electronics books and magazines; joined clubs and loaded his shop and home with some of the most outlandish combinations of equipment ever assembled. He has test equipment of his own manufacture for some applications, and the finest of laboratory units for others. He skips over the tedious explanations of engineers and tries out his own versions of circuits shown in magazines, thereby using up parts he acquires through the pages of advertising in the same magazine or from parts suppliers' catalogs, from local supply houses or from friends (and the hobbyist has friends).

As a group, I think he has proved his right to consideration by the financial contribution he makes to the industry, if nothing else.

A technician who tries to play dog in the manger with the hobbyist finds himself advertised to the hobbyist's friends in a manner that is not apt to help his business. Such a technician fails to take into account the fact that once a fellow takes up the soldering iron for fun and pleasure, the hobby is more expensive than drink.

JOHN E. DAVIS

Salem, Ore.

MORE ABOUT SPEAKERS

Dear Editor:

I read Mr. H. A. Hartley's letter in the July issue, replying to one by Mr. Paul W. Klipsch in May. The gist of Mr. Klipsch's letter seems to be that you can't hear low frequencies from a small cone; he used a 10-inch cone diameter as an example. Mr. Hartley's letter states that you can; he used an 8-inch cone as an example. Both used amplitude figures to support their arguments.

I believe I have news for these two gentlemen. My company has been trying to develop for speaker cones a material more suitable than paper, which is rather fluttery and not very strong. The work has had considerable success and it will interest Mr. Hartley to know that we eventually used the motor from a Hartley speaker to keep the cone in alignment under heavy loads.

As to the laws of nature: apparently with this cone they don't apply. I can assure Mr. Klipsch that with this cone at 8 inches actual diameter there is an abundance of frequencies where it is
(Continued on page 21)

THE RIGHT CEMENT FOR EVERY JOB...

SPECIALLY PRICED DURING SEPTEMBER!

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CONTAINS 14 DIFFERENT TYPES

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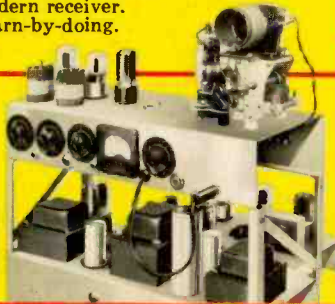


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appropriate to go into the basement to listen to them. I suspect that the Massa figures were derived from experiments with a paper cone. If that is the case, perhaps they should be considered as true when applied to paper cones, and to nothing except paper cones.

HAROLD J. LUTH

Harsyd Chemicals, Inc.
Holland, Mich.

MUSICAL COMPUTERS

Dear Editor:

"Syncopation by Automation" in RADIO-ELECTRONICS (June, 1957) reveals in a very lucid manner the virtuosity, as well as the versatility, of man's newest helpmate, the electronic computer. The mathematical structure underlying musical patterns was well shown, and the close relation of music to other forms of communication and data processing was brought to the reader's attention—for which my best thanks.

However, this is by no means the only aspect of the application of electronic computers to music. While *Push Button Bertha* enables dance bands to do without composers, other equally interesting devices will let composers bring their music to listeners without performers.

Computers use the binary system, which is very congenial to music, with its octaves (1-to-2 ratio), and its whole, half, quarter, eighth, sixteenth and thirty-second notes. Many electronic organs use one form or another of binary counters to make up chains of octave frequency dividers. Not only the mathematics inherent in computer programming, but also the logic, can assist the composer in developing works in the larger musical forms (symphony, sonata, etc.) out of relatively short musical themes.

To all this add the results of recent research into language structure, machine translation, information theory and so on, and you have a most promising field. As I am a composer and have done electronic research I am quite excited over the possibilities. Before signing off, I might mention that 10 years ago my article on electronic musical instruments, "Streamlined Instruments for the Modern Age," appeared in the *Musical Courier*.

IVOR DARREG

Los Angeles, Calif.

LICENSING NOT THE ANSWER

Dear Editor:

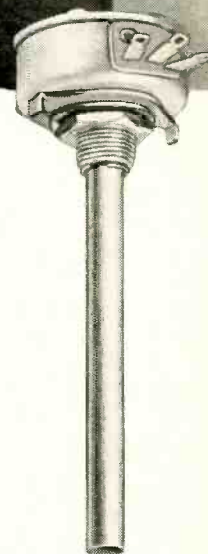
I am not a full-time operator. Neither do I own or operate a shop in any capacity. Still, after accepting training as an ex-GI and loving the electronics activity, I feel I should say something.

Every letter I've read so far has this to say: The automobile mechanic is licensed; there are no shysters, unlicensed lawyers; a doctor is the most ethical of the licensees.

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CORRESPONDENCE (Continued)

I still say it is hogwash!
You can read in your own paper any day of licensed doctors performing illegal abortions. Licensed lawyers are prosecuted for illegal practices. Automobile mechanics (some of them) replace unnecessary parts. Now for the radio-television technician. In this area, I've yet to see in any paper where a part-time man has been prosecuted for unfair practices. The ones yelling for a licensing plan either are forgetting their own part-time use of their training or they started out with a golden spoon of opportunity—a shop that is already set up for their occupancy.

Do what you will, say what you may, license all you can and someone will find a way to circumvent that license. Take the plain old everyday auto operator.

Look at all of the convictions for licenses fraudulently obtained for any number of them. Revocations speak for themselves.

What I am trying to say is: We have laws to cover practically everything in any trade. All we have to do is use them.

WILLARD L. HENRY

Washington, D.C.

MORE ON TUBE JOCKEYS

Dear Editor:

I have been reading the letters written about basement engineers and tube jockeys and would like to add my 2 cents' worth.

I have a large family to support and got out of ditch digging to get into a more lucrative job. I have two diplomas from correspondence schools and another one from Coyne Radio & Electrical School.

I work for an electrical contracting firm and like the job, but don't want to loose out on my radio and TV knowledge. I started a little business from my home and I am proud to say am doing quite well.

As for tube jockeys, basement engineers and even legitimate shops, I can see very little difference. I don't say tube swapping is infallible but some of these men are as good as the full timers, so, please, let us not throw too much mud!

VIRGIL G. CARTER

El Paso, Tex.

I'D LIKE TO SEE

Dear Editor:

How about a vhf device, transistorized, 108-122 mc, for light plane use, including a bridge null device for direction finding with a transistor amplifier built into the meter?

I am also wondering if a Where to Buy column might have reader interest. For example, I would like to purchase a vhf coaxial tuner for experimental work.

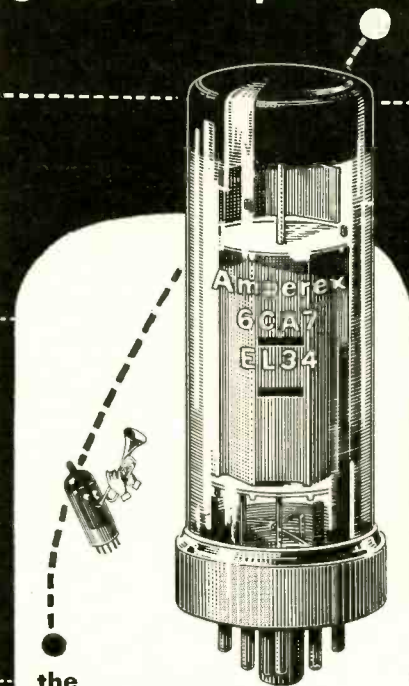
CLAUDE E. LOVE

Palos Park, Ill.

(The idea is interesting. How do the rest of our readers feel? And can anyone help Mr. Love?—Editor)

22

POWERING 4 OUT OF 5 of the world's greatest amplifiers



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HIGH-POWER OUTPUT PENTODE

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- ECC83/12AX7 Low-noise high- μ dual triode
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- EZ80/6V4 9-pin rectifier; cathode; 90 ma.
- EZ81/6CA4 9-pin rectifier; cathode; 150 ma.

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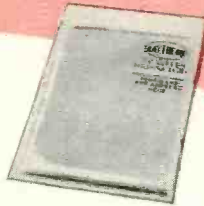


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TUBE AND TOOL CARRYING CASES



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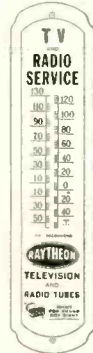


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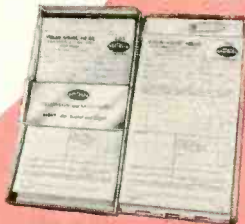
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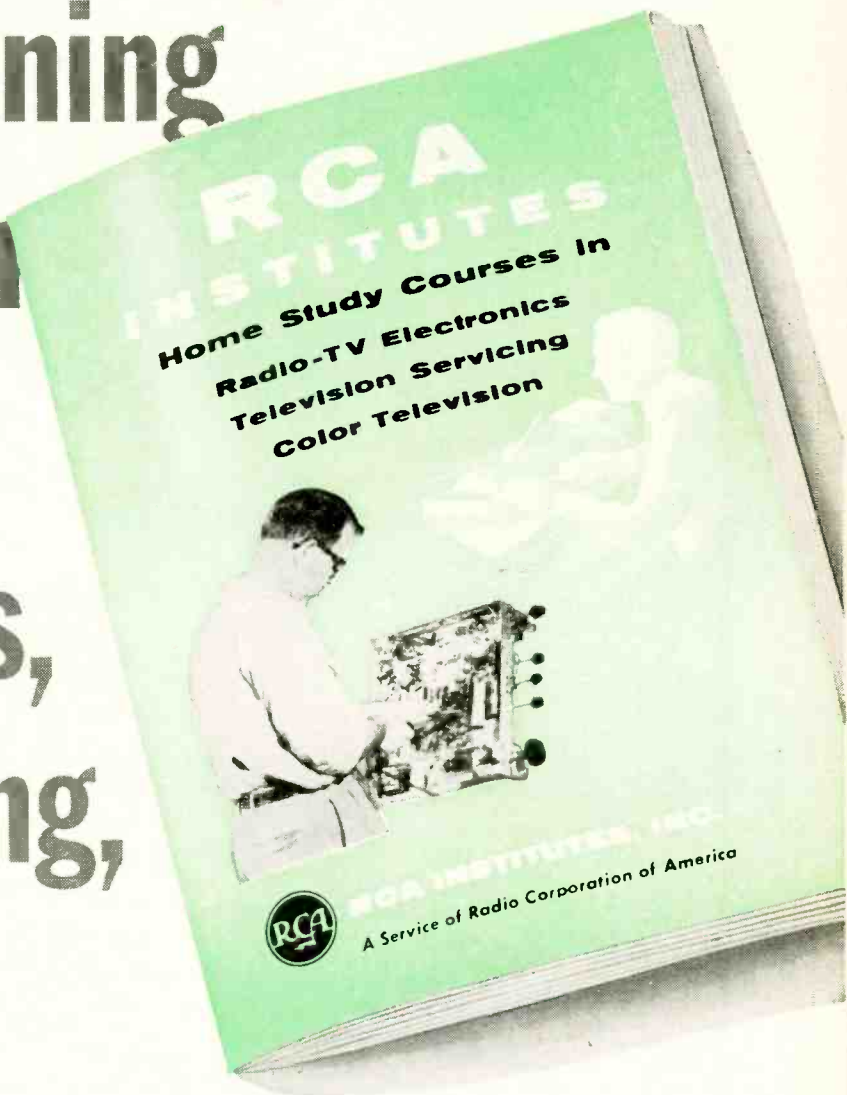
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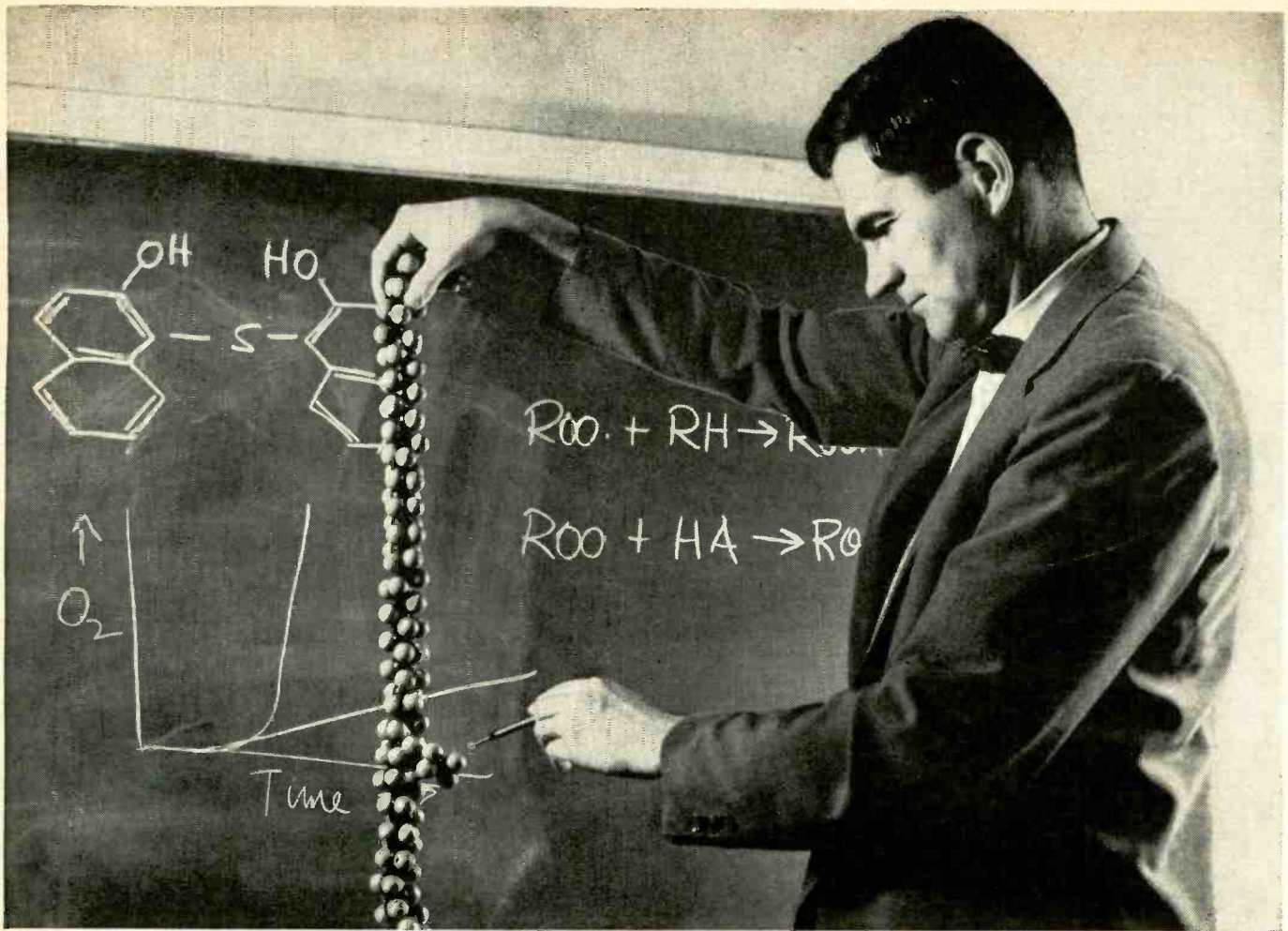
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Bell Laboratories chemist Field H. Winslow, Ph.D., Cornell University, with a scale model of a small section of a polyethylene molecule. Branch formation indicated by pencil is vulnerable to oxidation. Dr. Winslow and his associates worked out a simple way to protect long polyethylene molecules needed for durable cable sheathing.

THE DILEMMA OF GIANT MOLECULES

Solution: 2 plus 2 equals 5

Polyethylene is used to protect thousands of miles of telephone cables. It is tough, light and long lasting. Its strength lies in its giant molecules—a thousand times bigger, for example, than those of its brittle chemical cousin, paraffin wax.

But polyethylene has a powerful enemy: oxidation, energized by light and heat, shatters its huge molecules to pieces. This enemy had to be conquered if polyethylene was to meet the rigorous demands of cable sheathing. Paradoxically,

it was done by making the whole better than the sum of its parts—just as though 2 plus 2 could be made to add up to 5.

To check the ravages of light, Bell Laboratories chemists devised the simple yet highly effective remedy of adding a tiny dose of carbon black. Then antioxidants, such as those commonly used to protect rubber, were added to check attack by heat. But here the chemists encountered a dilemma: although the carbon black protected against the

effects of light, it critically weakened the effectiveness of the antioxidants.

To solve this dilemma, Bell Labs chemists developed entirely new types of antioxidants—compounds not weakened by carbon black but which, intriguingly, are very much more effective when carbon black is present. The new antioxidants, plus carbon black, in partnership, provide long-lasting cable sheath—another example of how research at Bell Telephone Laboratories works to improve your telephone service.

BELL TELEPHONE LABORATORIES



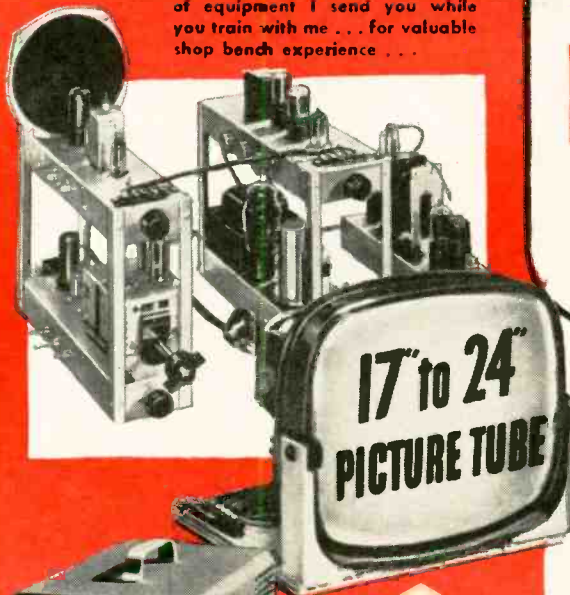
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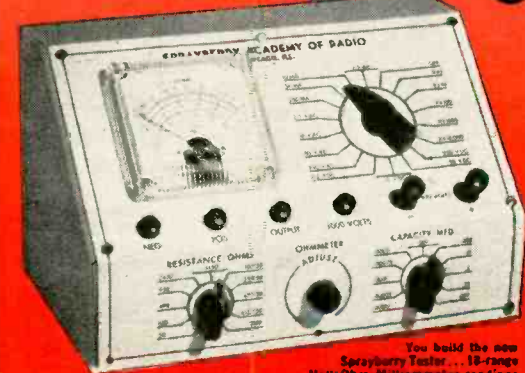
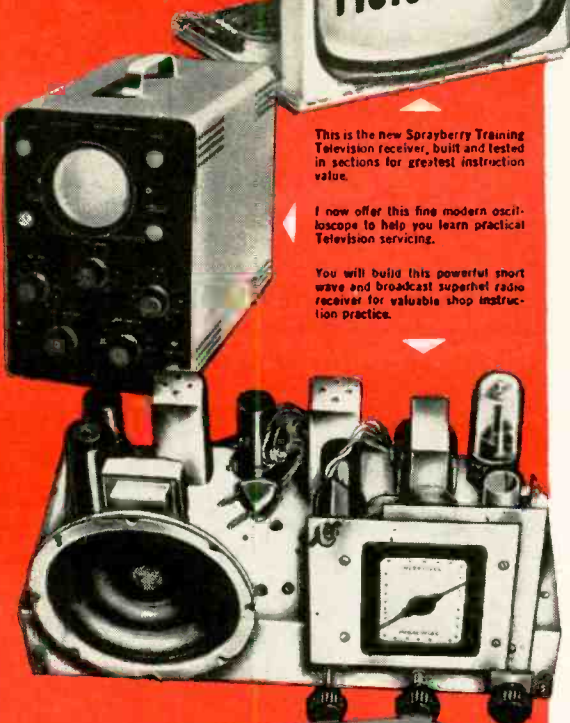
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Frank L. Sprayberry
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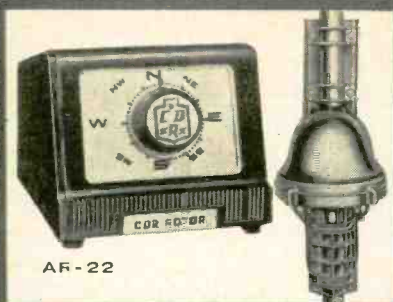
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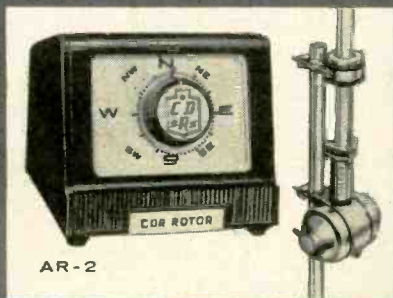
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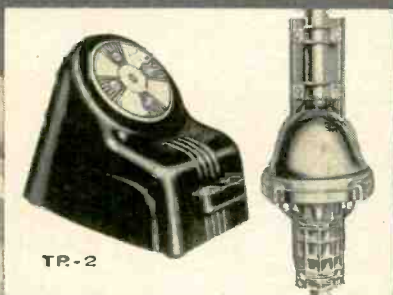


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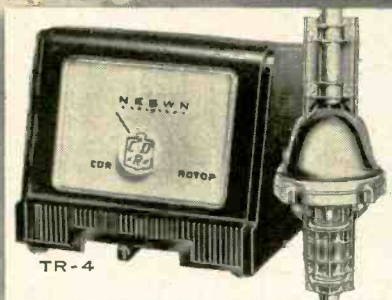
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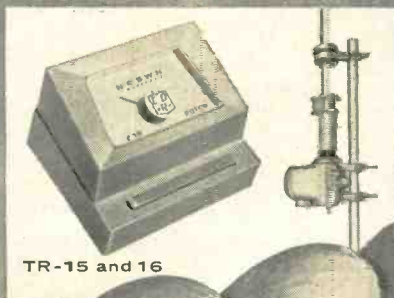


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with Preamplifier, Equalizer & Control Section
KIT \$34⁹⁵ WIRED \$57⁹⁵

Compact, beautifully packaged & styled. Provides complete "front-end" facilities and true high fidelity performance. Direct tape head & magnetic phono inputs with NARTB (tape) & RIAA (phono) feedback equalizers. 6-tube circuit, dual triode for variable turn-over bass & treble feedback-type tone controls. Output Power: 12 w cont., 25 w pk. IM Dist. (60 & 6000 cps @ 4:1): 1.5% @ 12 w; 0.55% @ 6 w; 0.3% @ 4 w. Freq. Resp. at 1 w: ± 0.5 db 12 cps - 50 kc; 12 w: ± 0.5 db 25 cps - 20 kc. Harmonic Dist: 20 cps: 2% @ 4.2 w; 1/2% @ 2.5 w; 30 cps: 2% @ 11 w; 1/2% @ 6.3 w; 40 cps: 1% @ 12 w; 1/2% @ 9.3 w; 2000 cps: 1/2% @ 12 w; 10 kc: 1% @ 10 w; 1/2% @ 6 w. Transient Resp: excellent square wave reproduction (4 usec rise-time); negligible ringing, rapid settling on 10 kc square wave. Inverse Feedback: 20 db. Stability Margin: 12 db. Damping Factor: above 8, 20 cps - 15 kc. Speaker Connections: 4, 8, 16 ohms. Tone Control Range: @ 10 kc, ± 13 db; @ 50 cps, ± 16 db. Tubes: 2-ECC83/12AX7, 1-ECC82/12AU7, 2-EL84, 1-EZ81. Size: HWD: 3 3/8" x 12" x 8 1/4". 13 lbs. Mounts in or out of cabinet.

NEW! 50-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER



HF50 KIT \$57⁹⁵ WIRED \$87⁹⁵

Like the HF60 shown below, the HF50 features virtually absolute stability, flawless transient response under either resistive or reactive (speaker) load, & no bounce or flutter under pulsed conditions. Extremely high quality output transformer with extensively interleaved windings, 4, 8, & 16 ohm speaker connections, grain-oriented steel, & fully potted in seamless steel case. Otherwise identical to HF60. Output Power: 50 w cont., 100 w pk. IM Distortion (60 & 6000 cps @ 4:1): below 1% at 50 w; 0.5% @ 45 w. Harmonic Dist.: below 0.5% between 20 cps & 20 kc within 1 db of rated power. Freq. Resp. at 1 w: ± 0.5 db 6 cps - 60 kc; ± 0.1 db 15 cps - 30 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. All other specs identical to HF60 below. Matching cover Model E-2, \$4.50.

NEW! 50-WATT Ultra-Linear HIGH-FIDELITY INTEGRATED POWER AMPLIFIER HF52
with Preamplifier, Equalizer & Control Section
KIT \$69⁹⁵ WIRED \$109⁹⁵

Combines a power amplifier section essentially identical to the HF50 power amplifier with a preamp-equalizer control section similar to HF20 below. Provision for use with electronic crossover network & additional amplifier(s). See HF50 for response & distortion specs; HF60 for square wave response, rise-time, inverse feedback, stability margin, damping factor, speaker connections; HF20 for preamplifier, equalizer & control section description. Hum & noise 60 db below rated output on magnetic phono input (8 mv input for rated output), & 75 db below rated output on high level inputs (0.6 v input for rated output). Matching cover Model E-1, \$4.50.

The specs are the proof...
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HIGH FIDELITY PREAMPLIFIER

#HF61A KIT \$24⁹⁵, WIRED \$37⁹⁵

With Power Supply: #HF61 KIT \$29⁹⁵, WIRED \$44⁹⁵

Will not add distortion or detract from the wide-band or transient response of the finest power amplifiers at any control settings. High quality feedback circuitry throughout plus the most complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece brown enamel steel cabinet for lasting attractive appearance. Feedback-type, sharp cut-off (12 db/octave) scratch & rumble filters. Low-distortion feedback equalization: 5 most common recording curves for LPs & 78s including RIAA. Low-distortion feedback tone controls: provide large boost or cut in bass or treble with mid-freqs & volume unaffected. Centrally printed-elliptical Senior "Compentrol" loudness control with concentric level control, 4 hi-level switched inputs (tuner, tv, tape, aux.) & 3 low-level inputs (separate front panel low-level input selector permits concurrent use of changer & turntable). Proper pick-up loading & attenuation provided for all quality cartridges. Hum bal. control. DC superimposed on filament supply. 3 convenience outlets. Extremely flat wideband freq. resp.: ± 1 db 8-100,000 cps; ± 0.3 db 12-50,000 cps. Extremely sensitive. Negligible hum, noise, harmonic or IM distortion. Size: 4-7/8" x 12-5/16" x 4-7/8". 8 lbs.



60-WATT Ultra-Linear

HIGH FIDELITY POWER AMPLIFIER #HF60
with ACRO TO-330 OUTPUT TRANSFORMER
KIT \$72⁹⁵ WIRED \$99⁹⁵

Superlative performance, obtained through finest components & circuitry. EF86 low-noise voltage amplifier direct-coupled to 6SN7GTB cathode coupled phase inverter driving a pair of Ultra-Linear connected push-pull EL34 output tubes operated with fixed bias. Rated power output: 60 w (130 w peak). IM Distortion (60 & 6000 cps at 4:1): less than 1% at 60 w; less than 0.5% at 50 w. Harmonic Distortion: less than 0.5% at any freq. between 20 cps & 20 kc within 1 db of 60 w. Sinusoidal Freq. Resp.: at 1 w: 35 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. Square Wave Resp.: excellent from 20 cps to 25 kc, 3 usec rise-time. Sensitivity: 0.55 v for 60 w. Damping Factor: 17. Inverse Feedback: 21 db. Stability Margin: 16 db. Hum: 90 db below rated output. ACRO TO-330 Output Transformer (fully potted). Speaker Taps: 4, 8, 16 ohms. GZ34 extra-rugged rectifier (indirectly-heated cathode eliminates high starting voltage on electrolytics & delays B+ until amplifier tubes warm up). Input level control. Panel mount fuse holder. Both bias and DC balance adjustments. Std octal socket provided for pre-amplifier power take-off. Size: 7" x 14" x 8". 30 lbs. Matching cover Model E-2 \$4.50.



COMPLETE with Preamplifier, Equalizer & Control Section
20-WATT Ultra-Linear Williamson-Type HIGH FIDELITY AMPLIFIER #HF-20
KIT \$49⁹⁵ WIRED \$79⁹⁵

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. Rated Power Output: 20 w (34 w peak). IM Distortion (60 & 6000 cps/4:1) at rated power: 1.3%. Max. Harmonic Distortion between 20 & 20,000 cps at 1 db under rated power: approx. 1%. Mid-band Harmonic Distortion at rated power: 0.3%. Power Response (20 w): ± 0.5 db 20-20,000 cps; ± 1.5 db 10-40,000 cps. Freq. Resp. (1/4 w): ± 0.5 db 13-35,000 cps; ± 1.5 db 7-50,000 cps. 5 feedback equalizations for LPs & 78s. Low-distortion feedback tone controls: large boosts or cuts in bass or treble with mid-freqs. & volume unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. 4 hi-level switched inputs: tuner, tv, tape, aux.; 2 low-level inputs for proper loading with all cartridges. Hum bal. control. DC superimposed on filament supply. Extremely fine output transformer: interleaved windings, tight coupling, careful balancing, grain-oriented steel. 8 1/2" x 15" x 10". 24 lbs. Matching cover Model E-1, \$4.50.

NEW COMPLETE with FACTORY-BUILT CABINET - 2-WAY HI-FI SPEAKER SYSTEM #HF51 \$39⁹⁵

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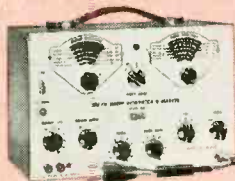
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GENERATOR &
MARKER #368**

KIT \$69⁹⁵ **WIRED \$119⁹⁵**

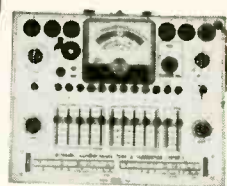
Entirely electronic sweep circuit (no mechanical devices) with accurately-biased inductor for excellent linearity. Extremely flat RF output; new AGC circuit automatically adjusts osc. for max. output on each band with min. ampl. variations. Exceptional tuning accuracy: edge-lit hairlines eliminate parallax. Sweep Osc. Range 3-216 mc in 5 fund. bands. Variable Marker Range 2-75 mc in 3 fund. bands; 60-225 mc on harmonic band. 4.5 mc Xtal Marker Osc., xtal supplied. Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

**NEW! RF
SIGNAL GENERATOR
#324**

KIT \$26⁹⁵ **WIRED \$39⁹⁵**



150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Idea for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. 6 fund. ranges: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to $\pm 1.5\%$; 6:1 vernier tuning & excellent spread at most important alignment freqs. Etched tuning dial, plexiglass windows, edge-lit hairlines. Colpitts RF osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. amplifier: only 3.0 v needed for 30% mod. Turret-mounted coils slug-tuned for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 μ s; AF sine wave output to 10 v. 50-ohm output Z. 3-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.



**NEW! DYNAMIC
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TUBE & TRANSISTOR
TESTER #666**
KIT \$69⁹⁵ **WIRED \$109⁹⁵**

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. Tests all receiving tubes (and picture tubes with adapter). Composite indication of Gm, Gp & peak emission. Simultaneous set of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). New series-string voltages: for 600, 450, 300 ma types. Sensitive 200 μ a meter. 5 ranges meter sensitivity (1% shunts & 5% pot). 10 SIX-position lever switches: freepoint connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. Direct-reading of inter-element leakage in ohms. New gear-driven rollerchart. Checks n-p-n & p-n-p transistors: separate meter readings of collector leakage current & Beta using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. CRA Adapter \$4.50



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and Monochrome
DC to 5 MC LAB & TV
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KIT \$79⁹⁵ **WIRED \$129⁵⁰**

• Features DC Amplifiers!

Flat from DC-4.5 mc, usable to 10 mc. VERT. AMPL.: sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull thruout; K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. SWEEP: perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); preset TV V&H positions; auto. sync. ampl. & lim. PLUS: direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equip. High intensity trace CRT. 0.06 μ sec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.



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VTVM #232 & UNI-
PROBE (pat. pend.)**

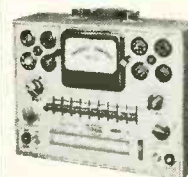
KIT \$29⁹⁵ **WIRED \$49⁹⁵**

Half-turn of probe tip selects DC or AC-Ohms.
Uni-Probe - exclusive with EICO - only 1 probe performs all functions!

Latest circuitry, high sensitivity & precision, wide ranges & versatility. Calibration without removing from cabinet. New balanced bridge circuit. High Z input for negligible loading. $1/2$ " meter, can't burn-out circuit. 7 non-skip ranges on every function. 4 functions: +DC Volts, -DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. Zero center. One zero-adj. for all functions & ranges. 1% precision ceramic multiplier resistors. Measure directly peak-to-peak voltage of complex & sine waves: 0.4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet.

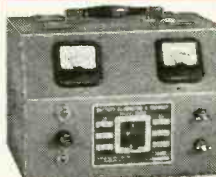


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#425**
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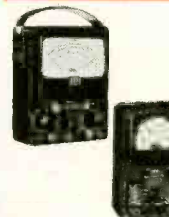
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ELECTRON KEYSTONES, PAST AND FUTURE

... *What Comes After the Transistor and the Solion?* ...

THE key—or the heart—of electronics, upon which the entire art and industry are built, has, curiously enough, no generic name. It used to be the electron (vacuum) tube but with the advent of the transistor, and now the solion, electronics has outdistanced the language. Can we call these devices triggers, relays or valves, as we did once upon a time? No. These names have become meaningless in the face of our rapid technical progress. Our vacuum tubes and transistors are detectors, rectifiers, oscillators and amplifiers—and a host of other things, depending upon what use we make of them.

Perhaps the name *klidion* (*klidi*—Greek for key, + *ion*) or *kliditron* or just *klitron* could be used for such key devices in electronics.

When the new solion was announced early last July by the U. S. Navy, Bureau of Ordnance, it was disclosed that the new device had been first proposed in 1941 by Dr. D. S. Muzzey, presently of Naval Ordnance Laboratory, White Oak, Md. During the past six years, Dr. N. N. Estes and his staff at NOL Defense Research Laboratory worked out the technical details of an entirely new technology which uses the flow of electrons in solutions. Hence the name *solion*. (Its technical name is an *electrochemical integrator*.)*

The solion utilizes ions in a solution, and thus differs from electrons in a vacuum, such as in electron tubes, or in solids, as in a transistor.

About the size of a golf ball, the solion consumes 100 to 1,000 times less power than a transistor. Differing vastly from former similar devices, the new device simplifies circuitry enormously. By comparison, transistor circuitry becomes "positively complicated," in the words of the physicists who developed the solion.

There are already a variety of solions (none are for sale as yet) in existence, most of them for navigational purposes. A rough overall description is difficult, as the solion is a most versatile instrumentality. In one form it converts electric energy to fluid flow by the use of electro-osmosis. In another form it converts fluid flow to electrical variations. The fluid flow can be started by a variety of physical stimuli (see below). While many fluids can be used, the inventors found iodine very suitable. Usually there are two cells, each with an electrode. The cells are divided by a porous diaphragm. Another model uses a detecting electrode of a piece of very closely woven platinum gauze in an orifice between the two cell compartments. This electrode is also its porous diaphragm.

The current flow is started by a very-low-voltage dry cell (less than 1 volt) connected to the solion. *The device is ex-*

traordinarily sensitive to stimulation by temperature, pressure, light, sound or acceleration.

This makes the solion an ideal device for aerial navigation. While it is not on the market so far, the Government will license manufacturers under its patents. It would appear thus that in due time solions will be commercially available in various forms.

As the device is still in its infancy, it naturally is not anywhere near perfection; it suffers, as have its predecessors, from various deficiencies. These, we feel certain, will be eliminated in the future. Thus, one of its greatest handicaps at present is its very limited operating range—it functions only between 0 and 200 cycles per second.

That brings up the logical question, *what comes after the solion?* This question, too, was asked when the transistor first came on the scene. The answer is not too simple: future parallel devices will not eliminate the present ones for each new device in this class will most likely have new and special uses, which will not duplicate the old ones.†

Thus the transistor will probably never obsolete all electron tubes nor will the solion eliminate all transistors or electron tubes. But it is quite certain that many future "klidions" will be discovered. We propose to speculate only on a few.

Gas Types. There have been gas types in the past. Indeed, the original de Forest Audion was poorly evacuated. It was a "soft" electron tube, in contradistinction to present-day "hard" tubes. Yet few true electron gas tubes are in existence today; none, as far as we know, with a plurality of conductive gases. It seems probable that such gaseous electron devices will appear in the future.

Semi-Solid Semiconductors. In all transistors in use today, solid semiconductors are used. There exist many semi-solid chemicals and elements from soft to semi-hard. None of these so far have been developed for "klidion" purposes. Aside from the ones found in nature, there are also many man-made compositions of this type, some of which may lend themselves to future new "klidions." As an example of such a substance, peroxide of lead, a soft-brittle chemical, was in use as a very good detector in the early days of wireless.

Atomic Types. Atomic batteries have been a reality for several years now. They usually use radioactive isotopes as a generator of the ensuing electric current. We have on this page called attention several times in the past to the possibility of future atomic type transistors, which at the same time could also be atomic batteries. Hence, they would not be dependent on batteries or an external current supply. Such a development is bound to come about.

Rest assured that the greatest electronic discoveries still lie in the future—the art has barely begun. —H.G.

*See "Electrochemical Units," RADIO-ELECTRONICS, August, 1957, page 12.

†See also *Spacitors*, page 8 of this issue.

BETTER BASS RESPONSE

What price 20 cycles—
1/2-inch cone excursion
—infinite baffles—reflex
systems—radial horn?

By **GEORGE L. AUGSPURGER**

LISTEN to that bass" is the watchword of the audiophile. The trend toward smaller speaker enclosures has produced real advances not only in reduction of cabinet size, but in extension of bass range and lowered distortion. However, clean bass reproduction is still a headache to the speaker manufacturer. What do we mean by good bass response? The following criteria seem to agree with most available information:

A suitable low-frequency limit is 40 cycles. Although the pipe organ and bass drum occasionally generate powerful fundamentals below 40 cycles, these grunts are few and far between, besides being almost impossible to reproduce at natural intensity.

Distortion must be low. This is the most difficult requirement to meet at very low frequencies. Fortunately, there are systems capable of generating satisfactory power in the 40-cycle region with less than 5% distortion. The important thing to keep in mind is that we are talking about sine waves. A common statement is, "I know my speaker reproduces 20 cycles because I can clearly hear the peak of each wave at that frequency." This notion is prevalent not only among amateurs, I have heard the same misconception

expounded by physics professors.

But 20 cycles does *not* mean 20 clicks or rattles or glubs per second—it means a 20-cycle sine wave. The two have nothing in common except the rate of repetition. An honest 20 cycles doesn't sound like much of anything—it is perceived as a rapid change in atmospheric pressure which interferes somewhat with normal hearing.

The useful bass range of the speaker should be audible. At 30 cycles the threshold of hearing lies at about 70 db. A good speaker should be capable of producing an intensity of at least 80 db at 40 cycles.*

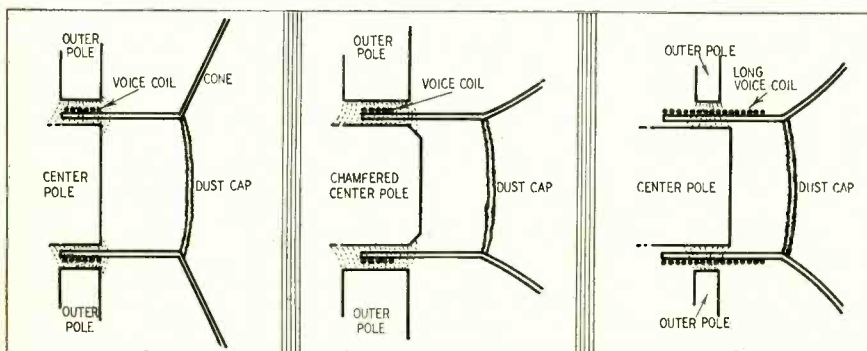
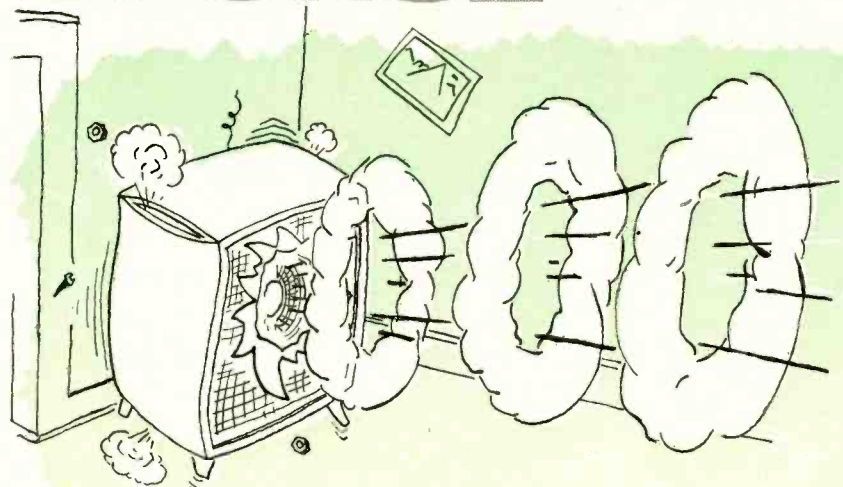
*In this article, 0 db will equal .0002 dynes per square cm in the listening area of an average room. Thus the figures quoted will be about 3 db below standard measurements taken 18 inches from the speaker in free-field conditions.

Suppose we try to design a speaker system which will meet these specifications. The first difficulty is the size of the vibrating diaphragm or piston. To get reasonable transfer of energy to air at 40 cycles, cone diameter should be about 10 feet. If such a device could be built, it would have fantastic bass efficiency with very little cone movement. Unfortunately, the cone would be so heavy that getting it to move at all is problematical—except in the case of an electrostatic unit. Perhaps we may someday buy our speaker like a roll of wallpaper and simply hang it up when we want to use it.

But for now, consider an ordinary 12-inch speaker. There is no reason why it cannot generate a thunderous 40-cycle note, provided the cone can move far enough. "Far enough" turns out to be about 1/2-inch maximum excursion at 40 cycles.

So, why not build a 12-inch speaker whose cone can move back and forth 1/2 inch? Doing it is a bit difficult for two reasons: first, the magnetic circuit must provide a perfectly uniform field in which the voice coil can travel and, second, the mechanical suspension of the cone has to be perfectly elastic under conditions of maximum cone excursion. At least three commercial systems are designed to generate low frequencies from a single diaphragm. (See Fig. 1). These units allow for large cone movement without introducing nonlinearity in the suspension or magnetic system.

Bozak speakers are built with long magnetic gaps and pronounced but reasonably low cone resonance. Bozak



Ordinary Gap Structure: Magnetic field concentrated in area occupied by voice coil. Coil cannot move without leaving area of maximum flux density.

"Long-Throw" Design similar to that of Hartley: Magnetic field spread out and kept uniform over distance much greater than voice coil length. High coil displacement possible without leaving uniform flux.

Villchur Type Gap Design: Magnetic field concentrated in very small gap. Flux lines cut only small percentage of voice coil winding regardless of its displacement.

Fig. 1—Comparison of speaker voice coil and gap structures.

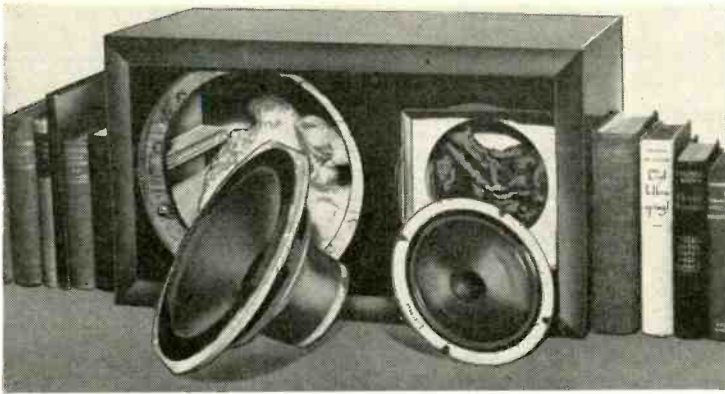


Fig. 2—AR-1 speaker system (disassembled), designed by Villchur.

specifically recommends that his speakers *not* be used with any acoustic flummery—they are intended to be mounted in infinite baffles.

The well-known Hartley speaker goes one step further: the cone suspension is so limp that there is practically no bass resonance at all! While this decreases efficiency, the suspension system ceases to be a major source of bass distortion and there is no tendency to boom at the resonant frequency. Hartley, too, is unwilling to jack up the bass response of his speaker with acoustic tricks. A special Hartley Baffle absorbs the back-wave in a filter system which acts as an infinite baffle even though the cabinet is comparatively small.

The AR-1 system

The newest long-throw speaker on the market is shown in Fig. 2. This is the AR-1 system designed by Edgar M. Villchur. Mr. Villchur wanted a perfectly elastic cone suspension and found a beautiful answer in compressed air. The bass driver of the Acoustic Suspension System has extremely low resonance in free air—the suspension is just strong enough to center the voice coil in its magnetic gap. Mounted in the airtight box provided for it, however, the cone pushes against the air trapped behind it and the resonant frequency of the system rises to 42 cycles.

Although above 100 cycles the AR-1 is not very efficient as speakers go, it delivers real acoustic power at low frequencies with little harmonic distortion. Putting out over 90 db (10 watts input) at 40 cycles, the system measures less than 3% distortion. This is remarkably good for a loudspeaker.

One weak point in any infinite-baffle arrangement is that mechanical resonance is used to compensate for loss of acoustic coupling at low frequencies. Consequently there is a potential ring at the system's resonance. Hartley damps out the resonance mechanically and relies on multiple drivers or amplifier bass boost to deliver adequate acoustic power.

Villchur suggests a damping factor of 1 as optimum for the AR-1 and warns that bass response is attenuated if higher damping factors are used. (Factors of 9 to 20 are standard on most amplifiers.) If you insist on

tighter electrical coupling with the AR-1, the only way to correct the resultant bass drop is by giving more electrical push to the system.

It is possible to damp the speaker acoustically at its normal resonant peak by installing it in a carefully matched reflex enclosure (Fig. 3). Lansing, Altec, Jensen and Pro-Plane all favor the use of bass-reflex cabinets and claim the following advantages for this design:

1. The speaker is heavily damped at system resonance.
2. Bass response extends further than for the same speaker in an infinite baffle.
3. Since radiation from both sides of the diaphragm is utilized, efficiency is higher than for an infinite-baffle system.

These features are accompanied by lowered distortion at the resonant frequency. The General Electric A1-400 in a 10-cubic-foot Distributed Port enclosure has only slightly more than 5% distortion at 40 cycles when producing an intensity of 90 db.†

But what happens in a reflex system above and below the system resonance? Well, at some frequency above that for which the cabinet is tuned it effectively becomes a closed box and the cone resonates with the air trapped in the enclosure. This resonance is responsible

†Petrie, Adolore F. "The Distributed Port Loudspeaker Enclosure," *Radio & Television News*, November, 1956.



Fig. 3—Reflex type speaker system: Pro-Plane, Prismatic III.

for the higher of the two characteristic impedance peaks shown in Fig. 4.

Below system resonance the cabinet ceases to exist for the speaker and the removal of acoustic loading results in the lower impedance peak. The only restriction on cone movement below this point is its mechanical suspension system. For this reason, it is desirable to protect reflex cabinets from frequencies more than a half-octave below system resonance. A rumble filter set at about 30 cycles will protect the speaker from subsonic burbling so often responsible for muddy coloration.

Some engineers attempt to flatten both of these peaks, even though they are not necessarily reflected in the unit's sound output, by introducing acoustic mass and viscosity in carefully calculated amounts. Mr. E. J. Jordan of Goodmans Industries has engineered a series of Acoustic Resistance Units to be used with speakers and cabinets of

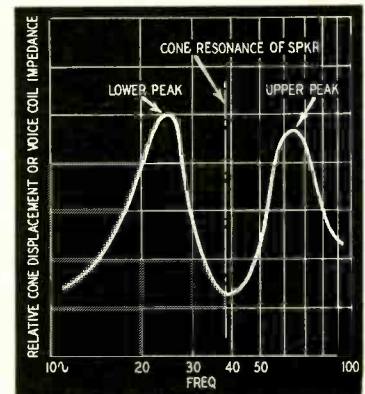


Fig. 4—Impedance curve of a bass-reflex system.

particular characteristics. The friction-loaded systems are said to have audible response to 20 cycles without excessive distortion.

The friction loading scheme has been carefully worked out to complement the characteristics of very-low-resonance speakers. The usual two-hump impedance curve of a reflex system is not found in the Jordan design; instead the impedance rises to a single peak at the very bottom of the audio spectrum. In effect (greatly simplified), the friction-loaded system is an acoustic sus-

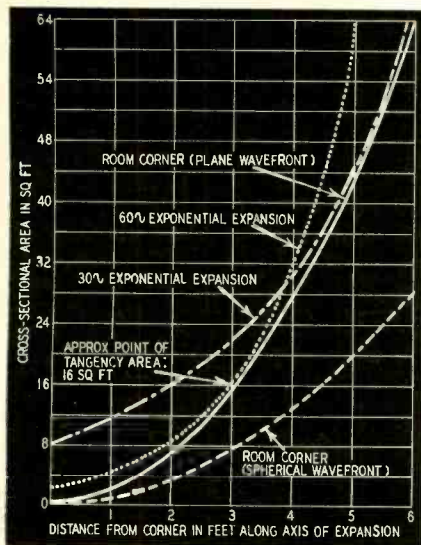


Fig. 5—Comparative rates of expansion of 60-cycle exponential horn and conical horn formed by room corner. Actual wave-form is probably between plane and spherical calculations. A 60-cycle exponential horn with a mouth area of 7 square feet is virtually infinite when tested in a corner.

pension arrangement with a reflex port adding radiation resistance at resonance, plus additional damping in the form of controlled viscosity.

Some experimenters have tinkered with the idea of adding bits of damping material—Tuflex, Ozite, Fiberglass—to the port of ordinary reflex enclosures in an effort to damp out objectional boominess. There is some merit to this if the cabinet is large and the port area equal to, or greater than, the area of the loudspeaker cone. Under these conditions, the Q of the enclosure becomes high and, although the Helmholtz resonance of the enclosure damps the driver



Fig. 6—Klipschorn corner enclosure.

cone, the speaker *does not* damp the enclosure. Consequently, some additional viscous damping is indicated.

However, most commercial reflex cabinets are built as small as possible and in this case, if boom is noticed, it is likely due to an over-predominance of the upper impedance peak of the system. This resonance lies about a half octave above the tuned frequency of the enclosure, and fiddling with the port will affect it only slightly. The remedy here is to stretch a screen of absorptive material across the inside

of the enclosure a short distance behind the speaker. The same trick (the precise location of the screen will have to be determined by trial and error) will help get rid of holes or peaks in response due to standing waves set up in the enclosure.

Bass horns

A full-sized horn, compared to a reflex cabinet, loads its driver evenly over a much wider frequency band. The horn is more efficient than other speaker baffles—efficiencies of 50% are not uncommon. From the standpoint of size, however, a horn is even more cumbersome than a 10-foot speaker. Not only must its mouth diameter be at least one-fourth the wavelength of the lowest frequency to be reproduced, but considerable depth is needed as

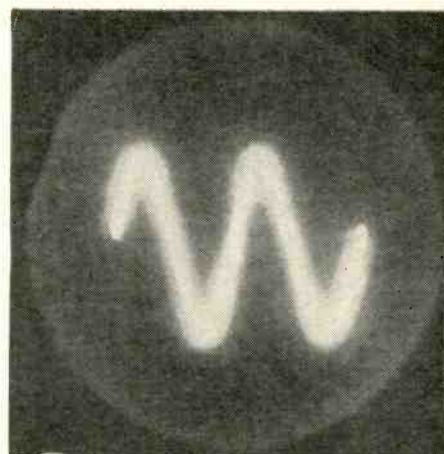


Fig. 7—Bass response of Jensen Imperial.

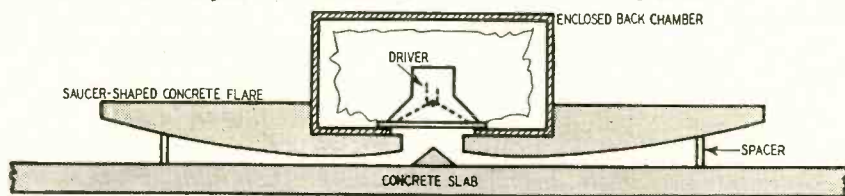


Fig. 8—Cross-section of concrete radial horn.

well.

There is only one way to cut down the size of a bass horn significantly without turning it into a tuned pipe. At some point along its length, the cross-sectional expansion of an exponential horn will match that of the conic horn formed by a room corner. It can be chopped off at this point and the corner takes over, but even this shortcut requires a big unit. Fig. 5 shows that a 60-cycle horn must have a mouth area from 8 to 16 square feet if the transition to corner is to be reasonably smooth. The famous Klipschorn (Fig. 6) is an impressive piece of furniture, yet the bass horn has a flare cutoff of about 50 cycles. An acoustic property peculiar to horns is employed to extend the bass response of the K-Horn to below 35 cycles.

Below its cutoff frequency, a horn acts as a mass coupled to the driver cone. Commercial bass horns use this inductive property in some sort of resonant system to extend response below cutoff. In very large systems like the Jensen Imperial and Electro-Voice Patrician, this squeezes out almost another octave of bass below the point where the horn ceases to be effective. Fig. 7 shows the output of the Imperial at 35 cycles with a 16-watt input.

The octave between 20 and 40 cycles

is nice to have, but about the only way to produce these extremely low notes with really satisfactory quality is to use 20 or 30 speakers or an immense horn such as the 11-foot radial monster designed by Doschek (Fig. 8). The radial horn is interesting because it seems to deliver lower frequencies for the amount of space occupied than do more normal noncorner configurations. One of high fidelity's best known pioneers, Maximilian Weil (who was building corner speakers in 1925!) investigated radial horn design years ago, but neither he nor Mr. Doschek has been able to build a unit of practical dimensions for the home.

Newer experimental speakers—large electrostatic units, the corona discharge speaker, direct aural induction—may someday reproduce the thunderous roar of the mighty Wurlitzer at its peak power. But right now the better reflex designs and the acoustic suspension speaker seem to offer the best bass response in moderate-size cabinets.

It is perhaps a pity that while we enlarge our garages to accommodate the new behemoths of the highways, we insist that our hi-fi set be reduced to the size of a suitcase. But then, if we were completely logical, we might learn to play the cello and not bother with hi fi at all. END

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COME IN AND SAY "HELLO"

ELECTRONIC

DIVIDING

NETWORKS

*Frequency-dividing
circuits and how
they work*

By **HERBERT RAVENSWOOD**

THE modern trend is toward dividing the frequencies delivered to different sections of a speaker system ahead of the power amplifier. The reasons for making this choice in preference to the more conventional crossover network at the power amplifier output have been dealt with elsewhere, so I will not elaborate on them.

These circuits operate at a low power level and use resistive and capacitive elements only, instead of including inductance. Inductance is regarded as undesirable as it is a possible source of distortion and can result in pickup of hum and other stray fields. So we will confine this discussion to the relative merits of different R-C circuits.

One type, and for many purposes the best, is the simple 6-db-per-octave dividing network shown in Fig. 1. This uses identical pairs of resistors and capacitors, except that resistance will be in series and capacitance in shunt for the low-pass output and just the opposite for the high pass. This produces a simple 6-db-per-octave ultimate rolloff, with the 3-db point where the resistance is equal to the capacitor's reactance. The slope at the 3-db point will be 3 db per octave.

This circuit has the advantage of simplicity. It is not likely to get seriously out of adjustment and, when correctly set up, the total energy distributed to the two outputs is constant with frequency—a fact which does not always apply to more complicated circuits.

Its disadvantage is that, for some speaker combinations, frequency separation is not sufficiently definite. A slope steeper than 6 db per octave may be regarded as necessary, to prevent high frequencies from getting to the low-frequency speaker or low frequencies from getting to the high-frequency speaker.

Multiple R-C

The next step is to multiply the num-

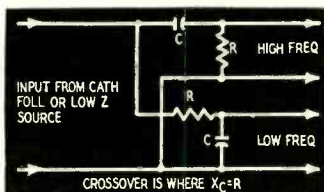


Fig. 1—Simple R-C network is as good as any, unless steep rolloffs are desired.

ber of R-C networks as in Fig. 2. Two networks in each output give an ultimate slope of 12 db per octave, three give an 18-db-per-octave slope and so on. Many circuits just do this. Unfortunately, the response is not all that is expected. The simplest effect of combining two or more networks with the same rolloff point is shown in Fig. 3.

The 12-db-per-octave ultimate slope gives an attenuation of 6 db at the turnover point, with a 6-db-per-octave slope. Similarly, the 18-db-per-octave ultimate slope gives an attenuation of 9 db and a 9-db-per-octave slope. Combining the energy fed through these two networks would leave a dip of 3 db and 6 db, respectively, at the crossover frequencies. This is shown by Fig. 4.

This calculation assumes there is no interaction between successive R and C components in each network. The only way to achieve this, even relatively, is to use a very low value of resistance with a large value of capacitance in the first pair and then go to higher impedances in successive pairs.

Using a 10-to-1 ratio between successive sections will considerably reduce interaction and produce a fairly close approximation of the responses shown in Fig. 3. A typical circuit used to achieve this at 1,000 cycles is seen in Fig. 5.

Using identical components in successive R and C values for both the high- and low-frequency networks, the attenuation at the design point for the

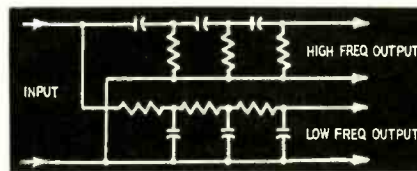


Fig. 2—The obvious way to get more rolloff is to add stages.

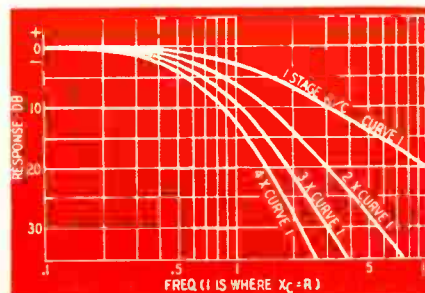


Fig. 3—Response curves for 1-2-3- and 4-stage R-C networks, assuming no interaction.

two-stage network is more than 6 db; in fact, it is 9.5 db. For the three-stage network, attenuation jumps from 9 to 17 db and, if we go to a four-stage network, it jumps from 12 to almost 24 db. It is evident from this that, unless some adjustment is made, using more

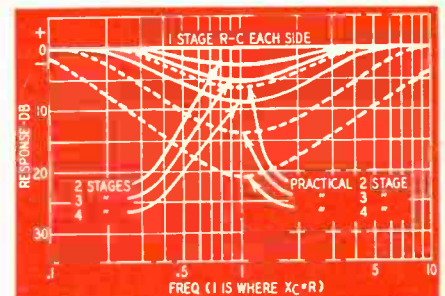


Fig. 4—Energy response: solid lines, assuming no interaction; dashed lines, identical component values for each stage.

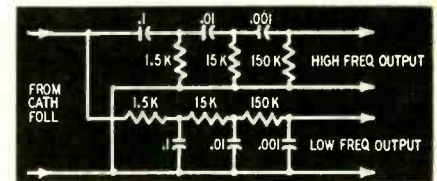


Fig. 5—Circuit for nearest practical approach to solid curve of Fig. 4 for 3 stages. 1,000-cycle crossover.

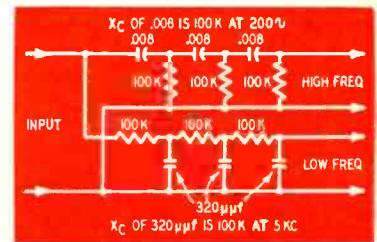


Fig. 6—Network provides 1,000-cycle crossover without a dip.

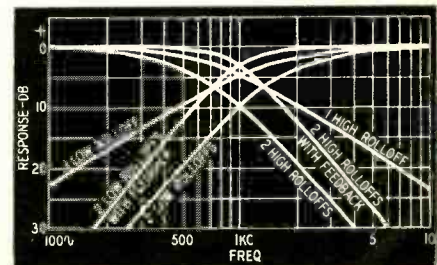


Fig. 7—Feedback sharpens knee of curve.

AUDIO—HIGH FIDELITY

resistors and capacitors to get a steeper ultimate slope results in considerable dip at the crossover frequency. Use of two-stage networks, using the same values as those intended for a single stage, produces a dip of 6.5 db. Three-stage networks cause a 14-db dip and four-stage networks a dip of almost 21 db.

It is fairly easy to see whether this has been done in an actual circuit, simply by examining the values to see if they are the same in both filters.

More often, identical or similar values are used for each stage in the same section, but the low-frequency rolloff point is not the same as the high-frequency rolloff point (Fig. 6). But by bringing the responses together (that is, making the low-frequency rolloff higher and the high-frequency rolloff lower), this dip can be avoided. Many designs do just this.

What seems to be overlooked is that

over point to extend from 700 up to 1,000 cycles and from 1,400 down to 1,000 cycles. This is shown in Fig. 7.

There are a variety of ways in which this principle can be applied. The R-C combinations can be separated by the stage of amplification, with one in the input or grid circuit and one in the plate circuit. Such a circuit is shown in Fig. 8.

Alternatively, the R-C elements can be put together, identical components being used for each network. About 13 db of feedback will be needed, which extends the rolloff frequency by a ratio of about 2.1 to 1. Thus, making the capacitors' reactance for the low-pass section equal the resistances at 475 cycles, and in the high-pass section at 2,100 cycles and using 13 db of feedback brings the required crossover at 1,000 cycles, with the true 12-db-per-octave rolloff (6 db per octave, 3 db down at 1,000 cycles).

the passband, the capacitive elements contribute relatively little. Thus the resistance connected to the output will appear as a corresponding negative resistance at the input and hence will neutralize the next resistance back. This means that the only load on the input circuit is one of the three actual resistances because the other two virtually neutralize one another.

A similar kind of thing happens right up to crossover frequency with the result that, instead of achieving something like 9-db (or more) loss at crossover frequency, the phase shift as well as the attenuation of the last R-C pair, separated by the negative converter, is reversed as a load for the middle R-C pair. This offsets the loss in the middle pair and enables the attenuation at the rolloff point to be only 3 db.

Beyond this point the effect is similar to any three-reactance crossover. Having passed its critical point, the rolloff

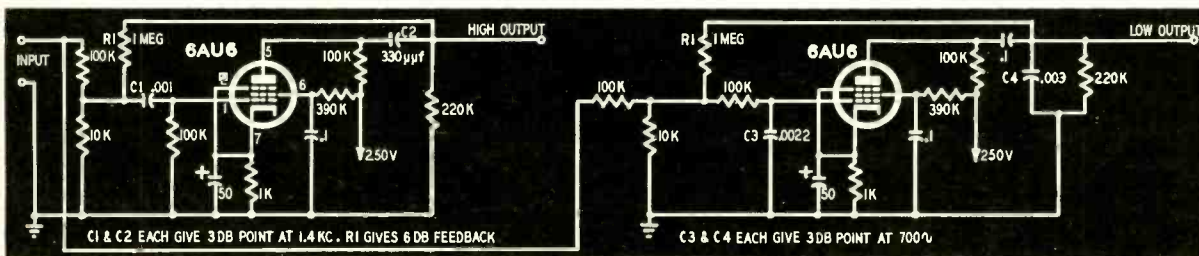


Fig. 8—Feedback type circuit gives response of Fig. 7.

making this change results in a response that is not so very different from the single R-C combination. Without going into mathematics, the slope at the 3-db point is almost exactly 3 db per octave. At a frequency 2 to 1 beyond this (twice or half the 3-db point frequency) the attenuation is almost exactly the same as it would be with a single R-C network, about 7 db. Only when a frequency very much beyond the crossover frequency is reached do the nominal ultimate slopes of 12, 18 or 24 db per octave begin to take effect.

So there is no real advantage to using more than the single R and C in each network, unless something else is done to accentuate the sharpness of the rolloff. There are two ways to do this, apart from resorting to inductive components and making it into a regular filter.

Feedback type

The first of these is to use the same R-C arrangement but apply feedback, which has the effect of sharpening the turnover point by causing interaction between these two rolloff frequencies. As well as sharpening the turnover point, feedback also extends the frequency range. To offset this, we have to start with a narrower band. For a crossover frequency of 1,000 cycles for example, the low-frequency turnover point should be 700 and the high-frequency turnover point 1,400 cycles. Application of about 6-db negative feedback will then bring the two stages to a sharper rolloff and cause the turn-

Other combinations of resistance and capacitance can be used with different design points and amounts of feedback. But the end result is similar. This kind of circuit is particularly adapted for the 12-db-per-octave ultimate slope, for which details have just been given. It can be extended to more complicated circuits, giving sharper rolloffs, but this involves the use of a considerable number of tubes and very critical adjustments.

The other type of circuit involves a comparatively recent development: a circuit element called a negative converter. This circuit has been developed experimentally for use with transistors, although it is possible that a similar circuit can be devised for vacuum tubes.

This circuit has the property of reflecting an impedance to the input which is the exact negative of the impedance connected at the output. When an impedance is connected at the output, consisting of resistive and capacitive elements, it will take a certain voltage and current combination, depending upon the impedance. The current reflected to the input circuit will be identical to that of the output circuit, but the voltage will be of opposite phase. Alternatively, we can regard the voltage as being the controlling factor since this is what is applied at the input. In that case the current will be of opposite phase to that which would be taken by the impedance connected at the output.

Applying this to the 18-db-per-octave arrangement of Fig. 9, we see that in

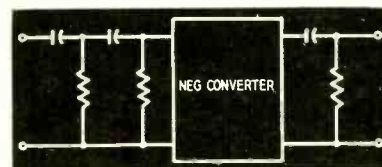


Fig. 9—Negative converter used in a high-pass filter.

is accentuated and the resultant response can be made identical to the true 18-db-per-octave constant-resistance type response. This method is particularly applicable to the sharper rolloffs, with an ultimate of 18 db per octave.

Practical problems

There is probably little to choose intrinsically about any of these approaches to the problem. Each circuit, with careful adjustment, can supply the type of response for which it is intended. By careful design, distortion and noise can be kept to an acceptable figure. A number of letters received about these devices, however, complain about either distortion or noise, including hum.

Investigation of these problems usually shows that the trouble is due to the level at which the electronic filters are operated. They are, of course, intended to go between the preamplifier and the power amplifiers. But best results are achieved only if the filters are operated in the correct dynamic range. If the level is too high, they are likely to run into distortion. If it is too low, they are likely to show noise troubles, including excessive hum.

Some filters are deliberately designed to have unity gain, so the output level is the same as the input level. This is a convenient feature because, provided the output level of your preamp and the input level of the power amplifier are correct for the filter, they will give a minimum of trouble in this regard. Other units of this type have quite a considerable gain, possibly as much as 20 db. This means that they may operate with an input of 0.1 volt and give an output of 1 volt, or they may accept an input as high as 1 volt and give an output of 10 volts, which is much more than the average power amplifier needs.

If, in the latter case, you put such a filter between a preamp and power amplifiers that normally operate at a level of a fraction of a volt, you will probably find hum trouble. Perhaps your amplifier gives full output, with the gain control turned all the way up, from an input of 0.25 volt. Your preamp may deliver an output of 2 volts.

When you feed the preamp output directly into the amplifier, you probably turn the gain control down so that the preamp does not give 2 volts, but only 0.25 volt, and the hum level is quite acceptable. What you may not realize at this stage is that the hum level is only just acceptable, because another 6 db of hum may really make it quite noticeable. However, that 6 db makes all the difference and you never hear it.

Then you inserted an electronic filter and promptly acquired an extra gain of 20 db. To lose this extra gain you turn down the preamp to give 20 db lower output. This way the input to the power amplifier is still 0.25 volt, but the working output from your preamp is only 25 mv. This is getting down into the hum region. If the preamp is designed to give a 2-volt output and has, say, a 70-db hum level (which is quite a good hum level for a preamp), working it at 25-mv output will reduce the margin by 38 db so the working hum level is only 32 db, which is quite audible.

So the hum you blame the electronic crossover for is not coming from the crossover at all, but from your preamp. The best thing to do is to use an attenuator between each electronic crossover output and the power amplifier so the levels are nearer to the maximum each unit can handle. If the power amplifier has a preset gain control, you could use this to adjust the relative level and eliminate undesirable hum.

At the other extreme you may run into distortion troubles. You may like to have the preamp volume control so that, all the way on, the program is as loud as you want it. This means the power amplifier preset volume control has to be turned almost all the way down and the preamp delivers its full 2-volt output.

This, again, is all right when the preamp is connected directly to the power amplifier. It may be introduc-

ing slightly more distortion in the output stages of the preamp than an intermediate compromise might, but it is still an acceptable quality.

However, when the electronic filter is inserted and the circuit readjusted for proper overall gain, using the same policy of adjusting so that the preamp's volume control is all the way up for the desired loudness, the filter gets 2 volts at its input and is probably designed to accept only 1 volt, if that. So the electronic filter will be causing distortion unnecessarily.

As mentioned earlier, this kind of trouble is less likely to occur if the filter itself is designed to have unity gain. But it is still advisable to check whether you are using the best level of transfer for the purpose; both distortion and noise-level effects can be cumulative.

If you are operating the whole system at too high a level, distortion may be acceptable when only the output stage is producing it. But when you add another small component of distortion due to an electronic filter it may become noticeable, although each piece of distortion might not be serious in itself.

Similarly the noise and hum level from the preamp, caused by working

the output at too low a level and using the power amplifier preset wide open, may be quite acceptable in the direct-transfer case. But when you add another possible source of noise, in the form of an electronic filter, it may become large enough to be quite noticeable—and even unbearable.

So, after you have selected a circuit that does what you really want it to as regards frequency separation, check that you work all the units at the best level to utilize their full dynamic range. This article may help you determine whether the circuit really gives the response you expect. Any circuit correctly operated will give you reasonably good performance. Practically all these circuits are designed to produce minimum distortion and provide a satisfactory dynamic range. Your problem is to operate it so that it works within this dynamic range and does not try to work either at the top or bottom extreme of the range. END

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VARIABLE AUDIO SELECTIVITY

AN interesting audio selectivity circuit appears in the GPR-90 amateur communications receiver (Technical Materiel Corp., Mamaroneck, N. Y.).

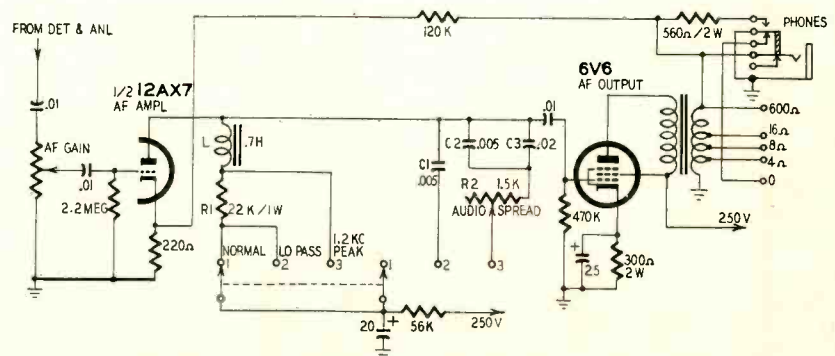
This feature of the GPR-90, a double conversion superhet receiver, extends its usefulness and makes it possible to receive stations whose signals would normally be blocked by background noise and other transmitters.

The variable audio selectivity circuit has four different levels. Three are selected with a 3-position rotary switch. The fourth is obtained by adjusting the audio spread control with the selectivity switch in the peak position.

In the first or normal position, the audio bandpass is determined by the circuit consisting of R1 and L (see figure). The resistance of R1 plus the inductance of L comprise the plate load of the 12AX7. This results in a wide flat bandpass suitable for broadcast reception.

In the second or low-pass position a .005- μ f capacitor C1 is added to the circuit, causing a high-frequency response drop of 17 db at 10,000 cycles. This setting is desirable for use in either communications or shortwave reception.

With the audio selectivity control in the third position we have two choices: a wide or a sharp 1,200-cycle peak. At this setting a tuned circuit is formed by L, R2, C2 and C3. By adjusting R2, the audio spread control, either a sharp or wide 1,200-cycle peak is selected. At the wide peak setting there is a 20-db drop from the peak at 325 and 6,000 cycles. For a sharp peak this drop is at 500 and 3,500 cycles. The sharp-peak position is extremely advantageous for CW reception. Much interference is eliminated and a clear sharp tone can be heard. The wide peak allows speech to be received even under extremely adverse conditions. END



assemble this Headset Booster

Increase the usefulness of your receiver with this transistor unit

Using the headset booster with a communications receiver.



By E. G. LOUIS

AS the electronics experimenter or novice ham gains experience and knowledge, his tastes change, his abilities and skills increase and the makeup of his laboratory or workshop changes. He graduates from a 1,000-ohms-per-volt meter to a 20,000-ohms-per-volt instrument or a vtvm and he starts using an oscilloscope and other complex equipment.

But one piece of gear is retained virtually unchanged—that old standby, the magnetic headset. Of all electronic equipment, the headset comes closest to being universal. There is hardly an electronics laboratory or workshop that doesn't have at least one pair of phones in its inventory and most have several.

The radio-TV service technician keeps a headset handy to use with his signal tracer. The ham, be he novice or general class, uses a headset every day. The laboratory technician or engineer uses a headset with his impedance bridges, detectors and other precision equipment. The home constructor, whether he specializes in simple crystal receivers or complex superhets, is sure to have at least one in his shop.

A simple accessory that will greatly increase the utility of any moderate-impedance magnetic headset is shown in the photographs—a headset booster amplifier. This low-cost, easily built instrument increases the effective sensitivity of a headset by providing circuit gain while maintaining a high input impedance. When used with a moderate-impedance set (500 to 2,000 ohms), the net result is a substantial increase in input impedance, reducing circuit loading.

The actual gain obtained from the instrument will vary with the type of headset with which it is used. However, the gain should be *not less* than 10 db

and may run as high as 25-30 db.

In any case, every user will find the headset booster a welcome addition to his equipment. The home constructor will find that his crystal receivers have a sensitivity he never thought possible and, in some cases, the instrument's higher input impedance may improve his receiver's selectivity as well. The ham, and especially the novice with his low-cost communications receiver, will find that he can "copy" formerly faint stations with ease. The service or laboratory technician will be able to use his specialized test gear with new convenience.

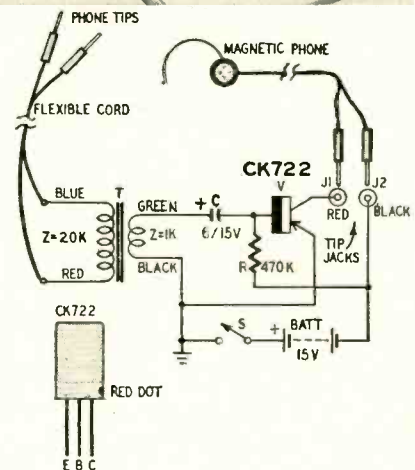
Circuit description

Basically, the headset booster is a self-contained, single-stage transistor audio amplifier (see schematic). A p-n-p transistor is used in a common-emitter configuration. Although a common-emitter amplifier stage generally has a low to moderate input impedance, using a stepdown input transformer insures a high input impedance (approximately 20,000 ohms).

In operation, audio signals are applied to the transformer primary and inductively coupled to its secondary. From here, the signal is applied to the base-emitter circuit of the CK722.

The amplified audio signal drives the magnetic headset connected to the output tip jacks and acts as the collector load impedance. Power is supplied by a single 15-volt hearing-aid battery.

Circuit gain will vary to some extent with the transistor used, since these components are manufactured to fairly broad tolerances. A greater variation in gain will occur with the headset used. Generally, the higher the headset's impedance, the greater the circuit gain. Best results are obtained with



- R—470,000 ohms, 1/2 watt
- C—6 μ f, 15 volts, miniature electrolytic
- J1, 2—Tip jacks
- T—Audio transformer; primary, 20,000 ohms; secondary, 1,000 ohms (Argonne AR-104 or equivalent)
- V—CK722
- Case—2 3/4 x 2 1/8 x 1 1/8 inches (ICA 29435 or equivalent)
- Phone tips (2)
- Battery, 15 volts (Burgess Y10 or equivalent)
- Battery holder (Lafayette MS-225 or equivalent)
- Miscellaneous hardware

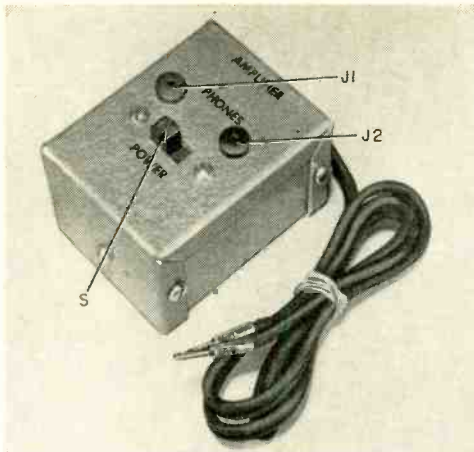
Circuit of headset booster. Insert shows transistor basing.

2,000-ohm impedance or higher. Crystal headsets *cannot* be used with the instrument. In any case, the gain should be at least 10 db, but may be much higher.

There is no provision for a gain control. It was omitted in the interest of circuit simplicity and to keep cost low. In practice the headset booster is generally used with equipment (receivers, test instruments, etc.) already equipped with a gain control. To provide one in the booster would be mere duplication.

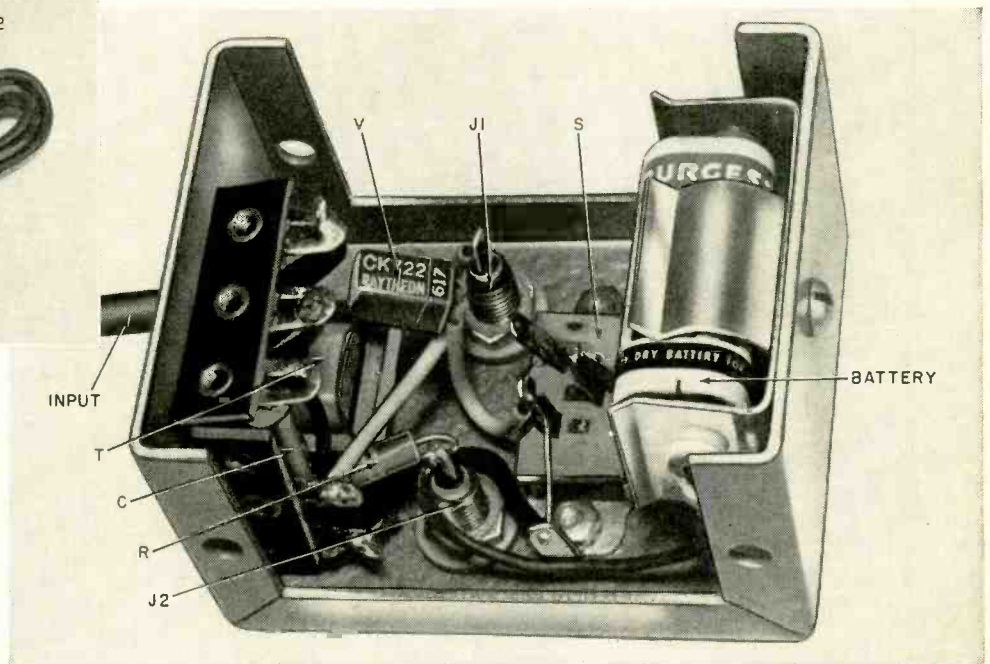
Construction hints

Only standard, readily available components are used. Construction details are illustrated by the photographs. The circuit is simple—relatively little con-



This easily built unit is a handy addition to a lab, shop or shack.

Interior view of the wired booster.



struction time is required. The average person should be able to assemble and wire a unit in one or two evenings.

A commercially available prefinished aluminum box measuring $2\frac{3}{4} \times 2\frac{1}{2} \times 1\frac{1}{2}$ inches serves as chassis and cabinet. The layout allows all electrical components to be mounted on one half of the box; four small rubber grommets were mounted on the other half and act as rubber feet. The layout is not critical and may be varied to suit the individual builder's taste or to fit a different-sized box or components.

For a professional, factory-wired appearance, the instrument may be labeled with standard decals. These are available through most radio parts suppliers. Either white or black decals show up well on the gray hammertone finish of the box.

The decals are applied after all drilling or other machine work is completed, but before component parts are mounted. After application, the labels should be protected with at least two coats of clear lacquer.

To save the cost of a subminiature socket, the transistor was wired permanently into the circuit. Avoid heat damage during this operation! Each transistor lead is held with a pair of long-nose pliers as it is soldered. The lead is grasped between the connection point and the body of the transistor, with the pliers acting as a heat sink to drain off excessive heat.

Lead dress is not critical, but the usual practice of keeping input and output circuits separated should be followed. The transformer's primary winding is left floating—neither side connected to circuit ground. This ar-

range ment prevents a hot case if the booster is connected into a vacuum tube's plate circuit. In some equipment a headset is connected in series between a vacuum tube's plate and B plus. The headset booster is designed to be used as a direct replacement for a magnetic headset as far as its input connections are concerned.

After the wiring is completed, all connections should be double-checked for possible errors and accidental shorts. Particular attention should be paid to electrolytic capacitor and battery polarities and to the color coding of the transformer leads. Since the battery does not have polarized terminals, the positive terminal of the battery clip should be marked.

A number of modifications may be made in the headset booster's design without adversely affecting operation or performance. Transistors other than the unit specified may be used—typical units are p-n-p types 2N107, 2N34, 2N222 and n-p-n types like the 2N170 or 2N35. *However, if an n-p-n transistor is used, the electrolytic capacitor and battery polarities must be reversed.*

The capacitor's size is not critical. It may have any value from 4 to 15 μf , as long as the unit has a working voltage of at least 15.

With extremely high-impedance headsets (8,000 ohms or more) or with low-impedance units (under 1,000 ohms) an adjustment in the base bias resistor's value may improve performance. Different values for this resistor also may be necessary if a different transistor is used. The best value can be determined experimentally, but should fall between 100,000 ohms and 1 megohm.

Modifications in the electrical hardware may be made at will to suit your needs. A phone plug, coaxial connector or phono plug may be substituted for the phone tips at the end of the input cord. If desired, the tip jacks may be replaced with a phone jack, screw type terminals or any other type of two-terminal connector. The magnetic headset can be wired permanently into the circuit. Finally, the spst switch may be replaced with any suitable equivalent.

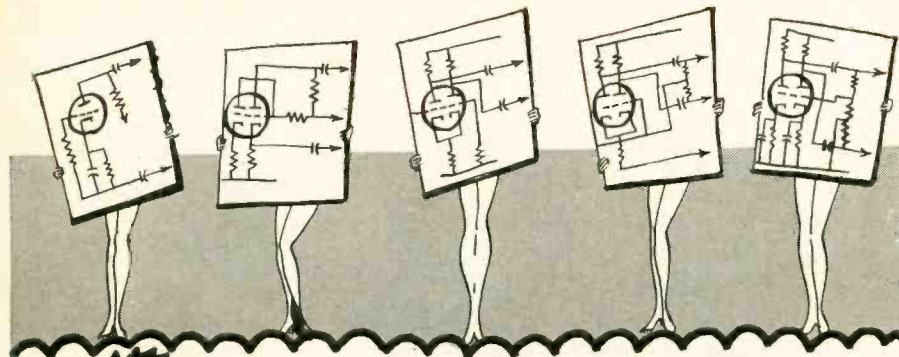
Application and use

Like any piece of electronic equipment, the headset booster will give satisfactory performance only if properly used. This instrument is not designed for use as a high-gain preamp nor as a substitute for an audio signal tracer. Rather, it is intended to provide a real boost in a magnetic headset's sensitivity and input impedance.

For optimum results, it is best to consider the headset booster and headset as a single instrument—a magnetic headset with greatly improved sensitivity and a high input impedance.

With this in mind, the instrument's input lead is connected in place of a headset's lead.

When operated in this fashion, the unit will give satisfactory performance whether used with communications receivers, impedance bridges, signal tracers or other pieces of specialized test equipment. Only one precaution is necessary—the gain control of the equipment with which the booster is used should be adjusted for good headset volume. An excessively strong input signal can overload the transistor, with resulting distortion. END



CHOOSING THE PHASE INVERTER

By NORMAN H. CROWHURST

Part II—The paraphase, floating paraphase and long-tail phase inverters

LAST month we discussed the popular split-load phase inverter. Now we are going to look at some of the less familiar phase-inverter circuits.

The simple *paraphase* circuit shown in Fig. 6 has the advantage, compared with the split-load inverter, that the available swing from each of the drive tubes comes from the full plate coupling resistor. This means that the available swing from this type of inverter, using the same type of tube, will be twice that for the split-load circuit.

The circuit operates with the normal voltage gain of one tube and thus is

somewhat similar in gain to the split-load circuit combined with a preceding stage.

The grid voltage for the second drive stage V2 is obtained by tapping down on the output from V1. Using the gain $N = 14$, a suitable value for R_g is 620,-

000 ohms. This gives $\frac{R_g}{N} = 43,000$ ohms

and $R_g (1 - \frac{1}{N}) = 560,000$ ohms, which

conveniently uses close-tolerance (5%) resistors. This will attenuate not only the amplified waveform, but also any

second-harmonic distortion due to the curvature of the first stage. As the grid swing on both stages is the same, the second harmonic contributed by the curvature will be the same. However, the swing applied to the second stage already contains a similar amount of second-harmonic distortion in *opposite* phase, produced by the first stage. The drive applied to the second output-tube grid has its second-harmonic distortion approximately cancelled by this second stage of amplification.

Assume each of these phase-inverter tubes gives 5% second-harmonic distortion. Output tube V3 has 5% second-harmonic added to it, while V4 has approximately 0% second, but about 0.25% fourth harmonic. When the signals are recombined in the output transformer—assuming no distortion due to the output tubes—the distortion adds up to about 2.5% second and 0.125% fourth, due to the drive stage.

In practice, of course, the output tubes are likely to add a bigger component of distortion, so this calculation does not always carry too much weight.

The drawback in this type of circuit is that the equality of drive for the two output tube grids depends upon accuracy of gain in the second of the phase-inverter tubes. If the gain of the tube is not equal to the attenuation provided by the resistances, the drive voltages for the two output tubes will not be equal. As individual tubes are liable to fluctuate in amplification factor and consequent gain by at least 20%, there can be as much as 20% deviation in the balance of the drive for the output tubes.

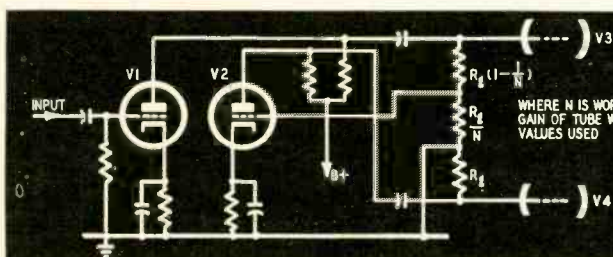


Fig. 6—A simple paraphase circuit.

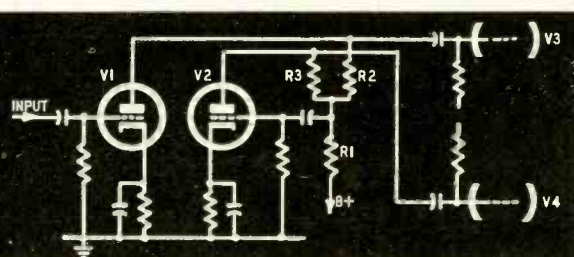


Fig. 7—One form of a floating-paraphase circuit.

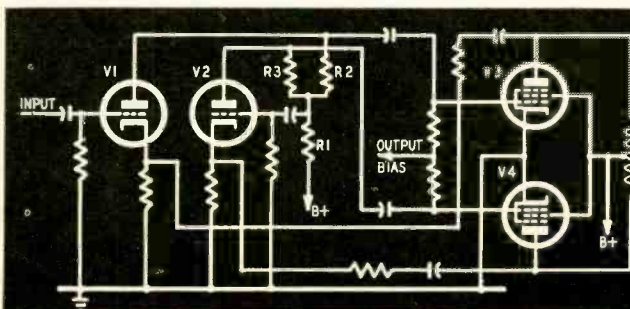


Fig. 8—Floating-paraphase circuit improves overall amplifier design by using short-loop feedback.

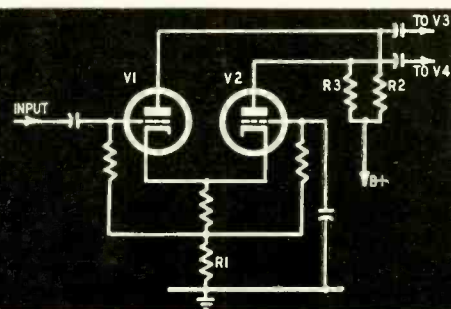


Fig. 9—Essential parts of long-tail inverter, using return to ground for tail.

There is one extra stage of coupling, for both the low- and high-frequency phase-shift effect, in the feed via the second output tube compared with that by the first output tube. This causes unbalance at extreme frequencies and also makes design or operation of an overall feedback loop more difficult.

Floating paraphase

Some disadvantages of the simple paraphase circuit are overcome in the floating paraphase circuit, shown in Fig. 7. However, the change does not contribute only advantages—it also contributes some disadvantages. If you switch from the split-load inverter to the paraphase to get more drive for your output stage, a change to the floating paraphase will put you nearly back to where you were with the split-load inverter.

It's true that each output grid receives almost the full swing from one tube because the junction of the three resistors upon which the design is based does not swing appreciably—only the amount necessary to drive the second half of the paraphase (V2). As this will be less than one-tenth of the drive required for the output tube grid, it will not reduce the plate swing a great deal.

The more serious loss of available plate swing is due to the fact that resistor R1 has to carry the combined plate current of the two halves. This means there will be a voltage drop across R1 approximately equal to that across each of the coupling resistors, R2 and R3. Hence, the effective B supply for the phase inverter is virtually that much lower. This will result in an output swing from each half that is only slightly larger than that available from the split-load inverter.

For example, a 12AU7 used as V1 and V2, with a plate coupling resistor of 47,000 ohms and a bias of 7.5 volts, with a plate supply of 300 volts, will give a peak-to-peak swing of 180 volts, from an operating point of 160 volts. This means the split-load circuit will give 90 volts peak to peak at each grid while the paraphase will give 180 volts peak to peak at each grid. The floating paraphase will drop the effective B plus by about 70 volts, to 230. From this point, a plate coupling resistor of 47,000 ohms for each tube will give a swing of about 120 volts peak to peak.

Independence from tube parameters is considerably improved because plate current fluctuation from the second half of the phase inverter passes through resistor R1, which provides the voltage for swinging its grid. So any variations in transconductance of the second half of the phase inverter are reduced by the effective feedback provided in resistor R1. This usually gives about a 10-to-1 reduction, so a fluctuation of 20% in the transconductance of the tube is likely to produce only a 1 or 2% deviation from balance.

The floating paraphase does not achieve the same distortion cancellation that the simple paraphase does. The two components of second harmonic in the second half of the paraphase drive cancel. In this circuit, negative feedback over the second half (V2) means that its tendency to generate second harmonic is reduced by a 10-to-1 factor. However, this reduction does not apply to the first half (V1). Consequently there is a resultant second harmonic of approximately equal magnitude in the drive to the grids of the output tubes. The second harmonic as well as the fundamental undergoes phase inversion in the second paraphase tube (V2), so the second harmonic generated by the first becomes a permanent addition to the waveform without any reduction due to the phase inversion. The only chance of reducing this component now rests in the overall feedback.

The floating paraphase still suffers from the disadvantage that in an overall feedback loop the second output tube has extra phase-shift components. However, the fact that some negative feedback is in effect applied over the second half of the phase inverter means that these additional shifts are reduced by a corresponding fraction and hence the possibility of a stable design is improved by the same factor as the improvement in stability of balance of the phase inverter itself.

It is possible to apply short-loop feedback with the floating paraphase inverter because each cathode can have its own bias resistor (see Fig. 8).

Long tail

The long-tail (cathode-coupled) inverter is another variation of the paraphase. Here the common resistor R1 is in the cathode circuit instead of in a common portion of the plate circuit (see Figs. 9 and 10). If the return point for the long tail is at ground potential the two grids of the paraphase tubes must be at a dc potential, above ground. The same restrictions referring to available swing, mentioned with the floating paraphase, apply to the long-tail circuit.

It is a little better from the viewpoint of stability because the coupling of the second paraphase grid to ground is at ground potential. A large-value coupling capacitor can be used, say 1 μ f, without running into difficulties due to its self-capacitance. This enables frequency response of the second half to be extended (both high and low ends) much further than the floating paraphase.

As the grids of the inverter must be at a positive potential, it would be well, in the interest of overall stability, to arrange this by direct coupling as shown in Fig. 10.

An alternative method with the long-tail inverter is to arrange that the grid potentials of the inverter are centered around ground. This means

that the negative end of the long tail must be considerably below ground. As many amplifiers that will need the large swing which this circuit provides also use negative fixed bias for the output tubes, it may be convenient to utilize the bias supply—which usually needs a bleed resistor anyway—to provide the negative for the long tail as shown at Fig. 11.

Continuing the previous example, with a 12AU7 (V1 and V2), the circuit of Fig. 9 or 10 is limited to a peak-to-peak swing each side of about 120 volts. Using a bias return point of about 70 volts negative, the circuit of Fig. 11 will give a peak-to-peak swing each side of 180 volts.

The long tail also avoids the distortion asymmetry produced by the floating paraphase because putting the balancing resistor in the cathode means the degeneration it provides will act on both tubes. Use of a ground average potential for both grids means the second grid can be solidly grounded and thus the number of phase shifts in both feeds is nearly identical because the source impedance for the second tube is the impedance seen at the cathode of the first tube. This is quite low—about 1,500 ohms. There is no series coupling capacitor at this point and the shunt capacitances will be very small, hence they will not contribute appreciable phase shifts at high frequencies.

This has covered most of the variations in the popular types of phase inverter. There are, however, some fairly new circuits such as the cross-coupled inverter and types that employ positive feedback from the output stage, but "that's another story," so we shall reserve it for another article. END

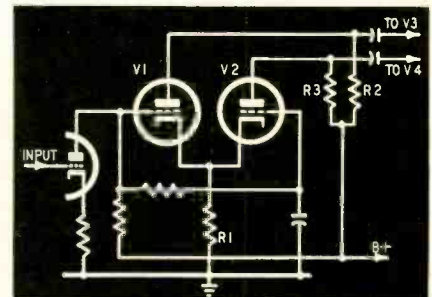


Fig. 10—Direct-coupled stage before long tail improves it in much the same way as split load.

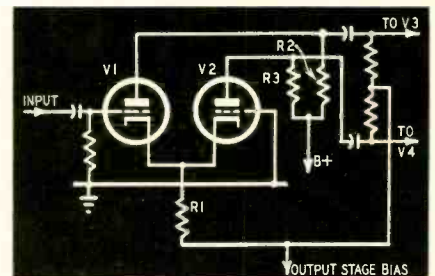


Fig. 11—Extending tail below ground, as here, is ideal for output circuits requiring a big grid swing and using fixed bias.

The COPY-CAT

Best features of Ampex 620 and Mullard 520 are combined in this high-quality hi-fi amplifier

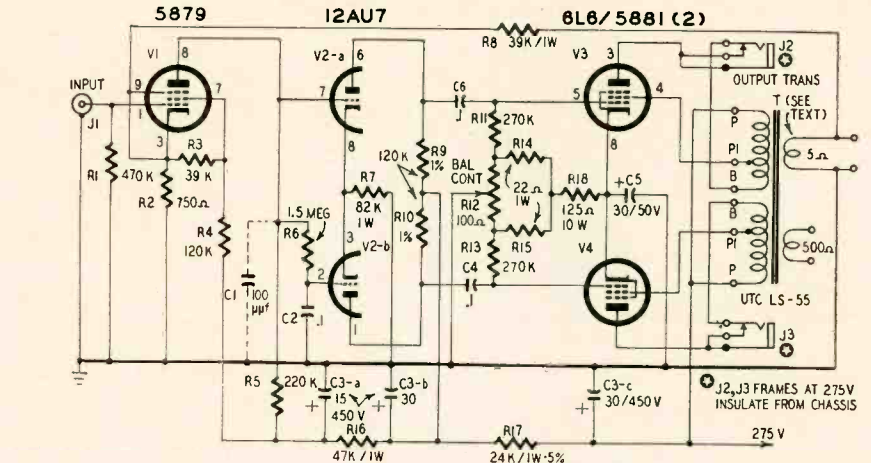
ALWAYS feel that each amplifier I build will be the final one. The response is terrific, the sound superb, the construction beautiful and the circuitry simple and without gimmicks. "The Amplifier Without Frills" (RADIO-ELECTRONICS, February, 1954) lasted for two whole years—fulfilling the above requirements and giving our happy home a measure of peace, since we could now eat at the kitchen table without solder in the soup.

But, alas, a new speaker enclosure and Monitor's survey of the Ampex 620 amplifier sent us after the tube manual and in search of the soldering iron!

The Ampex 620 is based on the Mullard 520—and both amplifiers are based upon older basic principles. Direct-coupled input stages may seem new but aren't, and the long-tailed or cathode-coupled phase inverter is an equally old device. The distributed loading of the Ultra-Linear method of operation, while fairly new, is only a refinement of circuitry used in many European transmitters, notably in audio stages of the outphasing system of modulation and in low-impedance drivers. The appeal of these circuits is not something new, but increased efficiency and reduced phase shift are.

The schematic (Fig. 1) will show that about equal parts of both commercial amplifiers have been used. The input stage and phase inverter follow the 620 circuit pretty closely. After all, they've got some good engineers to figure out such things! The output stages are the conventional Ultra-Linear, except that the 6L6's (or 5881's) are operated class A (almost) and no special output transformer is used. The UTC LS-55 used in the original "Amplifier Without Frills" is wired with the screens connected to the intermediate (P') taps on the primaries. The power supply for this and the original amplifier is a conventional unit on a separate chassis. Its circuit was not shown. You can use any convenient supply delivering around 275 volts at 150 ma or more.

If you built the first amplifier, changing things to conform with Fig. 1 requires only the mounting of different tube sockets for the input and phase inverter stages, and rewiring. We did the entire job in an evening, after convincing ourselves it was worth it. And it is. The response and distortion with the new circuit are about the same as the original amplifier. The difference is increased presence—a feeling that you



- R1—470,000 ohms
- R2—750 ohms
- R3—39,000 ohms
- R4—120,000 ohms
- R5—220,000 ohms
- R6—1.5 megohms
- R7—82,000 ohms, 1 watt
- R8—39,000 ohms, 1 watt
- R9, 10—120,000 ohms 1%
- R11, 13—270,000 ohms
- R12—pot, 100 ohms, wirewound
- R14, 15—22 ohms, 1 watt
- R16—47,000 ohms, 1 watt
- R17—24,000 ohms, 1 watt, 5%
- R18—125 ohms, 10 watts

- All resistors 1/2 watt 10%, unless noted
- C-1—100 μf, 600 volts, disc ceramic
- C2, 4, 6—0.1 μf, oil filled
- C3—15-30-30 μf, 450 volts
- C5—30 μf, 50 volts
- J1—phono jack
- J2, 3—closed-circuit phone jacks
- T—UTC LS-55 or equivalent
- V1—5879
- V2—12AU7
- V3, 4—6L6/5881
- Chassis
- Miscellaneous hardware

Fig. 1—Circuit of the Copy-Cat.

are right beside the piccolo player or inside the tympani.

There is also increased sensitivity and an apparent increase in the ability of the amplifier to handle high transients. The dynamic range which the amplifier can handle is definitely increased (see Fig. 2) and the low-distortion output power is greater, with less feedback.

In rebuilding the original amplifier or starting a completely new one, use only one grounding point. A piece of stiff tinned-copper wire, grounded at the 5879 socket only and insulated on tie-points across the chassis for the remaining connections to ground, is a must if you want stability and absence of hum.

Closed-circuit jacks, insulated from the chassis, are used to measure plate current of the output stages for balancing.

Capacitor C1 may or may not be necessary. In two of these amplifiers it was required to level-off the high-frequency response above 20,000 cycles. In another it was not used.

The LS-55 has multisection secondaries whose terminals may be strapped to provide 14 different load impedances ranging from 1.2 to 500 ohms. Refer to

the LS-55 data sheet for secondary connections. Reverse the ground and feedback connections to the voice-coil winding if the amplifier oscillates with the feedback loop connected.

The value of the feedback resistor (R8) should be changed for output load impedances other than 5 ohms. It should be approximately 47,000 ohms for 7.5-ohm outputs and 68,000 ohms for 15-ohm loads. For other loads, R8 equals 39,000 times $\sqrt{X/5}$ where X is the new output load impedance.

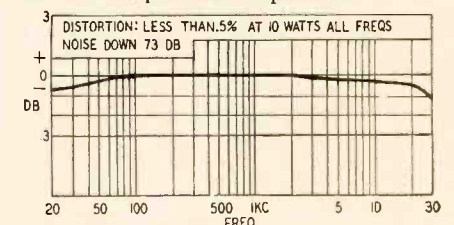


Fig. 2—Response of 4-tube hi-fi amplifier.

There is no final word. The amplifier sounds pretty wonderful driving our Western Electric 728-B in a Karlson enclosure. We'd say it sounds out of this world or any world except that we can't measure galactic response—yet!

END

Power Line Spikes and

Buz-z-z-z-z-z-z-z

*Some annoying types of noise
and how to stop them*

By HAROLD REED

HIGH-FIDELITY equipment must be designed and constructed for minimum noise and hum.

Random noise consists of thermal agitation, such as occurs in resistors, and shot effect or tube noise due to variations in the rate of flow of electrons within amplifier tubes. This type of noise is distributed uniformly throughout the audio-frequency spectrum.

Hum may be due to 60-cycle alternating current or 120-cycle ripple from the power supply. The 60-cycle variety of hum may be due to numerous causes, including internal conditions in tubes, or circuit design or layout. A 120-cycle ripple may be caused by insufficient filtering and decoupling. It may also be due to filter, decoupling and bypass capacitors in the same container, or too close together under the same chassis, or using a common path to ground.

Remedial applications for random noise and hum are well known and thoroughly covered in technical magazines. But it seems that line spikes and buzzing noise conditions have not been written about extensively, nor is the hi-fi builder as familiar with them as with other types of noise.

Line spikes and buzz can be extremely troublesome to the designer and constructor. The usual careful circuit design and layout, which may minimize random noise and hum, will not always remedy line-spike annoyances. Such things as hum-bucking potentiometers will not do the trick. It is an electrostatic phenomenon, the spikes appearing on the alternating-current wave and being caused by electrical equipment, appliances, etc., attached to power lines. Fluorescent lighting is an extremely efficient producer of this type of noise.

Carefully laid out amplifiers, with good signal-noise ratios as measured with an analyzer, with hum practically

inaudible at full gain, may be plagued with this very annoying buzzing noise. I have experimented with numerous arrangements to reduce or remove it and some of the remedial applications follow.

This is an electrostatic condition, so it is wise to use a power transformer with an internal electrostatic shield. It is pointed out in the *Radiotron Designer's Handbook* (Fourth Edition) that it is essential to use a transformer with an electrostatic shield, even if it supplies only the tube heaters. This shield, which is grounded to the transformer frame, provides some isolation between the primary and secondary windings. See Fig. 1. It was found in one test

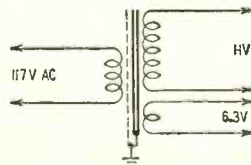


Fig. 1—Electrostatic shielding may reduce some line-carried noise.

setup, with the power supply entirely unattached to the amplifier chassis, that no improvement resulted.

Using one capacitor of from .01 to .05 μf from one side of the ac line to chassis or two capacitors directly across the line with their junction connected to the chassis (Figs. 2-a and 2-b) is an old trick used to reduce or eliminate noise. This is not an entirely

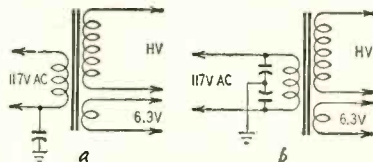


Fig. 2—Two line-grounding systems.

safe procedure for, should a capacitor break down, it may short the high side of the ac line to chassis. Then the op-

erator might get across the supply line by bridging between chassis and any common house ground.

Under some conditions, noise may be heard only when the pickup is connected to the amplifier, disappearing when the pickup cable is disconnected. Grounding the pickup arm to the amplifier chassis was found very beneficial in reducing line buzz with some amplifiers. This should include grounding the cartridge metal housing. In a cartridge such as the General Electric variable-reluctance type, the mounting screws do not make contact with the metal cover, which is left floating above ground. A piece of spring wire under the head of one mounting screw, with the other end pressing firmly against the metal cartridge housing, overcame this situation when using a metallic arm. With a plastic arm, the end of the spring wire was soldered to the shield of the pickup cable.

Grounding the amplifier chassis to a

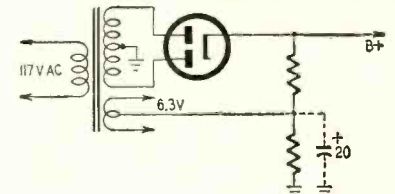


Fig. 3—An unbypassed filament tap sends noise into the signal.

common house ground has been found effective. There is nothing new about this and it can sometimes be inconvenient. However, it is not always necessary to ground to a water pipe; the ac outlet receptacle box or electrical cable or conduit usually will serve as well. Make sure the box is grounded—recent letters to this magazine point out that not all are.

Line spikes and buzz were found to be coming through a high-quality commercially available preamplifier. The positive filament bias taken from

AUDIO—HIGH FIDELITY

voltage divider across the power supply to the center tap of the filament winding was unbypassed. A 20- μ f capacitor at this point provided a cure. See Fig. 3.

An interesting and useful method of solving this line-spike problem was applied to a hi-fi amplifier employing a voltage-doubling selenium rectifier power supply. A cure could be effected by connecting a capacitor from one side of the ac power line to chassis. As this capacitor had to be fairly large to do the trick, it was considered unsafe and discarded. Therefore we had to find a similar remedy that could be applied to the secondary winding of the transformer rather than the primary winding.

A 0.5- μ f capacitor was first used between one side of the secondary wind-

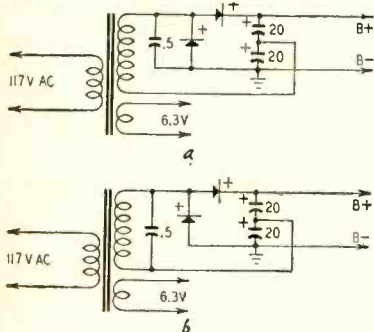


Fig. 4—Two steps in eliminating spikes in a voltage-doubler circuit.

ing and chassis ground, (Fig. 4-a), which resulted in some improvement. The capacitor was then connected across the high-voltage secondary winding as shown in Fig. 4-b. This removed the spikes. The higher the value of this capacitor, the better. However, a limit is imposed by the load placed on the transformer when capacitances are higher.

For instance, the reactance of a 0.5- μ f capacitor at 60 cycles is approximately 5,500 ohms, whereas, for 10 μ f it would be 270 ohms. The current flow in the primary of the transformer without a capacitor was 480 ma. A 0.5- μ f capacitor made negligible change. With a 10- μ f capacitor the primary current increased to 980 ma, causing the transformer to heat.

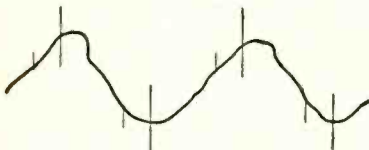


Fig. 5—Rough sketch of spikes as they appear on the scope screen on a 6-cycle ac wave.

This type of noise appears on an oscilloscope as spikes on the 60-cycle ac wave as shown in Fig. 5 which is a tracing taken from an oscilloscope screen, and as a buzzing sound in the loudspeaker. The constructor can very well eliminate this annoying condition with the help of listening tests alone, but it will be found helpful to employ both scope and speaker. END

Variable-Speed Electronic Phono Drive

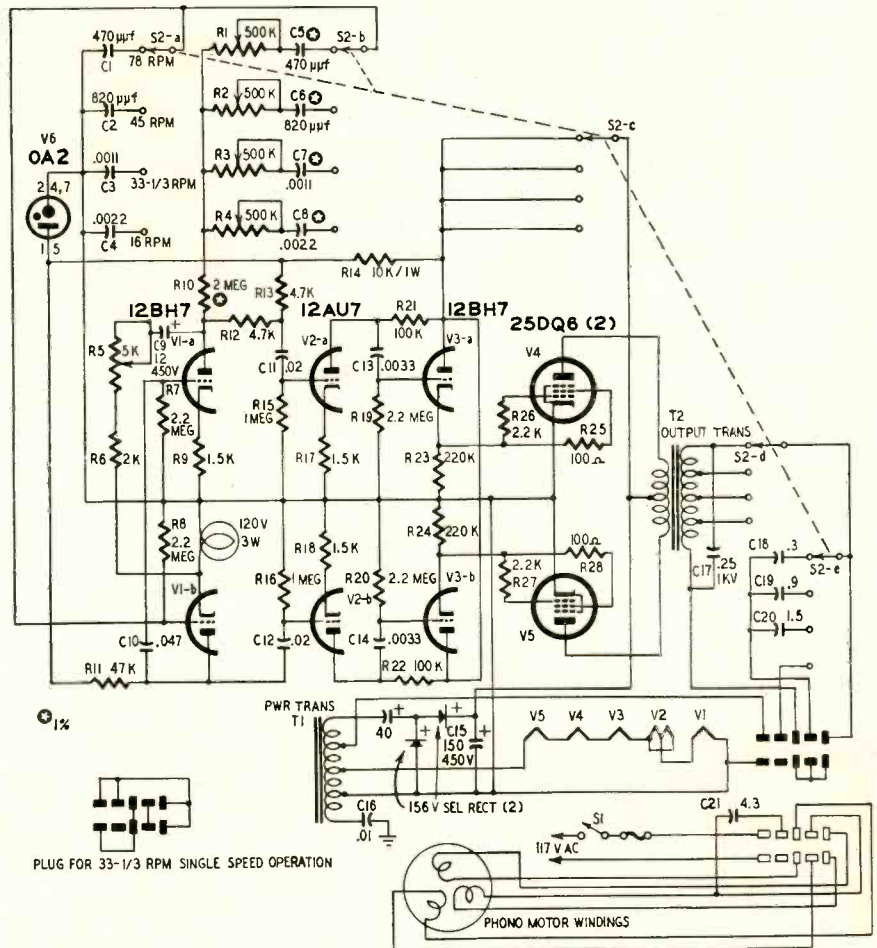
DUE to the interest in the electronic drive unit for phonographs, introduced recently by Fairchild Recording Equipment Co. (RADIO-ELECTRONICS, July 1957, page 56), we are publishing the complete schematic. The motor itself is a hysteresis type, coupled to the turntable by a belt, a method of coupling which has been more commonly used for recording machinery than playback turntables.

The motor is driven by current supplied from the output of a power amplifier, which receives its signals from an oscillator-amplifier combination which originates voltages of var-

ious frequencies. The oscillator-amplifier combination is so designed that changes in supply voltage or frequency have negligible effect on the frequency supplied to the motor (it can be used successfully with gas- or diesel-powered emergency power supplies or with battery-powered inverters). In addition to greater stability, the equipment has the advantage of being a purely electronic speed-changing system. The actual frequency supplied to the motor is what is changed, and as a hysteresis motor is a constant-speed device (as referred to its supply frequency) it becomes a very precise variable-speed

motor from the mechanical point of view. The frequencies are supplied by a 12BH7 double triode in a Wien-bridge oscillator circuit. It uses resistors and capacitors only and supplies frequencies of 30, 60, 81 and 141 cycles. The normal 60-cycle frequency is used for the LP speed of 33 $\frac{1}{3}$ rpm. Thirty cycles drives the turntable at 16 $\frac{2}{3}$ rpm for talking-book records (this is also the speed for automobile phonograph records). The old-time 78's are played with the help of 141-cycle frequency, and 45's at 81 cycles.

The output of the 12BH7 oscillator



ious frequencies. The oscillator-amplifier system is so designed that changes in supply voltage or frequency have negligible effect on the frequency supplied to the motor (it can be used successfully with gas- or diesel-powered emergency power supplies or with battery-powered inverters). In addition to greater stability, the equipment has the advantage of being a purely electronic speed-changing system. The actual frequency supplied to the motor is what is changed, and as a hysteresis motor is a constant-speed device (as referred to its supply frequency) it becomes a very precise variable-speed

is amplified through a 12AU7 push-pull buffer-preamplifier, which in turn feeds a 12BH7 driver, cathode-coupled to the 25DQ6 output tubes. An output transformer of the proper characteristics couples the output tubes to the motor.

The system can be operated as an electronic-drive single-speed unit, supplying 60 cycles where line voltages are unstable. Another interesting feature of the equipment is the autotransformer-voltage-doubler power supply. Filament and rectifier voltages are both tapped off the same winding. END

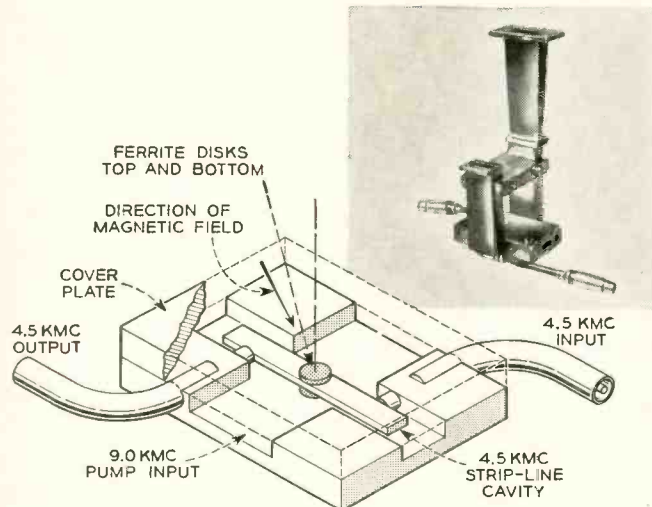
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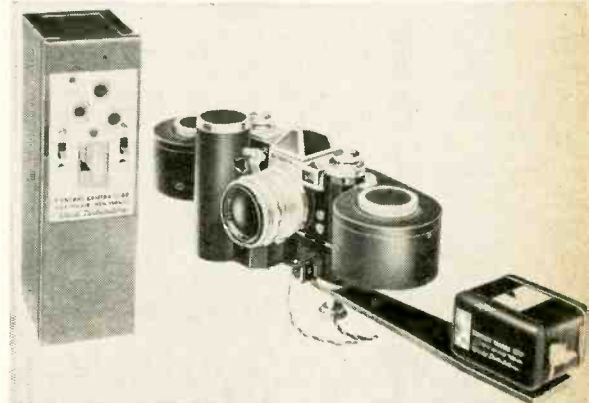
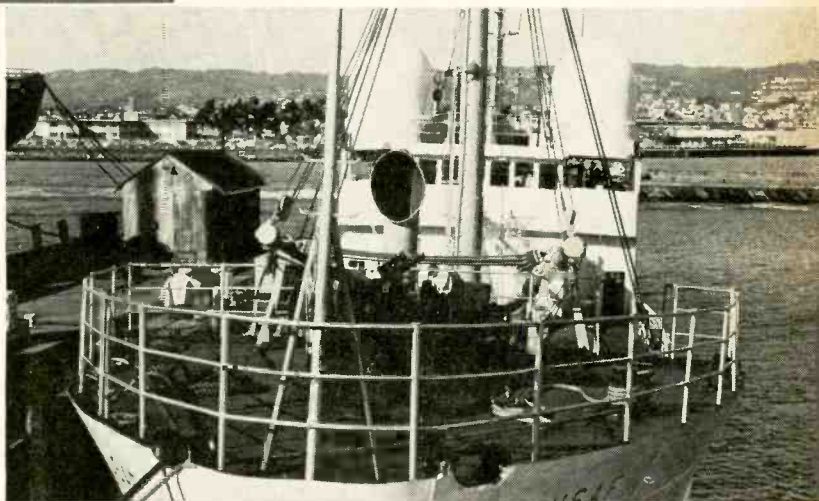
?

TELEMETRY SHIP is one of six which will form a 3,000-mile chain of floating bases in the Atlantic Ocean. The ships, operated for the USAF's Air Research and Development Command (ARDAC), have been modified with special electronic equipment to record and transmit data concerning missile tests to Cape Canaveral, Fla., where the range station of ARDAC's Air Force Missile Test Center is located. Helical telemetry antennas are housed in the twin plastic radomes on the ship's bridge.

The electronic equipment on the ships will be operated by RCA. The No. 2 holds function as the telemetry centers. They have been dehumidified, air-conditioned, soundproofed and insulated to insure accuracy of the recorded data.

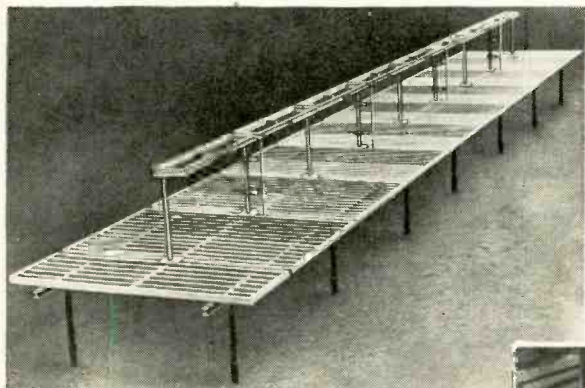


NEW MICROWAVE AMPLIFIER uses a ferrite material as the active element. Theoretical operation of the solid-state device was predicted by Dr. H. Suhl. The unit was built and operated at Bell Telephone Laboratories. The device requires a ferrite sample, placed in a microwave cavity which is simultaneously resonant at two separate frequencies. Microwave power, at a frequency equal to the sum of the two signal frequencies, is then pumped into the cavity. A dc magnetic field, properly oriented and strong enough to cause gyromagnetic resonance at this sum frequency is also applied. Through non-linear coupling in the ferrite, amplification or oscillation will occur at either of the lower frequencies.

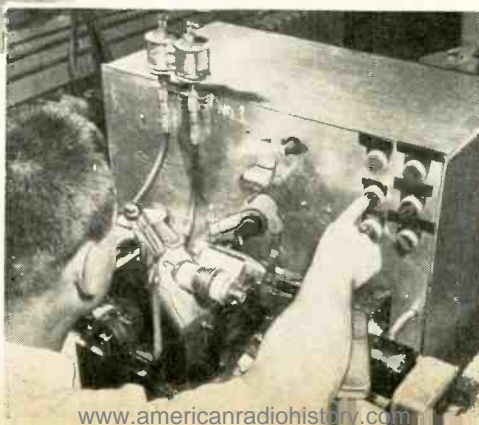


RADIO-TRIGGERED CAMERA

operates over distances of 1 mile or more. The Praktina FX Radio Control Unit is designed to be used with the Praktina 35-mm camera and is distributed by the Standard Camera Corp. The receiver is connected to an electric motor attached to the camera. When the photographer presses a button on the transmitter, a relay circuit in the receiver closes. A sequence of operations takes place in which the shutter is released to take the picture, the film is transported to the next frame and the shutter wound for the next exposure. The unit will have many uses in the field of intelligence and surveillance. Banks could install the unit over vaults and tellers' cages to provide a visual record of criminals' faces and actions for police.



SATELLITE TRACKING antenna array for Project Vanguard has been developed by TACO for the Naval Research Laboratory as part of the Mark I Minitrack system. Eight of these arrays will be used in each tracking system. The antenna systems will pick up signals from the satellite. These signals will be used to determine its orbit.



ELECTRONIC DIAMOND-GRINDING machine automatically forms and polishes jewels to a cone-shaped tip for diamond phonograph needles. After two years of research, Walco Products has developed what is said to be the first process for automatic production of diamond phonograph needles. An expected price cut, about 40%, due to this automation, should make diamond needle a common feature of hi-tems. Until now the cost of diamond systems, has been very high.

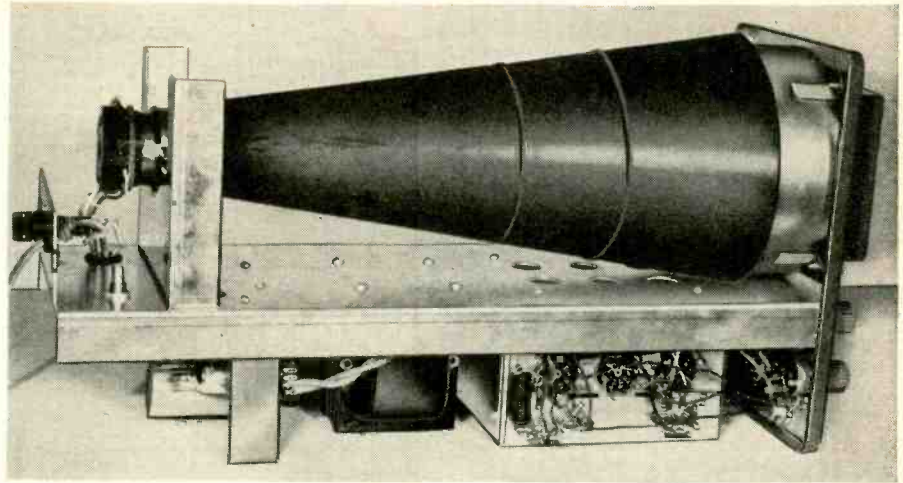
amplitude and width of this pulse are of course dependent only on multivibrator circuit constants and are completely independent of the size of the pulse originating in the engine.

A portion of this pulse is fed (via the LEFT EDGE control) through an isolation cathode-follower stage (half of a 12AU7) to the sweep generator. The first section of the sweep generator is a charging diode (half of a 12AU7). The positive pulse charges a capacitor, selected by the COARSE SPEED control. The capacitor discharges through the FINE SPEED control potentiometer and the 1-megohm resistor in series with it.

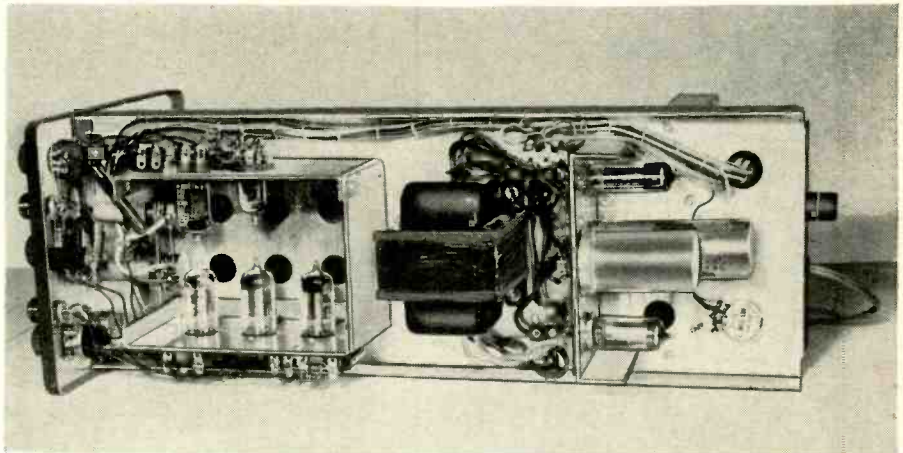
The usual capacitor discharge circuit has the discharging resistance in shunt with the capacitor. This causes an exponential drop in capacitor voltage as the discharge proceeds. In the Heathkit circuit the voltage across the resistor is held at a fixed level of from 50 to 60 by an NE-51 neon lamp between the FINE SPEED control and the load resistors of the sweep cathode-follower section of the sweep generator. Because of this, voltage drop across the capacitor occurs at a constant rate per unit of time, continuing until the voltage reaches a nonlinear region or a new pulse recharges the capacitor. With the analyzer connected to an engine, regularly recurring pulses are supplied to the sweep generator and the discharge never reaches the nonlinear region. The resulting sweep voltage is like a sawtooth.

This voltage is applied to the sweep cathode-follower grid and of course appears at the cathode, too. Part of the cathode signal is fed to the grid of the horizontal amplifier (half of a 12AX7). The other half of the 12AX7 is coupled to the first half through a 27,000-ohm common-cathode resistor. Its grid is grounded to signal voltages and so it functions as a grounded-grid amplifier. A voltage divider sets the grid bias.

The sawtooth voltage is amplified by each half of the 12AX7 and appears across both plate load resistors. However, because of the cathode-coupled grounded-grid arrangement on the second half of the 12AX7, the voltages



The scope tube has a mu-metal shield around it.



Underchassis view of the ignition analyzer.

at each plate are opposite in phase although nearly equal in amplitude. These out-of-phase voltages are applied directly to the two horizontal deflection plates of the C-R tube, providing horizontal sweep triggered by the high-voltage transients in the ignition system of the engine under test. Sweep rate depends on the setting of the SPEED controls and the spark repetition rate of the engine, a function of its rpm.

At their slowest settings the SPEED controls give full-screen display of all sparks for an engine idling at 400 rpm. At their fastest settings, they give full-screen display of a single spark at 7,500 rpm for a four-cylinder engine, at 5,000 rpm for a six and at 3,750 rpm for an eight. Of course, by changing the settings of the SPEED controls a single spark can be seen at 400 rpm, and all sparks can be seen simultaneously at 7,500 rpm.

Use, interpreting displays

To use the analyzer, the probe cable for the vertical input is connected across the low-voltage breaker points of the engine. The horizontal input cable is capacitively coupled to one of the high-voltage wires leading to a spark

plug, as shown in Fig. 2. When the engine is started, adjustment of the FINE SPEED, COARSE SPEED, LEFT EDGE and TRIGGER controls should produce a pattern similar to Fig. 3 or 4, depending on the setting of the controls and engine speed. Fig. 3 shows the pattern display from a single spark of an engine in good condition with part of the next spark showing at the right. The legend accompanying the figure explains the significance of the various parts of the trace. Adjustment of the LEFT EDGE control permits the spark from each cylinder to be viewed in turn. Fig. 4 shows the display for four cylinders. The first spark at the left is that of the plug to which the horizontal sweep cable is attached. The following sparks appear in their firing order. A six-cylinder engine would display six sparks. With an eight, it may not be possible to show eight sparks at one time (we couldn't in our tests) except at idling speed. In this event, start out with the spark-plug clip lead attached to the wire of the plug which is No. 1 or 2 in the firing sequence. Then after viewing the five or six sparks displayed with this connection, shift the clip to the lead going to plug No. 6, 7 or 8 to view the sparks from these cylinders.

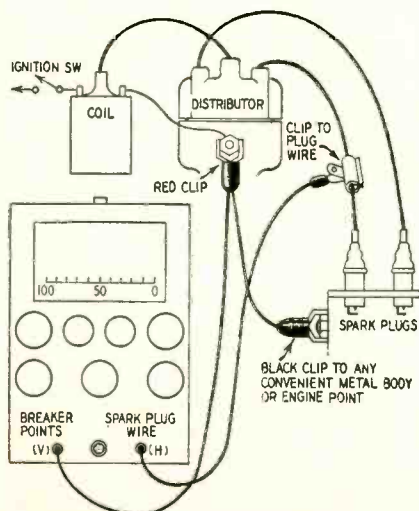


Fig. 2—How analyzer is hooked up.

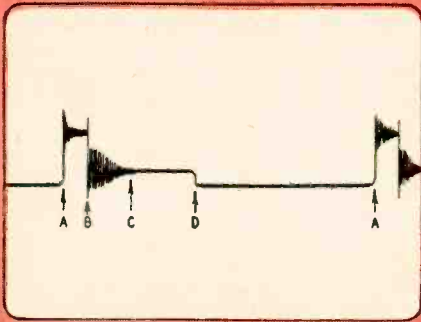
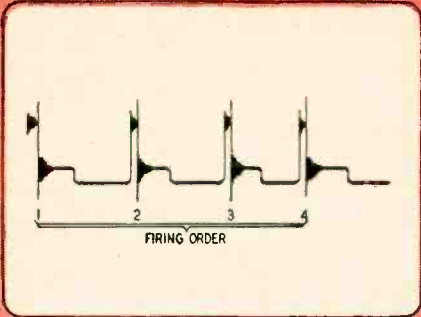
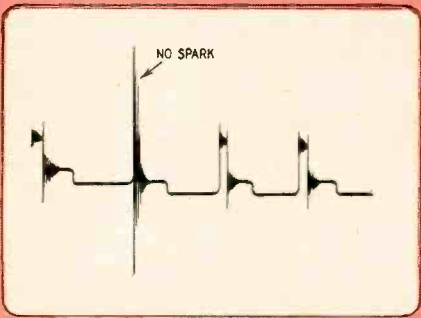


Fig. 3—How a single spark looks.

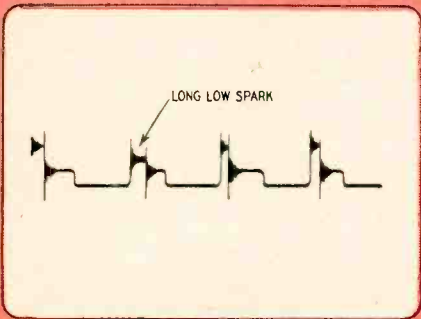
A—Points open, high voltage in coil starts spark. A-B, duration of spark.
 B—Energy level in coil has dropped to point where spark extinguishes. B-C, remaining energy in coil dissipates without spark.
 C—All energy in coil dissipated.
 D—Points close. D-A, dwell time (time that points are closed).



4—A 4-cylinder display pattern.



5—"Missing-cylinder" indication.



6—Effect of narrow spark gap.

This same technique may be necessary when viewing a single spark from each cylinder in turn.

Figs. 5 and 6 show two displays produced by different ignition defects. In Fig. 5 there is no spark at one cylinder. Fig. 6 shows a spark that is too long and too weak. A multiple-cylinder display as in Figs. 5 and 6 or a single-cylinder display as in Fig. 3 can be selected by an adjustment of the two SPEED controls. The single display permits detailed examination of each cylinder's spark.

Other uses

Dwell time (the length of time the

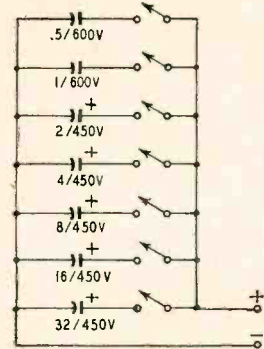
points are closed in each cycle) can be measured by using the scale on the face of the C-R tube. It is also possible to check the synchronization of dual ignition systems.

A few minutes' use of the analyzer demonstrated its value in quickly localizing the source of ignition-system defects in an automotive engine. The multiple-cylinder display made the job of locating a bad sparkplug child's play. Of course, as in any type of electronic servicing, a piece of test equipment will not interpret—that's the job of the operator. His skill in interpreting what he sees determines how quickly a defect can be rectified. END

Capacitor Substitution Box

By JOHN A. DEWAR

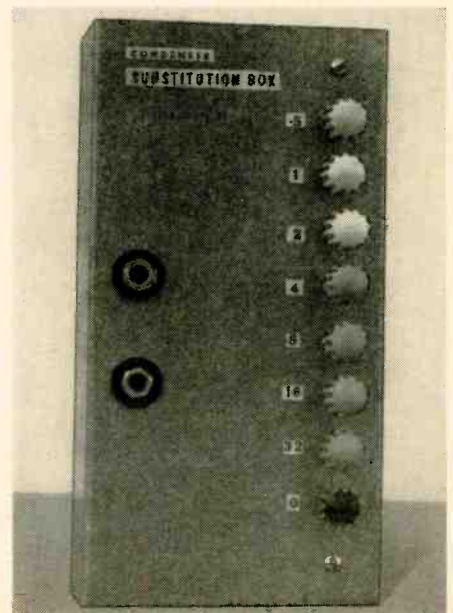
Anyone who has used resistor and capacitor substitution boxes for service or development work knows how valuable they are. However, capacitor substitution boxes available in kit form



often go up to only 0.22 μ f. This box has a range of 0.5–62.5 μ f, supplying 126 capacitances in 0.5- μ f steps. Only seven capacitors are used, singly or in parallel to supply the desired value.

The 0.5- and 1- μ f capacitors are papers, the rest electrolytics. Polarity is indicated by color-coding the panel terminals.

A 4 x 8 x 2-inch chassis with a bottom plate is used for a cabinet. Numbers to show capacitor values were clipped from a small calendar and glued to the panel. I used pushbutton switches but spst toggle switches are just as good.

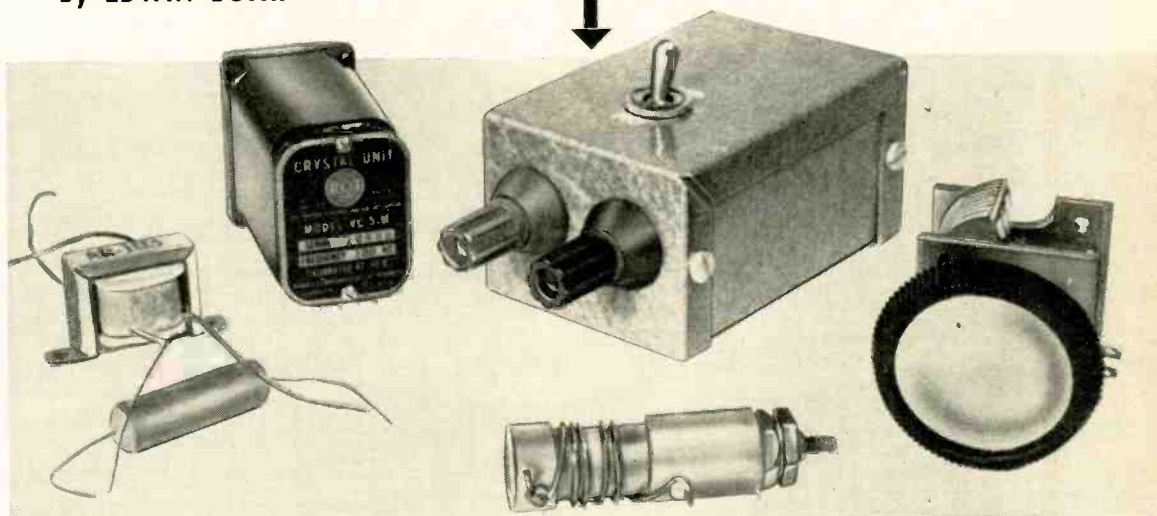


The Black-Box Oscillator

By EDWIN BOHR

Merely by adding a tuned circuit, you have a two-transistor pocket oscillator with a range up to 30 mc

Typical tuned-circuit components that will oscillate when connected to the box.



WE are tempted to call this gadget a black box. But, speaking humorously, it is really just a gray box with two terminals and a switch on the outside.

But it does have an interesting black-box property. Connect a tuned circuit to the terminals and it oscillates. Feedback loops or taps are unnecessary. It works with quartz crystals, too!

The tuned circuit can be anything from very low audio frequencies to those in the 10-meter band. The maximum oscillating frequency depends upon the Q of the tuned circuit and the particular transistors used. Without special attention to coil Q and using SB-100 transistors, the box functions to 30 mc.

There are few components inside: only a battery, a couple of transistors and a few small parts. The circuit is equally simple and uncomplicated (see Fig. 1).

Circuit theory

Two transistors are connected to form a positive feedback loop. The output of one supplies the input of the other. One transistor is grounded-base and the other is grounded-collector connected. Neither configuration introduces phase shift (except for the phase shift of the transistors themselves).

For example, if the emitter of V1 goes positive, its collector passes more current and becomes less negative because of the voltage drop across the tuned circuit. (Going less negative is equivalent to a positive signal swing.)

As V2's base goes more negative (less positive) the emitter voltage follows this change and also goes more negative—or vice versa.

If a tuned circuit is connected across

J1 and J2, the voltage change across it will be amplified by V2 and coupled to the emitter of V1. More current will flow in V1 and, consequently, cause more drop across the tuned circuit. Thus V1's current climbs until the drop across the tuned circuit is equal to the available battery voltage. When this point is reached, current can no longer increase.

Capacitors C4 and C5 can couple only changing signals. Therefore, the signal buildup stops at this point and begins to collapse, since this is the only

further change possible. When the collapse is complete, buildup starts over again.

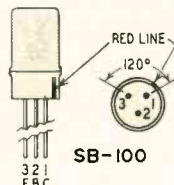
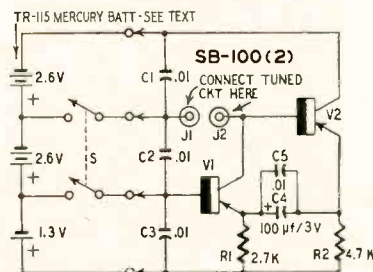
This buildup and collapse continues at the resonant frequency of the tuned circuit.

If the tuned circuit is replaced by a 1,000-ohm resistor, another mode of oscillation, determined by the R-C time constants of capacitor C4 and associated circuit resistances, results. The oscillator frequency, because of the large value of C4, is a slow putt-putt.

When a very-low-Q tuned audio circuit is used, it may oscillate at either the L-C or R-C frequency. Suppose we use headphones with a parallel capacitor as the tuned circuit. Phones are poor inductors and most of their reactance is pure resistance. Because of this, the circuit, as the power switch is flipped on and off, may give either a putt-putt or audio-tone oscillation.

Up to about 4 mc, oscillator output is about 2.6 volts, which is the available collector voltage for a single transistor. Above this frequency, output tapers off to about 0.5 volt at the highest operating frequency. The method of measuring the unit's output is seen in Fig. 2.

Three capacitors (C1, C2 and C3) are placed on the breadboard chassis. They bypass rf from the mercury battery leads. Capacitor C5, paralleling C4, is necessary because of the notably poor rf characteristics of electrolytics.



- R1—2,700 ohms, 1/2 watt
- R2—4,700 ohms, 1/2 watt
- C1, 2, 3, 5—.01 µf, ceramic
- C4—100 µf, 3 volt, electrolytic
- V1, 2—SB-100, 2N135, 2N136, 2N137
- J1, 2—Binding posts
- S—dpst toggle
- Battery—6.5 volts, (Mallory TR-115R mercury cell, or equivalent)
- Case—1 1/2 x 2 1/4 x 3/4 inches
- Terminal board
- Miscellaneous hardware

Fig. 1—Circuit of the two-transistor oscillator.

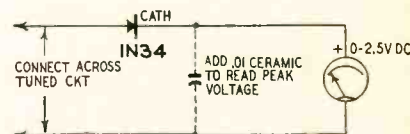
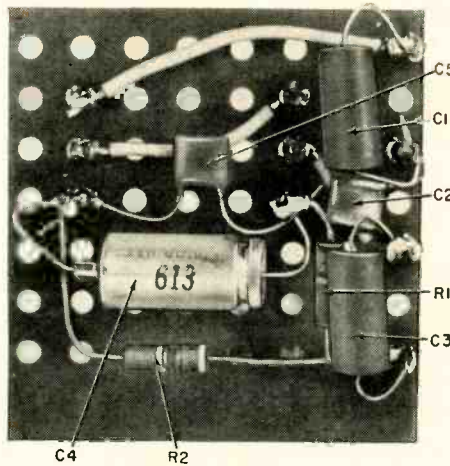
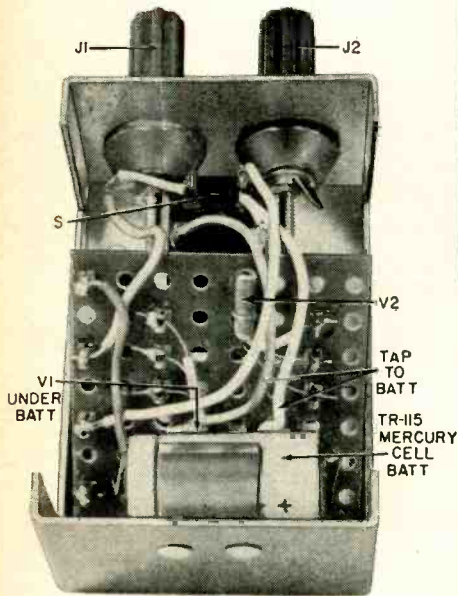


Fig. 2—Measuring the oscillator-box output at radio frequencies. Use a scope at audio frequencies.



Bottom (above) of the breadboard chassis.

Internal view (left) of the oscillator box.

These capacitors should be miniature units. Ceramic or paper types are satisfactory. The photo shows we used two ceramic and two paper units. The ceramics are smaller and less expensive, so they are recommended.

The battery voltages deserve some mention and explanation. A standard TR-115R Mallory mercury cell with a nominal output voltage of 6.5 powers the box. For our application, voltage taps at 1.3 and 3.9 volts are necessary. These connections are made by puncturing the cardboard-cover sleeve and soldering two extra connections to the battery. This will be explained later.

The 1.3-volt tap biases V1 in the forward direction so it will conduct. This bias current flows through the base to the emitter and through resistor R1 back to the battery. V1's collector current is approximately equal to the bias voltage divided by the value of the emitter resistance.

A 2.6-volt section of the battery provides V1's collector voltage. This potential plus the 1.3-volt section is the bias voltage for the V2. Finally, the 2.6-volt remainder is applied to the collector of V2. This arrangement ties the collector voltages and currents down to good, stiff voltage points, resulting in excellent immunity to temperature and transistor variations.

It might be well to mention that, generally, surface-barrier transistors such as the SB-100 have more uniform characteristics than alloy-junction types. The surface-barrier type also has a much lower value of temperature-induced leakage current.

At present, surface-barrier transistors are more expensive than high-frequency alpha cutoff junction units. However, Philco has just initiated a

new automated transistor plant at Spring City, Pa., and their SB transistors are now appearing in personal radios. It should not be long until prices begin to tumble. (A new pair of transistors, the SB-101 and SB-102, will ultimately replace the -100. The SB-101 is a direct replacement—the more expensive -102 may, however, be worth getting for this application.—*Editor*)

Although the megacycle end of the oscillator-box performance will suffer, transistors other than the SB-100 may be used. A 2N137, 2N136 or 2N135 can be substituted directly without circuit change.

Construction hints

As the photos show, the case is an aluminum Flexi-Mount unit with two General Radio type binding posts mounted on one end and the on-off switch on top. The two transistors and other components are mounted on a small pegboard type terminal card. This card is held in the case by the connecting wires and the fact that it is wedged into the box corner and against the switch. A small piece of felt or foam rubber in the cover presses the card into this position when it is closed.

The battery is held in place with a clip riveted to the case. Use aluminum rivets like those on display in most hardware stores. They are very soft and really ideal for this job.

Making the tap connections to the TR-115R mercury cell is easy. First notice that the cell cases are the positive electrodes. All connections will be made to these. Because of this, the 1.3-volt tap is made to the case of the second cell. Locate the second cell from the positive end by running your thumb

nail over the cardboard jacket. Now, punch a hole in the jacket over this cell and enlarge it enough to scrape the cell case and make the solder connection.

Solder to the outermost circular spine. The surface must be scraped before soldering. Now, quickly tin a small spot of scraped area with a hot iron and a good grade of rosin-core solder. A pre-tinned lead can then be tacked to the tinned area of the cell. Use the same procedure for the second tap. Caution! *Overheating will ruin the mercury cell.*

Long leads were left on the SB-100 transistors as a precaution against lead breakage near the glass seal and excess soldering heat reaching the interior. Be sure battery polarity is correct. Wrong battery polarity can damage the transistors.

Only two of the battery leads are broken, leaving a very small current drain—only about a μ a—on the battery when the unit is off. Practically speaking, we can forget it. It is usually interesting to note the expected battery life. Using the TR-115R about 160 hours of operation can be expected.

Using the unit

One of the photos shows an assortment of tuned circuit components for the box, ranging from a miniature transformer-tuned audio circuit to a five-turn coil for megacycle operation. Crystals also work if they are shunted with an rf choke to provide a direct current path around the crystal. This choke can be slug-tuned or shunted with a capacitor to vary the crystal frequency slightly.

Representative tuned circuit arrangements are shown in Fig. 3. The diagram in (Fig. 2) shows how a diode and multimeter can be connected to indicate the strength of oscillation of the tuned circuit at radio frequencies. At audio frequencies, it is better to use an oscilloscope. In any of these cases, the dc resistance of the tuned circuit should be as low as possible. Of course, this is no problem at radio frequencies, but miniature audio components and ear-phones possess quite a bit of built-in resistance and may cause oscillation at an R-C frequency.

Quite frankly, we found this box much more useful than we first imagined. It is our prize workbench gadget. Every day or so some opportunity arises to prove its usefulness. END

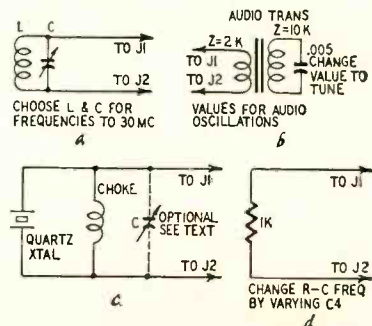
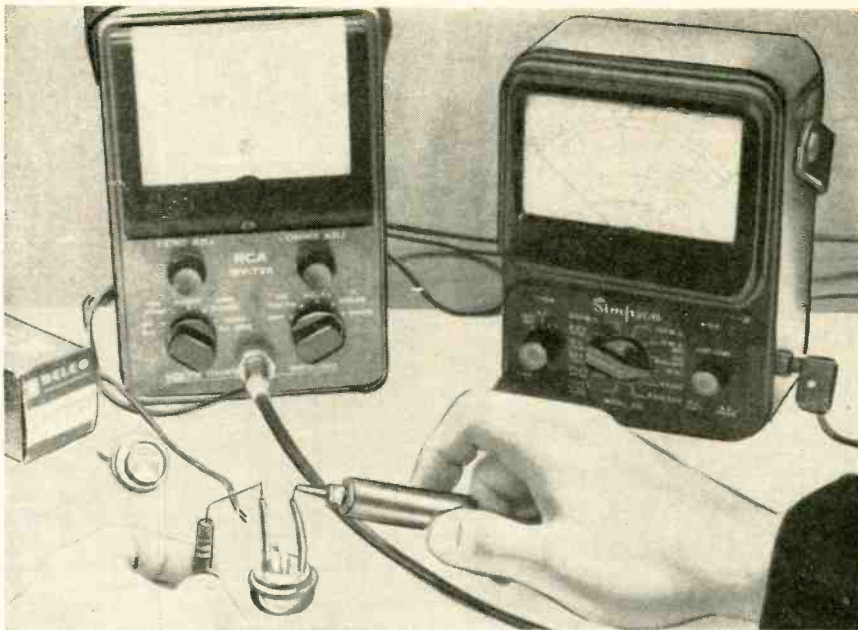


Fig. 3—Four types of tuned circuits used with the oscillator.



Check gain and leakage of power transistors with your ohmmeter

Power transistor being checked for gain. Vom at right is not being used.

Simple Power-Transistor Test

By WILLIAM C. CALDWELL *

HIGH-POWER transistors are becoming popular in auto radio applications, where they are used in the audio output stage. Their role is important—to reproduce the signal at an amplified level and to develop enough power to drive the speaker properly.

In view of their popularity, it has become essential for the radio technician to have a method of measuring the amplifying ability of the transistor and determine whether the unit is good or bad.

The transistor, unlike the vacuum tube, is a solid device with no element insulated by air or vacuum from its associated elements. It will generally operate at lower voltages than a tube, and depends more on current than voltage to activate it. All these factors point to using an ohmmeter as a measuring stick, since it has a self-contained low-voltage supply and is capable of measuring current, which is inversely proportional to resistance.

Although much has been written about ohmmeters being dangerous in transistor testing, we have checked thousands of *power* transistors without damaging one. The real danger is, we believe, in the use of ohmmeters in checking small, low-power transistors which can be damaged much easier.

The first test of a p-n-p power transistor is for leakage between emitter and collector with the base left open. As seen in Fig. 1, with a voltage of opposite polarity applied to the emitter and collector, one of these elements has a reverse bias, drawing all available current carriers away from the junction between collector and base. The negative collector voltage is chosen because this is the way it will be required to operate in the amplifier circuit. The resulting current is known as I_{CEO} (current between collector and emitter with base open) and becomes excessive if the transistor is shorted, leaky, or has suffered a voltage breakdown. The same circuit can be represented by an

ammeter and battery in series, exactly what an ohmmeter contains. The internal battery of the ohmmeter, usually 1.5 or 3 volts, supplies the voltage, and the resistance reading indicates what I_{CEO} the transistor is capable of drawing at the applied voltage. The lower the resistance, the greater the leakage current will be. Zero ohms indicates the transistor has suffered a complete punch-through where areas of the collector material are actually touching the emitter internally. This is the most common cause of transistor failures.

Transistor temperature and ohmmeter scale used play important roles in obtaining leakage readings. The transistor should be at *room temperature*, as low-resistance readings may be obtained at high temperatures on normal transistors. *The only scale used should be R × 1.* Readings taken on other scales will be confusing and meaningless for this test. Base and emitter leads must be disconnected from the circuit before attempting to check the transistor. (The ohmmeter should be a low-resistance series type. Certain meters, such as low-ohm shunt types or a very-high-resistance series meter, will not give intelligible results. — Editor)

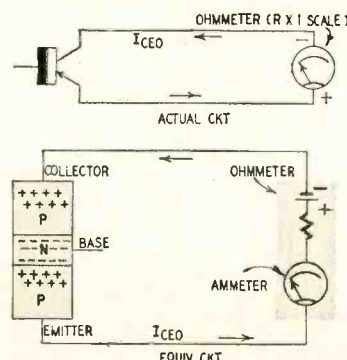


Fig. 1—Test for leakage between emitter and collector.

Gain test

The next step is to make certain the

*Service engineer, Delco Radio Division, General Motors.

TEST INSTRUMENTS

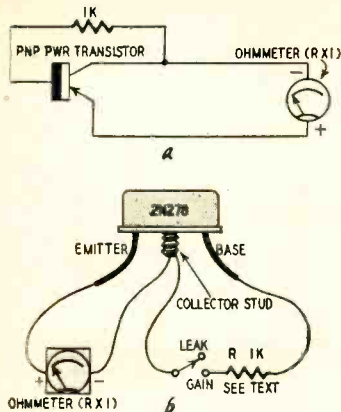


Fig. 2—Quick gain test: a, test circuit; b, physical arrangement.

transistor will amplify. For this check, the same ohmmeter connections that were employed during the leakage test are used, and a 1,000-ohm resistor is added, as shown in Fig. 2, between the transistor base and collector. A notable decrease in resistance should be observed on the ohmmeter as this is done. This is due to the ohmmeter being in the collector circuit and responding to changes in current through it. The greater the collector current, the lower the resistance.

As the 1,000-ohm resistor is added, the base receives some negative voltage from the ohmmeter battery, causing a difference in potential between base and emitter. This draws current carriers out of the emitter, reducing the internal emitter-to-collector resistance and also causing more collector current (I_C) to flow. If, during the gain test, the resistance reading does not change from what it was during the leakage test, the base is probably open. If the reading after the resistor is added is over 50 ohms, the power transistor has very low gain. Typical gain readings are 10–30 ohms, with extra-high-gain units measuring 5–10 ohms and some lower-gain types 30–50 ohms. *Caution: Meter polarity may have been wrong. Try reversing the leads before rejecting the transistor.*

The dc gain, or dc beta, in a common-emitter circuit may be easily estimated by this extremely simple test. The formula for this is:

$$\text{Approximate current gain} = \frac{1,200}{R}$$

where R is the direct reading in ohms. The accuracy of base-to-collector gain factor thus obtained is usually best for transistors measuring between 13 and 50 ohms, which represents current gain factors of about 25 to 90. Higher-gain units usually tend to be estimated conservatively by this formula, as will be shown by the following data taken during the experiments with this test.

The equivalent circuit during the gain test is shown in Fig. 3. R2 represents the internal resistance in the meter, which includes a series resistor to adjust 0 ohms and a minute amount of meter resistance. A typical value for R2 may be 8–15 ohms, depending on

meter design. This resistance has a slight effect on base current, since base current I_B must flow through both R1 and R2. This means that as collector current increases, which it will do for higher-gain units, the corresponding voltage drop across R2 will tend to retard base current slightly. If base current is decreased, the collector current will also be affected. However, the gain estimates by the formula given have a higher degree of accuracy than might be imagined at first glance, as shown by the following data. Power transistors used were of various types and applied into the simple gain-test circuit:

Transistor	R	V_{BE}	I_B	I_C	Gain $\frac{I_C}{I_B}$	Gain $\frac{1,200}{R}$
A	11.5	0.13	0.55	60	109	105
B	15.0	0.12	0.65	51	79	80
C	19.0	0.12	0.72	45	63	63
D	42.0	0.12	1.00	28	28	29

The ohmmeter used for above test was an RCA model WV-77A. R is the measured resistance in ohms during the gain test (Fig. 2); V_{BE} is the voltage between base and emitter (shown because it remains almost constant). I_B is the base current (calculated by the voltage drop across the 1,000-ohm resistor) and I_C is the collector current (measured with a separate ammeter).

Test results

Note how closely the measured current gain $\frac{I_C}{I_B}$ for each transistor compares to the current gain estimated by our formula $\frac{1,200}{R}$. This represents the current gain at fairly low values of I_C and would probably be very close to small signal beta. To obtain an estimate of large signal gains, higher values of forward bias are used in laboratory checks and the collector load resistance is removed (the collector connected directly to the power source). The collector current is then set at much higher value, and the base current is read. To determine how closely our simple gain test compares to the larger current gain tests, a series of over 1,000 transistors were run through both tests. The following are examples of 10 transistors from various manufacturing sources, checked first by our simple ohmmeter test and then through the laboratory 1.2-ampere I_C test:

Transistor	Leakage (Ohms) ($R \times 1$ Scale)	Ohms in Our Gain Test (R)	Estimated Gain $\frac{1,200}{R}$	Actual Gain (Lab test)
A	750+	42	29	30
B	500	38	32	32
C	750+	25	48	49
D	300	23	52	44
E	750+	15	80	88
F	300	14	86	88
G	200	13	92	92
H	100	11	109	130
I	150	9	133	160
J	45	7	171	220

Note: + indicates meter near high end of scale, but the exact reading is unimportant. Meter used for above test: Simpson model 260.

All of the ohmmeters used in these checks had a lead potential of 1.5 volts on the $R \times 1$ scale. Models using 3 volts on the $R \times 1$ scale have been tried, with very little change in readings. This is due to the stabilizing effect of the 1,000-ohm resistor on base current. Slightly higher than actual gain readings (lower resistance readings) may be obtained in some cases, when the lead potential is 3 volts on the $R \times 1$ scale.

The leakage-gain test does not check diode voltage ratings on the transistor. However, most power transistors which have suffered voltage breakdowns in service are completely shorted between emitter and collector. Those prone to breakdowns may show excessive leakage or extremely high gain on the test.

This system of measuring gain may be used to match transistors for reliable push-pull amplifier operation. Transistors which are not well matched cause distortion in push-pull audio amplifiers. The amount of distortion which can be tolerated depends principally upon the application in which the amplifier is employed.

This test is *not designed* for the small low-power transistors. It *should not be used* on small medium-power transistors sometimes found in audio driver stages. It is designed *only for the power units* used in the output stage of auto radio receivers, which are capable of handling about 0.5 amp or more collector current. Only p-n-p units have been used for this type of application to date, due to the techniques involved in the manufacturing of these transistors and the characteristics of the materials used. However, if power n-p-n units should come into the picture, it is expected that this test will give reliable readings by simply using the opposite meter polarity during the checks.

Almost any ohmmeter employing an $R \times 1$ range may be used. Since lead polarity is extremely important, it would be well to determine this by checking with a separate voltmeter. Simply place the ohmmeter to be used for transistor testing on the $\times 1$ scale, and connect to a voltmeter. With the two common leads tied together, if the voltmeter goes in a negative direction (against the bottom pin), the common lead of the ohmmeter is actually connected to the positive pole of the internal battery. However, if the voltmeter reads correctly, the common lead is the negative one. The voltage, in either case, should be 1.5 to 3.0 for this test. END

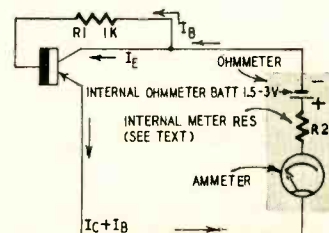


Fig. 3—Equivalent circuit during gain test.

One instrument does the work of three when this switch probe is used

switch probe

for rapid measurement

By FORREST H. FRANTZ, SR.

IN determining the performance of an electronic circuit, several measurements are usually made, a condition is varied and the measurements are repeated. This may be repeated for the same measurements a number of times.

A typical example is the study of audio-amplifier frequency response (see Fig. (1-a). Here an audio generator is connected to the amplifier. At point 1, generator output voltage is measured so that it may be maintained constant; at point 2 the output of the first stage is measured and at point 3 the output of the total amplifier. The measuring instruments may be audio vtvm's or oscilloscopes. Since the measurements will be repeated at several frequencies, measurement is more rapid when three meters or three oscilloscopes are used. This is not economically feasible for most of us. However, the probe switch described in this article will extend the utility of a single instrument and make the measurement process as fast and convenient as a three-instrument procedure. Fig. 1-b shows the switch probe and a single meter connected to make the measurements. The colors refer to the color coding of the switch-probe leads for easy identification. If a single meter is employed without the switch probe, a considerable amount of time is spent moving the instrument probe from one point to another. Furthermore, this presents a chance to apply the instrument probe to a terminal other than the actual test point.

The probe switch also provides a convenient means of making quick measurements at several points on intermittent radio or TV chassis without disturbing the chassis. The two switching circuits make it possible to employ two instruments simultaneously wherever a common ground can be used. As an example, a dc vtvm might be employed with one switch section and a scope with another section.

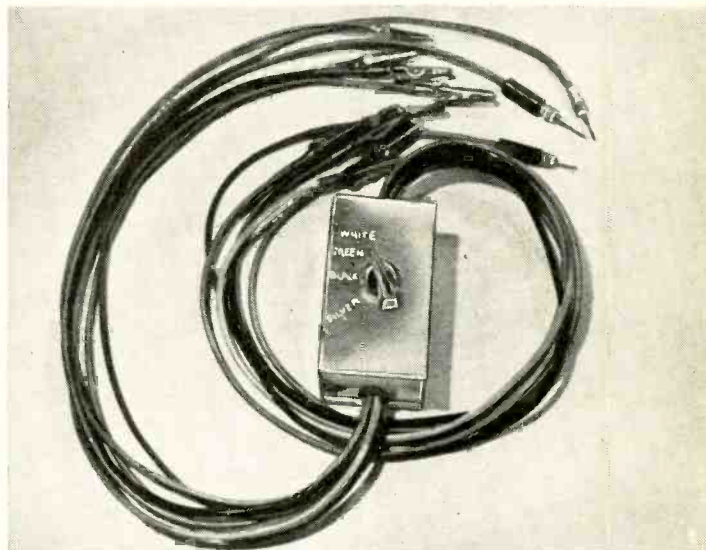
The big advantages of a probe switch are:

Your eyes are free to read your instruments.

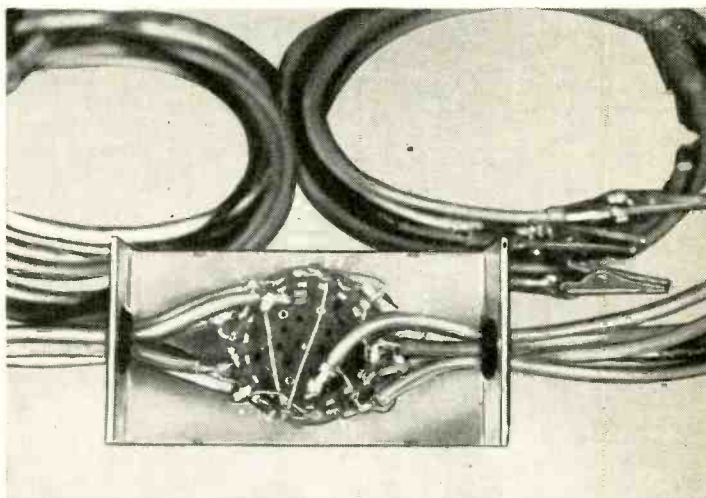
Both hands are free for switching and writing, recording or plotting when required.

There's no chance of measuring at

The completed switch probe.



Wiring the switch. Shields are connected together and grounded.



the wrong terminal once you've clipped into the circuit.

Construction hints

Construction is simple and at most requires only an hour or two. The switch should be mounted in a metal case to provide electrostatic shielding. This one was housed in a commercial box. Alternate switch terminals are tied to ground to provide shielding between switch terminals, and all leads are shielded to keep the circuits under

test isolated. Be sure to tie all shields together and ground to the box at a common point. The shielded leads and switch indexes are color-coded for quick connection and switch identification, by painting their outside coverings. A dot of the same color or the name of the color is placed on the panel at the switch knob position where the lead has a closed-circuit connection to the instrument lead. Bring the A leads out one side of the box, the B leads out the other for ease in tracing. The box

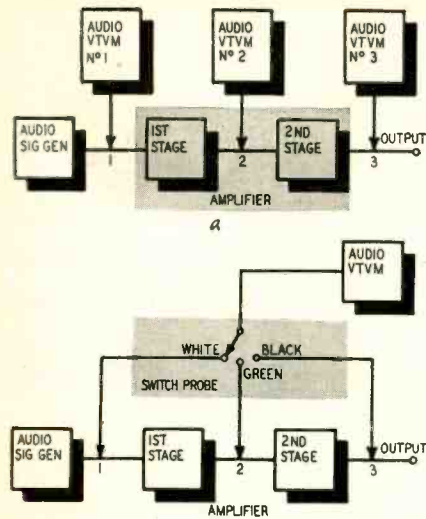


Fig. 1-a.—Stage-by-stage amplifier response analysis with three meters; b—same analysis with switch probe.

may be fastened to your bench or instrument shelf or provided with an alligator clip or two for direct attachment and grounding to the chassis under test or measurement. We used 2-foot leads terminated with alligator clips for our color-coded "pickup" leads with pin-jack terminations for the instrument leads. When you fasten the alligator clips to the shielded leads, be careful to cut and insulate the shields so they do not short against the clips. We used spaghetti sleeves to do this.

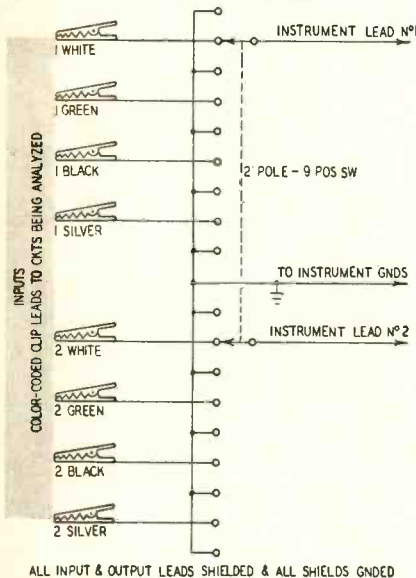


Fig. 2—Switch-probe circuit. Switch—2-pole, 9-position (Mallory 3229J or equivalent) CASE—ICA 29200 or equivalent Insulated shielded cable, 22 feet Clips—(8) alligator Plugs—(3) to match instrument input terminals

Fig. 2—Switch-probe circuit.

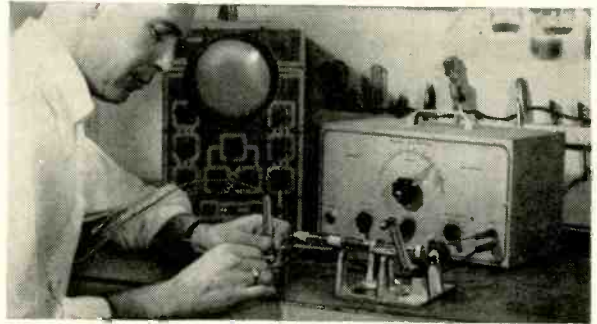
Parts for the switch probe cost less than \$4. This investment triples the value of every instrument you own and pays off in your most valuable resource, time. END

(Shielded leads are used to prevent capacitance coupling between leads connected to a high-level and a low-level stage from causing positive feedback.—Editor)

Simple Method Checks Coil Inductance

By ELLIOTT A. McCREADY

Use your scope and signal generators to determine coil inductance



Checking coil inductance as you wind it.

DESIGNING a coil when reasonable accuracy is desired can be quite a chore. Those of us not possessing an impedance bridge usually resort to the cut-and-try method, which invariably means a lot of work and questionable results.

The formulas used in the design of large multilayer coils are extremely unwieldy. Using them for calculating single-layer solenoids for rf use isn't quite so tough, but then we run into the problem of the increase in inductance brought about when we insert a powdered-iron core. (This is the point at which the textbook is thrown into the fire and the constructor winds a coil that looks good.)

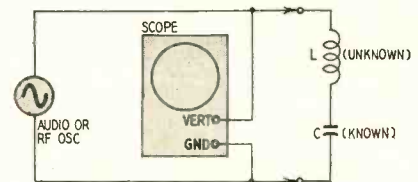
The following method of checking inductance "as you wind" has been found invaluable for use in the construction of loudspeaker crossover inductors and air- or iron-core coils for use at frequencies up to a few megacycles. Don't try to use it with filter chokes as their inductance varies rather widely with the current they carry. The range of this method is limited only by the frequency response of the oscilloscope used as a measuring device.

A sensitive measuring device such as an oscilloscope and a signal generator or audio oscillator are required. The scope should have a fairly wide-band vertical amplifier if this method is used at radio frequencies.

The inductor to be measured and a capacitor of known value are connected in series (see diagram). The capacitor should be chosen so that it will resonate with the inductor within the frequency range of the signal generator. For instance a 0.1- to 1.0- μ f capacitor used with a fairly hefty-looking coil would probably resonate at audio frequencies, while a small mica capacitor (500 μ f on down) would be a good bet when checking a coil which is obviously used at radio frequencies. The coil and capacitor form a series-resonant circuit. Its impedance, for our purposes, is zero at the resonant frequency.

With the equipment connected as shown in the diagram, reduce the scope's horizontal gain to zero, set the vertical

gain for a 1- to 2-inch trace and vary the frequency of the oscillator, starting with its lowest frequency. If a modulated signal generator is used, switch off the internal modulation. The first null on the oscilloscope will be the fundamental resonant frequency of the coil and capacitor. After locating the null, advance the horizontal gain control and tune the oscillator off frequency on both sides to be sure that the trace is still a reasonable sine wave. If a sharp pulselike waveform appears, reduce the output of the oscillator until the output is again a sine wave and recheck the null. A pulselike wave will give an erroneous reading.



Circuit of a coil inductance test.

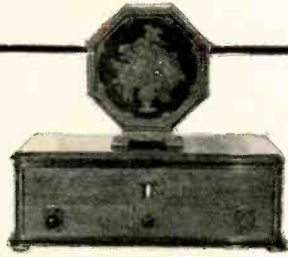
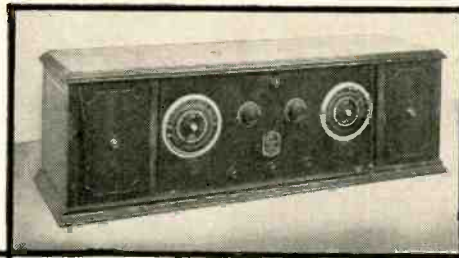
The use of a reactance chart like that found in the *Radio Amateurs' Handbook* will quickly show the value of the inductance under test. A highly detailed chart very easy to use appears on the inside back cover of Terman's *Radio Engineers' Handbook*. For increased accuracy the following equation can be used to determine the inductance of the coil under test:

$$L = .025/Cf^2$$

where L is the inductance in microhenries, C the capacitance in microfarads and f the resonant frequency in megacycles.

The accuracy of this test will depend on the accuracy of the capacitor used. Good-quality paper units are usually accurate within 20% and micas within 5% or better.

One of the advantages of being able to test for inductance is that the test can be performed as coil winding progresses. I use a needle-point test prod to pierce the insulation of the wire. Frequent checks while winding will result in a coil that performs as it is supposed to when inserted in the circuit. END



Those



OLD RADIOS

By A. VON ZOOK

HERE is the story of two old radios I rebuilt recently. Business was slow and I was ready to work on anything, when a customer walked into the shop. He asked me to help bring his radio in, an old Zenith 42. This is a bulky cabinet job with the power supply and speaker on the lower shelf and the rest upstairs. A thick cable connects the two sections. I started to say that this set was not worth working on, but these words were never uttered. He was waving some green stuff in front of my eyes, causing my vocal cords to fail. The customer asked me if \$30 would be enough. I said it's more than enough, immediately realizing I had said the wrong thing.

I looked at the power supply, a Zenith ZE-11. Its case was new and shiny and I figured it was good. The chassis was put on the bench. Its layout was perfect. All the old parts were easy to get at. All the tubes were good. The speaker (it was one of those old field coil jobs) needed some cleaning. I checked the power supply again. The only things visible were the two 81 rectifier tubes. Testing showed them to be good. I turned the set on and started to tune the radio. It sounded darn good. I was thinking this \$30 is easy money. The set was spread out on the bench—sort of breadboard style, when I bumped the power supply and the fun started.

There was a loud combination of hissing, crackling, popping and a small explosion. I pulled the plug. After the smoke cleared I took stock of the situation. The power supply had blown its lid. Lifting it off, I saw a jumble of bare wires, bleeder resistors and smoking transformers. Things looked bad. The insulation had dried out and crumbled with the passing of time. This lack of insulation included the power transformer leads.

It was an awful-looking mess. I had to rebuild the supply. With the schematic before me, I got to work. Some parts were substituted for those called for in the circuit. By a stroke of luck and some fancy thinking, the power unit was made to operate once again. However, the new parts had cost a large part of the \$30 I had figured as gravy. Even worse, I had worked for almost nothing. Although the customer was pleased with his set, I did not dare ask for more money. I had a sickly remembrance of saying that \$30 was more than enough.

Second time around

Some days later, I was again confronted with an old radio. It was a Philco table model that played on only a few stations. There was some bad hum which new filter capacitors could cure. Remembering my recent experience I approached this set with extra caution. Doing some deliberate thinking, I mentally ran over a couple of items.

The power supply seemed to be OK. I knew the speaker was good. A few stations could be heard. It had to be capacitor trouble. I decided to take the job and told the customer that I would work on his set only during my spare time. He said all right and I collected for parts in advance. All details were typed on my bill. After the customer signed the original copy he received a copy of the agreement.

Getting off to a flying start, I discovered that this set had no model number and there was no sign of one. Shucks, this would be easy to find in my guide book. The set had six tubes. Philco sets with six tubes were compared to the one on the bench. Nothing matched and I checked again with the same results. Someone must have switched an original tube. Which one was it? It could not be determined. Oh well, in Philco

radios, volume controls have numbers on them. This limited me to eight possibilities. Looking the set over again I found a shadow tuning indicator. Of the eight circuits in question only two had this indicator. One of these had a phono jack. The set I was looking for did not so I finally had the right circuit. It was a Philco 630. I marked this number on the chassis.

The set should have had two 78 tubes. There was only one. A 6D6 had been substituted for the other.

With the correct schematic before me I replaced all the capacitors in the radio. Some were not marked. Without the diagram to refer to, this radio would have presented real problems!

Eventually the job was finished. However, during a 10-hour air test the set decided to play on the upper end of the band only. This meant the oscillator coil had failed. A new one was obtained and installed. The set was given another 10-hour test and passed with flying colors. When the owner received his radio, he was so pleased that he gave me an extra \$5.

So what?

If an old radio seems to be in fair shape, don't be afraid to tackle it. Make sure the customer understands that it will be worked on only during your spare time. Collect money for parts in advance. This should be fairly high. Assume the worst and the advance fee will pay for anything that might come up. If there is money left over apply it toward the labor. Labor should run about \$15. Using \$10 in parts would require you to charge \$25 for the job. This is why only expensive old radios should be rebuilt. It would not pay for the customer to have a radio rebuilt that only cost \$15 when it was new. And don't forget—if it looks very bad refuse the job!

END

the CD monitor

By R. M. MENDELSON

In recent years, many public-safety and public-service radio communications services have switched to FM and moved to the 152-162-mc band. Since this band is now used by municipal police and fire departments, public transportation and utilities companies and maritime mobile services, it is of vital importance in Civil Defense activities. Equally important in CD work are the nearby 2-meter (144-148-mc) amateur band, used for organized local communications in disasters and other public emergencies, and the Civil Air Patrol frequency (148.14 mc).

Unfortunately, the few commercial receivers available for the 152-162-mc band do not cover the 2-meter amateur band or the CAP frequency, while those which cover the 2-meter and CAP frequency do not cover 152-162 mc. This article describes a receiver, specially designed for Civil Defense monitoring, which provides continuous coverage from below 144 to above 162 mc and is built for less than \$25. Basically it is an FM receiver, but a strong AM signal may be received by tuning slightly away from the carrier frequency. The FM discriminator will not be able to balance out the large variation in amplitude present on the AM signal and will therefore provide audio detection. Operated in this manner, it is satisfactory on strong signals but loses its vol-

ume as the signal becomes weaker. Because the receiver is designed primarily for monitoring local stations operating with moderately high power, and for portability, its circuitry is deliberately kept simple. The design is flexible enough to permit the addition of various refinements.

The receiver uses a conventional FM circuit: converter stage, two 10.7-mc if amplifier stages, ratio detector and a two-stage audio amplifier. Its circuit is shown in the diagram. A 12AT7 twin triode is used as a combined oscillator and mixer, with coupling provided by internal capacitance between the triode units. 6BJ6's are used as if amplifiers because of their low heater current requirements (150 ma each). A 6T8 triple-diode triode is used as the ratio detector and first af amplifier, and a 6AK6 as the af output amplifier.

A simple half-wave power supply, using a selenium rectifier, was provided for compactness. Although even more space could be saved by omitting the isolation transformer and using series-string heaters, the change would introduce a serious safety hazard, particularly since a metal cabinet is used.

A ratio detector is used as it does not require a limiter and is much quieter between signals than a limiter-discriminator and makes an audio squelch circuit unnecessary. Little AVC is provided as fading of local signals is practically

Fire, police, Civil Defense, CAP and the amateur 2-meter band are covered by this compact receiver

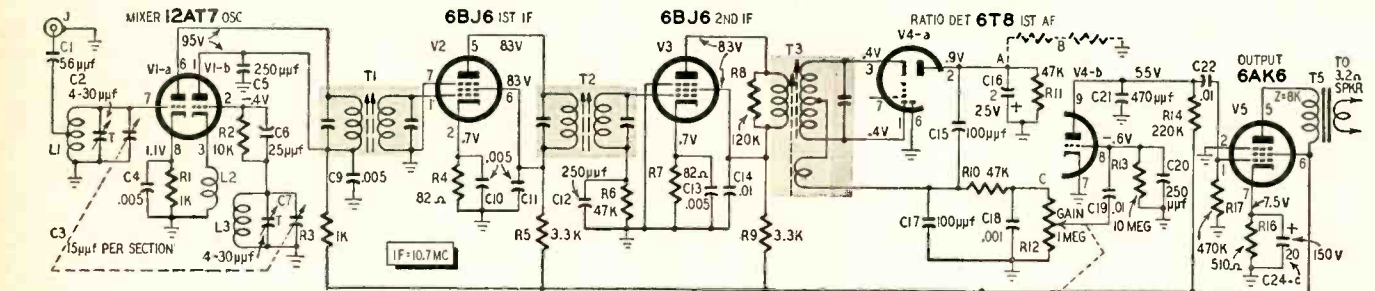
Construction details

Receiver construction is seen in the photos. The front section of the tuning capacitor is used for the oscillator and the rear section for the mixer. A double-bearing capacitor of the type listed or an equivalent salvaged from surplus equipment should be used to allow reasonably precise calibration of the tuning dial. This consideration is important because stations of the type to be monitored transmit intermittently, making it difficult to find the one desired by ear alone.

To achieve portability, small components are used when possible. Ceramic capacitors were used for all bypassing and coupling applications. Even the 2- μ f stabilizing capacitor (C16) is a miniaturized electrolytic about the size of a 1-watt resistor.

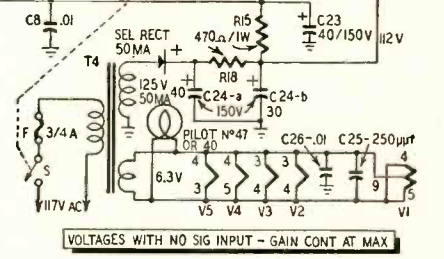
No difficulties should be encountered if the circuit and layout shown are followed. The 120,000-ohm resistor across the primary of the last if transformer cures local oscillation in the receiver shown and may not be necessary in others.

The if and ratio-detector circuits of this receiver are best aligned with a



- R1, 3—1,000 ohms
- R2—10,000 ohms
- R4, 7—82 ohms
- R5, 9—3,300 ohms
- R6, 10, 11—47,000 ohms
- R8—120,000 ohms
- R12—pot, 1 meg, audio taper, with spst switch
- R13—10 megohms
- R14—220,000 ohms
- R15, 18—470 ohms, 1 watt
- R16—510 ohms, 1 watt
- R17—470,000 ohms
- All resistors 1/2 watt unless noted
- C1—56 μ f, ceramic
- C2, 7—4—30 μ f, ceramic trimmer
- C3—15 μ f per section, 2 sections, variable (Hammarlund type HFD-15-X or equivalent)
- C4, 9, 10, 11, 13—.005 μ f, ceramic
- C5, 12, 20, 25—250 μ f ceramic
- C6—25 μ f, ceramic
- C8, 14, 19, 22, 26—.01 μ f, ceramic
- C15, 17—100 μ f, ceramic
- C16—2 μ f, 25 volts, miniature electrolytic
- C18—.001 μ f, ceramic
- C21—470 μ f, ceramic
- C23—40 μ f, 150 volts, electrolytic

- C24—40—30—20 μ f, 150 volts, electrolytic
- F—fuse, 3/4 amp
- J—coaxial connector
- L1—hairpin loop, No. 12 bare copper wire, 3/4 inch wide, 1 1/2 inches long, center-tapped
- L2—25 turns No. 26 enameled wire, close-wound on a 1/4-inch diameter 1-megohm resistor
- L3—hairpin loop, No. 12 bare copper wire, 3/4 inch wide, 1 inch long
- S—on-off switch, spst on R12
- T1, 2—if transformer, 10.7 mc (Miller 1463)
- T3—ratio-detector transformer, 10.7 mc (Miller 1465)
- T4—Power transformer; primary, 117 volts; secondary, 125 volts, 50 ma; 6.3 volts, 2 amps
- T5—Output transformer; primary, 8,000 ohms; secondary, 3.2 ohms
- V1—12AT7
- V2, 3—6BJ6
- V4—6T8
- V5—6AK6
- Rectifier, selenium, 117 volts (rms), 50 ma
- Speaker, PM, 4 inches
- Chassis, 5 x 8 x 1 inch
- Case, 5 x 9 x 6 inches
- Pilot-light assembly, with 6-8-volt type 40 or 47 bulb
- Miscellaneous hardware



Circuit of five-tube CD monitor.

sweep generator and oscilloscope. Use standard methods for if adjustment and detector balancing. However, for those who do not have a sweep generator, there is a method of alignment using a conventional signal generator and voltmeter.

A signal generator capable of delivering fundamental output at 142 to 162 mc should be used to align the front end. If such a generator is not available, suitable harmonics of a low-frequency generator may be used. As a last resort, the front end can be aligned on received signals, provided the mixer and oscillator coils were made to the specific dimensions.

1. Temporarily solder a matched pair of 100,000-ohm resistors between point A in the diagram and ground (shown with dashed lines). Connect a vtvm or 20,000-ohms-per-volt dc voltmeter between A and ground, with its negative terminal at A. Tune the signal generator to 10.7 mc and connect it through a .01- μ f isolation capacitor to the mixer-grid terminal (pin 7) of the 12AT7 socket.

2. Adjust both slugs of transformers T1 and T2, and the primary slug in T3 for maximum reading on the meter. During these adjustments, reduce the output of the signal generator if necessary, keeping the meter reading below 2 volts.

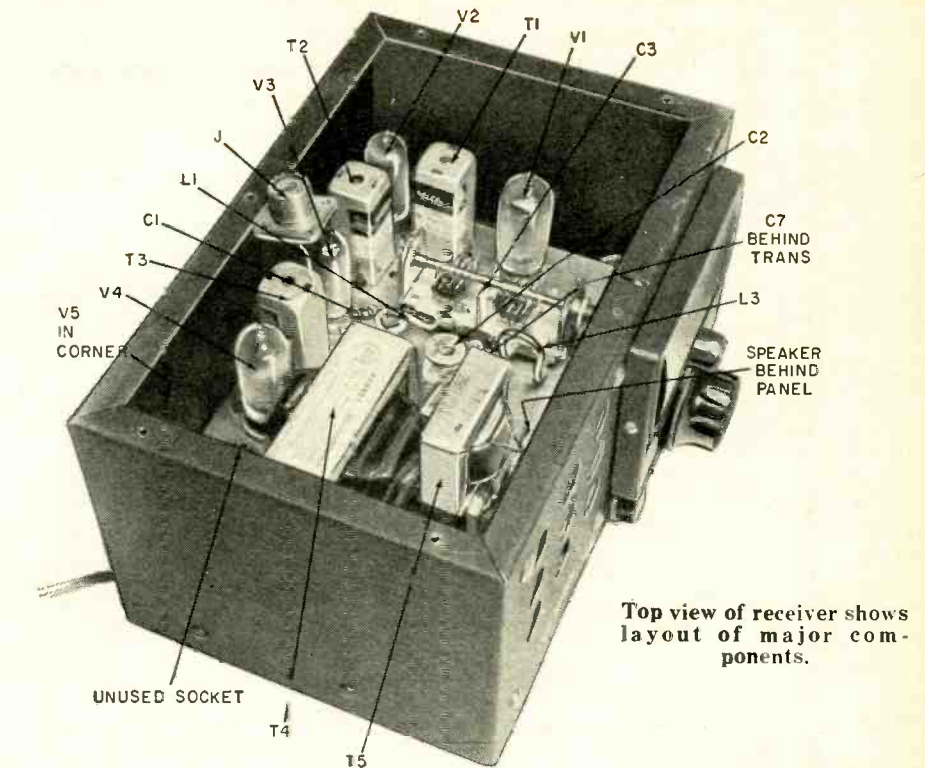
3. After all five slugs have been adjusted, connect the voltmeter between points B and C. Carefully adjust the secondary slug of T3 for zero reading on the meter. This adjustment completes the alignment of the if and ratio-detector stages.

4. Reconnect the voltmeter between point A and ground, and connect the signal generator to the antenna connector. Tune the generator to 162 mc and set the tuning capacitor with its rotor about 80% out of mesh. Then adjust the oscillator trimmer C7 until the voltmeter indicates that the 162-mc signal from the generator is coming through. Keeping the voltmeter reading below 2 volts by use of the generator output attenuator, adjust the mixer trimmer capacitor (C2) for maximum reading.

5. Retune the signal generator to 142 mc and try to tune in the signal on the receiver by adjusting C3, the main tuning capacitor. The signal should come through with C3 at about 80% of full capacitance. If it does not, open or squeeze mixer coil L1 until it does and continue these adjustments until a maximum reading is obtained. If the adjustments appreciably change the dimensions of the mixer coil, retune the generator to 162 mc and repeat step 4. Several adjustments back and forth may be necessary to obtain good tracking over the entire band.

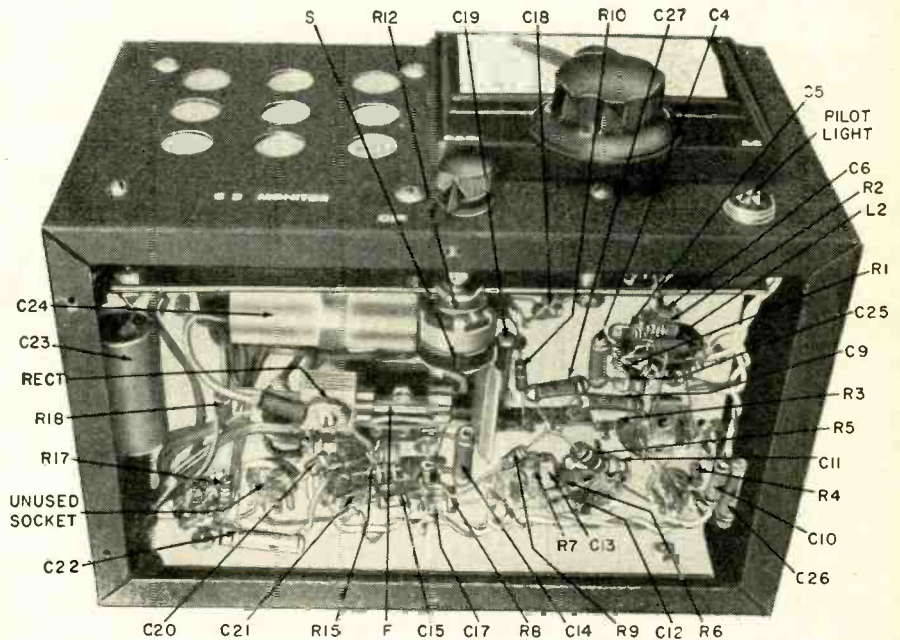
An 18-inch whip plugged into the antenna connector should be adequate for local reception. An outside antenna will add many signals from farther away.

Several refinements may be added if desired. For example, frequency sta-



Top view of receiver shows layout of major components.

Receiver compactness is aided by using ceramic capacitors where possible.



bility can be improved by using a regulated plate-voltage supply for the oscillator. Because of the low B-supply voltage the regulator tube should be an OA3. Better space conservation and less current drain can be obtained with a 5651 voltage-reference tube as a regulator. This miniature tube draws a maximum of 3 ma and will provide 87 volts regulated. A substitute, less expensive than a tube but not as stable, is a NE-51 neon bulb.

A source of avc voltage is available at point A and may be used, by the

addition of the proper R-C filters, in the same manner as in an AM receiver. The avc voltage can also be used to trigger an audio squelch circuit to provide absolute quiet between transmissions. Another addition for those who want to look for weak signals is an rf amplifier stage. This stage may be an untuned broad-band type so a variable capacitor is not required. An rf stage will also minimize the possibility of radiation from the rf oscillator which might cause interference with other services.

END

GATED-BEAM OSCILLATOR

By Charles Erwin Cohn

dent, a series-tuned (Clapp) version is used for the vfo. A fundamental oscillator frequency of 28 mc was selected for several reasons. Among them were unanswered questions about stability and output voltage versus frequency; frequency pulling of the oscillator by amplifier tuning, and effects of modulation on the oscillator.

Using a Philco SB-100 transistor in the vfo, sufficient output is obtained to drive a Philco L-5108 transistor to a 2-mw output, measured in the 28.0-29.5-mc range. As expected, the output falls off a minor degree at the high-frequency end of the range. The oscillator frequency can be pulled about 200 kc by tuning the amplifier output tank. Once the amplifier is tuned and the oscillator brought back to its original frequency, stability is surprisingly good. Frequency drift was not noticed during a 1-hour four-way local contact.

Modulation technique

Modulation was obtained by connecting a carbon microphone in series with the negative battery terminal and the cold end of the amplifier tank circuit. This is roughly the equivalent of plate modulation in a vacuum-tube amplifier, but here it produced narrow-band *frequency modulation*. Audio quality was very good.

The oscillator frequency was then halved, since we reasoned that something of the sort should be expected with the vfo and modulated amplifier on the same frequency. This change slightly reduced frequency swing due to modulation, but the transmitter's output power increased to a little over 5 mw.

This power output falls just short of being three times that measured on the W7MPQ push-pull final amplifier. Better coupling efficiency and more driving power to the amplifier seem to be the two major factors in obtaining this improvement.

Data received from Philco² contain a very interesting chart showing the decrease in transistor collector efficiency as the operating frequency approaches the transistor's maximum usable frequency (comparable to the alpha cutoff frequency). As the ratio between operating and maximum frequencies approaches unity, collector efficiency approaches zero, being approximately 25% at an F/F_{max} ratio of 0.50. This helps explain the improvement in performance of the vfo rig as the oscillator frequency is lowered.

Construction of the transmitter presents no unusual problems and should be clear from the photographs and diagram. Component values are not critical, although variation in individual transistor characteristics makes minor experimental value changes worth while.

Several components are surplus items, but in all cases their direct

equivalents are available commercially. Specific examples are the vfo coil form which is a National XR-50 and the variable capacitors which are the Hammarlund APC variety. The amplifier tank coil and link are made from one section of B & W Miniductor No. 3011 coil stock. Separate batteries power each stage to avoid interaction via a common power supply impedance.

A wide-open field-strength meter is used for making tuning adjustments. (The term wide open indicates that an rf choke replaces the conventional tuned circuit in the meter so that it is not particularly frequency-sensitive.) Once an approximate frequency is set with the vfo, the amplifier tuning and loading capacitors are adjusted for maximum meter reading. By leaving the meter connected to the antenna lead there is no loss of signal strength, according to all stations contacted.

Output power

The method of power output measurement is simple and apparently reliable. The only equipment needed is a vtvm with a diode probe and a non-inductive resistor of known value. We used a Heathkit V-6 vtvm with a 100-ohm 2-watt carbon resistor as the load (at these power levels one can't be too careful). By placing the resistor (shunted by the diode probe) across the transmitter output link and tuning the amplifier tank and link circuit for maximum vtvm reading, the voltage across the load is determined. Substituting the measured voltage and resistor values in the conventional power formula gives the power output.

Connecting the vtvm and field-strength meter across the load resistor and alternately disconnecting one meter while watching the other, we found that neither meter significantly affects the load so as to invalidate the readings obtained.

Purely as a shot in the dark, we set the transmitter's output frequency at 30.3 mc and used the little rig as a vfo exciter for a Central Electronics 10A SSB exciter on 21 mc. While not completely successful due to frequency instability previously unnoticed, results were good enough to warrant further investigation.

Frequency instability was undoubtedly due to operating voltages somewhat in excess of the transistor manufacturer's recommendations and the lack of a high-quality double-bearing variable capacitor in the vfo. By operating the vfo in the 12-mc range (for 21-mc SSB output), frequency stability and output power are expected to improve considerably with less input power.

Data obtained during operation of this little rig should lend encouragement not only to those few hardy souls striving for communication with minimum power, but also to those contemplating the construction of an all-transistor receiver for the higher frequencies. END

IN the 6BN6, unlike conventional pentodes, the cathode current is not markedly affected by grid action. If plate current is cut off by grids 1 or 3, the total cathode current flows to the accelerator grid (grid 2). If a positive voltage on G1 or G3 increases the plate current, the accelerator current drops. This corresponds to negative transconductance between G1 and G2 or G3 and G2, making a negative-resistance oscillator possible.

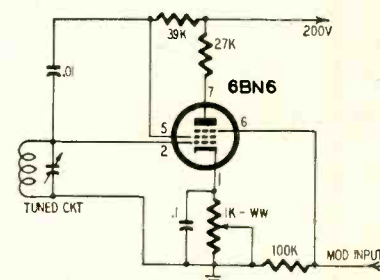


Fig. 1

Fig. 1 is a simple oscillator using this effect. A tuned circuit is connected between G1 and ground and is capacitance-coupled to G2. If G1 goes positive, the plate current increases and accelerator current decreases, making it (G2) more positive. Since G1 and G2 are coupled by the .01- μ f capacitor, the original disturbance that drove G1 positive is reinforced and the circuit oscillates. Output can be taken from G2 or the plate.

About 15 volts rf output was obtained with this circuit oscillating at 550 kc. Grid 3 may be keyed or modulated. A 0.4-volt 60-cycle signal provides about 60% modulation. The cathode potentiometer should be adjusted for most linear modulation. The cathode and G3 can be grounded directly if the circuit is not modulated or keyed.

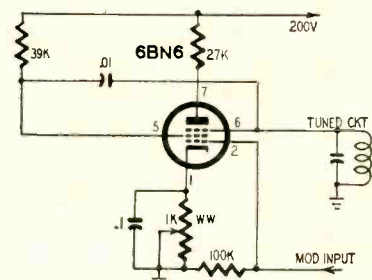


Fig. 2

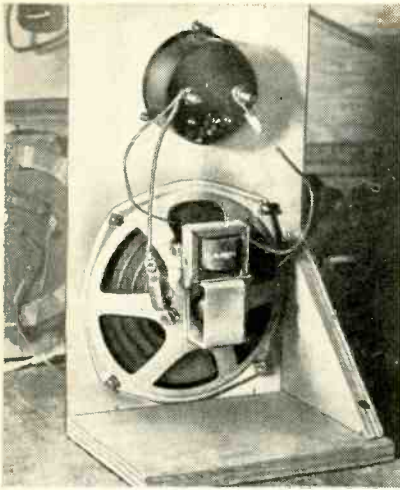
Fig. 2 shows the circuit with G3 in the oscillator and G1 used for modulation. This circuit has more output and modulation sensitivity. Here, 0.1 volt gives 40% modulation.

This circuit makes an excellent superhet converter when the 100,000-ohm grid resistor is replaced by the antenna or rf coil and the plate resistor by the primary of the first if transformer. Adjust the cathode potentiometer for maximum gain and minimum modulation distortion. END

²Application Notes on the Philco Surface Barrier Transistor, Philco Corp., Government & Industry Division, 4700 Wissahickon Ave., Phila., Pa.

TRICKS of the TRADE

By HARRY M. LAYDEN



Construction of wireless output meter.

Short indicator in action. A 25-watt bulb limits current.

IN radio repairing—as in any other business—efficiency is spelled M-O-N-E-Y! So it's plain common sense for a technician to latch onto anything that increases his efficiency. There are many devices he can use to turn out better work and save time. Four such easily built, low-cost units are described here. Over the years we have found them to be, not merely useful, but downright indispensable!

Open heater detector

The first one is an open heater detector used to locate quickly the dead tube in those ac-dc series heater strings. Usually when these sets conk out, just one tube is at fault. We use a special outlet to test these sets. The hot leg of the line that feeds it has an ac socket connected in series with it. If a 10-watt bulb is inserted in the socket, it will indicate current flow through the outlet whenever an appliance or radio is plugged in and turned on.

If the set's heater is not open, the bulb will light. If it doesn't, we have an open circuit. We substitute one tube at a time and watch the indicator. When the bad tube is replaced, the bulb lights. This will not locate a bad on-off switch or an open line cord nor will it be useful in sets that have more than one open heater. But the majority of the time, a set can be serviced right on the

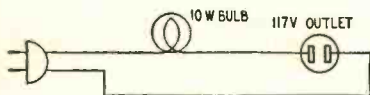


Fig. 1—Open filament detector uses 10-watt bulb as indicator.

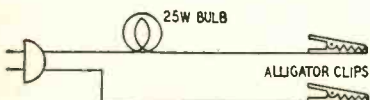
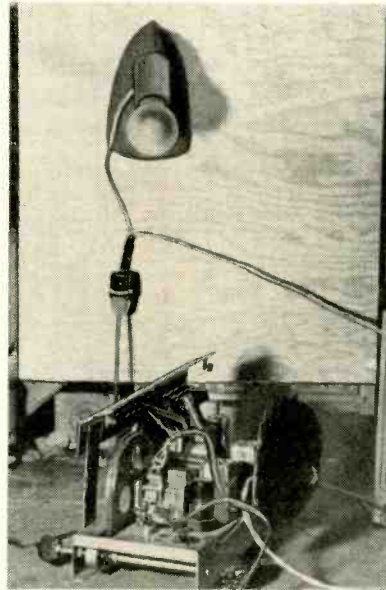


Fig. 2—Short indicator spots defects in tuning capacitors.



counter by unskilled personnel. Fig. 1 is a drawing of the hookup.

Short indicator

Another highly useful rig is the one we call the "short indicator." This gadget will let you actually see the short! Many sets develop shorts between plates of the tuning capacitor, which are sometimes difficult to remove. Again an ac socket in series with one side of the line is used. This time with a 25-watt bulb.

After all connections are removed from the capacitor, ac is applied through this hookup. Shorted plates are, showing a blue spark at the point of the trouble. Since the current in the line is limited only by the 25-watt bulb, be careful while working with this hookup.

This gadget will also burn out any dust particles between the plates. Be sure to remove all connections to the capacitor before testing. Fig. 2 shows this hookup.

Wireless output meter

Our third aid will help keep your customers happy. Their radios will have that oomph that sets have only when

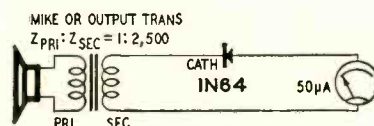


Fig. 3—Wireless output meter requires no connection to set being tested.

aligned with an output meter. The ear is no substitute for that instrument!

Voice coil connections are often too hard to get at and ear alignment is all that these sets get. You can get around this difficulty with a wireless output meter.

It consists of an ordinary 5- or 6-inch PM speaker, a mike transformer and a low-current (rectifier type) ac meter. The hookup is seen in Fig. 3. This gadget, moved close to and facing the set's speaker will work as a microphone, picking up the tone from the set and translating it into an ac voltage which is read on the meter. The mike transformer's high stepup ratio makes this possible. Use it for a while and notice the difference in performance.

The slicer

The fourth and last time saver is the cheapest to construct but is worth its weight in plutonium. I venture to say that not one ac-dc radio in 10 tracks properly! How many times have you run across a set that had two or more stations fighting to be heard right in the middle of the broadcast band?

How can we alleviate this situation? Take a piece of plastic, such as that used for the dial face in older radios. Cut it to the shape of a crescent. Now you have "the slicer," a gadget that acts like a magic wand when used properly.

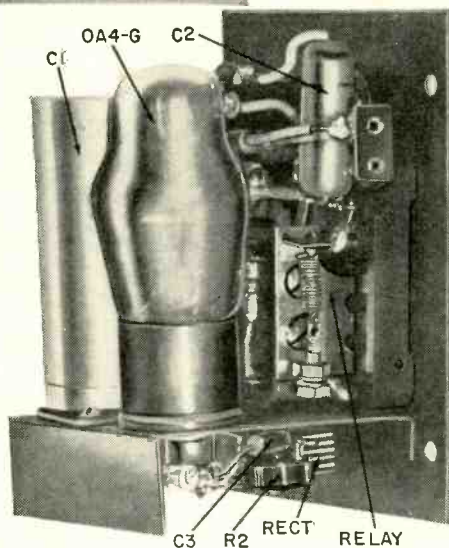
Get in the middle of the band, with your generator feeding a 1,000-kc signal to the set. Now insert the slicer between a stator and rotor plate of the tuning capacitor's antenna section. Do this slowly and watch the output meter as the slicer begins to add capacitance to that section. Does the meter needle rise or fall as the slicer enters between the plates? If it rises, that section of the gang needs more capacitance. If it falls, either there is too much or just enough capacitance. To correct, bend the end plates either in or out as needed. Be sure to bend only the section of the gang that affects the frequency you're on.

These gadgets will save you time and money. Your reputation for fine service will gain and you personally will know the feeling of satisfaction that comes with a job well done. END

touch plate controller

Thyratron device obsoletes the doorbell—has other interesting applications

The control unit is both simple and small.



By RICHARD J. SANDRETTO

GENTLY touch a small metal disc. Instantly a doorbell rings, room lights go on, a door automatically opens and closes behind you or the toy electric train in the store window alternately stops, starts and reverses. A contact-sensitive relay controls the action.

Either a single OA4-G or 1C21 thyatron is used in its simple circuit. Once installed the controller can be forgotten, operating reliably for only a few pennies a year.

Briefly this is how it operates: A single wire connects a touch plate to the controller. The touch plate is simply a piece of metal mounted on an insulating section of plastic. Whenever a person or any other large conducting object touches the metal, the capacitance between his body and ground fires the thyatron. This causes the plate relay to close and some device is actuated.

The controller has both practical and amusing applications. The author made the following novel installation at his home: The touch plate shown in the photograph was mounted at the front door where a doorbell button would ordinarily be located. Whenever a caller touches the disc, the door chime instantly sounds. At the same time the porch light turns on automatically.

My unit is adjusted so that, if no one answers within 25 seconds, the

light automatically turns off. If someone is close by and they turn on the light in the living room. The porch light will stay on only 9 seconds. This is completely automatic and does not interfere with normal living-room or porch-light operation.

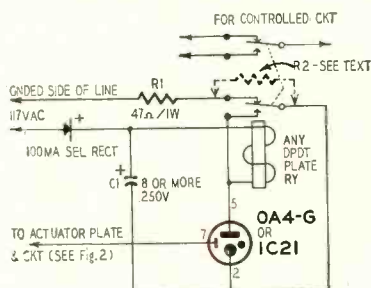


Fig. 1—A general purpose relay.

A circuit description of the porch-light-door-chime installation will fol-

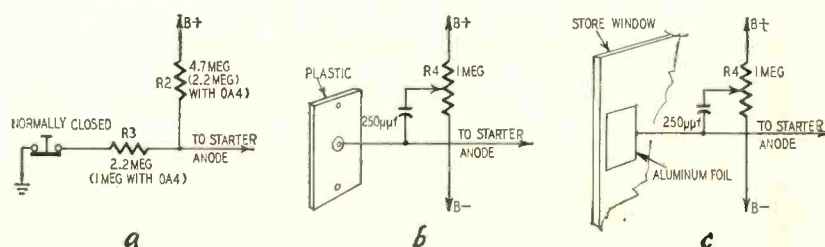


Fig. 2—Actuation plates: a—pushbutton, b—contact control, c—capacitance.

low that of a general purpose controller.

Circuit details

Fig. 1 is the circuit of the general-purpose unit. The selenium rectifier charges C1 to the peak value of the line voltage—approximately 165 (1.414 times 117). Yet the thyatron does not conduct until it is fired by a triggering starter-anode potential.

When the tube is fired, the plate relay closes. One contact opens, breaking the circuit which charged C1. Its closing contact shorts out the tube's plate-cathode connections and thyatron conduction instantly stops. Now the plate relay is connected directly across C1, which discharges through the relay. The relay armature is held in for a period determined by the capacitance of C1 and the relay coil resistance. Standby operation is restored when the armature drops out. R1 limits the surge current recharging C1 at this moment. Spdt relay contacts are needed for circuit resetting; therefore a dpdt relay is used. This allows a second pair of spdt contacts for the controlled circuit.

Slightly increased relay hold-in periods can be obtained if an experimentally selected resistance (R2) is placed as indicated by dotted lines (Fig. 1).

Actuator plates

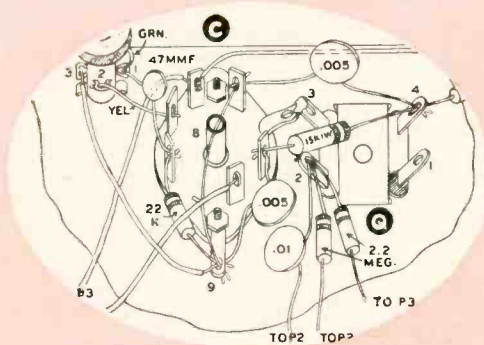
There are three types of actuator plates. Each utilizes the already grounded side of the power line so only one wire is needed to connect the plate to the controller. Capacitance between the connecting line and ground must be kept at a minimum except for the first type. Otherwise, sensitivity decreases as capacitance increases and a large capacitance may even fire the unit. The

(Continued on page 78)



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Motion picture and TV personality, Jackie Coogan, looks on with unbelieving interest as his 14-year-old son, Anthony, prepares to assemble his latest Heathkit, a hi-fi FM tuner. The Coogans have found out about the fun and savings of building their own electronic equipment the Heathkit way . . . so why don't you?



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- { } Bend socket lug C5 and IF transformer lug Q3 toward each other until they make contact and overlap slightly. Solder the connecting securely. (1).
- { } Install a .005 μfd capacitor from socket (NS) to ground lug C9 (NS). Dress the capacitor close to chassis under the capacitor previously installed.

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MODEL W-6M

MODEL W-6: Consists of W-6M kit, plus WA-P2 preamplifier. Express only. Shpg. Wt. 59 lbs. \$129.70

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This tuner can bring you a rich store of FM programming, your least expensive source of high fidelity material. It covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. Features broadbanded circuits for full fidelity, and better than 10 uv sensitivity for 20 db of quieting, to pull in stations with clarity and full volume. Employs a high gain, cascode RF amplifier, and has AGC. A ratio detector provides high-efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit. Special alignment equipment is not necessary. Edge-lighted glass dial for easy tuning. Here is FM for your home at a price you can afford. Shpg. Wt. 8 lbs.

MODEL FM-3A

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This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuits feature broad band-width, to insure low signal distortion. Audio response is ± 1 db from 20 cps to 9 kc, with 5 db of preemphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent, and tuner covers complete broadcast band from

550 to 1600 kc. Quiet performance is assured by 6 db signal-to-noise ratio at 2.5 UV. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide-rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 8 lbs.

MODEL BC-1A

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HEATHKIT MASTER CONTROL PREAMPLIFIER KIT

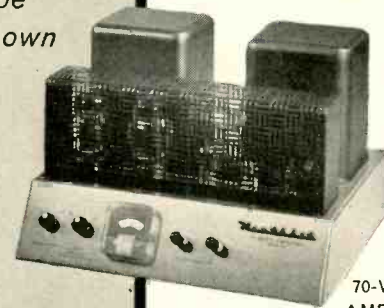
Designed for use with any of the Williamson-type amplifiers, the WA-P2 has five switch-selected inputs, each having its own level control to eliminate blasting or fading while switching through the various inputs, plus a tape recorder output. A hum control allows setting for minimum hum level. Frequency response is within $\pm 1\frac{1}{2}$ db from 15 to 35,000 cps. Equalization provided for LP, RIAA, AES, and early 78's. Separate bass and treble controls. Low impedance cathode follower output circuit. All components were specially selected for their high quality. Includes many features which will eventually be desired. Shpg. Wt. 7 lbs.

MODEL WA-P2

\$19⁷⁵

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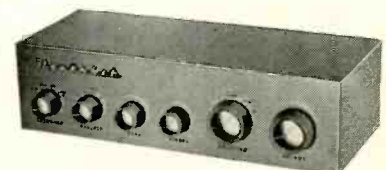
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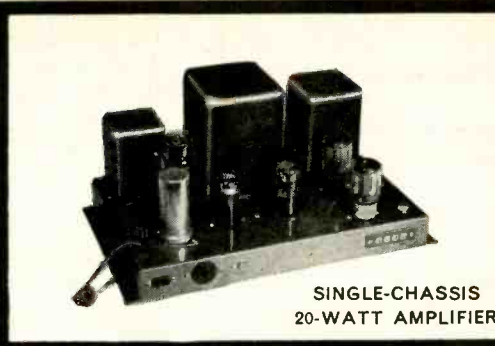
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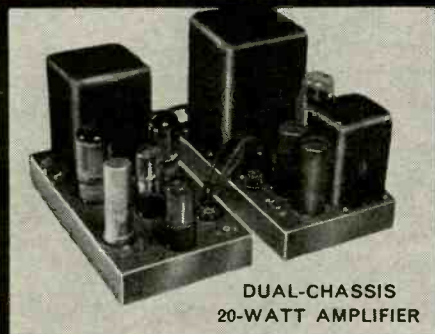
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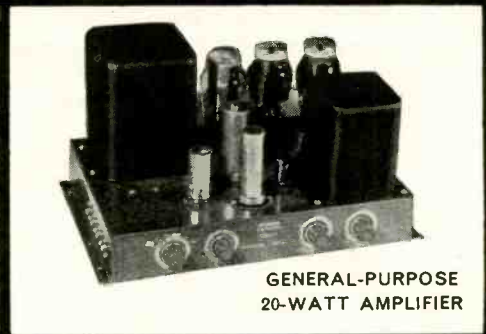


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Designed especially to satisfy critical audio requirements, the W-5M incorporates the extra features needed to complement the finest in program sources and speaker systems. Faithful sound reproduction is assured with a frequency response of ± 1 db from 5 to 160,000 cps at 1 watt, and harmonic distortion is less than 1% at 25 watts, with IM distortion less than 1% at 20 watts. Hum and noise are a full 99 db below rated output, assuring quiet, hum-free operation. Output taps are 4, 8 and 16 ohms. Exclusive Heathkit features include the "tweeter saver", and the "bas-bal" balancing circuit, requiring only a voltmeter for indication. Years of reliable service are guaranteed through the use of conservatively rated, high quality components. KT66 tubes and Peerless output transformer are typical. Shipped express only. Shpg. Wt. 31 lbs.

MODEL W-5: Consists of W-5M kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 38 lbs. \$79.50

MODEL W-5M
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HEATHKIT DUAL-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W3-AM is a Williamson-type amplifier built on two separate chassis. The power supply is on one chassis, and the amplifier stages are on the other chassis. Using two separate chassis provides additional flexibility in installation. Features include the famous acrosound model TO-300 "ultralinear" output transformer and 5881 tubes for broad frequency response, low distortion, and low hum level. The result is exceptionally fine overall tone quality. Frequency response is ± 1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion is less than 1% and IM distortion is less than 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Designed to match the speaker system of your choice, with taps for 4, 8 or 16 ohms impedance. A very popular high fidelity unit employing top quality components throughout. Shipped express only. Shpg. Wt. 29 lbs.

MODEL W-3A: Consists of W-3AM kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 37 lbs. \$69.50

MODEL W-3AM
\$49⁷⁵

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The model W4-AM Williamson-type amplifier will amaze you with its outstanding performance. A true Williamson circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can provide you with many hours of listening enjoyment with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extending from 10 cps to 100 kc within ± 1 db at 1 watt assures you of full coverage of the audio range, and clean clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms. Shipped express only. Shpg. Wt. 28 lbs.

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Heathkits...

BY DAYSTROM

*bring you the lasting satisfaction
of personal accomplishment*

HEATHKIT GENERAL-PURPOSE 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model A-9C will provide you with high quality sound at low cost. Features a built-in preamplifier with four separate inputs, and individual volume, bass and treble controls. Frequency response covers 20 to 20,000 cps within ± 1 db. Total harmonic distortion is less than 1% at 3 db below rated output. Push-pull 6L6 tubes are used, with output transformer tapped at 4, 8, 16 and 500 ohms. A true hi-fi unit using high-quality components throughout, including heavy-duty "potted" transformers.

Shpg. Wt. 23 lbs.

MODEL A-9C
\$35⁵⁰

**HEATHKIT "BASIC RANGE"
HI-FI SPEAKER SYSTEM KIT**

The extremely popular Heathkit model SS-1 Speaker System provides amazing high fidelity performance for its size. Features two high-quality Jensen speakers, an 8" mid-range woofer and compression-type tweeter with flared horn. Covers from 50 to 12,000 CPS within ± 5 db, in a special-design ducted-port, bass reflex enclosure. Impedance is 16 ohms. Cabinet measures 11 $\frac{1}{2}$ " H x 23" W x 11 $\frac{3}{4}$ " D. Constructed of veneer-surfaced plywood, $\frac{1}{2}$ " thick, suitable for light or dark finish. All wood parts are precut and predrilled for easy, quick assembly. Shpg. Wt. 30 lbs.

MODEL SS-1
\$39⁹⁵

**HEATHKIT "RANGE EXTENDING"
HI-FI SPEAKER SYSTEM KIT**

Extends the range of the SS-1 to ± 5 db from 35 to 16,000 CPS. Uses 15" woofer and super-tweeter both by Jensen. Kit includes crossover circuit. Impedance is 16 ohms and power rating is 35 watts. Measures 29" H x 23" W x 17 $\frac{1}{2}$ " D. Constructed of veneer-surfaced plywood $\frac{3}{4}$ " thick. Easy to build! Shpg. Wt. 80 lbs.

MODEL SS-1B
\$99⁹⁵

**HEATHKIT "LEGATO"
HIGH FIDELITY SPEAKER SYSTEM KIT**

The quality of the Legato, in terms of the engineering that went into the initial design, and in terms of the materials used in its construction, is matched in only the most expensive speaker systems available today. The listening experience it provides approaches the ultimate in esthetic satisfaction. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high-frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high frequency channel into phase with the low frequency channel to eliminate peaks or valleys at the crossover point, by equalizing the acoustical centers of the speakers. The enclosure is a modified infinite baffle type, especially designed for these speakers. Cabinet is constructed of veneer-surfaced plywood, $\frac{3}{4}$ " thick, precut and predrilled for easy assembly. Frequency response 25 to 20,000 CPS. Power rating, 50 watts program material. Impedance is 16 ohms. Cabinet dimensions 41" L x 22 $\frac{1}{4}$ " D x 34" H.

Choice of two beautiful cabinets. Model HH-1-C in imported white birch for light finishes, and HH-1-CM in African mahogany for dark finishes. Shpg. Wt. 195 lbs.

MODEL HH-1-C
MODEL HH-1-CM
\$325⁰⁰
EACH

Heathkits...

By DAYSTROM

*let you save up to 1/2
or more on all types
of electronic equipment.*

HEATHKIT SINE-SQUARE GENERATOR

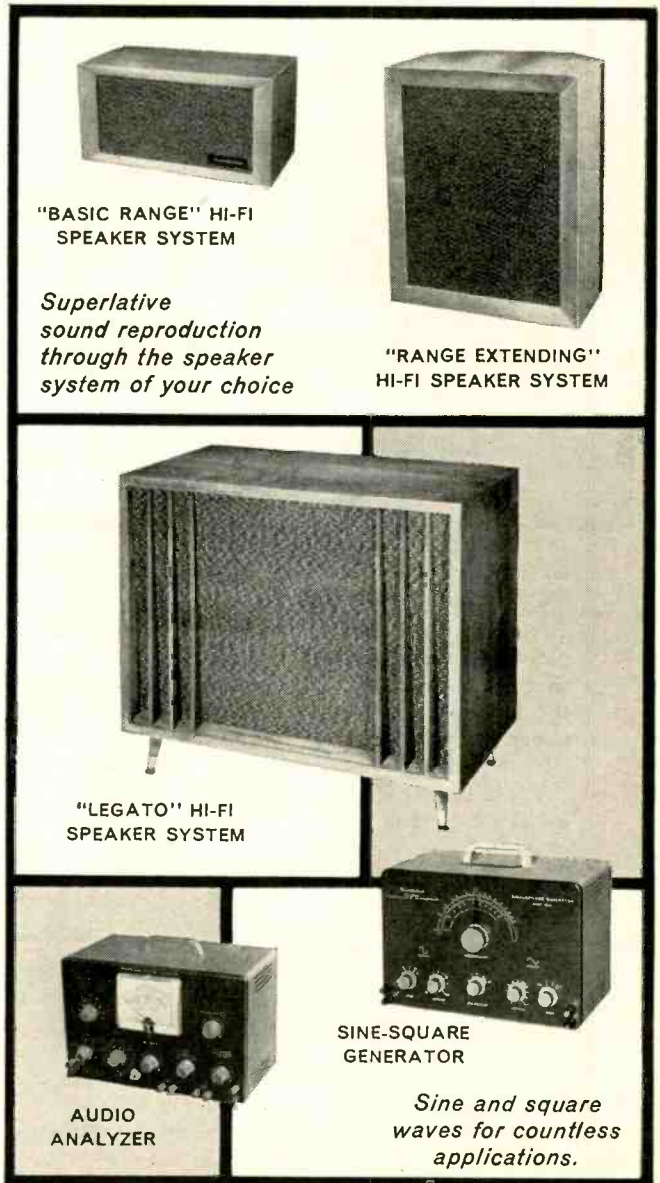
The new AG-10 provides high quality, sine and square waves over a wide range, for countless applications. Some of these are: radio and TV repair work, checking scope performance, as a variable trigger source for telemetering and pulse work, and checking audio, video and hi-fi amplifier response. Frequency response is ± 1.5 db from 20 CPS to 1 MC on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Sine wave output impedance 600 ohms, square wave output impedance 50 ohms, (except on 10v ranges). Square wave rise time less than .15 usec. Five-position band switch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1, and .1 volts for both sine and square wave, with extra range of .01 volt on sine wave. Both sine and square wave can be used at the same time without affecting either wave form. Power supply uses silicon-diode rectifiers. Shpg. Wt. 12 lbs.

MODEL AG-10
\$49⁹⁵

HEATHKIT AUDIO ANALYZER KIT

The AA-1 is actually three instruments in one compact package. It combines the functions of an AC VTVM, an audio wattmeter, and an intermodulation analyzer. Input and output terminals are combined, and high and low frequency oscillators are built in. VTVM ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts (RMS). Wattmeter ranges are .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w and 150 w. IM scales are 1%, 3%, 10%, 30% and 100%. Provides internal load resistors of 4, 8, 16 or 600 ohms. A tremendous dollar value. Shpg. Wt. 13 lbs.

MODEL AA-1
\$49⁹⁵



"BASIC RANGE" HI-FI
SPEAKER SYSTEM

*Superlative
sound reproduction
through the speaker
system of your choice*

"RANGE EXTENDING"
HI-FI SPEAKER SYSTEM

"LEGATO" HI-FI
SPEAKER SYSTEM

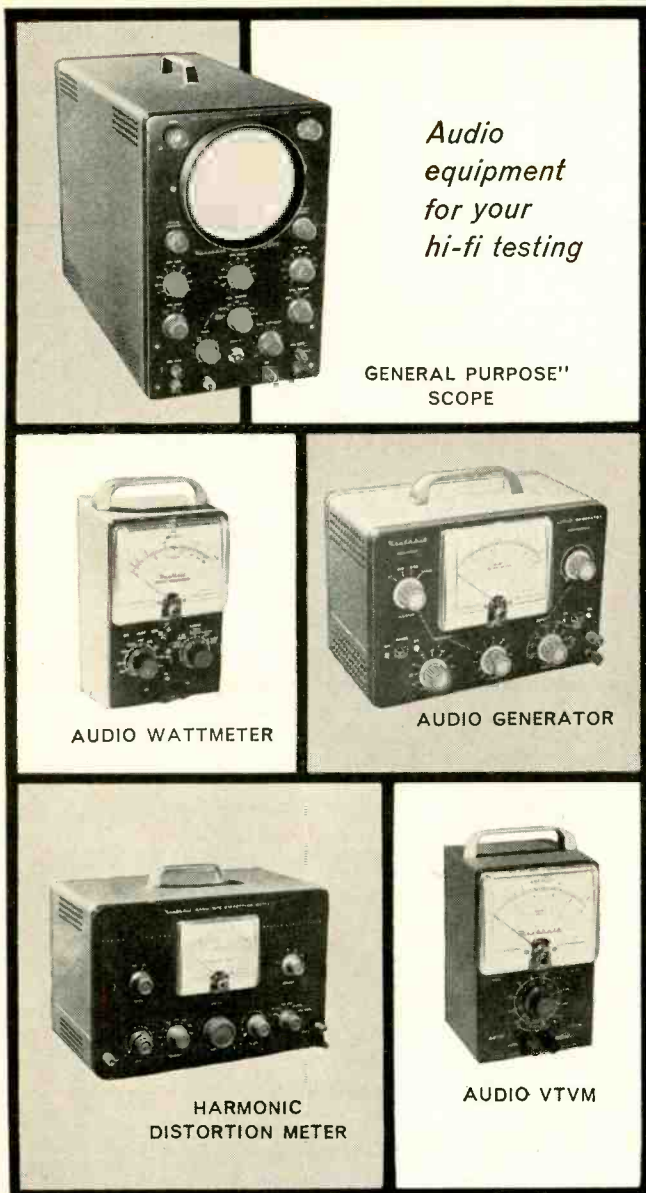
AUDIO
ANALYZER

SINE-SQUARE
GENERATOR

*Sine and square
waves for countless
applications.*

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 20, MICH.**

SEPTEMBER, 1957



Audio equipment for your hi-fi testing

GENERAL PURPOSE" SCOPE

AUDIO WATTMETER

AUDIO GENERATOR

HARMONIC DISTORTION METER

AUDIO VTVM

HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

The model OM-2 Oscilloscope is especially popular with part-time service technicians, students, and high fidelity enthusiasts. It features good vertical frequency response ± 3 db from 4 cps to over 1.2 mc. A full five-inch crt, and sweep generator operation from 20 cps to over 150 kc. Stability is excellent and calibrated grid screen allows precise signal observation. Extra features include external or internal sweep and sync, 1-volt peak-to-peak calibrating reference, 3-position step-attenuated input, adjustable spot shape control, push-pull horizontal and vertical amplifiers, and modern etched-metal circuits. Easy to build and a pleasure to use. Ideal for use with other audio equipment for checking amplifiers. Shpg. Wt. 21 lbs.

MODEL OM-2

\$42⁵⁰

HEATHKIT AUDIO WATTMETER KIT

The AW-1 Audio Wattmeter can be used in any application where audio power output is to be measured. Non-inductive LOAD resistors are built in for 4, 8, 16 or 600 ohms impedance. Five power ranges cover 0-5 mw, 50 mw, 500 mw, 5 w, and 50 w full scale. Five switch-selected db ranges cover -10 db to +30 db. All indications are read directly on a large 4½" 200 microampere meter. Frequency response is

± 1 db from 10 cps to 250 kc. Precision type multiplier resistors used for high accuracy, and crystal diode bridge for wide-range frequency response. This meter is used in many recording studios and broadcast stations as a monitor as well as servicing. A fine meter to help supply the answers to your audio operating or power output problems. Shpg. Wt. 6 lbs.

MODEL AW-1

\$29⁵⁰

HEATHKIT AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1.3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within $\pm 5\%$. Distortion less than .1 of 1% between 20 and 20,000 cps. Total range is 10 cps to 100 kc. Shpg. Wt. 8 lbs.

MODEL AG-9A

\$34⁵⁰

HEATHKIT HARMONIC DISTORTION METER KIT

All sounds consist of dominant tones plus harmonics (overtones). These harmonics enrich the quality and brightness of the music. However, additional harmonics which originate in the audio equipment, represent distortion. Used with an audio signal generator, the HD-1 will accurately measure this harmonic distortion at any or all frequencies between 20 and 20,000 cps. Distortion is read directly on the panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio measurements are also permitted through the use of a separate meter scale calibrated in db. High quality components insure years of outstanding performance. Full instructions are provided. Shpg. Wt. 13 lbs.

MODEL HD-1

\$49⁵⁰

Heathkits...

By DAYSTROM

are well known for their high quality and reliability.

HEATHKIT AUDIO VTVM KIT

This new and improved AC Vacuum Tube Voltmeter is designed especially for audio measurements and low-level AC measurements in power supply filters, etc. Employs an entirely new circuit featuring a cascode amplifier with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding stages. It emphasizes stability, broad frequency response, and sensitivity. Frequency response is essentially flat from 10 cps to 200 kc. Input impedance is 1 megohm at 1000 cps. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover -52 db to +52 db. Features large 4½" 200 microampere meter, with increased damping in meter circuit for stability in low frequency tests. 1% precision resistors employed for maximum accuracy. Stable, reliable performance in all applications. Shpg. Wt. 5 lbs.

MODEL AV-3

\$29⁵⁰

HEATHKIT COLOR BAR AND DOT GENERATOR

The CD-1 combines the two basic color service instruments, a Color Bar Generator and White Dot Generator in one versatile portable unit, which has crystal-controlled accuracy and stability (no external sync lead required). Produces white-dots, cross hatch, horizontal and vertical bars, 10 vertical color bars, and a new shading bar pattern for screen and background adjustments. Variable RF output on any channel from 2 to 6. Positive or negative video output, variable from 0 to 10 volts peak-to-peak. Crystal controlled sound carrier with off-on switch. Voltage regulated power supply using long-life silicon rectifiers. Gain knowledge of a new and profitable field by constructing this kit. Shpg. Wt. 12 lbs.

MODEL CD-1
\$59⁹⁵

Heathkits...

By DAYSTROM

*are guaranteed to
meet or exceed
advertised specifications*

HEATHKIT TV ALIGNMENT GENERATOR KIT

This fine TV alignment generator offers stability and flexibility difficult to obtain even in instruments costing several times this low Heathkit price. It covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. The all-electronic sweep circuit insures stability. Crystal marker and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking to eliminate return trace. Phasing control. Kit is complete, including three output cables. Shpg. Wt. 16 lbs.

MODEL TS-4A
\$49⁵⁰

HEATHKIT "EXTRA DUTY" 5" OSCILLOSCOPE KIT

This fine oscilloscope compares favorably to other scopes costing twice its price. It contains the extra performance so necessary for monochrome and color-TV servicing. Features push-pull horizontal and vertical output amplifiers, a 5UPI CRT, built in peak-to-peak calibration source, a fully compensated 3-position step-type input attenuator, retrace blanking, phasing control, and provision for Z-axis modulation. Vertical amplifier frequency response is within +1.5 and -5 db from 3 CPS to 5 MC. Response at 3.58 MC down only 2.2 db. Sensitivity is 0.025 volts RMS /inch at 1 kc. Sweep generator covers 20 CPS to 500 kc in five steps, five times the usual sweep obtained in other scopes through the use of the patented Heath sweep circuit. Etched-metal circuit boards reduce assembly time and minimize errors in assembly, and more importantly, permit a level of circuit stability never before achieved in an oscilloscope of this type. Shpg. Wt. 21 lbs.

MODEL O-11
\$69⁵⁰

HEATHKIT ELECTRONIC SWITCH KIT

A valuable accessory for any oscilloscope owner. It allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. Four switching rates. Provides gain for input signals. Frequency response ± 1 db, 0 to 100 kc. A sync output is provided to control and stabilize scope sweep. Ideal for observing input and output of amplifiers simultaneously. Shpg. Wt. 8 lbs.

MODEL S-3
\$21⁹⁵

HEATHKIT VOLTAGE CALIBRATOR KIT

This unit is an excellent companion for your oscilloscope. Used as a source of calibrating voltage, it produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors insure accurate output amplitude, and multivibrator circuit guarantees good sharp square waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switches are: .03, 0.1, 0.3, 1.0, 3.0, 10, 30 and 100 volts peak-to-peak. Allows measurement of unknown signal amplitude by comparing it to the known output of the VC-3 on oscilloscope. Shpg. Wt. 4 lbs.

MODEL VC-3
\$12⁵⁰

*Functional
styling with
clean uncluttered
look*



COLOR BAR AND
DOT GENERATOR



"EXTRA DUTY"
SCOPE



TV ALIGNMENT
GENERATOR



ELECTRONIC
SWITCH



VOLTAGE
CALIBRATOR

HEATH COMPANY A Subsidiary of Daystrom, Inc. BENTON HARBOR 20, MICH.

SEPTEMBER, 1957

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HEATHKIT TUBE CHECKER KIT

Eliminate guesswork, and save time in servicing or experimenting. The TC-2 tests tubes for shorted elements, open elements, filament continuity, and operating quality on the basis of total emission. It tests all tube types encountered in radio and TV service work. Sockets are provided for 4, 5, 6 and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, 5 pin hytron miniatures, and pilot lamps. Tube condition indicated on 4½" meter with multi-color "good-bad" scale. Illuminated roll chart with all test data built in. Switch selection of 14 different filament voltages from .75 to 117 volts. Color-coded cable harness allows neat professional wiring and simplifies construction. Very easy to build, even for a beginner. Shpg. Wt. 12 lbs.

MODEL TC-2

\$29.50

HEATHKIT HANDITESTER KIT

The small size and rugged construction of this tester makes it perfect for any portable application. The combination function-range switch simplifies operations. Measures AC or DC voltage at 0-10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 (3000 ohm center scale). Very popular with home experimenters, electricians, and appliance repairmen. Slips easily into your tool box, glove compartment, coat pocket, or desk drawer. Shpg. Wt. 3 lbs.

MODEL M-1

\$14.50

HEATHKIT PICTURE TUBE CHECKER KIT

The CC-1 can be taken with you on service calls so that you can clearly demonstrate the quality of a customer's picture tube in his own home. Tubes can be tested without removing them from the receiver or cartons if desired. Checks cathode emission, beam current, shorted elements, and leakage between elements in electromagnetic picture tube types. Self-contained power supply, and large 4½" meter. CRT condition indicated on "good-bad" scale. Relative condition of tubes fluorescent coating is shown in "shadow-graph" test. Permanent test cable with CRT socket and anode connector. No tubes to burn out, designed to last a lifetime. Luggage-type portable case. Shpg. Wt. 10 lbs.

MODEL CC-1

\$22.50

HEATHKIT ETCHED-CIRCUIT VTVM KIT

This multi-purpose VTVM is the world's largest selling instrument of its type—and is especially popular in laboratories, service shops, home workshops and schools. It employs a large 4½" panel meter, precision 1% resistors, etched metal circuit board, and many other "extras" to insure top quality and top performance. It's easy to build, and you may rely on its accuracy and dependability. The V7-A will measure AC (RMS) and DC voltages in ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. It measures peak-to-peak AC voltage in ranges of 0-4, 14, 40, 140, 400, 1400 and 4000. Resistance ranges provide multiplying factors of X 1, X 10, X 100, X 1000, X 10k, X 100k, and X 1 megohm. Center-scale resistance readings are 10, 100, 1000, 10k, 100k, 1 megohm and 10 megohms. A db scale is also provided. The precision and quality of this VTVM cannot be duplicated at this price. Shpg. Wt. 7-lbs.

MODEL V7-A

\$24.50

Heathkits...

By DAYSTROM

*let you fill your exact needs
from a wide variety
of instruments*

HEATHKIT 20,000 OHMS/VOLT VOM KIT

This fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a 50 ua 4½" meter, and features 1% precision multiplier resistors. Requires no external power. Ideal for portable applications. Sensitivity is 20,000 ohms-per-volt DC and 5000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts, AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are X 1, X 100 and X 10,000, with center-scale readings of 15, 1500 and 150,000 ohms. Covers -10 db to +65 db. Easy to build and fun to use. Attractive bakelite case with plastic carrying handle. Shpg. Wt. 6 lbs.

MODEL MM-1

\$29.50

*High quality
test gear you
will be
proud to own*

TUBE CHECKER

ETCHED
CIRCUIT VTVM

20,000
OHMS/VOLT VOM

PICTURE TUBE
CHECKER

HANDITESTER

*Priced low
to fit your
budget*

HEATHKIT RF SIGNAL GENERATOR KIT

Even a beginner can build this prealigned signal generator, designed especially for use in service work. Produces RF signals from 160 kc to 110 mc on fundamentals in five bands. Covers 110 mc to 220 mc on calibrated harmonics. Low impedance RF output in excess of 100,000 microvolts, is controllable with a step-type and continuously variable attenuator. Selection of unmodulated RF, modulated RF, or audio at 400 CPS. Ideal for fast and easy alignment of radio receivers, and finds application in FM and TV work as well. Thousands of these units are in use in service shops all over the country. Easy to build and a real time saver, even for the part-time service technician or hobbyist. Shpg. Wt. 8 lbs.

MODEL SG-8
\$19.50

HEATHKIT LABORATORY RF GENERATOR KIT

Tackle all kinds of laboratory alignment jobs with confidence by employing the LG-1. It features voltage-regulated B+, double shielding of oscillator circuits, copper-plated chassis, variable modulation level, metered output, and many other "extras" for critical alignment work. Generates RF signals from 100 kc to 30 mc on fundamentals in five bands. Meter reads RF output in microvolts or modulation level in percentage. RF output available up to 100,000 microvolts, controlled by a fixed-step and a variable attenuator. Provision for external modulation where necessary. Buy and use this high-quality RF signal generator that may be depended upon for stability and accuracy. Shpg. Wt. 16 lbs.

MODEL LG-1
\$48.95

HEATHKIT DIRECT-READING CAPACITY METER KIT

Here's a fast, simple capacity meter. A capacitor to be checked is merely connected to the terminals, the proper range selected, and the value read directly on the large 4½" panel meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, .01 mfd, .1 mfd full scale. Not affected by hand capacity. Shpg. Wt. 7 lbs.

MODEL CM-1
\$29.50

Heathkits...

By DAYSTROM


*are educational
as well as functional*

HEATHKIT "IN-CIRCUIT" CAPACI-TESTER KIT


With the CT-1 it is no longer necessary to disconnect one capacitor lead to check the part, you can check most capacitors for "open" or "short" right in the circuit. Fast and easy—to save your valuable time in the service shop or lab. Detects open capacitors from about 50 mmf up, so long as the capacitor is not shunted by excessively low resistance value. Will detect shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage.) Employs 60 cycles and 19 megacycle test frequencies. Electron beam "eye" tube used as indicator. Compact, easy-to-build, and inexpensive. Test leads included. Shpg. Wt. 5 lbs.

MODEL CT-1
\$7.95


Use these kits for faster and more efficient testing




RF SIGNAL GENERATOR




DIRECT-READING CAPACITY METER




LABORATORY RF GENERATOR



CONDENSER CHECKER



"IN CIRCUIT" CAPACI-TESTER



VISUAL-AURAL SIGNAL TRACER

HEATHKIT CONDENSER CHECKER KIT

This handy instrument uses an electron beam "eye" tube as an indicator to measure capacity in ranges of .00001 to .005 mfd, .5 mfd, 50 mfd and 1000 mfd. Also measures resistance from 100 ohms to 5 megohms in two ranges. Checks paper, mica, ceramic and electrolytic capacitors. Selection of five polarizing voltages. Shpg. Wt. 7 lbs.

MODEL C-3
\$19.50

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed originally for radio receiver work, the T-3 finds application in FM and TV servicing as well. Features high-gain channel with demodulator probe, and low-gain channel with audio probe. Traces signals in all sections of radio receivers and in many sections of FM and TV receivers. Built-in speaker and electron beam eye tube indicate relative gain, etc. Also features built-in noise locator circuit. Provision for patching speaker and/or output transformer to external set. Shpg. Wt. 9 lbs.

MODEL T-3
\$23.50

HEATHKIT IMPEDANCE BRIDGE KIT

The model IB-2A employs a Wheatstone Bridge, a Capacity Comparison Bridge, a Maxwell Bridge, and a Hay Bridge in one compact package. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 100 mmf to 100 mfd, inductance from 0.1 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. A 100-0-100 ua meter provides for null indications. The decade resistors employed are of 1% tolerance for maximum accuracy. Completely self-contained. Has built in power supply, 1000-cycle generator, and vacuum-tube detector. Special two-section CRL dial insures convenient operation. Instruction manual has entirely new schematic that clarifies circuit functions in various switch positions. A true laboratory instrument, that will provide you with many years of fine performance. Shpg. Wt. 12 lbs.

MODEL IB-2A

\$59⁵⁰

HEATHKIT "LOW RIPPLE" BATTERY ELIMINATOR KIT

This modern battery eliminator incorporates an extra low-ripple filter circuit so that it can be used to power all the newest transistor-type circuits requiring 0 to 12 volts DC,

and the new "hybrid" automobile radios using both transistors and vacuum tubes. Its DC output, at either 6 or 12 volts, contains less than .3% AC ripple. Separate output terminals are provided for low-ripple or normal filtering. Supplies up to 15 amps on 6 volt range or up to 7 amps on 12 volt range. Output is variable from 0 to 8 or 0 to 16 volts. Two meters constantly monitor output voltage and current. Will also double as a battery charger. Shpg. Wt. 23 lbs.

MODEL BE-5

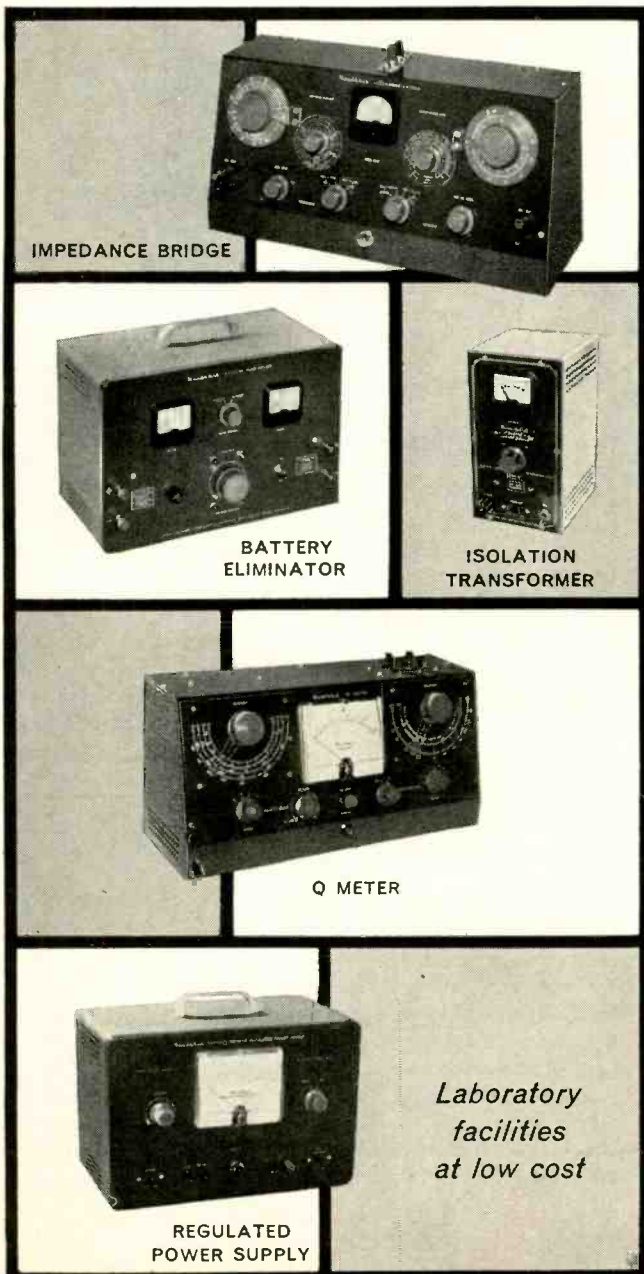
\$39⁹⁵

HEATHKIT ISOLATION TRANSFORMER KIT

The model IT-1 is one of the handiest units for the service shop, home workshop or laboratory. Provides complete isolation from the power line. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot". Output voltage is variable from 90 volts to 130 volts allowing checks of equipment under adverse conditions such as low line voltage. Rated for 100 volt amperes continuously or 200 volt amperes intermittently. Panel meter monitors output voltage. Shpg. Wt. 9 lbs.

MODEL IT-1

\$16⁵⁰



IMPEDANCE BRIDGE

BATTERY ELIMINATOR

ISOLATION TRANSFORMER

Q METER

REGULATED POWER SUPPLY

Laboratory facilities at low cost

Heathkits...

BY DAYSTROM

are designed with high-quality, name-brand components to insure long service life

HEATHKIT "Q" METER KIT

At this price the laboratory facilities of a Q Meter may be had by the average service technician or home experimenter. The Q Meter permits measurement of inductance from 1 microhenry to 10 milihenry, "Q" on a scale calibrated up to 250 full scale, with multipliers of 1 or 2, and capacitance from 40 mmf to 450 mmf \pm 3 mmf. Built in oscillator permits testing components from 150 kc to 18 mc. Large 4 1/2" panel meter is featured. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed, compile data for coil winding purposes, or measure RF resistance. Also checks distributed capacity and Q of coils. No special equipment is required for calibration. A special test coil is furnished, along with easy-to-follow instructions. Shpg. Wt. 14 lbs.

MODEL QM-1

\$44⁵⁰

HEATHKIT REGULATED POWER SUPPLY KIT

Here is a power supply that will provide DC plate voltage and AC filament voltage for all kinds of experimental circuits. The DC supply is regulated for stability, and yet the amount of DC output voltage available from the power supply can be controlled manually from 0 up to 500 volts. At 450 volts DC output, the power supply will provide up to 10 ma of current, and provide progressively higher current as the output voltage is lowered. Current rating is 130 ma at 200 volts output. In addition to furnishing B+ the power supply also provides 6.3 volts AC at up to 4 amperes for filaments. Both the B+ output and the filament output are isolated from ground. Ideal unit for use in laboratory, home workshop, ham shack, or service shop. A large 4 1/2" meter on the front panel reads output voltage or output current, selectable with a panel switch. Shpg. Wt. 17 lbs.

MODEL PS-3

\$35⁵⁰



*Terrific values
in amateur
equipment!*



DX-20 TRANSMITTER



DX-35 TRANSMITTER



DX-100 TRANSMITTER

HEATHKIT DX-20 CW TRANSMITTER KIT

The Heathkit model DX-20 "straight-CW" transmitter features high efficiency at low cost. It uses a single 6DQ6A tube in the final amplifier stage for plate power input of 50 watts. A 6CL6 serves as crystal oscillator, with a 5U4GB rectifier. It is an ideal transmitter for the novice, as well as the advanced-class CW operator. Single-knob band switching is featured to cover 80, 40, 20, 15, 11 and 10 meters. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long life. It has been given full "TVI" treatment. Access into the cabinet for crystal changing is provided by a removable metal pull-out plug on the left end of the cabinet. Very easy to build from the complete step-by-step instructions supplied, even if you have never built electronic equipment before. If you appreciate a good, clean signal on the CW bands, this is the transmitter for you! Shpg. Wt. 18 lbs.

MODEL DX-20

\$35⁹⁵

Heathkits...

By DAYSTROM

*are designed by
licensed ham-engineers,
especially for you*

HEATHKIT DX-35 PHONE AND CW TRANSMITTER KIT

The DX-35 transmitter can be thought of as the "little brother" of the DX-100. It features both phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 65 watt plate power input on CW, or controlled carrier modulation peaks up to 50 watts for phone operation. Modulator and power supplies are built right in and single knob band switching is combined with a pi network output circuit for complete operating convenience. The tight fitting cabinet

presents a most attractive appearance, and is designed for complete shielding to minimize TVI. Back panel control provides convenient switch selection of three different crystals, reached through access door at rear of cabinet. A most remarkable power package for the price. Complete step-by-step instructions with pictorial diagrams to assure your success in assembly. Shpg. Wt. 24 lbs.

MODEL DX-35

\$56⁹⁵

HEATHKIT DX-100 PHONE AND CW TRANSMITTER KIT

Listen to any ham band between 160 meters and 10 meters and note how many DX-100 transmitters you hear! The number of these fine rigs now on the air testifies to the enthusiasm with which it has been accepted by the amateur fraternity. No other transmitter in this power class combines high quality and real economy so effectively. The DX-100 features a built in VFO, modulator and power supplies, complete shielding to minimize TVI, and pi network output coupling to match impedances from approximately 50 to 600 ohms. Its RF output is in excess of 100 watts on phone and 120 watts on CW, for a clean strong signal on all the ham bands from 10 to 160 meters. Single-knob band switching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as "potted" transformers, silver-plated or solid coin silver switch terminals, aluminum heat-dissipating caps on the final tubes, copper plated chassis, etc. This transmitter was designed exclusively for easy step-by-step assembly. Shpg. Wt. 107 lbs.

MODEL DX-100

\$189⁵⁰

FUNCTIONAL DESIGN . . .

The transmitters described on this page were designed for the ham, by hams who know what features are desirable and needed. This assures you of the best possible performance and convenience, and adds much to your enjoyment in the ham shack.

Automatically turns off transmitter and gives visual signal



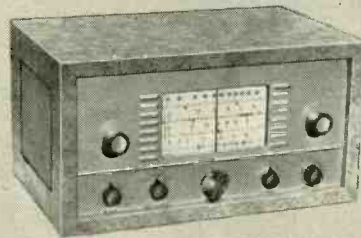
"AUTOMATIC"
CONELRAD ALARM



GRID DIP METER



"Q" MULTIPLIER



COMMUNICATIONS-TYPE
RECEIVER

*An ideal receiver
for the beginning
ham or short
wave listener*

HEATHKIT "AUTOMATIC" CONELRAD ALARM KIT

This conelrad alarm works with any radio receiver; AC-DC-transformer operated—or battery powered, so long as the receiver has AVC. Fully complies with FCC regulations for amateurs. When the monitored station goes off the air, the CA-1 automatically cuts the AC power to your transmitter, and lights a red indicator. A manual "reset" button reactivates the transmitter. Incorporates a heavy-duty six-ampere relay, a thyratron tube to activate the relay, and its own built-in power supply. A neon lamp shows that the alarm is working, by indicating the presence of B+ in the alarm circuit. Simple to install and connect. Your transmitter plugs into an AC receptacle on the CA-1, and a cable connects to the AVC circuit of a nearby receiver. A built-in sensitivity control allows adjustment to various AVC levels. Receiver volume control can be turned up or down, without affecting alarm operation. Build a Heathkit CA-1 in one evening and comply with FCC regulations now! Shpg. Wt. 4 lbs.

MODEL CA-1
\$13⁹⁵

HEATHKIT "Q" MULTIPLIER KIT

The Heathkit Q Multiplier functions with any AM receiver having an IF frequency between 450 and 460 KC, that is not "AC-DC" type. It derives its power from the receiver, and needs only 6.3 volts AC at 300 ma (or 12 VAC at 150 ma) and 150 to 250 volts DC at 2 ma. Simple to connect with cable and plugs supplied. Adds additional selectivity for separating signals, or will reject one signal and eliminate heterodyne. A tremendous help on crowded phone and CW bands. Effective Q of 4000 for sharp "peak" or "null". Tunes any signal within IF band, pass without changing the main receiver tuning dial. A convenient tuning knob on the front panel with vernier reduction between the tuning knob and the tuning capacitor gives added flexibility in operation. Uses a 12AX7 tube, and special high-Q shielded coils. Instructions for connecting to the receiver and operation are provided in the construction manual. A worthwhile addition to any communications, or broadcast receiver. It may also be used with a receiver which already has a crystal filter to obtain two simultaneous functions, such as peaking the desired signal with the crystal filter and nulling an adjacent signal with the Q Multiplier. Shpg. Wt. 3 lbs.

MODEL QF-1
\$9⁹⁵

HEATHKIT GRID DIP METER KIT

A grid dip meter is basically an RF oscillator for determining the frequency of other oscillators, or of tuned circuits. Extremely useful in locating parasitics, neutralizing, identifying harmonics, coil winding, etc. Features continuous frequency coverage from 2 mc to 250 mc, with a complete set of prewound coils, and a 500 ua panel meter. Front panel has a sensitivity control for the meter, and a phone jack for listening to the "zero-beat." Will also double as an absorption-type wave meter. Shpg. Wt. 4 lbs.

Low Frequency Coil Kit: Two extra plug-in coils to extend frequency coverage down to 350 kc. Shpg. Wt. 1 lb. No. 341-A. \$3.00

MODEL GD-18
\$19⁹⁵

HEATHKIT ALL-BAND COMMUNICATIONS-TYPE RECEIVER KIT

This communications-receiver covers 550 kc to 30 mc in four bands, and provides good sensitivity, selectivity, and fine image rejection. Ham bands are clearly marked on an illuminated dial scale. Features a transformer-type power supply—electrical band spread—antenna trimmer—headphone jack—automatic gain control and beat frequency oscillator. Accessory sockets are provided on the rear of the chassis for using the Heathkit model QF-1, Q Multiplier. Accessory socket is handy, also, for operating other devices that require plate and filament potentials. Will supply +250 VDC at 15 ma and 12.6 VAC at 300 ma. Ideal for the beginning ham or short wave listener. Shpg. Wt. 12 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Part no. 91-15A. Shpg. Wt. 5 lbs. \$4.95.

MODEL AR-3
\$29⁹⁵
(Less cabinet)

Heathkits...

By DAYSTROM

*are outstanding in performance
and dollar value*

HEATHKIT REFLECTED POWER METER KIT

The Heathkit reflected power meter, model AM-2, makes an excellent instrument for checking the match of the antenna transmission system, by measuring the forward and reflected power or standing wave ratio. The AM-2 is designed to handle a peak power of well over 1 kilowatt of energy and may be left in the antenna system feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances for 50 or 75 ohm lines. No external power required for operation. Meter indicates percentage forward and reflected power, and standing wave ratio from 1:1 to 6:1. Another application for the AM-2 is matching impedances between exciters or R.F. sources and grounded grid amplifiers. Power losses between transmitter output and antenna tuner may be very easily computed by inserting the AM-2 in the line connecting the two. No insertion loss is introduced into the feeder system, due to the fact that the AM-2 is a portion of coaxial line in series with the feeder system and no internal connections are actually made to the line. Complete circuit description and operation instructions are provided in the manual. Cabinet size is 7-3/8" x 4-1/16" x 4-5/8". Can be conveniently located at operating position. Shpg. Wt. 3 lbs.

MODEL AM-2

\$15⁹⁵

HEATHKIT VARIABLE FREQUENCY OSCILLATOR KIT

Enjoy the convenience and flexibility of VFO operation by obtaining the Heathkit model VF-1 Variable Frequency Oscillator. Covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10 volt average RF output on fundamentals. Plenty of output to drive most modern transmitters. It features voltage regulation for frequency stability. Dial is illuminated for easy reading. Vernier reduction is used between the main tuning knob and the tuning condenser. Requires a power source of only 250 volts DC at 15 to 20 miliamperes and 6.3 volts AC at 0.45 amperes. Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts throughout. VFO operation allows you to move out from under interference and select a portion of the band you want to use without having to be tied down to only two or three frequencies through use of crystals. "Zero in" on the other fellow's signal and return his CQ on his own frequency! Crystals are not cheap, and it takes quite a number of them to give anything even approaching comprehensive coverage of all bands. Why hesitate? The model VF-1 with its low price and high quality will add more operating enjoyment to your ham activities. Shpg. Wt. 7 lbs.

MODEL VF-1

\$19⁵⁰

Heathkits...

By DAYSTROM

are the answer for your electronics hobby.

HEATHKIT BALUN COIL KIT

The Heathkit Balun Coil Kit model B-1 is a convenient transmitter accessory, which has the capability of matching unbalanced coax lines, used on most modern transmitters, to balance lines of either 75 or 300 ohms impedance. Design of the bifilar wound balun coils will enable transmitters with unbalanced output to operate into balanced transmission line, such as used with dipoles, folded dipoles, or any balanced antenna system. The balun coil set can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will easily handle power inputs up to 250 watts. Cabinet size is 9" square by 5" deep and it may be located any distance from the transmitter or from the antenna. Completely enclosed for outdoor installation. Shpg. Wt. 4 lbs.

MODEL B-1

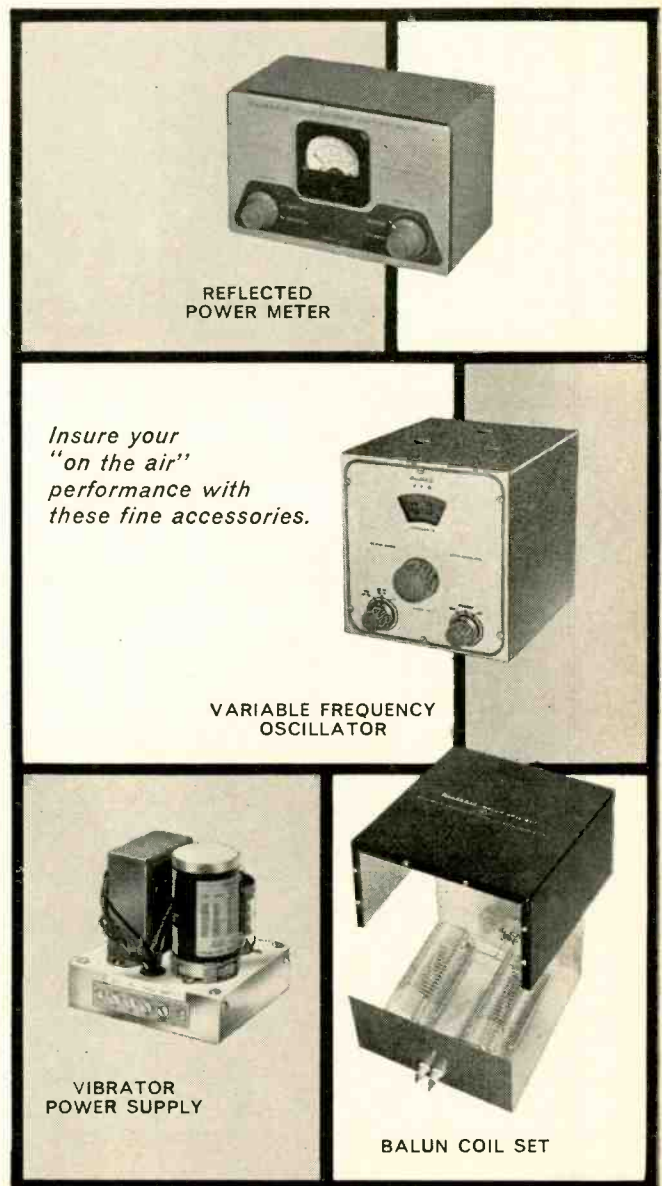
\$8⁹⁵

HEATHKIT 6 OR 12 VOLT VIBRATOR POWER SUPPLY KITS

These little power supply kits are ideal for all portable applications with 6 volt or 12 volt batteries, when you are operating electronic equipment away from power lines. By replacing the power supplies of receivers, small public address systems, or even miniature transmitters with these units, they can be used with conventional 6 or 12 volt batteries. Use in boats, automobiles, light aircraft, or any field application. Each unit provides 260 volts DC output at up to 60 miliamperes. More than one power supply of the same model may be connected in parallel for increased current capacity at the same output voltage. Everything is provided in the kit, including a vibrator transformer, a vibrator, 6X4 or 12X4 rectifier, and the necessary buffer capacitor, hash filter, and output filter capacitor. Shpg. Wt. 4 lbs.

6 VOLT
MODEL VP-1-6
12 VOLT
MODEL VP-1-12

\$7⁹⁵ Each



REFLECTED POWER METER

Insure your "on the air" performance with these fine accessories.

VARIABLE FREQUENCY OSCILLATOR

VIBRATOR POWER SUPPLY

BALUN COIL SET

HEATH COMPANY A Subsidiary of Daystrom, Inc. BENTON HARBOR 20, MICH.

SEPTEMBER, 1957

73

HEATHKIT ELECTRONIC IGNITION ANALYZER KIT

Previous electronic experience is not necessary to build this fine ignition analyzer. The construction manual supplied has complete step-by-step instructions plus large pictorial diagrams showing the exact placement and value of each component. All parts are clearly marked so that they are easily identified. The IA-1 is an ideal tool for engine mechanics, tune-up men, and auto hobbyists, since it traces the dynamic action of voltage in an ignition system on a cathode-ray tube screen. The wave form produced is affected by the condition of the coil, condenser, points, plugs, and ignition wiring, so it can be analyzed, and used as a "sign-post" to ignition system performance. This analyzer will detect inequality of spark intensity, a poor spark plug, defective plug wiring, breaker-point bounce, an open condenser, and allow setting of dwell-time percentage for the points. An important feature of this instrument is its ability to check dynamic performance, with the engine in operation (400 to 5000 RPM). It will show the complete engine cycle, or only one complete cylinder. Can be used on all types of internal combustion engines where breaker-points are accessible. Use it on automobiles, boats, aircraft engines, etc. Shpg. Wt. 18 lbs.

MODEL IA-1

\$59⁹⁵

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This Heathkit professional-type radiation counter is simple to build successfully, even if you have never built a kit before. Complete step-by-step instructions are combined with giant-size pictorial diagrams for easy assembly. By "building it yourself" you can have a modern-design, professional radiation counter priced far below comparable units. Provides high sensitivity with ranges from 0-100, 600, 6000 and 60,000 counts-per-minute, and 0-.02, .1, 1 and 10 miliroentgens-per-hour. Employs 900-volt bismuth tube in beta/gamma sensitive probe. Probe and 8-foot expandable cable included in kit price, as is a radiation sample for calibration. Use it in medical laboratories, or as a prospecting tool, and for civil defense to detect radioactive fallout, or other unknown radiation levels. Features a selectable time constant. Meter calibrated in CPM or mR/hour in addition to "beep" or "click" from panel-mounted speaker. Prebuilt "packaged" high voltage power supply with reserve capacity above 900 volt level at which it is regulated. Merely changing regulator tube type would allow use of scintillation probe if desired. Employs five tubes (plus a transistor) to insure stable and reliable operation. Kit price includes batteries. Shpg. Wt. 8 lbs.

MODEL RC-1

\$79⁹⁵

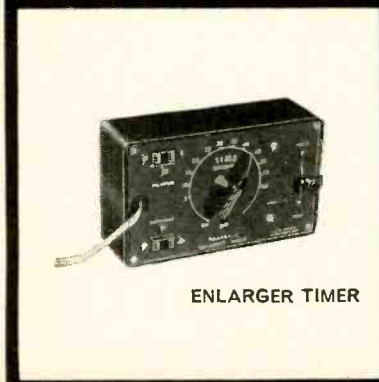


IGNITION ANALYZER



Kit includes everything you need for construction — even batteries!

RADIATION COUNTER



ENLARGER TIMER



BATTERY TESTER

Heathkits...

By DAYSTROM

are supplied with comprehensive instructions that eliminate costly mistakes and save valuable time

HEATHKIT ENLARGER TIMER KIT

The ET-1 is an easy-to-build electronic device to be used by amateur or professional photographers in timing enlarger operations. The calibrated dial on the timer covers 0 to 1 minute, calibrated in 5-second gradations. The continuously variable control allows setting of the "on" cycle of your enlarger, which is plugged into a receptacle on the front panel of the ET-1. A "safe light" can also be plugged in so that it is automatically turned "on" when the enlarger is turned "off." Handles up to 350 watts with built-in relay. All-electronic timing cycle insures maximum accuracy. Timer does not have to be reset after each cycle, merely flip lever switch to print, to repeat time cycle. A control is provided for initial calibration. Housed in a compact plastic case that will resist attack of photographic chemicals. A fine addition to any dark room. Shpg. Wt. 3 lbs.

MODEL ET-1

\$11⁵⁰

HEATHKIT BATTERY TESTER KIT

The BT-1 is a special battery testing device that actually "loads" the battery under test (draws current from it) while it is being tested. Weak batteries often test "good" with an ordinary voltmeter but the built-in load resistance of the BT-1 automatically draws enough current from the battery to reveal its true condition. Simple to operate with "good-weak-replace" scale. Tests all kinds of dry cell batteries within ranges of 0-15 volts and 0-180 volts. Slide switch provides for either 10 ma or 100 ma load, depending on whether you're testing an A or B battery. Not only determines when battery is completely exhausted, but makes it possible to anticipate failure by noting weak condition. Ideal for testing dry cell hearing aid, flashlight, portable radio, and model airplane batteries. Test batteries in a way your customers can understand and stimulate battery sales. Shpg. Wt. 2 lbs.

MODEL BT-1

\$8⁵⁰



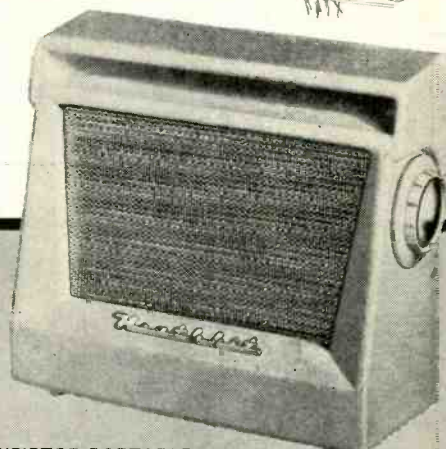
CRYSTAL RADIO



Now you can have radio
wherever you go —
with the portable
that plays anywhere!



BROADCAST BAND RADIO



TRANSISTOR PORTABLE

HEATHKIT CRYSTAL RADIO KIT

The Heathkit model CR-1 crystal radio is similar to the "crystal sets" of the early radio days except that it has been improved by the use of sealed germanium diodes and efficient "high-Q" coils. The sealed diodes eliminate the critical "cats whisker" adjustment, and the ferrite coils are much more efficient for greater signal strength. Housed in a compact plastic box, the CR-1 uses two tuned circuits, each with a variable tuning capacitor, to select the local station. It covers the broadcast band from 540 to 1600 kc. Requires no external power whatsoever. This receiver could prove valuable to emergency reception of civil defense signals should there be a power failure. The low kit price even includes headphones. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. The instruction manual also provides the builder with the basic fundamentals of signal reception so that he understands how the crystal receiver functions. An interesting and valuable "do-it-yourself" project for all ages. Shpg. Wt. 3 lbs.

MODEL CR-1
\$7⁹⁵

result of these efforts. Six name-brand (Texas Instrument) transistors were selected for extra good sensitivity and selectivity. A 4" by 6" PM speaker with heavy magnet was chosen to insure fine tone quality. The power supply was designed to use six standard size "D" flashlight cells because they are readily available, inexpensive, and because they afford extremely long battery life (between 500 and 1000 hours). Costs you no more to operate from batteries than what you pay for operating a small table-model radio from the power line. An unbreakable molded plastic was selected for cabinet material because of its durability and striking beauty. Circuit is compact and efficient, yet components are not excessively crowded. Transformers are prealigned so it is ready for service as soon as construction is completed. Has built in rod-type antenna for reception in all locations. Cabinet dimensions are 9" L x 8" H x 3 3/4" D. Comes in holiday gray, with gold-anodized metal speaker grille. Compare this portable, feature by feature, to all others on the market, and you'll appreciate what a tremendous dollar value it represents! Shpg. Wt. 4 lbs.

MODEL XR-1

\$34⁹⁵

(less batteries)
(With cabinet)

Heathkits...

By DAYSTROM

are easy and fun to build,
and they let you learn
by "doing-it-yourself"

HEATHKIT TRANSISTOR PORTABLE RADIO KIT

Heath engineers set out to develop a "universal" AM radio, suitable for use anywhere. Their objective was a portable that would be as much "at home" inside as it is outside, and would feature top quality components for high performance and long service life. The model XR-1 is the

HEATHKIT BROADCAST BAND RADIO KIT

This table-model broadcast radio is fun to build, and is a fine little receiver for your home. It covers the standard broadcast band from 550 to 1600 kc with good sensitivity and selectivity. The 5 1/2" PM speaker provides surprisingly good tone quality. High-gain IF transformers, miniature tubes, and a rod-type built in antenna, assure good reception in all locations. The power supply is transformer operated, as opposed to many of the economy "AC-DC" types. It's easy to build from the step-by-step instructions, and the construction manual includes information on operational theory, for educational purposes. Your success is assured by completely detailed information which also explains resistor and capacitor color codes, soldering techniques, use of tools, etc. A signal generator is recommended for final alignment. Shpg. Wt. 10 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Shpg. Wt. 5 lbs. Part no. 91-9A. \$4.95.

MODEL BR-2

\$18⁹⁵

(less cabinet)

protects against possible explosion and fire from undetected fuel vapor



FUEL VAPOR DETECTOR

detects electrolysis currents which cause deterioration of underwater metal fittings on your boat

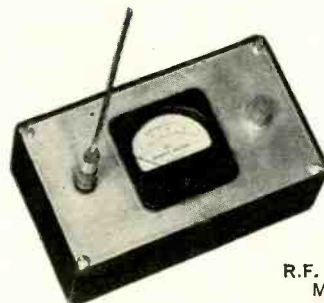


ELECTROLYSIS DETECTOR

indicates condition and charge of batteries for safe cruising



BATTERY CHARGE INDICATOR



R.F. POWER METER

HEATHKIT FUEL VAPOR DETECTOR KIT

Protect your boat and its passengers against fire or explosion from undetected fuel vapor by building and using one of these fine units. The Heathkit Fuel Vapor Detector indicates the presence of fumes on a three-color "safe-dangerous" meter scale and immediately shows if it is safe to start the engine. A pilot light on the front panel shows when the detector is operating, and it can be left on continuously, or just used intermittently. A panel control enables initial calibration of the detector when installed. Features a hermetically-sealed meter with chrome bezel, and a chrome-plated brass panel. It is very simple to build and install, even by one not having previous experience. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from your boat batteries. The kit is complete in every detail, even to the inclusion of a spare detector unit. Shpg. Wt. 4 lbs.

6 volt
MODEL FD-1-6
12 volt
MODEL FD-1-12

\$35⁹⁵
EACH

HEATHKIT BATTERY CHARGE INDICATOR KIT

The Heathkit model CI-1 Marine Battery Charge Indicator has been designed especially for the boat owner, although it has found use in service stations, power stations, and radio stations where banks of batteries are kept in reserve for emergency power. It is intended to replace the hydrometer method of checking storage batteries, and to eliminate the necessity for working with acid in small, below-decks enclosures. Now it is possible to check as few as one, or as many as eight storage batteries, merely by turning the switch and watching the meter. A glance at the meter tells you instantly whether your batteries are sufficiently charged for safe cruising. Dimensions are 2-7/8" W x 5-11/16" H x 2" D. Operates on either 6 or 12 volt systems using lead-acid batteries, regardless of size. Simple installation can be accomplished by the boat owner in fifteen minutes. Shpg. Wt. 3 lbs.

MODEL CI-1
\$16⁹⁵

HEATHKIT ELECTROLYSIS DETECTOR KIT

The Heathkit model ED-1 Electrolysis Detector indicates the extent of electrolysis currents between the boat's common ground and underwater fittings, except on boats having metal hulls. These currents, undetected, could

cause gradual corrosion and deterioration of the propeller or other metal fittings below the water line. It is particularly helpful when installing electrical equipment of any kind, or to determine proper polarity when power is obtained from a shore supply. Easy-to-build, the model ED-1 consists of a hermetically-sealed, waterproof meter, special sensing plate, and sufficient wire to install, including the necessary hardware. Mounts on instrument panel where it can be easily seen. Requires no power for operation, and gives instant warning to guard your boat for a lifetime. Shpg. Wt. 2 lbs.

MODEL ED-1
\$9⁹⁵

HEATHKIT RF POWER METER KIT



The Heathkit RF Power Meter Kit is designed to sample the RF field in the vicinity of your transmitter, whether it be marine, mobile, or fixed. Output meter is merely placed in some location close to the transmitter, to pick up RF radiation from the antenna. Requires no batteries, electricity, nor direct connection to the transmitter. It provides you with a continuing indication of transmitter operation. You can easily detect if power is dropping off by comparing present meter readings with past ones. Operates with any transmitter having output frequencies between 100 kc and 250 mc, regardless of power. Sensitivity is 0.3 volts RMS full scale, and a special control on the panel allows for further adjustment of the sensitivity. Meter is a 200 ua unit, mounted on a chrome-plated brass panel. The entire PM-1 measures only 3 3/4" W x 6 1/4" L x 2" D. An easy way to put your mind at ease concerning transmitter operation. Shpg. Wt. 2 lbs.

MODEL PM-1
\$14⁹⁵

Heathkits...

By DAYSTROM

now offer you completely modern marine equipment with outstanding design features

Because of a continued increase in the demand for Pickering high fidelity products — manufacturing facilities have been expanded, and more efficient fabrication techniques have been developed. As a result — we are happy to announce new low audiophile net prices for the Series 350  Twin Fluxvalve Cartridge, and the Series 3500  “T-Guard” Styli. Prices of the Series 350 Fluxvalve Cartridge now start at a modest \$24. Now! Everyone can afford the world’s finest cartridge.

Pickering & Company, Inc.

P.S. We are also excited about our new Series 370 Single Fluxvalve Cartridge — why not see and hear the 370 at your hi-fi dealer today — we know that you will be excited too. P.C.



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“For those who can **hear** the difference” FINE QUALITY HIGH FIDELITY PRODUCTS BY



PICKERING & COMPANY, INC.,

Oceanside, N. Y.

ELECTRONICS

(Continued from page 61)
following precautions will insure low line capacitance and should be followed as far as possible:

1. Install the controller as near to the plate as possible.
2. Keep the line as far away from the ground and other conductors as possible.
3. Use small-gauge wire that has heavy plastic insulation.

Varying degrees of moisture in the earth and nearby objects may cause corresponding changes in lead capacitance and unit sensitivity in some installations. Constant line capacitance and sensitivity can be assured if shielded connecting cable is used, but this should be done only if such mois-



The Sandretto door-chime control plate. ture or possible other variations interfere. High-frequency cable such as RG-62/U or RG-71/U is recommended because it has very low capacitance (13.5 μf per foot for the types mentioned). The shield must be connected to a good earth ground.

Fig. 2-a shows the first type of actuator. Whenever the normally closed pushbutton switch is pressed, the starter anode is ungrounded and resistor R2 fires the thyatron. R3 is a protective resistor. Note that different values are used, depending on whether an 0A4 or a 1C21 is used. Ground capacitance of the connecting line does not interfere with circuit operation unless the line is rather long. In this instance a slightly lower value may be necessary for R2. The power cord of the unit must be inserted so that the grounded side of the power line goes to the tube cathode. The two following types of actuation plates require the opposite polarity.

Fig. 2-b illustrates a touch plate like the one in the photograph. Constructors will probably prefer this type over the other two because of its simplicity and novelty. When a person touches the small piece of metal in the center, his body capacitance to ground fires the controller. Fig. 3 shows how a touch plate is constructed. Moisture acts as a short to ground. Therefore, when the sandwich construction is used, the plate edges should be water-sealed with ce-

When you build your High Fidelity sound system, use **THE VERY BEST** **LOUDSPEAKERS YOU CAN GET**



You are planning to build, or improve, your high fidelity sound system. Unstintingly, you will pour out your enthusiasm, time, and energy to get the finest music reproduction you can bring into your home. Get a loudspeaker that will do full credit to your handiwork... Install a JBL Signature Extended Range Loudspeaker, or two-way speaker system, in your enclosure.

JBL Signature Loudspeakers are made with the same careful craftsmanship, the same precision forming and fitting that you yourself would use if you set out to make the finest loudspeaker the world had ever heard. JBL Signature precision speakers are the most efficient loudspeakers made.

With a JBL Signature Loudspeaker in your high fidelity system, you can exhibit your components with pride, confident that those you have made yourself are being demonstrated in the most effective way possible.



MODEL D130—15" extended range loudspeaker The only 15" extended range speaker made with a 4" voice coil is the world-famous JBL Signature D130. The large voice coil stiffens the cone for crisp, clean bass; smooth, extended highs. Your basic speaker, the D130 works alone at first, later becomes a low frequency driver when you add a JBL Signature high frequency unit and dividing network to achieve the ultimate excellence of a JBL Signature two-way system.



MODEL D208—8" extended range loudspeaker A precision transducer in every sense of the word, the famed JBL Signature 8" D208 is made with the same care and precision as the larger units in the James B. Lansing Sound, Inc., line. If space and cost are major considerations, the D208, properly enclosed, provides the most lastingly satisfactory sound you can get. It is widely used in top quality systems where extension speakers are desired for areas other than the main listening room.



MODEL D123—12" extended range loudspeaker With outstanding "presence" and clean response throughout the entire audio spectrum, the D123 features an unusual shallow construction. Only 3 3/8" deep, it is designed to mount flush with the wall, between studding, in any standard wall or partition. Frequently, the D123 is used in multiples in "infinite baffle" wall installations. In this case the JBL Signature 075 is a logical high frequency unit to add when you advance to a two-way system.

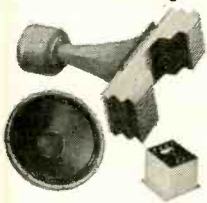


MODEL 175DLH high frequency assembly The acoustical lens is only available on JBL Signature high frequency units. The 14 element lens on the 175DLH disperses sound within the listening area over a 90° solid angle, smoothly, with equal intensity regardless of frequency. The acoustical lens is the greatest contribution to lifelike high frequency reproduction in 20 years, and it was developed for use with high fidelity equipment by James B. Lansing Sound, Inc. In addition to the lens, the 175DLH consists of a high precision driver with complex phasing plug and a machined aluminum exponential horn. Designed for crossover at 1200 cycles with the JBL Signature N1200 Network.



MODEL 075 high frequency unit Another exclusive for James B. Lansing Sound, Inc. is the ring radiator in the JBL Signature 075 high frequency unit. A ring, rather than a diaphragm, radiates into the annular throat of an exponential horn. The result is high frequency reproduction of unmatched smoothness and clarity, absolutely free of resonances and strident peaks. The horn is beautifully machined from aluminum, the entire unit a gratifying, solid piece of fine craftsmanship. Designed for crossover at 2500 cycles with the JBL Signature N2500 Network.

JBL Signature two-way systems are available as kits



086 KIT This two-way system is made up of units which have been acclaimed by impartial authorities as the finest available anywhere today. Included in the kit are the 150-4C Low Frequency Driver, N500H Network, 375 High Frequency Driver, 537-509 Horn-Lens Assembly. These are the same units — including the serpentine acoustical lens — which are used in The Hartsfield... units designed originally for installation in the most modern theaters in the world.



002 KIT Including some of the newest speakers made, the JBL Signature 002 Kit includes a D123 for low frequency reproduction, N2500 Network, 075 High Frequency Unit. The 002 Kit is moderately priced, yet gives the user all the advantages of a two-way system made with independent drivers.



001 KIT Probably the most popular high quality two-way system on the market, the JBL Signature 001 system consists of a 130A Low Frequency Driver, N1200 Network, 175DLH High Frequency Assembly. The D130 may be substituted for the 130A without disturbing the balance or coverage of the system.

There are many more kits and loudspeakers in the JBL Signature line. Whatever your needs, you will find exactly the right unit or system in the complete JBL Signature catalog. Send for your free copy. A limited number of technical bulletins are also available. Please ask only for those in which you are vitally interested.



JAMES B. LANSING SOUND, INC.
2439 Fletcher Drive • Los Angeles 39, California

Please send me the following:

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TECHNICAL BULLETINS ON:

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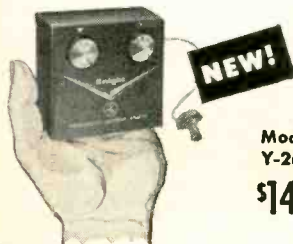
Zone _____

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BUILD THE BEST— BUILD ALLIED'S OWN knight-kits

Here is a typical Knight-Kit value—available only from ALLIED—one of 45 great Knight-Kits you'll find in our special Supplement No. 165. Write for your FREE copy today.

knight-kit HOBBYIST VALUE 2-TRANSISTOR POCKET RADIO



Model
Y-262
\$1465

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ELECTRONICS

ment. The connection-wire hole must also be sealed with several coats of cement.

The 250- μ f capacitor and 1-megohm potentiometer shown in 2-b and 2-c are not used unless a completed unit falsely fires. Then they are mounted on the controller and R4 adjusted to balance out the most likely cause of false firing—the ground capacitance of the connecting line. Inserting this control allows sensitivity adjustment, too.

A piece of conducting metal foil attached to a window or other piece of glass or plastic forms the third type of actuation plate. This is shown in Fig. 2-c. Body capacitance fires the unit when a person places his hand on the opposite side of the glass. The intervening glass reduces sensitivity. Consequently larger pieces of metal foil and thinner glass give greater sensi-

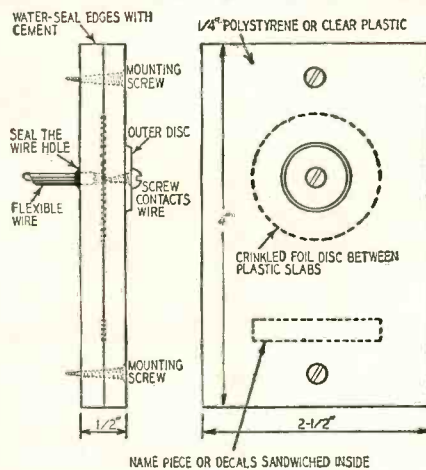
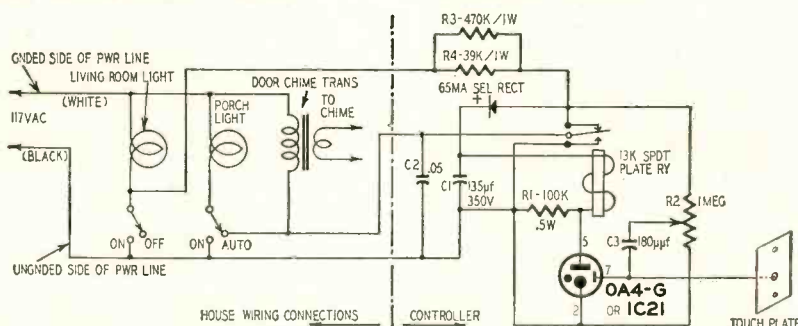


Fig. 3—Details of contact control actuation plate.

tivity because they increase the effective body capacitance. The connection to the aluminum foil may be made with a small alligator clip.

Special circuit

The circuit for the previously described porch-light-door-chime unit is given in Fig. 4. Simplicity and unique control functions were easily achieved with few parts. The circuit can be modified for other uses and serves as an example of individual tailoring. (If only a doorbell or chime controller is wanted, use the Fig. 1 circuit.)



R1, R3, R4—See text
R2—1-megohm pot
C1—100-300 μ f, see text (350-volt electrolytic)
C2—.05 μ f paper, 600 volts
C3—180- μ f mica or ceramic

Basically the Fig. 4 circuit differs from that of Fig 1 only in the method of resetting. During standby periods virtually the full line voltage appears across the controller terminals because little current is drawn through the porch-light or chime transformer. When the tube is fired the closing relay contacts short out the controller connections, causing the chime to sound and the lamp to light unless it has already been switched on manually.

Many homes have a double wall switch for the living room and porch lights. Replace the porch-light switch with a two-way unit (spdt) and connect a wire from the chime transformer to the proper terminal. If the common wire to the switches is already the ungrounded side of the power line, all three controller connections are then made to the switches. The door chime is connected directly to the transformer secondary. Although current will be flowing through the chime for many seconds it is unlikely that its coil will overheat.

The component values given are those used in the author's own unit. Resistors R1 and R3-R4 must be experimentally selected, however, for each individual unit. R1 extinguishes the tube just before the relay opens, but its value must not be so low that the relay armature is drawn in during standby periods. R3-R4 adds considerable length to the relay hold-in period. Decreasing resistances are tried for R4 until a hold-in period of approximately 20 seconds is obtained. After the unit has been in operation several weeks and the components have aged, a high parallel resistance R3 can be added to obtain a longer relay hold-in period.

A large value of capacitance has been used for C1. Greater capacitances, obtained by adding capacitors in parallel, will give longer hold-in periods.

The relay is from a surplus marker-beacon receiver and is carefully adjusted for maximum sensitivity.

(The connection of this controller—or any device requiring changes or additions to the original house wiring should be made by an electrician familiar with local codes. Also, it is advisable to obtain written permission from your fire-insurance agent before installation.—Editor) END

RECT—65-ma selenium rectifier
RY—Plate circuit relay, 13,000-ohms or higher coil resistance
V—0A4-G or IC21 thyratron

Fig. 4—Schematic of the combination door-chime and porch-light control.

ELECTRONIC SURVEILLANCE KIT

A compact, completely portable kit for police and counter-intelligence work. Part I includes the amplifier and the rf and induction pickups

By LOUIS E. GARNER, JR.



CONTRARY to most radio and TV programs, novelists and motion pictures, not all undercover work is strictly cloak and dagger, nor are all espionage agents slinky brunettes with long-stemmed cigarette holders or tall, thin, hollow-cheeked, monocle-wearing, heel-clicking middle-aged men with thick accents. And not all counter-intelligence agents are clean-cut, blond young men in trench coats. Often, a successful agent is a highly trained electronics technician.

In fact, some of the most interesting, yet least publicized, applications of electronics have been in the field of undercover investigations and counter-intelligence operations. Detectives, police officers and government agents frequently use electronic equipment to obtain evidence on known or suspected criminals or to discover illegal activities. Counter-intelligence operatives find electronic equipment valuable in breaking up spy networks and sabotage groups.

While nearly all the equipment used in espionage work is highly classified, the type used in counter-intelligence and police work is not especially secret, although not too well known outside the fields in which it is used. Many of the most useful pieces of equipment can be duplicated easily and at moderate cost by a competent technician.

The most useful electronic item in counter-intelligence work is not any one item but a kit of essential electronic instruments, tools and accessories. With a complete kit, an operative can meet various situations as they arise in the field, without returning to "home base" for some special unit. The basic electronic components in such an electronic surveillance kit are shown in the photographs.

Basically, the kit consists of an audio amplifier, an assortment of sensitive pickup probes and transducers, and various types of output devices. In

addition, spare parts, installation materials and tools are included. All the components fit into a lightweight, sturdy and easy-to-carry case.

The amplifier

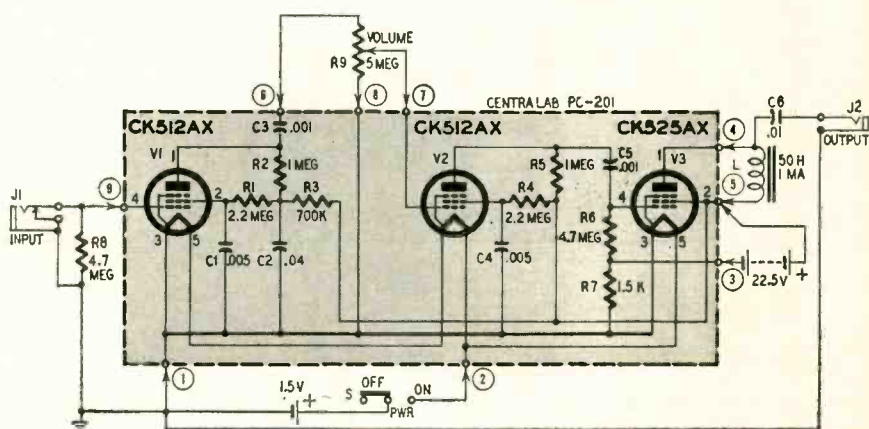
The heart of the kit is a compact, high-gain, battery-operated amplifier. Except for the input and output jacks and the lack of a built-in microphone, its circuitry is very similar to that of a hearing aid. The circuit of a suitable amplifier is seen in Fig. 1. Interior and exterior views of an assembled model are shown in the photographs. This unit incorporates a commercially available three-stage printed-circuit amplifier in its design.

Audio signals obtained from a sensi-

tive pickup probe are applied to IN jack J1 and to the grid of the first amplifier stage, a CK512AX subminiature hearing-aid type tube.

After amplification through two more stages, the output signal appears across miniature audio choke L, the output stage's plate load impedance and is coupled through blocking capacitor C6 to the output jack J2. Either high-impedance magnetic or crystal phones may be connected to this output jack.

An external volume control R9 also serves as the grid return resistor for the second stage. Screen grid voltages are furnished through resistors R1 and R4. Capacitor C2 and resistor R3 form a decoupling and isolation network for



*R1, 4—2.2 megohms

*R2, 5—1 megohm

*R3—700,000 ohms

*R4—4.7 megohms

*R7—1,500 ohms

*R8—4.7 megohms

R9—5 megohms, subminiature control (Centralab No. B16-128)

All resistors $\frac{1}{2}$ watt

*C1, 4—.005 μ f

*C2—.04 μ f

*C3, 5—.001 μ f

C6—.01 μ f, disc ceramic

J1—closed-circuit phone jack

J2—open-circuit phone jack

L—miniature audio choke, 50 h,

1 ma (UTC No. SO-5)

S—spst slide

*V1, 2—CK512AX

*V3—CK525AX

BATT—1.5 volts (Burgess No. Z

penlight cell)

BATT—22.5 volts (Burgess No.

U20E)

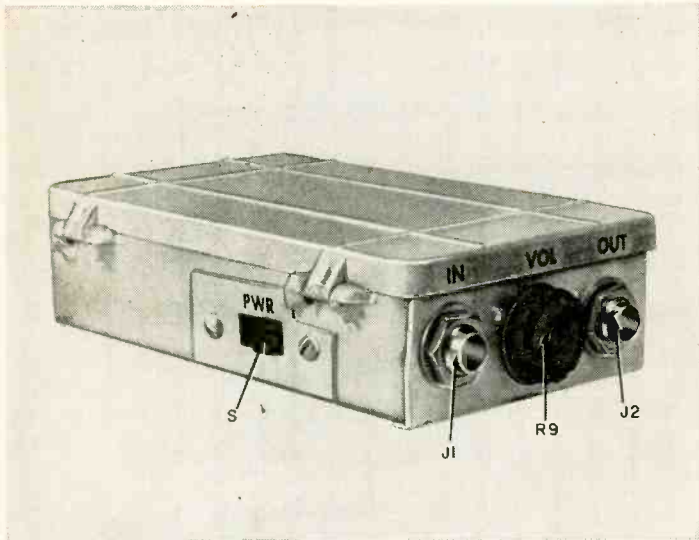
Plastic Case

Miscellaneous hardware

*Components in Centralab Ampec

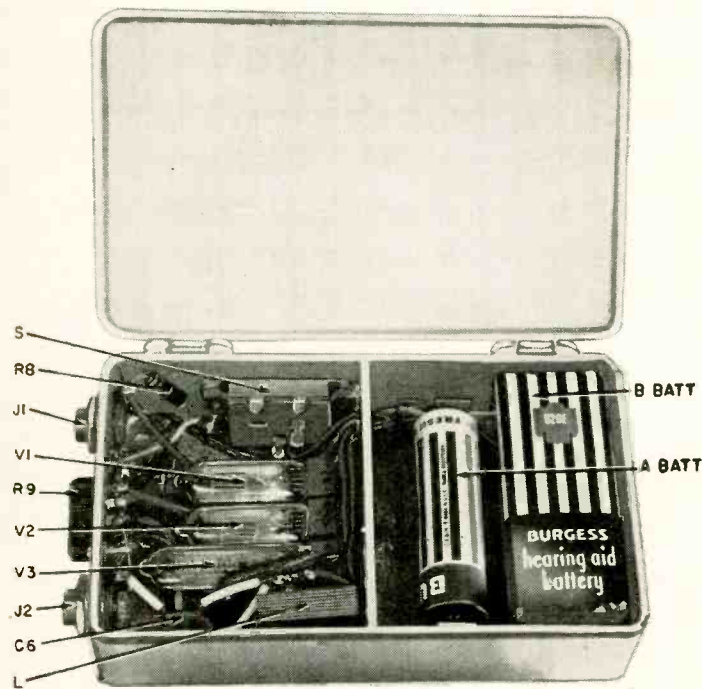
PC-201 amplifier.

Fig. 1—Miniature amplifier's circuit.



Complete amplifier fits into a small plastic case.

Layout of kit. Everything is securely fastened to case.



Amplifier layout, heart of the surveillance kit.

the first stage. Grid bias for the output stage is obtained from the voltage drop across R7, in series with the B-minus supply. The screen grid of the final stage returns directly to B plus.

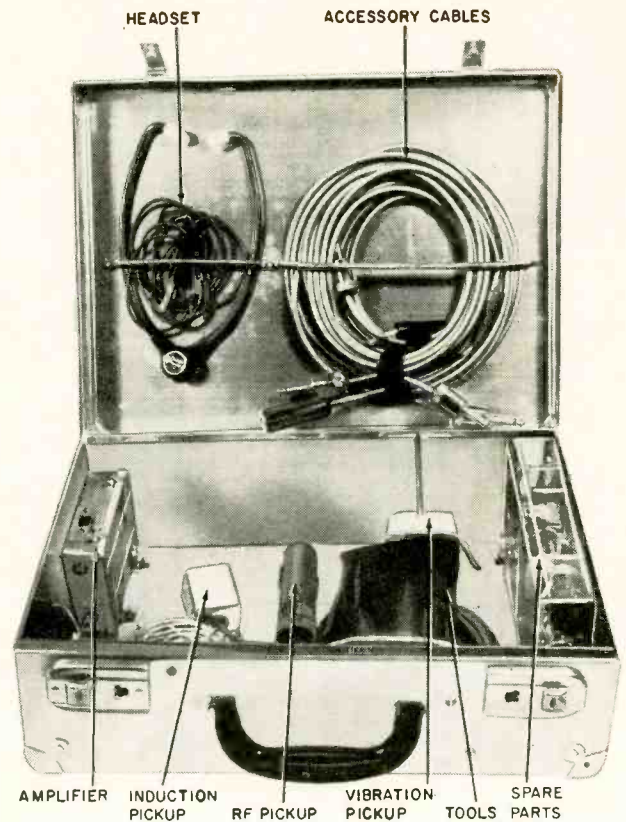
Power is obtained from a 1.5-volt A battery and a 22.5-volt hearing-aid type B battery. All components within the dashed line (Fig. 1) are part of the printed-circuit amplifier.

Since a printed-circuit amplifier is used, the actual wiring and assembly of the kit's amplifier is a relatively simple operation. The printed circuit's

lead connections are identified in Figs. 1 and 2.

The amplifier and power supply can be built into a small plastic or metal case. The unit, shown in the photographs, was built into a two-compartment plastic box, with the printed circuit and its associated components in one compartment and the batteries in the other. The amplifier was shielded by lining its compartment with aluminum foil.

Although circuit layout is not critical, IN jack J1, OUT jack J2 and volume



control R9 should be located so that the circuit's input and output leads are kept well separated and do not overlap. Lap type joints are satisfactory for all soldered connections. Bare leads should be protected by lengths of insulating spaghetti.

Accessory equipment

Although it is the most important single component in the surveillance kit, the amplifier alone is of little value. The kit's utility depends on the variety and versatility of its accessory pickup and output devices. The basic electronic accessories included in the kit are identified in the photos. While a kit may be made up using the amplifier and two or three of the accessories, utility is maximum when all are included.

Rf pickup. The circuit of this probe is shown in Fig. 3. This accessory is used with the amplifier to receive and detect radio signals. It is useful for identifying and locating hidden or "planted" radio and "wired wireless" transmitters in a room, office or building. Since such transmitters may be operated at almost any frequency, the probe is untuned and detects whatever radio signal may be present. In this respect it is very similar to rf probes used with oscilloscopes and vtvm's in radio-TV servicing.

In operation, radio signals coupled through capacitor C1 appear across

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To insure valid statistics, this tabulation covers the largest selling brands, based on a four-year survey (April 1953 to March 1957) of classified and "Swap or Sell" ads for used high fidelity loudspeakers. All ads authenticated as placed by private individuals in *Audio*, *High Fidelity* and *Music At Home*

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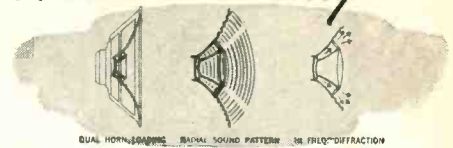
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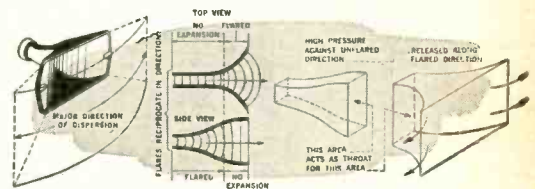
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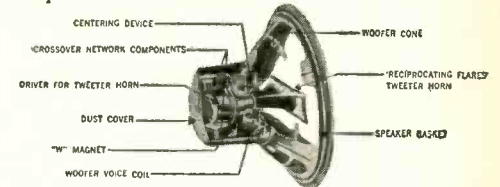
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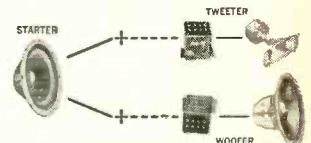
TRUE THRU-THE-AXIS DESIGN

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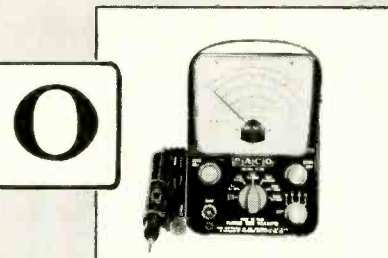
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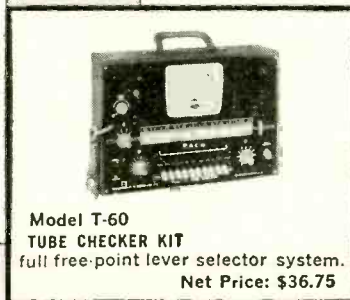
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input resistor R1 and are applied to a simple diode detector. The detected rf signal appearing across diode load resistor R2 has rf, audio and dc components. The rf component is removed by a simple R-C filter (R3 and C3). Finally, output coupling capacitor C2 blocks the dc component and allows only the detected audio signal to be fed to the amplifier.

The rf pickup is built into a short length of metal or fiber tubing. If fiber tubing is used, the inside surface should be lined with aluminum foil to serve

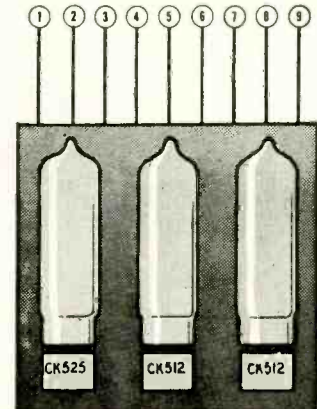
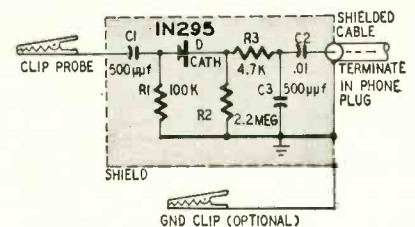


Fig. 2—Pictorial view of PC-201, printed-circuit basic amplifier.

as a shield. The probe's shield, whether foil or a metal tube, is connected to circuit ground and to the shielding braid of the output cable. A 3- or 4-foot shielded output cable is provided, with its end terminated in a plug to match the amplifier's IN jack. A separate ground lead attached to the probe's shield is useful under some conditions.

Induction pickup. This accessory is used to listen in on telephone or intercom conversations. Construction details are shown in Fig. 4. The induction pickup consists of a high-impedance coil (2,000 ohms or more) mounted on a high-permeability core. A coil salvaged from a sensitive plate relay can be used. A gap, large enough to slip over a standard telephone line or intercom lead, is left in the core piece.

The core and coil assembly is mounted in a small aluminum can which serves as an electrostatic shield. The can and one side of the coil are connected to the outer braid of a 3- or 4-foot shielded



- R1—100,000 ohms, 1/2 watt
- R2—2.2 megohms, 1/2 watt
- R3—4,700 ohms, 1/2 watt
- C1, 3—500 µF, tubular ceramic
- C2—.01 µF, disk ceramic
- D—IN295 diode
- Alligator clips (2)
- Fiber or metal tube
- Phone plug
- Shielded cable, 3 to 4 feet
- Miscellaneous hardware

Fig. 3—Rf pickup circuit.

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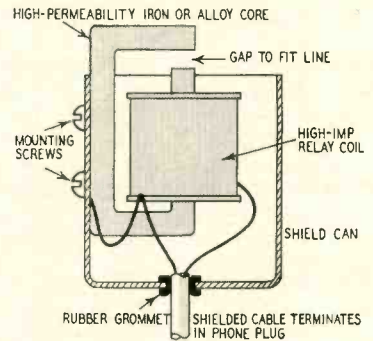
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output cable. The other side of the coil is connected to the cable's center lead. The end of the cable is terminated in a plug to fit the amplifier's IN jack.

In operation, the gap is slipped over the telephone or intercom line to be monitored and the induction pickup connected to the amplifier. The line should be centered in the gap. Signals traveling over the line are coupled to the high-impedance coil through transformer action and transferred to the amplifier.

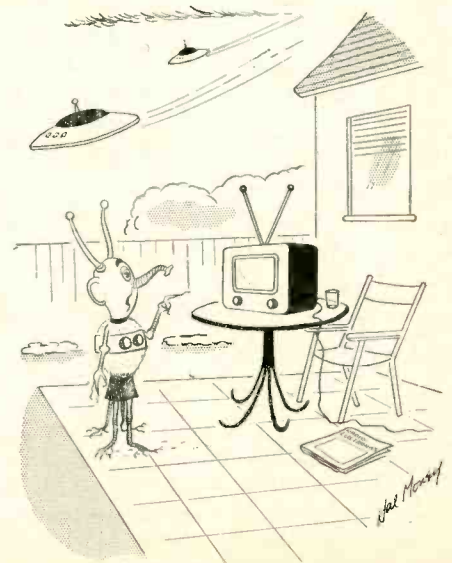


Shield can
High-permeability metal core, see text
High-impedance relay coil, 2,000 ohms or more
Phone plug
Shielded cable, 3 to 4 feet
Miscellaneous hardware

Fig. 4—A cutaway view of the induction pickup.

The induction pickup's ability to detect a signal will vary considerably, depending on such factors as the strength of the line signal, background and ambient noise, man-made static or interference and the proximity of heavy-duty transformers, large motors or other equipment producing strong induction fields and inducing hum in the line.

Now, you have the amplifier and two pickups to use. Next month, details of several other pickups and accessories will be described. Among them are: the vibration and telephone pickups, remote microphone, special earphone, accessory cables, spare parts kit, tool kit and carrying case. **TO BE CONTINUED**



Take me to your Leader!

Pedro beats an electronic design engineer at his own game

"THE trouble with you guys," Pedro was saying when I walked into the little restaurant around the corner from my shop, "is you don't believe in the simple approach." Pedro used to work for me when he was a kid. Now he's in the radio-TV business for himself. He was sitting at a table with two fellows I recognized as engineers from Capital Electronics, across the street.

"Hi, men," I said, easing myself into a chair across from Pedro and signaling Sadie, the waitress. "What's the hassle about?"

"No hassle, Herk," Adams, chief project engineer for Capital, grinned at me. "Only Pedro's reading us off about the channel-switching arrangement on one of those tuners we developed for the International TV people."

"You bet," Pedro said vehemently. "You know the one, Herk. That job with the screwy switching. Ain't that a mess?"

"I'm with Pedro on that, fellows," I said, taking a sip of the steaming java Sadie set down in front of me. "Seems like a little redesigning could simplify that switching arrangement about a thousand percent. It's a heck of a thing to service."

Phillips, Capital's industrial design man and a guy with a slippery temper, shook his head. "It works, doesn't it?"

"Sure," Pedro said. "It works. Until a speck of dirt bridges across the switch terminals. Then you've got a 2-hour disassembly job before you can get in it to wipe a little carbon tet across the contacts."

"You service guys have to make a buck," Adams said. "If nothing went bad, you'd starve to death."

"Pedro's point is that tuner could have been simplified," I tried to explain. "If you'd used shunt coils, one end of each coil could have been grounded."

"Certainly," Pedro cut in scathingly. "That would have made half as many switching contacts and twice the clearance between them."

"It's not always that easy," Phillips said, his voice beginning to rise like a heterodyne on the far side of zero beat. . . . "I don't remember just why we used series coils in that particular tuner. But there was a reason."

"Sure there was," Pedro shot back. "It's against an engineer's religion to do anything the simple way."

"What's on the fire now, fellows?" I asked, trying to change the subject. Pedro isn't a bit diplomatic sometimes, and I figured I'd better slip a conversational wedge in here before he needled these guys too much.

"The usual stuff," Adams said, draining his coffee cup. "A little of this and a little of that."

"Anything of interest to us radio men?"

Adams shook his head. "Mainly industrial account stuff. Hole detection devices, that sort of thing."

Pedro laughed. "You guys must get



Pedro, Layman

By GUY SLAUGHTER

paid by the tube." He winked at me. "Friend of mine works in the steel mill. He claims their electronic gear never uses a single stage if 20 will do the job. You boys design that equipment?"

"Some of it," Phillips said, his plate current beginning to climb. I could see he was starting to burn. "The trouble with you laymen is you never hear about an electronic problem until after some engineer has solved it. It looks easy, then."

"Us *laymen*," Pedro echoed pointedly. "You hear that, Herk? Now we're *laymen*." He sniffed. "Phillips, some of us 'laymen' could give you so-called professionals a lesson in simple, clean design."

"Oh, fine," Adams grunted. "Twenty-six weeks in the Army electronic school and now he's an expert in the field."

I figured I'd better come to Pedro's defense. I said, "Hold the phone, guys. Pedro's just needling you birds, but he's half right at that. I think most radio men *could* do a passable job of design engineering if they took a crack at it. You'd be surprised how much you can learn servicing other people's mistakes."

Put up or shut up

Phillips swung around to me with his eyes arcing over. "Put your money where your mouth is, Herk," he said. "Put up or shut up."

"Take it easy, Phillips," Adams soothed. "This is just a friendly argument. Don't go getting sore about it."

"Certainly," Pedro cut in. "You must have a guilt complex." He winked at me. "And think how embarrassing it would be to have a mere layman outdesign a design engineer."

"That does it," Phillips exploded. You could smell the ozone as he got to his feet. "You smart guys make me tired. If you're not willing to make a bet out of it, keep your yaps shut."

"Willing?" Pedro echoed. He stood

up, grinning. "Man, we're *eager!*" He winked at me again. "Name your weapons, boys."

"Hold it," Adams said. "You're nuts, Pedro. Designing is our *business*. You'd lose your shirts."

"Maybe," Pedro, replied happily. "And maybe not. I've been wanting a chance to show some of you boys up for a long time. You name the stakes and the design problem, and Herk and I'll beat you at your own game."

"Hey," I bleated, getting up. "This has gone far enough. Include me out."

Phillips turned on me. "Chicken, huh?" He was wearing that nasty, high-voltage smile. His eyes were still spitting sparks.

"No," I said. "Not at all. It's just that . . ."

Pedro cut me off. "Name your stakes, gentlemen. Herk and I'll cover. Then we'll agree on a project."

I stood there with my mouth open while Pedro and the two engineers decided on the stakes. If we won, Adams was to buy at retail the best TV set in my shop, and Phillips was to do the same from Pedro's place; but they were to get the merchandise free, gratis, if we lost. The arrangements were complete before I found my voice.

Then I shouted, "Hey, how about getting *my* views on this thing. I can't afford to . . ."

"Forget it, Herk," Pedro said placatingly. "We can't lose. You know these guys have to do everything the hard way." He turned back to the men from Capital. "Now then, what sort of project shall we make it?"

"We've got one in the works," Adams said. "Should be a simple little thing. One of our industrial accounts needs a sheet counter."

"Fine," Pedro beamed. "Tell us about it."

Phillips was beginning to cool off again. He said, "Let's sit down and

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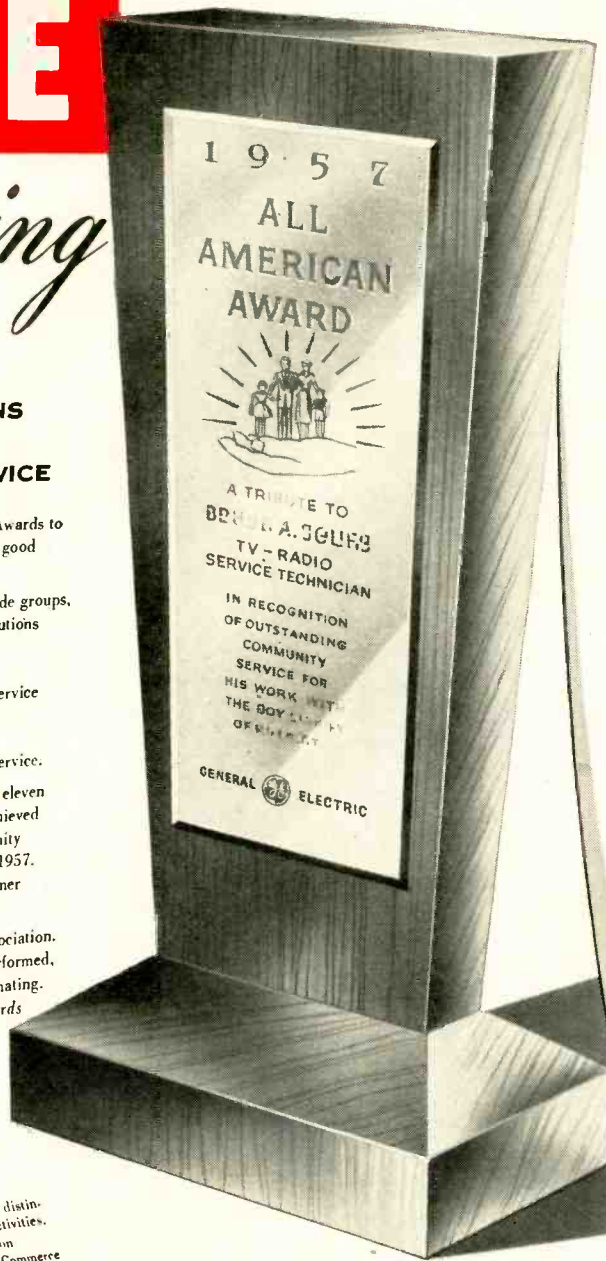
Nominations may be made by any individual, club or association. Simply write a letter describing the community service performed, give the name and address of the serviceman you are nominating, and mail it before October 19th to the All-American Awards Committee, General Electric Company, Owensboro, Ky.



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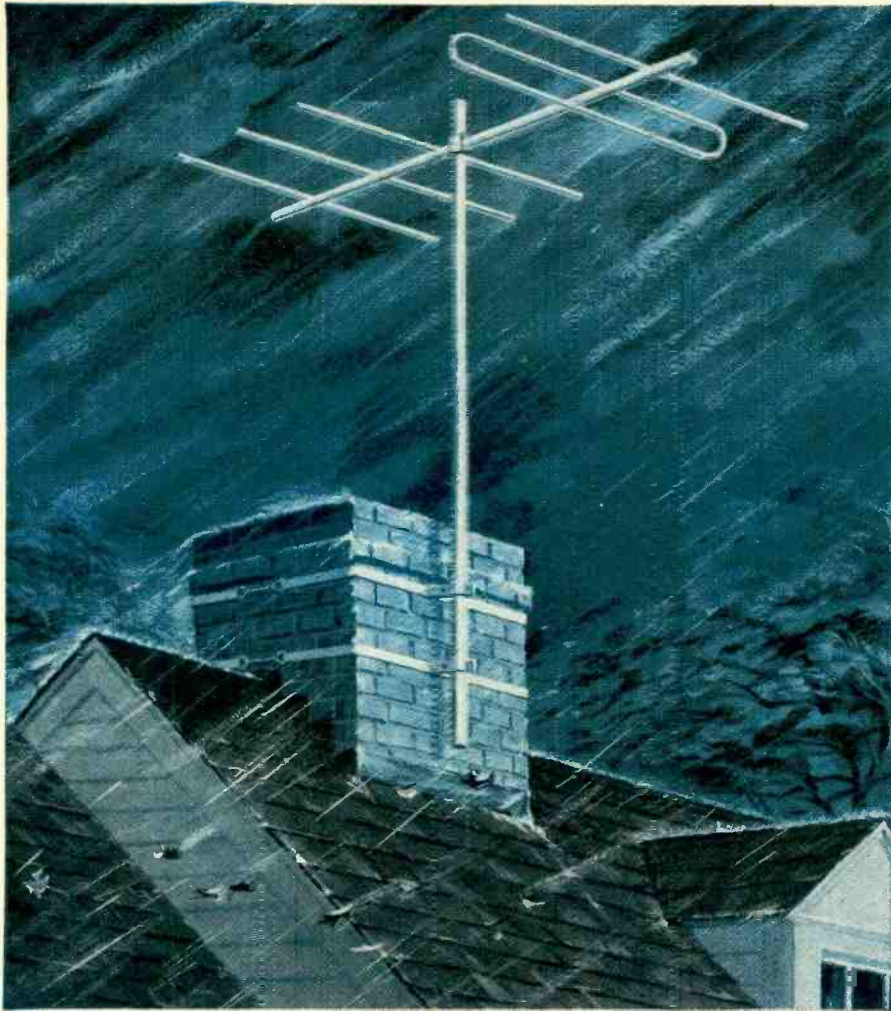


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ELECTRONICS

have some more coffee, and we'll brief you on the specs."

"Roger," Pedro said. "Sit down, Herk. And close your mouth."

"Sure," I said. I sat down and closed my mouth and thought about the beautiful blond combination AM-FM-phonograph-TV console in my front window, and how I was going to miss it after I delivered it to Adams free. Sadie showed up with the coffee pot and filled the mugs. I sighed, feeling bereaved at my imminent loss, and turned my attention back to the conversation.

"Okay," Pedro was saying. "That's it then. And it's agreed that the simplest workable counter wins. Right?"

"Right," Adams and Phillips said.

"Two weeks?" Pedro asked.

"Two weeks," Adams said. "And may the best men win." He winked at Phillips, and I said a mental goodbye to my console for the third time. "We'll be seeing you," Adams added, and he and Phillips left.

I turned to Pedro, shaking my head sadly. "You and your big mouth."

"You did all right, yourself, Herk," Pedro said, grinning at me.

"That console cost me five hundred clams," I said bitterly. "Why didn't I pass up my coffee today?"

"Cut it out, Herk. This is for the honor of all radio men everywhere." Pedro looked serious for a change. "And anyway, we're going to win. Don't worry about a thing."

"You know what?" I said thoughtfully. "I may kill myself."

We're going to win?

Pedro came into my shop one afternoon about a week later.

"Hi, Herk," he called cheerily. "How's it going?"

"Drop dead," I said. "What're you so happy about?"

"You get that cabinet for me?" he wanted to know, ignoring my question.

"Yesterday," I said. I jerked my thumb toward the bench. "Over there in the corner."

Pedro walked over to where the thing lay and gave it a quick scan. It was a little 5 x 6 x 9 steel cabinet from the local radio parts jobber's shelves. On top of the cabinet I had mounted the conventional magnetic counter Adams had supplied us with. It was a 5-digit affair, whose count advanced 1 number for each time a current of 10 mils or so flowed through its coil and actuated its armature.

"Looks good, Herk," Pedro said.

"Thanks," I said. "It was nothing. But what about the control circuit. You got any ideas?"

"I'm working on it. No problem, really."

"Sure," I said, skeptically. "What kind of circuitry you figuring on?"

"The simplest kind," Pedro said cryptically. "I'll see you later." He tucked the cabinet under his arm, grinned at me and took off.

ELECTRONICS

The day of reckoning came, as it always does. Pedro and I were the guests of Capital Electronics for lunch that noon. Adams and Phillips introduced us to the people on the staff whom we didn't already know, and without exception they greeted us with poorly concealed smiles. Evidently everyone in the place knew about the bet and could hardly wait for the big moment when we laymen would be shown up by the old pros.

After a hearty meal in the plant cafeteria, the condemned men, in the persons of Pedro and me, were led into the lab where the tests were to take place. I hadn't seen Pedro's gadget yet and didn't know what kind of device he'd come up with, if any. I asked him a dozen times but he wasn't talking. He just grinned at me in that aggravating way of his. Finally I gave it up.

Phillips and Adams put on their little show first. They had brought one of the girls from the steel mill over to act as the guinea pig for the tests, and I watched with interest the way the girl flipped the sheets of tinfoil from a pile in front of her into either of two racks on the table alongside her; evidently she was looking for flaws and sorting the sheets into "good" piles and "bad" ones. She would scan a sheet, turn it over, then flip it into its proper rack without a moment's hesitation and never miss a motion in doing it.

The test begins

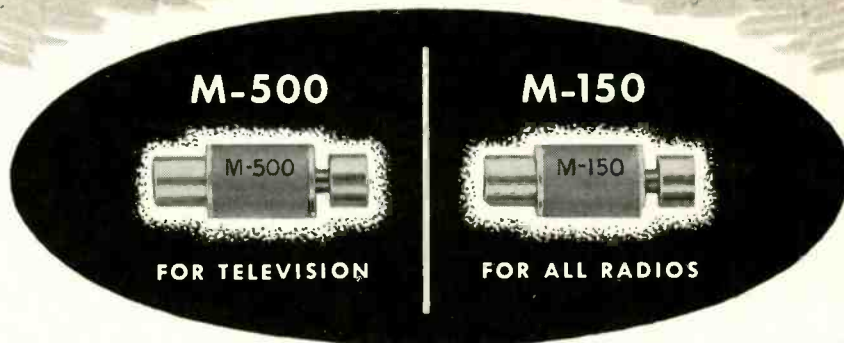
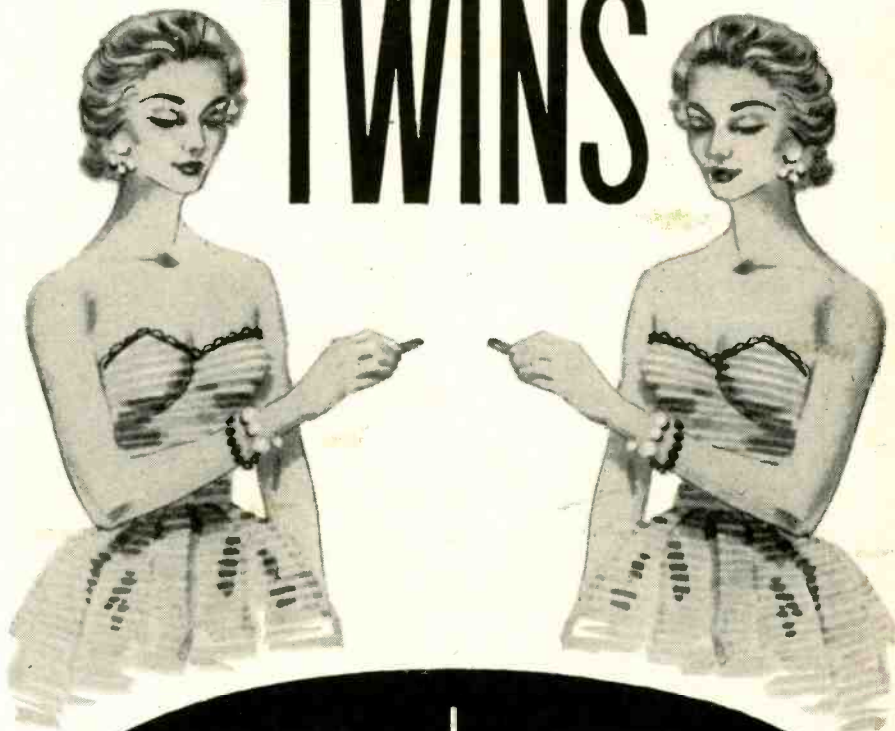
Adams and Phillips set up their gear, plugged it in, then turned the counter back to zero and motioned for the girl to start flipping sheets again. She went back to work and, as each sheet settled into the right-hand rack, the magnetic counter tallied up the new total. After perhaps 10 minutes, Adams stopped the girl again and turned to Pedro and me. We were standing in front of the rest of the audience, maybe 10 or 12 engineers from the plant.

"I'll explain the equipment," Adams said proudly. "The control circuit consists of a photocell and amplifier, feeding the counter. Each time a sheet of tinfoil is flipped into the rack, incident room light is reflected into the cell housing at some time during the sheet's travel, initiating the signal which the amplifier then causes to actuate the counter mechanism. Because we have tipped the photocell housing to this particular angle, light changes caused by personnel moving back and forth in front of it do not affect the cell."

"A question, please," Pedro cut in. "A friend of mine at the mill tells me overhead cranes move back and forth over the assorting tables all the time between the racks and the lights mounted on the ceiling girders. How do you keep the resultant light changes from affecting the photocell?"

"Simple," Adams grinned. "We

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don't. The photocell feeds an amplifier which is, so to speak, tuned. That is, only a steep wavefront can key the amplifier input and initiate a signal that will trip the counter. The cranes move so slowly that the light fluctuation is gradual and not rapid enough to key the amplifier."

"I see," Pedro said, nodding. "Clever. The amplifier is designed for high-frequency response and won't pass lows. Right?"

"Exactly," Adams smiled benignly. "But the reflected light from a sheet en route to the rack strikes the photocell as a short burst of light, and therefore its signal is high-frequency."

"Ingenious," Pedro admitted. I groaned. I hadn't expected him to give up without a fight. "A little complex," he added, "but ingenious."

Adams frowned. "Nothing complex about it, Pedro. Perfectly straightforward. Four tubes and a photocell."

"Try ours," Pedro offered. He picked up the gadget in the steel cabinet, carried it over to the assorting rack, set it down on the table, plugged the line cord into the socket on the table's lip. He walked back and winked at me.

It works!

Adams reset our magnetic counter to zero, moved his own gadget out of the way and motioned for the girl to begin sorting. As each sheet settled into the rack our counter ticked over another digit. Adams watched a while, then motioned the girl to stop.

"Okay, Pedro, explain your gear."

"Sure," Pedro said. "Be glad to." He walked over to the gadget, pointed to a hole in the side of the cabinet. "Each sheet acts like a huge palm-leaf fan; when it falls into the rack, it creates a little puff of air."

Adams and Phillips looked at each other. Adams' eyebrows rose. "So?"

"So," Pedro said, grinning over at me. "That puff of air enters this hole in the side of the cabinet and actuates the circuitry inside."

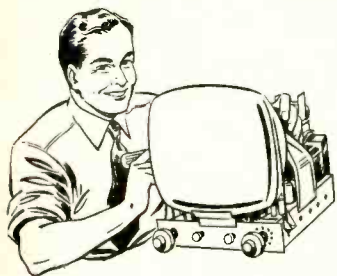
"Now just a minute," Phillips exploded. "That's all very well. But what kind of circuitry? There's only the four tubes and the photocell in ours. How about yours? Remember the final test was to be the simplicity of the gadget."

"I remember," Pedro said, grinning wider. "I remember well. Our circuitry is fairly simple, too. It consists of one microswitch with a balsa-wood vane cemented to its arm to catch the puff of air, plus one dropping resistor, one selenium rectifier to feed the magnetic counter and one red brick."

"Is this a joke?" Adams spluttered. "What's the brick for?"

"To make the cabinet heavy," Pedro said. "So you fellows wouldn't know it was practically empty when you hefted it behind our backs."

Adams got my blond console job all right. But, thanks to Pedro, he paid for it. Through the nose... END



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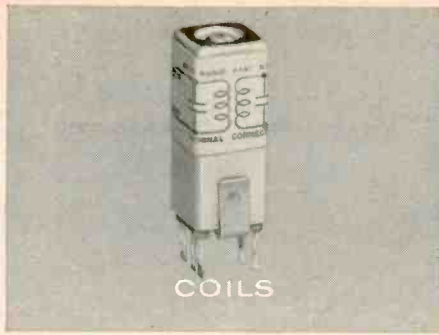
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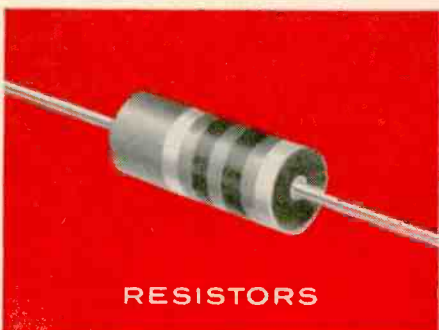


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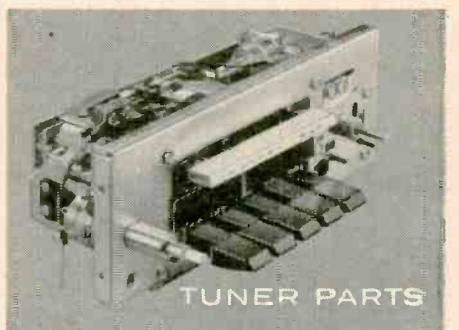
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Organizing a Profitable Home Servicing Business

With the necessary attention and planning, home service can function as smoothly and as profitably as bench servicing

By CHARLES GARRETT

Fig. 1—Drop cloth protects clothes when carrying a dusty chassis.

LANE'S Radio Shop in New London, Conn., has increased its profit, enlarged its list of steady customers and secured public respect for its organization by applying a systematic, professional approach to its TV home-servicing business. We at Lane's have given careful attention to all its aspects and the effort has paid off. Where home service was once considered secondary to bench service, it is now correctly treated as the *primary* part of the business. Home service comprises about 70% of our TV servicing.

This article will detail our somewhat elaborate service-call equipment, how we try to inspire customer confidence and goodwill while on house calls, and how we went about increasing the efficiency of our home service from the shop end.

Tube-caddy contents

Along with a full complement of TV tubes including two or more of the common varieties, an assortment of fuses and the usual assortment of tools, we supply the tube caddy with the following extra items for servicing efficiency:

1. A large mirror to facilitate rear-panel adjustments. Mirrors are available in either glass or unbreakable stainless steel—the better investment.
2. A flashlight with a spare bulb and batteries.
3. An assortment of dial lamps for tuners, rotor boxes, boosters, radios, etc.
4. A small, neat drop cloth is an important piece of service equipment. It is not only used to protect rugs and varnished floors, but is often wrapped around a dusty TV chassis to protect the technician's clothes when the set is carried out of the house (see Fig. 1).
5. A quick-heating soldering gun to be used, not so much for replacing parts, as for repairing obvious wiring

defects, including those accidentally caused by servicing and handling the chassis.

6. An inexpensive TV picture-tube brightener, carried for testing, installation and sale. With it, a quick check can be made of the picture tube when the complaint is low brightness.

7. A small volt-ohmmeter is a must. It takes the guesswork out of checking for open fuses, fused resistors, speaker voice coils, etc.

8. Two ac interlock jumper cords—one for the standard interlock and the other for the older Zenith type. An interlock type line cord is also in the caddy for replacement purposes.

9. An antenna-terminal jumper also makes for convenient servicing on sets (Philco, RCA, Stromberg-Carlson, etc.) whose antenna leads from the tuner plug into pin sockets on the back cover. The jumper allows the back cover of a set to be completely removed and placed out of the way and still have a connection between the antenna lead-in wire and the receiver's tuner lead-in.

10. A dispenser of service-record tags. A service-record tag (Fig. 2) pasted to the back of every receiver is also a servicing aid. Printed on the tag is our company's name, address and phone number. On it the technician notes the tubes and parts installed, their function, any adjustments made and the date the work was performed.

On future calls the technician will have a convenient record of the tubes and parts replaced and the date they were installed. This ends disputes as to whether tubes and parts previously changed are within their warranty period. A repetitious failure of one particular tube or part can indicate the need for bench service.

11. A screw-on, plunger type control cleaner is indispensable on house calls. It allows a scratchy or noisy control to be cleaned without removing the chassis

from the cabinet, saving 10 to 15 minutes of valuable servicing time. Ours paid for itself in less than a week (see Fig. 3).

12. Paper bags. A few small paper bags tucked into the tube caddy have proved to be ideal for holding small parts when a chassis is pulled for shop service. A paper bag holding knobs, chassis bolts, back-cover screws and cabinet accessories is stored inside the empty cabinet to prevent loss of these hard-to-replace parts.

13. A complement of the common radio and phono tubes for phonographs, small table and portable radios is available to the outside technician. About one out of five TV customers asks the technician—or the shop when he calls for TV service—about having his radio or phonograph repaired. This extra service has been profitable to us.

The following 31 *extra* tubes handle most modern radio and phono work.

Portables: 1L6, 1R5, 1S4, 1S5, 1T4, 1U4, 1U5, 3S4, 3V4.

Ac radios: 5Y3-GT, 6BA6, 6BE6, 6SA7, 6SK7, 6SQ7, 6X4.

LANE'S RADIO SHOP	
GI 3-6661	
130 Jefferson Ave. New London	
DO NOT REMOVE	
Date _____	
Serviced By _____	
Tubes _____	

Fuses _____	
Adj. _____	

Misc. _____	

Fig. 2—Adhesive tags are attached to the set. They aid the technician on the next service call, and are good advertising.

Ac-dc sets: 12AT6, 12AV6, 12BA6, 12BE6, 12SA7, 12SK7, 12SQ7, 35B5, 35C5, 35L6-GT, 35W4, 35Z5-GT, 50B5, 50C5, 50L6-GT.

These tubes are kept in a small, separate tube caddy.

14. A filament-continuity tester. This simple instrument is handy when servicing series-string TV and radio receivers. Our shop picked these up as a bonus with tube orders. When purchased, they cost \$3 or \$4—a worthwhile investment.

Build confidence

The public's confidence in our organization's integrity and fairness is more valuable to us profitwise than all the skill, experience and knowledge of our technical staff. We believe that, like a politician, a service company is judged by what it does, not by what it says in its advertisements. The following are some of the approaches that we have proved to be most effective.

All defective tubes and parts are left with the set owner (see Fig. 4) and, when a chassis is returned from the shop, the old tubes and parts are also returned. This simple practice may not actually prove much, but to our customers it is a symbol of integrity.

We use only standard-brand, well advertised and individually boxed tubes. The set-owner comment, "I never heard of that brand," would mean that he believes it is not a first-quality product and would reflect on our service.

We try to keep the tube caddies uncluttered, well-arranged and completely stocked by periodic and systematic checks and inventories (see Fig. 5). A misarranged, half-stocked caddy not only looks unprofessional to the set owner, but is unprofessional. Inventories are easier when empty tube boxes are put into the tube caddy backward so that the used tubes are obvious.

Where practical, we install new picture tubes in the home—and from a sealed container. When a picture-tube replacement is indicated, a tube brightener is tried first or a less expensive rebuilt tube is offered. If a brightener is installed, a refund is made on it when the set owner decides to purchase a new tube—from our service company, of course. Most customers prefer new tubes to rebuilt ones or the temporary correction sometimes afforded by a brightener.

A receipt is left by the outside technician for the receiver, listing make, model and serial number (Fig 6), when removing it for shop service. If a technician has ever heard a set owner argue, as happened to me a few years back, that the wrong chassis was delivered, he will see the value of this receipt. Fortunately for me, the TV dealer had the chassis serial number in his files and got me off the hook.

If the customer is not home when the technician calls, a business card is left in the door or mailbox with the time

(Continued on page 98)

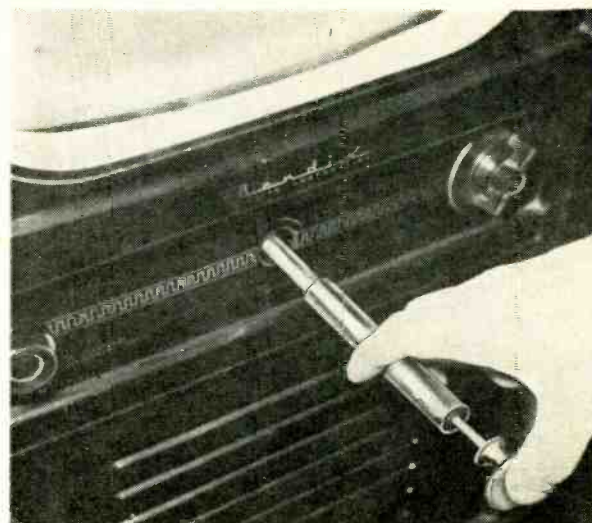


Fig. 3—Plunger type control cleaner permits cleaning controls without pulling chassis.

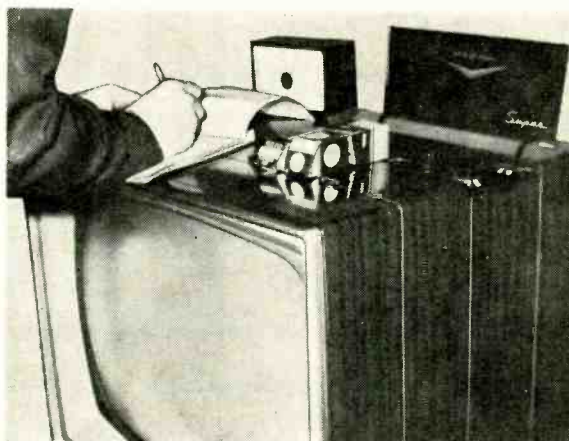


Fig. 4—Leave defective tubes and parts with the customer.

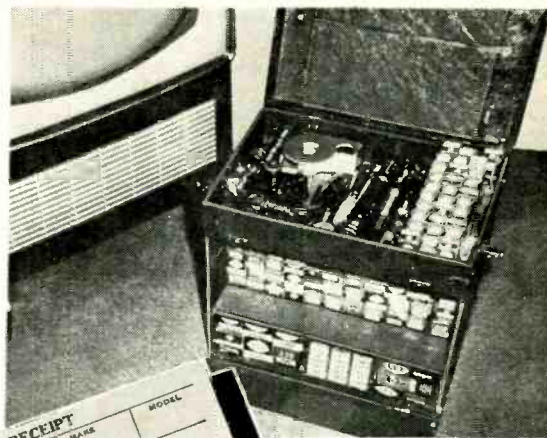


Fig. 5—Well arranged and equipped tube caddy.

CUSTOMER'S RECEIPT			
DATE	JOB NO.	MAKE	MODEL
RECEIVED (for shop service)			
PER		SERVICE TECHNICIAN	
CUSTOMER'S RECEIPT			
DATE	JOB NO.	MAKE	MODEL
RECEIVED (for shop service)			
PER		SERVICE TECHNICIAN	

Fig. 6—When a chassis is pulled to the shop a receipt is left with the customer.



MODEL TD-55

Terms: \$6.95 after 10 day trial then \$5.00 per month for 4 months.



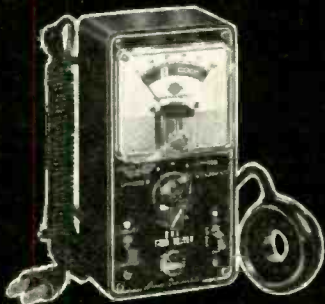
MODEL TW-11

Terms: \$11.50 after 10 day trial then \$6.00 per month for 6 months.



MODEL TV-12

Terms: \$22.50 after 10 day trial then \$10.00 per month for 5 months.



MODEL TV-40

Terms: \$3.85 after 10 day trial then \$4.00 per month for 3 months.

SHIPPED ON APPROVAL NO MONEY WITH ORDER NO C.O.D.

Superior's New Model TD-55 EMISSION TYPE TUBE TESTER

FOR } The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by: 1. Simplification of all switching and controls. 2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Checks for shorts and leakages between all elements

The Model TD-55 provides a supersensitive method of checking for shorts and leakages up to 5 Meg-ohms between any and all of the terminals.

Elemental switches are numbered in strict accordance with R.M.A. Specifications.

The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No.

7 of a tube is under test, button No. 7 is used for that test. Complete with carrying case..... **\$26⁹⁵** NET

Superior's New Model TW-11 STANDARD PROFESSIONAL TUBE TESTER

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyatron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity Fuse Types, etc.

- Uses the new self-cleaning Lever Action Switches for individual element testing. All elements are numbered according to pin-number in the RMA base numbering system.

- Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

- Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE SEPARATE SCALE FOR LOW-CURRENT TUBES
Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types. **\$47⁵⁰** NET
Housed in hand-rubbed oak cabinet

Superior's New Model TV-12 TRANS-CONDUCTANCE TUBE TESTER

- ★ Employs improved TRANS-CONDUCTANCE circuit.

An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

- ★ NEW LINE VOLTAGE ADJUSTING SYSTEM. A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

- ★ SAFETY BUTTON—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

EXTRA FEATURE!
Model TV-12 Also Tests Transistors!
A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale. **\$72⁵⁰** NET
Housed in hand-rubbed oak cabinet

Superior's New Model TV-40 PICTURE TUBE TESTER

NOT A GADGET—NOT A MAKE-SHIFT ADAPTER, BUT A WIRED PICTURE TUBE TESTER WITH A METER FOR MEASURING DEGREE OF EMISSION—AT ONLY \$15.85

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (Ion trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests. Only..... **\$15⁸⁵** NET

USE APPROVAL FORM ON NEXT PAGE

We invite you to try before you buy any of the models described on this and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

TRY FOR 10 DAYS

before you buy!

then if satisfactory pay in easy, interest free, monthly payments. See coupon below.

Superior's New Model 770-A

POCKET-SIZED VOLT-OHM MILLIAMMETER

USING THE NEW
"FULL VIEW" METER
71% MORE SCALE AREA

Occupies exactly the same space used by the older standard 2 1/2" Meters, yet provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type.

• Housed in round-cornered, molded case. Beautiful black etched panel.

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts • 6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts • 2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm • 3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps. • 3 DECIBEL RANGES: -6 db to +18 db, +14 db to +38 db, +34 db to +58 db.

Complete with test leads.....

\$1585
NET



MODEL 770-A

Terms: \$3.85 after 10 day trial then \$4.00 per month for 3 months.

Superior's New

Model 670-A

SUPER-METER

A Combination VOLT-OHM MILLIAMMETER PLUS Capacity, Reactance, Inductance and Decibel Measurements

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
• A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
• D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes • RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms • CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of

electrolytic condensers.) • REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
• INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries • DECIBELS: -6 to +18, +14 to +38, +34 to +58.
Complete with test leads.....

\$2840
NET



MODEL 670-A

Terms: \$7.40 after 10 day trial then \$3.50 per month for 6 months.

Superior's New Model

76

IT'S A CONDENSER BRIDGE IT'S A SIGNAL TESTER
IT'S A RESISTANCE BRIDGE IT'S A TV ANTENNA TESTER

Specifications

✓ CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad, .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

✓ RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

✓ SIGNAL TRACER SECTION

With the use of the R.F. and A.F. Probes included

with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

✓ TV ANTENNA TESTER SECTION

Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals. Complete with R.F. and A.F. probes and test leads.....

\$2695
NET

Superior's New

Model TV-50

GENOMETER

7 Signal Generators in One!

- ✓ R.F. Signal Generator for A.M.
- ✓ R.F. Signal Generator for F.M.
- ✓ Audio Frequency Generator

R.F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

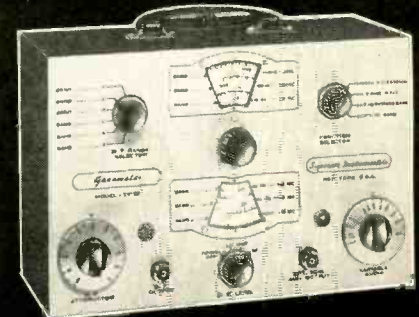
Complete with shielded leads..

\$4750
NET



MODEL 76

Terms: \$6.95 after 10 day trial then \$5.00 per month for 4 months.



MODEL TV-50

Terms: \$11.50 after 10 day trial then \$6.00 per month for 6 months.

MOSS ELECTRONIC DISTRIBUTING CO., INC.

Dept. D-381, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name

Address

City Zone State

All prices net. F.O.B. N.Y.C.

- Model TW-11.....Total Price \$17.50 \$11.50 within 10 days. Balance \$6.00 monthly for 6 months.
- Model 76.....Total Price \$26.95 \$6.95 within 10 days. Balance \$5.00 monthly for 4 months.
- Model TD-55.....Total Price \$26.95 \$6.95 within 10 days. Balance \$5.00 monthly for 4 months.
- Model TV-50.....Total Price \$47.50 \$11.50 within 10 days. Balance \$6.00 monthly for 6 months.
- Model TV-40.....Total Price \$15.85 \$3.85 within 10 days. Balance \$4.00 monthly for 3 months.
- Model 670-A.....Total Price \$28.40 \$7.40 within 10 days. Balance \$3.50 monthly for 6 months.
- Model 770-A.....Total Price \$15.85 \$3.85 within 10 days. Balance \$4.00 monthly for 3 months.
- Model TV-12.....Total Price \$72.50 \$22.50 within 10 days. Balance \$10.00 monthly for 5 months.



Fig. 7—If the customer is not at home, a card left in the door shows you were there.

(Continued from page 95)

the technician called noted on it and requesting the customer to call the shop and make new arrangements to have his set serviced (see Fig. 7). Otherwise, the customer would be irritated because he would assume we failed to show up as we had promised.

Improving efficiency

Our service equipment and our efforts at building consumer confidence and goodwill are constantly in the forefront of our field of attention. We are always trying to improve our equipment and the treatment of our customers. We know from experience that when we improved one or the other or both, either our profits increased or the business ran smoother with fewer customer complaints.

Careful attention to certain small business details plus a new approach or two to the handling of service calls makes the difference between profit and loss in our home-service business. Some of these practices may seem obvious; nevertheless, they are listed because at one time we did not follow them:

A systematic method of receiving calls for home service adds to its efficiency by preventing loss of a customer's call as sometimes happens when phone calls for service are noted on scratch pads. We now use a commercially available phone-call book (Fig. 8) that provides us with an efficient method of receiving calls, convenient call slips for the outside technician and a permanent shop record of all calls.

Our schedule of house calls always gives preference to callbacks—the unpleasant and inevitable part of TV servicing. When these special calls for service are not handled promptly, dissatisfied customers take their business elsewhere.

We found that it is particularly important that the same technician who handled the original call handle the

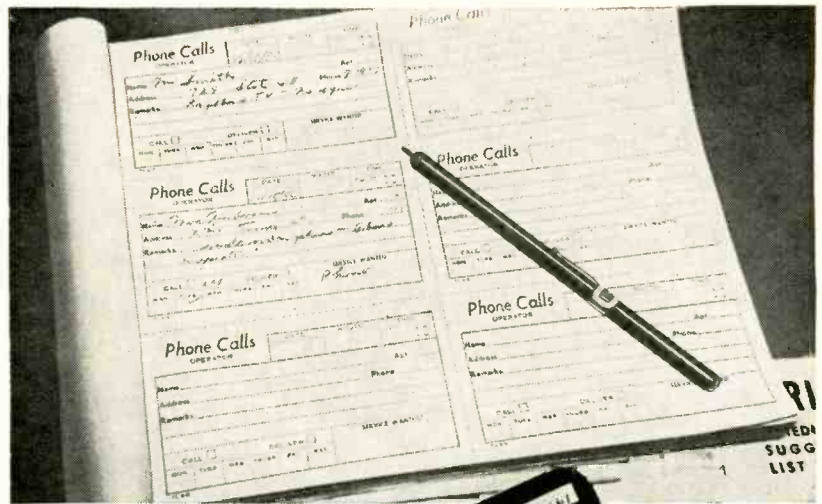


Fig. 8—Calls for service are listed in this phone book.

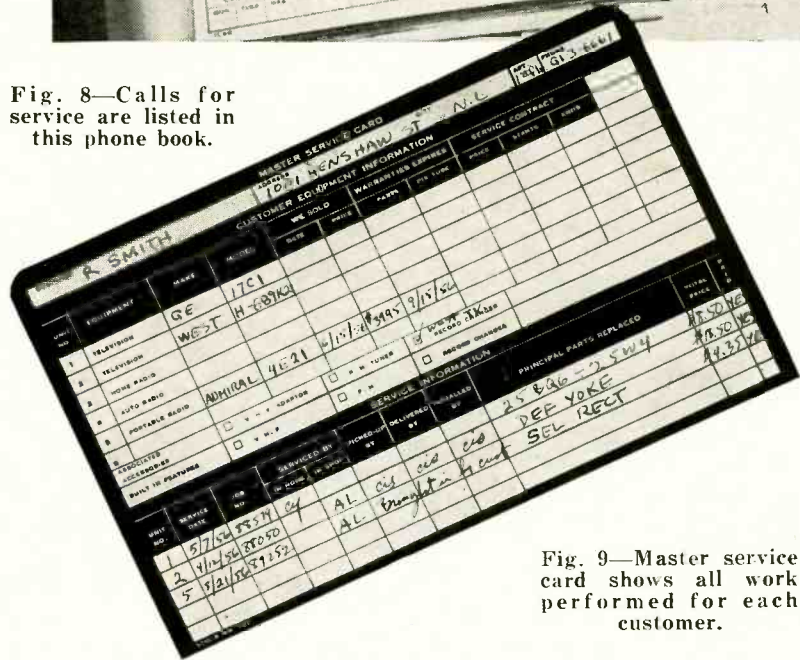


Fig. 9—Master service card shows all work performed for each customer.

callback. He can deal more easily with an irate customer than another technician who may be unaware both of the customer situation and the original complaint. In general, set owners seem to prefer to have a regular technician than various men service their sets.

A two-priced service-call system has proved to have certain advantages. For example, many TV calls amount to little more than a misadjusted front-panel control, a simple rear-panel adjustment (horizontal drive, centering, etc.) or, as sometimes happens, the antenna lead-in wire is disconnected or improperly connected to the set's antenna terminals. Also, noncorrectable outside interference sometimes is the cause of the trouble. The repair in most of these cases is fast and simple.

It is embarrassing for the technician to charge and annoying to the set owner to pay the full service-call price for seemingly so little work performed. Our company charges \$4 (for example) with the first \$1.50 applied as house call and the next \$2.50 as set service. Then when the complaint is a trivial matter quickly and easily correctable only the \$1.50 house call is charged. The full

price of \$4 is charged when the technician has to go into the receiver to correct the trouble.

This practice has been well received by set owners and, in the long run, the seemingly lost \$2.50 has been recovered many times over, due to our customers recommending us to their friends.

A complete file on each customer is a necessity if home-service efficiency is to be improved and then maintained. Each customer's card lists all work performed on his sets—both home and bench service. Special information is often noted on it—directions on how to get to his home, a repetitious complaint he may have, whether he pays promptly, whether he tries to repair his set himself and whether he is a chronic complainer and a consistent nuisance-callback customer (see Fig. 9). A customer with an unprofitable service record is dropped.

Over a period of five or six years, by applying a systematic and detailed approach and some trial and error, our efficiency and profits have steadily increased to where home service is the major source of income in our TV servicing business. END

The

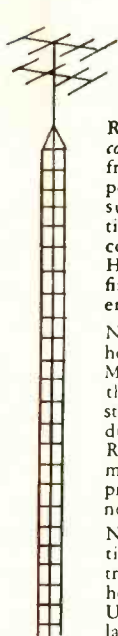
"GEM" of them all--

ROHN

Telescoping
MASTS



Heavy-duty hot-dipped galvanized steel tubing and rigid joints give extraordinary strength. Quick installation... mast attached to base—antenna fixed, then mast hoisted quickly to desired height. Utilizes special clamp and guy ring arrangement. Flanged interior section; crimped exterior section gives you a mast that won't pull apart with unequalled stability. Complete with guy rings and necessary erection parts. In 20, 30, 40 and 50 ft. sizes. Bases and ground mounts available.



TOWERS

Rohn Towers are the only complete line of towers... from the No. 6 "all purpose" tower which is most suitable for TV installations, to the giant No. 40 communications tower. Hot-dipped galvanized finish is featured in the entire line.

No. 6 Tower is ideal for heights 50-120'. Features Magic Triangle construction that assures great strength, stability and durability. Stocking Rohn No. 6 Towers means you can fulfill practically all tower needs!

No. 40 Communications Tower for extreme heights and heavy duty work. Uses large 18" equilateral triangular design which allows heights up to 300 ft.

For lesser heights where considerable strength is needed. Used widely for radio communication and micro wave throughout U. S. Sell this tower for these requirements existing in your locality.

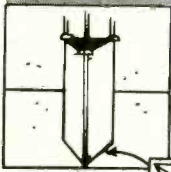
Both the No. 6 and No. 40 Towers are in 10' sections and are easily installed without special equipment.

Also available: No. 30 Towers and a unique space-saver PACKAGED TOWER, the latter available in heights from 24' to 64'.



NEW BASE

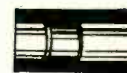
"Same day" installation base available NOW for No. 6 and P. T. Tower! Use this unique base that permits "on the spot" erection and "on the ground" assembly. Towers are then merely "walked up" into position.



ROHN
"superior design"
LINE



TUBING



True hot-dipped galvanized tubing coating both inside and out. Machined to perfection... available with 6" expanded end or plain—and in either 5' or 10' lengths. Painted if desired also available.



ACCESSORIES

A full line of accessories are available—all—Hot Dipped Galvanizing! Some of the items are: rotor posts, house brackets, eave brackets, peak and flat roof mounts, instant drive-in bases, hinged base sections, telescoping mast bases, guying brackets, UHF antenna mounts, erection fixtures, and a variety of mounts and supports for masts or tubing.



ROHN offers these exclusives

- Hot-dipped galvanizing
- unequalled design and engineering
- mass production for low cost
- universal customer acceptance
- pioneer manufacturers
- complete line.



ROOF TOWERS

5 "Superior Design" roof towers in heights from 2½' to 10'. Most all models are collapsible for easy shipping and storage. All models ideal answer for quick, inexpensive roof top installation. Get full information on this fine line of roof towers.

SEND COUPON TODAY!

"World's Largest Exclusive Manufacturer of TV-Communications Towers"

ROHN Manufacturing Co.

116 LIMESTONE, BELLEVUE

PEORIA, ILLINOIS PHONE 4-9156

GET COMPLETE DETAILS AND CATALOG NOW

Rohn Mfg. Co., 116 Limestone, Bellevue Peoria, Ill.

Gentlemen: Please rush me complete details on the full line of Rohn Towers and Accessories.

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NAME _____ TITLE _____

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Antenna TOWERS

for TV-AMATEURS
COMMUNICATIONS

... from Aermotor Company—since 1888 leaders in the manufacture of Steel Windmill Towers.

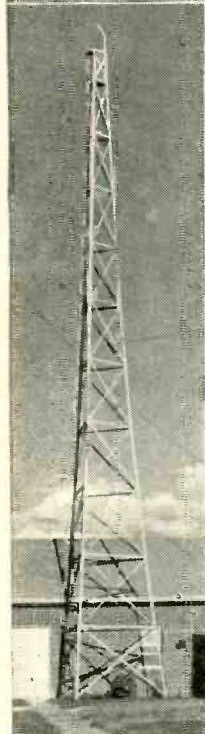
Check these features—they're found in all Aermotor Towers.

SELF SUPPORTING — no cumbersome guy wires.

HEAVILY GALVANIZED AFTER FABRICATION—completely protected against rust.

EASILY ASSEMBLED

STRONG—towers safely sustain loads of 1500 lbs.—safe in winds to 85MPH.



↑ TYPE MI-98

For TV Antenna up to 6 square feet of projected area. Heights to 100'.

◀ TYPE MP-5

For Amateur Beams up to 20 square feet of projected area. Heights to 97'3".

TYPE MP-9 (Not illustrated)

Meets "RETMA" Standard TR-116 Specifications. Heights to 123'5".

Write today for complete information on Aermotor Steel Antenna Towers and an Aermotor Franchise in your territory.

42

AERMOTOR COMPANY

2500 W. Roosevelt Road Chicago 8, Illinois
Dept. RE-9

TELEVISION



IN servicing color TV receivers, we find that quick checks are among our most valuable aids for localizing trouble. Although a complete book could be written on this subject, we can cover a few of the highlights. Ever have a set with a good monochrome picture and no color?

Loss of color

The complaint of *no color* can be due to a fault in the antenna system, such as a break in the lead-in which produces strong standing waves. The best quick check is to apply a rainbow-generator signal to the receiver's antenna input terminals. If a rainbow pattern is obtained on the screen of the color picture tube, the trouble is in the antenna system. If a rainbow pattern is not obtained, the trouble is in the receiver.

When *no color* is the trouble, always check the settings of the color-killer threshold, age threshold, and noise-gate controls before working on the chassis. Remember that Junior may have been playing technician. This is the do-it-yourself era and a disappointed do-it-yourselfer sometimes dislikes to admit that he tried and failed.

If operating thresholds are ample and *no color* is still the problem, turn the fine-tuning control to inject sound into the picture. If the chroma channels are operative, you will see predominantly blue interference, with some red and a little green. Blue is normally predominant because the gain of the B-Y channel is higher than that of R-Y and G-Y. If you see color interference of this type, the trouble is in the color sync section. If you do not see the interference, the chroma signal is not getting through.

If you obtain normal color interference patterns you can conclude that the color subcarrier oscillator is operating because the chroma signal can evidently pass through the color detectors. However, you can also conclude that the color subcarrier oscillator is running off-frequency so that the rainbow signal, or a station signal, runs rapidly on the screen and appears as a neutral gray (we cannot see the three primary colors when they are in rapid motion).

That's about all the space that the boss will give us for quick checks this

month. Maybe we can slip in a few more next time, if you want them.

Cascade tuner

Can I install a Standard Coil cascade tuner in an RCA T120 TV receiver? Will I get better reception? Is this a split-sound receiver?—J. H.

Although a cascade tuner can be installed, there are several considerations to be taken into account, some of which might deter you from the job. A properly installed cascade tuner can be expected to provide better weak-signal reception. The T120 is a split-sound receiver.

The first consideration is mechanical: experience quickly teaches that the amount of work required to mount and secure a different tuner in the correct operating position is often excessive, and costs more than the customer is willing to pay.

From the electrical standpoint, you will require a 23-mc tuner, since this receiver has a 23-mc if strip. Since the receiver has a low-impedance feed from the mixer to the first if tube, you need a tuner with a low-impedance output.

Although cascade tuners are available with low-impedance output at 45 mc, a survey of jobbers indicates that a tuner to meet your requirements would have to be improvised. There are two ways of handling this problem:

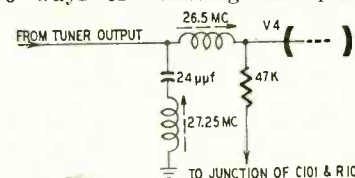


Fig. 1.—RCA T120 modification allows installation of cascade tuner.

You can rearrange the input circuit of the first if stage for high-impedance drive or you can modify a high-impedance tuner for low-impedance output. The first approach is probably less tricky.

Remove the if transformer and 19.75-mc trap from the grid circuit of the first if tube (V4). Obtain a simple if coil which is tunable through 26.5 mc and an L-C series trap tunable through 27.25 mc. Wire these components and a

(Continued on page 103)

**WHERE
Would You
be Today
in Radio-TV
Electronics
IF ...**



**you had sent for
this FREE Valuable Booklet 12 Months Ago**

Thousands of men did send for it. They read it. And now they are a full year ahead in their march toward:

- a better job
- better pay
- promotion
- greater security
- greater confidence
- better living for self and family

All these benefits can be yours . . . if you act now to see what the rapidly expanding field of Electronics offers you. Take that first big step this minute. No obligation whatsoever!

TAKE A MINUTE TO MAIL THIS COUPON FOR FREE BOOKLET!

CAPITOL RADIO ENGINEERING INSTITUTE

ECPD Accredited Technical Institute Curricula. Founded 1927

Dept. 149 D 3224 16th St., N.W., Washington 10, D. C.

Please send me your course outline and FREE Illustrated Booklet "Your Future in the New World of Electronics" . . . describing opportunities and CREI home study courses in Practical Electronics Engineering Technology.

- CHECK FIELD OF GREATEST INTEREST
- Electronic Engineering Technology
 - Broadcast (AM, FM, TV) Engineering Technology
 - Television Engineering Technology
 - Aeronautical Electronic Engineering Technology

To help us answer your request intelligently, please give the following information:

EMPLOYED BY

TYPE OF PRESENT WORK

SCHOOL BACKGROUND

ELECTRONICS EXPERIENCE

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED?

Name Age

Street

City Zone State

Check: Home Study Residence School Korean Veteran



MR. ELECTRONICS MAN:

**If you're willing
to lose your job tomorrow
to a technically-trained man,
don't read this!**

But, if you're interested in an honest-to-goodness career in the vigorous young electronics industry, here's how you can step ahead of competition, move up to a better job, earn more money, and be sure of holding your technical job even if the brass is firing instead of hiring.

The "how" is CREI training in radio-television-electronics. You don't have to be a college graduate. You *do* have to be willing to study—at home. You can do it while holding down a full-time job. Thousands have. However, you must have some prior electronic experience, either in military service, professional employment, experimenting, or ham operating. Since 1927 CREI has provided alert young men with the technical knowledge that leads to more responsibility, more job security, more money. More than a quarter century of experience qualifies CREI to train you.

What qualifies *you* for CREI? If you have a high school education, you're off to a good start. If you have a knack for math, so much the better. If you are currently working in some phase of the electronics industry, you'll get going faster. But remember this: CREI starts with fundamentals and takes you

along at your own speed. You are not held back by a class, not pushed to keep up with others who have more experience or education. You set your own pace. Your CREI instructors guide you through the lesson material and *grade* your written work personally. You master the fundamentals, then get into more advanced phases of electronics engineering principles and practice. Finally you may elect training at career level in highly specialized applications of radio or television engineering or aeronautical radio.

How good is CREI training? Here are a few ways to judge. Ask an electronics engineer, if you know one. Ask a high-school or college physics teacher. Ask a radio station engineer. Check up on our professional reputation: CREI home study courses are accredited by the Engineers' Council for Professional Development; CREI is an approved member of the National Council of Technical Schools. Ask personnel managers how they regard a man with a CREI "ticket." Look at this partial listing of organizations that choose CREI to train their own personnel: United Air Lines, Canadian Broadcasting Corp., Trans-Canada Airlines, Douglas Aircraft Co., Glenn L. Martin Co., Columbia Broadcasting System, All-American Cables and Radio, Inc., Gates Radio Co., Canadair Ltd., Federal Electric Corp. and U. S. Information Agency (Voice of America). Finally, ask a CREI graduate to tell you about our Placement Bureau, which currently has on file more requests for trained men than we can fill.

What's the next step? The logical one is to get more information than we can cram into one page. The coupon on reverse side, properly filled out, will bring you a fact-packed booklet called "Your Future in the New World of Electronics." It includes outlines of courses offered, a resume of career opportunities, full details about the school, and tuition details. It's free.

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(Continued from page 100)

47,000-ohm resistor into the grid circuit of V4 as shown in Fig. 1.

The cascode tuner has a mixer plate (output) circuit arranged as shown in Fig. 2. If your particular tuner is not exactly the same type, make sure that a grid coupling capacitor is provided. If it is not provided, you must supply it.

Connect the tuner output to the input of the first if stage, being sure to suspend this lead in free air as it is hot with if signal. Connect heater and age lines as usual, but make sure you have enough B-plus voltage—at least 225 volts. The cascode tuner has two rf tubes in series and requires more B voltage than other configurations.

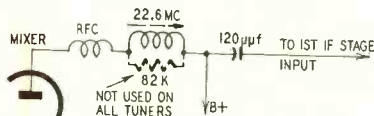


Fig. 2.—Mixer plate circuit of a typical cascode tuner.

Finally, use a good sweep and marker generator and scope to align the if system properly. The output coil in the mixer plate peaks at about 22.6 mc and the if input coil peaks at about 26.5 mc. The trap operates at 27.25 mc.

Buzz in sound

On a service call for a Sylvania 21T103M, we were having trouble getting channel 2, until I accidentally found that disconnecting one side of the lead-in brought 2 in OK. However, the other channels were then unsatisfactory. There is a buzz in the sound which cannot be tuned out.—S. T.

On the basis of the data supplied, it would appear that there is a wide variation in field strength, which the age system of the receiver cannot contend with. Since disconnecting one side of the lead-in improved reception on channel 2, it appears that your basic trouble is probably overload. Because the buzz cannot be tuned out, overload may also be present on all channels.

It sounds like an age problem and, if you cannot correct it by replacing tubes in the signal circuits and the age section, you will have to pull the chassis. To localize the trouble definitely to the age section, it is advisable to apply override bias to the age bus with a bias box. If you can obtain normal reception on any chosen channel when you adjust the bias box suitably, the trouble will be found in the age system. Sometimes this type of trouble can be eliminated by adjusting the tuner's oscillator slugs as slight misalignment will also cause a buzz in the sound. Another possible remedy is a light pad across the antenna terminals. A 3- or 6-db drop in signal strength should knock out the buzz without hurting reception on other channels.

Remote tuner

I wish to convert a G-E 901 chassis to place the tuner 20 feet away from the receiver.—A. P.

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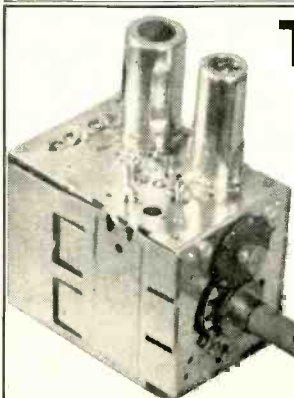
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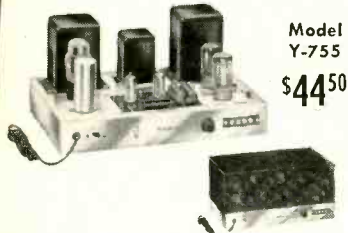
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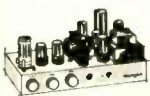
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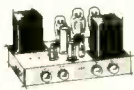
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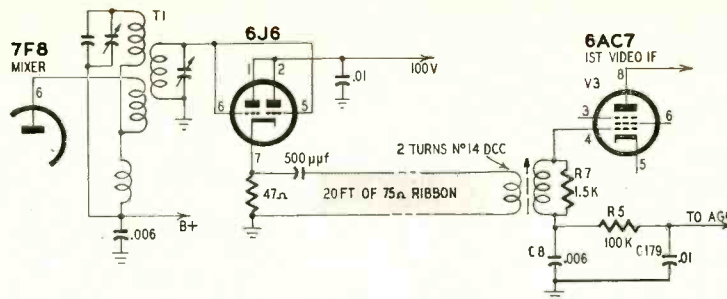


Fig. 3—Modification makes a remote tuner for the G-E 901 possible.

sis for removal of the tuner is not easy nor economical. However, it is not impossible. To move the tuner 20 feet from the chassis requires converting the tuner output to very low impedance so that 75-ohm ribbon line can be fed to the receiver. (I assume from your letter that you do not contemplate using any electromechanical gadget for remote operation of the tuner.)

To obtain the necessary low output impedance from the tuner, I suggest that you add a 6J6 tube to it, using both triode sections connected in parallel to obtain high permeance. The tube is utilized as a cathode follower (see Fig. 3). The if output from T1's secondary is applied to the grid of the cathode follower, and a 47-ohm cathode resistor is used to drive the line to the receiver.

Note that the secondary of T1 is now returned directly to ground. This takes care of driving the line and brings us to the output end of the line. Here we have to convert back from the low line impedance to the high grid impedance of the first if amplifier tube V3. Impedance is converted by improvising a suitable transformer from an if coil tunable through the 23-mc band—a two-turn primary is wound directly over the if coil and connections are made as in Fig. 3.

There is inevitably some signal loss through the cathode follower and the impedance transformer but unless you are concerned with weak-signal reception, this should not be a practical disadvantage.

Use a good sweep and marker generator and scope, and carefully align the if system for the response specified in the receiver service notes. Don't peak T1 too near the frequency of V3's plate transformer or you will have trouble with regeneration or oscillation.

Excessive horizontal drive

The owner of a Sparton 15V215 chassis reports that a vertical drive bar has been on his screen since he got the set. I noticed it only after I repaired some other trouble. The owner reports that he took the set back to the store but was shown another similar Sparton set which also had the bar and was told that in time it would go away.

It looks like a simple case of horizontal overdrive, but I backed off on the drive control all the way and the trouble persists. It seems as though

some slight circuit change should be made to reduce the drive. I experimented with changing values in the drive control circuit and did get the drive lowered to a point where the line disappeared, but the horizontal sweep was then distorted.—J. L., Flint, Mich.

The drive bar you report did appear on many sets in this Sparton series. While it is possible to reduce drive by altering the drive circuit, it is far simpler to reduce the plate supply to the horizontal oscillator. This circuit is fed from the B-boost supply through a 56,000-ohm resistor. The voltage on the plate of the vertical oscillator can be decreased, and hence the drive, by increasing the plate-dropping resistor. Some later models use a 100,000-ohm resistor and this is not too much; you may have to use more. With lower oscillator output the drive control can then be adjusted to remove the center compression or drive line.

Increasing sensitivity

A set came in with poor contrast. Checking revealed that the tuner gain was good and there was no snow. However, the sensitivity of the if amplifier was poor as indicated by the low voltage developed across the video detector load. I have good test equipment and am experienced in alignment, and I went over this receiver (Sylvania 1-520) with a fine-tooth comb. The front end and the if amplifier are adjusted perfectly as per Sylvania instructions. Further, I made a thorough check of all voltages in the if amplifier, and all components are within tolerance limits. Any suggestions you can give would be appreciated.—B. L., Philadelphia, Pa.

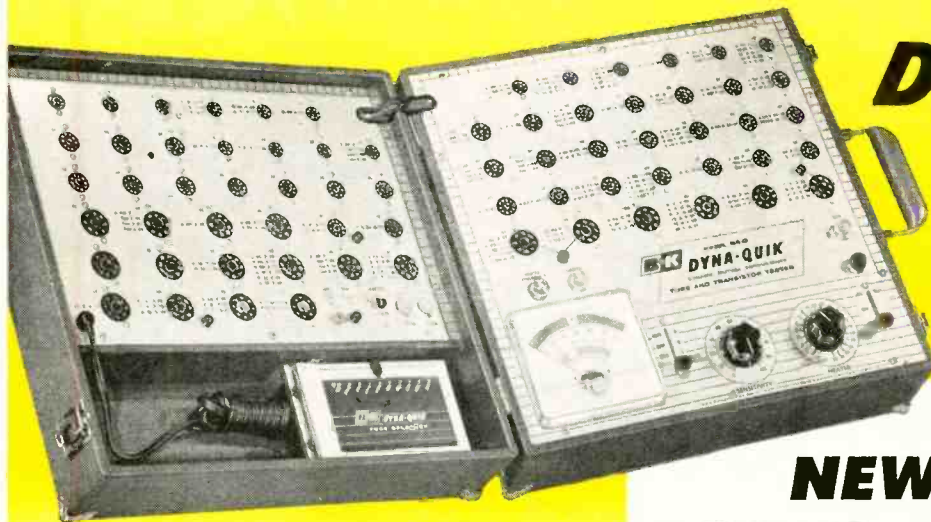
Judging from your address you are in a strong signal area and your problem is not one of reception. Although Sylvania has never made any circuit modifications toward improving this condition, I have found this chassis to be extremely sensitive to changes in values in the if circuits—both component and voltage values.

On one chassis the cathode resistor of one of the if stages measured 55 ohms. This was well within the 20% limits of the 47-ohm resistor specified. On replacing it with a resistor that measured exactly 47 ohms, the increase in if gain was astounding. Thus, the proper approach here is to replace all 47-ohm cathode resistors with exact selected values. Do the same with all other components that might affect the

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if tubes' operating characteristics (including the age circuit) and you will most likely obtain a significant increase in gain.

Horizontal drive range

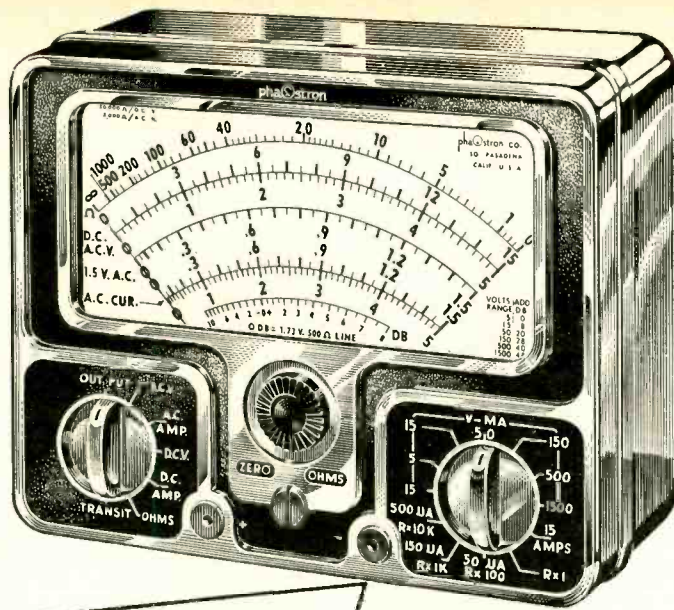
A Crosley chassis 472 came in with a condition of horizontal foldover that could be varied by turning the horizontal drive control. The best effect was obtained with the trimmer to its maximum capacitance. This also improved the width and brightness. I replaced this control with a capacitor of about 180 μf , with the condition improved considerably. My major concern now is if I am overdriving the horizontal output tube. The set appears to be working fine.—L. S., Groton, Conn.

The set you have is probably an early production model using a 68- μf capacitor. It was found that this drive control was not sufficient to adjust for certain tubes, and the later models of this chassis increased their drive range by replacing the 68- μf capacitor with a 330- μf unit. Thus, you might do well to insert a 330- μf drive control—you may get still better performance from the horizontal sweep circuits.

Color-killer adjustment

A customer has a Stromberg-Carlson model K-1 color TV set on which I have made several calls to adjust the color-killer control. Unfortunately, I cannot get a schematic for this set and thus hesitate to make any circuit changes or even detailed troubleshooting. However, I would appreciate some information on the setting and adjusting of the controls that cause interference when switching from a color to a black-and-white program.—T. S., Rochester, N.Y.

You did not state positively just what the trouble was nor the nature of the interference. However, the color-killer control can be adjusted in the home by tuning in a black-and-white picture. Then turn the chroma control to its mid-position. Adjust the color-killer control for a 920-ke beat (a coarse vertical beat) and then readjust until the beat just disappears. The color-killer control will now be adjusted so that the chroma control can be left in its on position even though there is no color signal present. This also eliminates adjustment of the chroma control between color and black-and-white programs. If the above fails to react as stated, you have no alternative but to go carefully over the color-killer circuit and, if nothing else, replace any components that are off-value by more than 10%.
END



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Fuzzball knows black-and-white servicing, but needs a little help when he gets a color installation. Red helps Fuzz out with some valuable pointers

Part I

practical COLOR TV installation



by BOB MIDDLETON

ARE you going to buy one, or be one?" Red asked pointedly. "Two more coffees," Fuzzball called. "I'll drink mine naked," he added.

Red reached for a puss-wipe and gave the counter a couple of swipes. "Joe cleans this counter once a year," he remarked, "whether it needs it or not."

"I got troubles," Fuzzball confided.

"You mean this color TV installation?"

"Yep. Confidentially, I don't know all the answers," Fuzzball admitted.

"Fuzz, you don't even know the questions. You got black-and-white service savvy, but you don't know from nothing about this color rat race."

"Sure don't," Fuzzball said. "Where do I start in at?"

Red set his cup down slowly. "Well, you know I always give a color set a rough setup and check it out before it's delivered. You got a problem, but it's only an installation problem. It starts with the customer.

"You have to explain that the re-

ceiver must be permanently located in the room and left there. If it's moved to another corner of the room, the change in stray magnetic fields is likely to throw the purity off."

"You're saying that the colors won't be right, and a black-and-white picture will be tinted," suggested Fuzz.

"Roger."

"So what would cause a change in stray fields if the set is moved?"

"Use your bean, man. There's usually pipes in the wall, radiators and plenty of metal in any building. Even the earth's magnetic field can affect color purity, it says in the better books," Red advised.

"I guess that's about the only problem with the customer?"

"Got news for you," Red retorted. "next you got to tie down what kind of lighting will be used for most of the program viewing."

"You got me snowed," Fuzz protested, "why?"

"Well, if Mrs. Jones likes to use her color set mostly during the daytime, you have to balance the picture tube

for daylight. Because, the picture tube won't show a neutral raster for tungsten lighting, or for fluorescent lighting, when it is balanced for daylight. If she likes to use the set mostly in the evening, you have to darken the room, turn on the light that is going to be used, and balance the picture tube for that particular kind of light. Otherwise, she will complain that the screen is tinted red, or blue, or green and you'll have a callback."

"How do I set up the picture tube for a neutral raster?" Fuzz asked.

"To start with, just turn the screen controls for the picture tube until the raster is neutral. You can get to the background controls later on."

"Let's take this step by step," Fuzz suggested, "and some'll rub off."

"It better," Red replied. "Now that we know where the set will be located, and what type of room lighting will be used, we remove the back from the cabinet and look for the high-voltage interlock."

"Do all sets have interlocks?"
(Continued on page 110)

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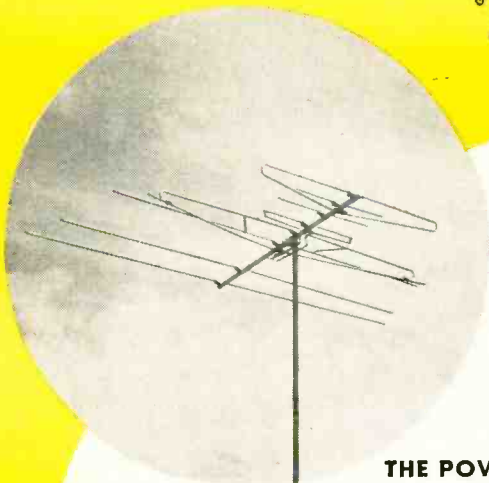
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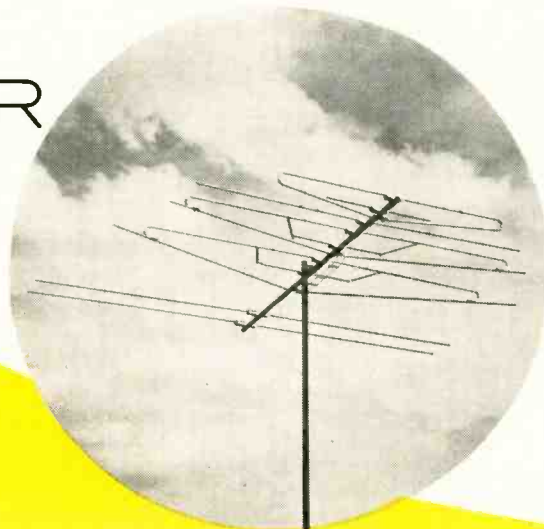
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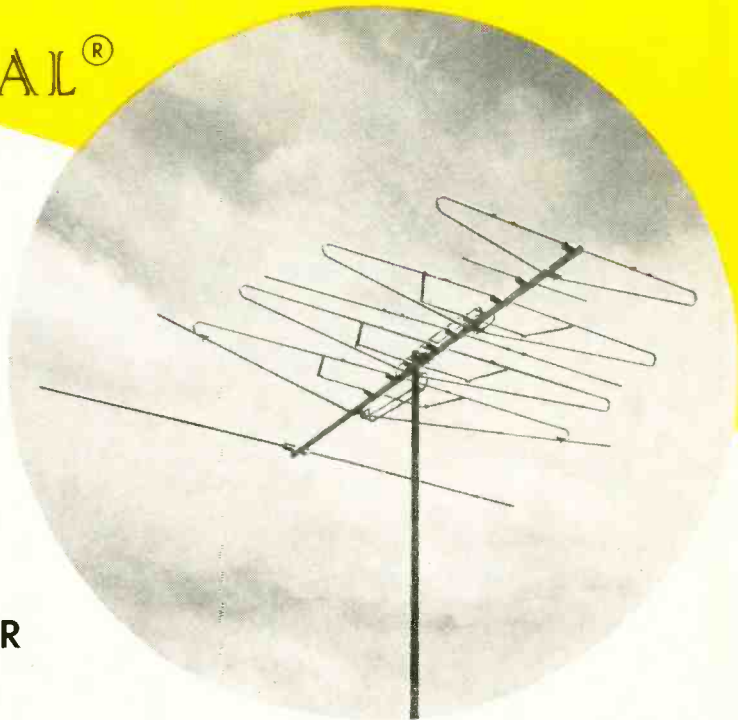
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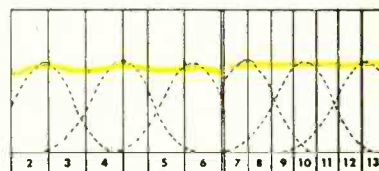


Figure A

response such as indicated in Figure A can be obtained by tuning the antenna on these frequencies—an equally flat response is obtained on channels 3, 5, 8, 9, 11, 12. The dotted line indicates the frequency response of the "Wing" dipoles alone. These three dipoles, in combination with each other and with the "Wing" director system, provide the over-all gain and flat response shown by the solid line.

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(Continued from page 107)

"Not all. There are different types of interlocks to watch for, too."

"Gimme a f'rinstance," suggested Fuzz.

"Well now, when you take the backboard off an Admiral, you'll see a poly tube about 4 inches long and half an inch in diameter that pulls out of the interlock with the backboard. When you take the backboard off a Sylvania set, there's a wire lever springs back from the high-voltage cage—closes a switch that shorts the high voltage."

"Reckon I shouldn't turn the set on with the high voltage shorted."

"You know it," Red replied. "You'll blow the flyback fuse quick, if you try. How can you cheat the interlock?" Fuzz asked next.

"In case you're working with the Admiral type, you shove a poly tube into the interlock. Walsco makes a handy cheater of this type. But if you're working with the Sylvania type, you look for a hooked trigger wire to hold the interlock open while the back is off the set."

"Tell me more."

"Well, you have to learn how the cabinet comes apart."

"Dog bite! You mean the cabinet comes apart?"

"In most cases. On an RCA, the top can be removed so you can stand in front of the picture tube while you're making the setup. On a Hoffman, the side of the cabinet swings out. On a Sentinel, both sides and top can be lifted off.

"That's a real good steer, Red," Fuzz acknowledged gratefully.

"Be my guest, buddy. Now you're ready to go to work. The first job will be blood, sweat, and tears, but it gets easier as you learn the ropes."

"How do I go about making the setup?"

Measure the high voltage

"You remember about setting the screen controls for a fairly balanced or gray raster. Of course, the customer's brightness control—that's the master brightness control—must be set high enough too. Now we usually have to measure the high voltage."

"Skip it, Red. I been measuring high voltage for years."

"Down, boy. You're going to have to run like hades to keep up with the foot of the class."

"What are you driving at?"

"These color picture tubes run at 25 kv," Red explained, "and you don't go poking around with a high-voltage probe like in a black-and-white set that has low voltage and low current. That 25 kv will spray and arc like crazy if it's not treated with care. Now, if you're using a Walsco cheater, you can stick the high-voltage probe down inside the hollow cheater and measure the high voltage on a meter. If you're working with some other kind of set, like a Packard Bell, is isn't convenient to measure high voltage directly. So you put a voltmeter across a resistor mounted on the side of the high-voltage cage. Then you adjust the high-voltage pot until you read 0.9 volt; the high-voltage will then be set to 25 kv."

"Suppose you don't set the high voltage?"

"That is ungood," Red advised. "You may work all day on convergence and draw a blank."

"Then you have to check and set the high voltage on every color receiver?"

"Not quite all," Red explained. "On some Motorolas, the old TS-902A f'rinstance, you don't have a triode regulator tube. Instead, a Victoreen 25-kv hydrogen bleeder tube is used in the set. It looks like a big black club mounted on the horizontal chassis."

"You don't worry about the high volt-

age when a bleeder regulator tube is used?"

"Right. Unless the set has been in service for a long time, the bleeder will do its job automatically. Of course, it might eventually have to be replaced, like any other tube."

"No kidding, I really appreciate these tips," Fuzz said gratefully.

"I didn't know you cared," Red replied. "Anyhow, next we have to make all the usual black-and-white setup adjustments, like linearity, height, and width."

"Suppose I goof and forget."

"You'll just knock yourself out. If you converge the picture tube, and then go back to the linearity and height adjustments, you'll mess up the convergence and throw all your hard work down a rat hole."

"What comes after setting up the linearity, height, and width?"

Now, the beam magnets

"Then you connect a white-dot generator to the set and see whether the picture tube is in rough convergence. We rough-converge the sets before they leave, and in most cases you will be OK on this one. However, if the white dots in the center of the screen are splitting up into red, green and blue dots, you have to get on the beam magnets and bring the center screen into convergence."

"Take it easy," Fuzz protested. "Where are these beam magnets?"

"They're mounted around the neck of the picture tube, just back of the yoke," Red explained. "There's three of them; one for red, green and blue. They have little round knobs, and when you turn a beam magnet, it moves its own beam, mainly. But there's some interaction—the red beam magnet also moves the blue and green dots to some extent."

"Sounds easy enough," Fuzz replied.

"But don't forget this," Red cautioned, "on the Motorola set, for example, there is a beam-retraction lever; it's thrown to one side during shipment so the iron cores of the magnets don't rest against the glass neck of the tube. Unless you remember to throw the retraction lever and lower the magnets to the tube, you'll never get the picture tube converged."

"Where is this retraction lever at?"

"It's mounted on the back of the yoke, between the yoke and the beam magnets."

"So we have three beam magnets to work with at this time?"

"Nope, there are four. In addition to the blue beam magnet, there is a blue lateral corrector magnet."

"Translation, please."

"Well, this blue lateral corrector is mounted on the neck of the picture tube nearest the base. It looks like the ion-trap magnet used on some black-and-white sets. But it's not an ion trap—and there's no ion trap on a color picture tube. The blue lateral corrector is a strap and spring arrangement, with

TELEVISION

a magnet that can be pushed or turned in or out. In some sets, the magnet is rotated in the strap mounting."

"Fill me in on these beam magnets and lateral corrector."

"Here's the pitch: The blue gun will be mounted straight up or straight down on the neck of the picture tube. The red and green guns are mounted 120° around the neck from the blue gun. The convergence magnets are built so that the blue beam magnet moves the blue dot only up and down. We need to move it sideways, too, to get convergence. You adjust the blue lateral corrector for this sideways motion."

"Then I reckon the green and red beam magnets would make the green and blue dots move diagonally?"

"You're right on the stick," Red said admiringly.

"I do it by osmosis," Fuzz explained.

"So, when you adjust the red and green beam magnets, you get opposite diagonal travel of the color dots, and the red and green dots cross over at some point and converge. Then, you adjust the blue beam magnet and the blue lateral corrector to converge the blue dots with the yellow dots—of course, when you overlap the green and red dots, you get yellow dots."

"And when the blue dots overlap the yellow dots, I'll get white dots?" Fuzz hazarded.

"Right again," Red said admiringly, "you're the genius type. Now, you'll find the beam magnets and lateral corrector produce convergence only in the center part of the screen. The picture tube will be out of convergence on both sides, and at the top and bottom."

"What do I do about that?"

"For the moment, nothing. We need to get only rough convergence at this time, because we have to set up the purity and purity is affected by convergence if the convergence is way out."

"You spoke about purity before," Fuzz recalled.

"Yep. And now we have to get down to brass tacks. We check the purity by turning off the blue and green guns. The red field is produced with a heavier beam current, which is a little harder to control—so, if we set up purity on the red field, the green and blue fields will usually fall in OK."

"How do I turn off the blue and green guns?"

"Depends on the set," Red observed. "On a Motorola, for instance, the grid leads to the color guns are terminated with plugs, which can be unplugged from the amplifier circuits and plugged into grounding jacks on the back of the vertical chassis."

"How do I know which lead is which?"

"They're color-coded. Look at the leads coming from the socket of the picture tube. Among them, you will see a red, a green and a blue lead. We ground the blue and green leads."

"That leaves a red field on the screen of the picture tube."

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TELEVISION

"You're so right!"

"But only on a Motorola," Fuzz remarked.

"Check. On an RCA set, you use another method: you shunt 100,000-ohm resistors to ground from the terminals of the green and blue grid leads."

"I guess you could always turn the green and blue screen controls down to minimum," Fuzz suggested.

"Right again. And on some color receivers, that's the only practical way of getting the red field by itself."

"How high do I set the red screen control?"

"That's a good question, and I like good questions," Red replied. "Usually you'll have a red screen control provided. But on the Hoffman set the red screen is controlled by fixed resistors, and you don't adjust the level."

"Should the red screen control be turned wide open on the other sets?"

"Not always. You have to be careful here. Sometimes you can set the red screen control too high, and damage the color picture tube. Check the receiver service manual, find out how much red screen current is allowable, and don't exceed the limit."

"So I have to measure the red screen current in such cases?" Fuzz asked.

"Yep. But you usually measure it indirectly, just like you often measure the high voltage indirectly. The service manual will tell you how to make the measurement."

Purity setup

"How about setting up the purity?"

"There are three adjustments for purity. In the first place, the yoke should be slid to the point of best purity along the neck of the picture tube."

"Then you don't mount the yoke clear forward against the flare of the tube, like in a black-and-white set?"

"Absolutely not. There is no danger of neck shadow in a color tube, because the neck is large. The yoke is mounted on slotted brackets and is located for best red field purity. At the same time, you adjust the purity magnets on the neck of the tube."

"What's with these purity magnets?" asked Fuzz.

"They are a pair of flat ring magnets located between the convergence magnets and the lateral corrector. You might guess that the purity magnets were centering magnets, like on some black-and-white tubes, but they're not for centering—they control the purity."

"Then how do I center the raster?"

"You'll find a couple of pots on the chassis like in the old-time black-and-white receivers. Now, the purity magnets will change the picture centering, but the off-centering is corrected by the centering pots."

"How do I adjust the purity magnets?" asked Fuzz.

"Well, each of the flat rings has a tab and you can rotate the two rings face-to-face by pulling these tabs apart, or moving them closer together. (See

(Continued on page 116)

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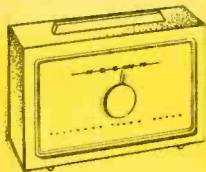
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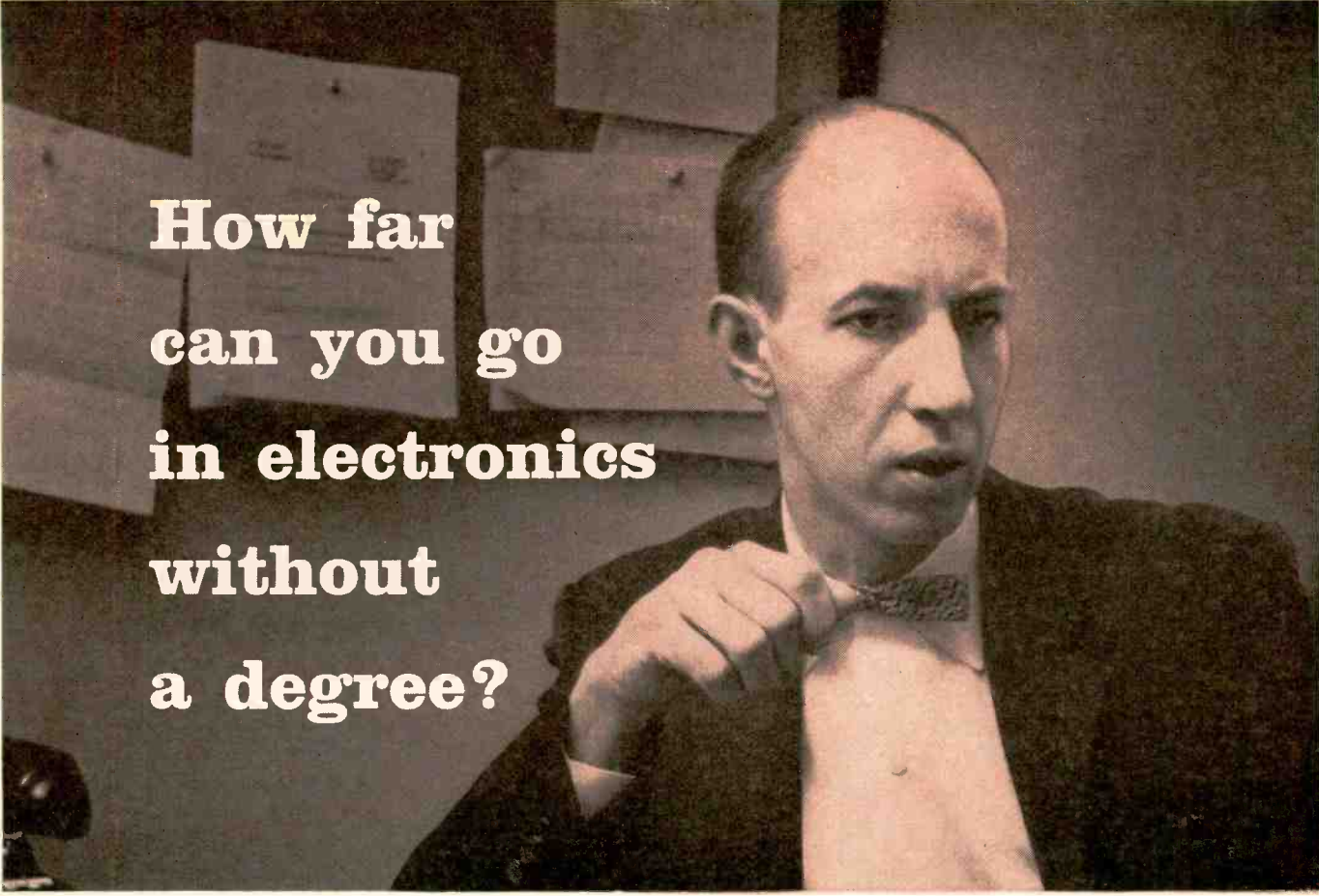
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How far can you go in electronics without a degree?

Bill Miles talks frankly about the technicians' biggest problem

2 years ago, degreeless Bill Miles had reached a blind alley in his career. Yet today, with IBM, he's actually supervising engineers in America's biggest electronics project. Here's how this technician broke through the "education barrier."

"Training and local assignments," recalls Bill Miles, "were what caught my eye when I saw an IBM ad in 1955. So I investigated. Now here I am with an advanced electronics education under my belt—and responsibility as a Group Supervisor in Project Sage. I work on the world's largest and most advanced computer. I live in my home town. And my future in the company is what I make it. Yet only 2 years ago, I thought I'd gone as far as a technician ever could!"

Becomes radar technician

Bill's background is typical of thousands of capable, ambitious technicians who never acquired a formal engineering degree. His interest in electronics, aroused in Camden, New Jersey, high school, was nourished by a 3-year stint as Aviation Radar Technician in the Navy's "Black Cat" air-sea rescue squadron.

Takes night courses

Discharged in 1946, Bill married a girl he'd known in high school. During the

next 9 years, Bill was teacher in a radio-TV institute, TV service man, TV company technician, and chief supervisory TV technician. All the while he pursued an engineering education at night. But growing family responsibilities made it more and more difficult.

Finds doors barred

However, feeling he was equipped for greater responsibility, Bill, now 30, investigated several companies but found that, while they liked his abilities, his lack of degree barred the door to any significant future advancement.

Enters IBM school

In May, 1955, when he moved his family to Kingston, New York, and started at IBM, Bill wasn't quite sure what to expect. The 8-month training course—valued at many thousands of dollars per man—had been the big magnet for him. He hoped the future would match his expectations.

Meets head of school

"Sixty of us started school at IBM, attending class 8 hours a day. The course consisted of about 20 subjects, mostly dealing with computer circuits and units,

and maintenance techniques. The teaching was adult, superb. During training, we received a living expense allowance, over and above salary. We kept our own grades, and every 6 weeks when we reviewed them with the instructors, they asked us for ways to improve the course. I expected a casual 'hello' when I met the Division Manager of Education, but he talked to me for an hour about myself and my interests. The real concern IBM has for you as an individual, both before and after they hire you, is undoubtedly one reason why we all began to take a lot of pride in this outfit."

Joins home-town computer site

Bill had joined IBM as a Field Systems Engineer. After graduation, when 10 of his classmates were immediately promoted to specialized assignments, Bill was assigned to a computer site near his home in Mt. Holly, New Jersey, with IBM paying his moving expenses. For the first two months he helped install the SAGE computer, an important link in America's air defense. Ultimately, such computers will ring America's entire air defense perimeter. Looking back, Bill notes, "I'll admit the work was laborious and difficult, but still I have a sense of great accomplishment. Together we all helped create something of value from almost nothing."

World's largest computer

"The computer is probably the largest one in the world, with over a million components. Flattened out, it would probably fill a ball field. The computer analyzes radar data on every object in the sky. Then it checks each object against available traffic information and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against what it thinks is a 'baddie.' Only airmen can make that decision."



Bill gets electronic computer education at IBM Kingston

Supervises fifteen

Recently promoted to Group Supervisor, Bill now directs an entire shift of 15 men, reporting to a Group Manager. His job: to maintain the computer in combat readiness. "I have to be familiar with the entire system. I rely on two types of specialists to help me: computer units men who are specialists in certain areas; systems engineers for the over-all computer."



Miles does diagnostic programming on the Operating Console of the Sage Computer



Miles nails down problem with Site Manager R. Schimmel

Buys house, car

Bill has bought a 7-room house in Mt. Holly. When not busy with his son and twin daughters, he likes to bowl. He drives a new automobile. He's enjoying the good life, and expects it to get even better. His employee benefits alone represent a cash value of many hundred dollars a year. He expects the IBM-sponsored General Education Program will prepare him for higher management responsibilities. Later, Bill's manager said, "He's currently assuming the responsibilities of an electrical engineer."

But the question remains: Is Bill really an engineer?

The "professional" engineer

"No, I certainly don't consider myself a 'professional' engineer, qualified to design machines, for instance. But the point is, I'm doing work ordinarily done by engineers . . . work usually denied to men without a degree."

IBM upgrades technicians

Could he do this elsewhere? "Of all the companies I know, IBM appears to be one of the few upgrading the technician to the level of engineering responsibility. Fortunately for me, IBM had the imagination to get men without degrees and encourage them to rise in responsibility and income to the level of their native talents . . . not what their formal education dictates."



"Student" Bill Miles diagrams computer circuit

Both titles gain

Is this a sign that the educational system is wrong? "Not at all," answers Bill Miles. "A Doctor's, a Master's, a B.S. degree stand for something and always will. But if a technician can perform many jobs that traditionally belong to the engineer, they both stand to gain. The technician, because he gets much of the engineer's salary, satisfaction and recognition; the engineer, because he is free to do work which *only* a man with his formal training can do. When everybody wins, and nobody loses, it's the sign of a good thing."

Since Bill Miles joined IBM, opportuni-



Home-town assignment pleased Miles' wife, son, twin girls

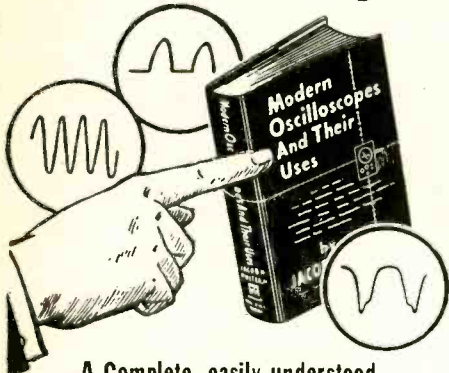
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(Continued from page 112)

"Black and White Adjustments in Color TV," RADIO-ELECTRONICS, January 57.) When, the tabs are together you have the weakest purity field, because the poles of the two rings cancel. When you pull the tabs apart, the purity field is increased. The complete purity assembly can be rotated on the neck of the tube and you work with both adjustments, along with the yoke position, until you get the purest red field."

"You said there was a third adjustment for purity, too."

"There is. You will find that when you get the best purity possible by adjusting the purity magnets and yoke position, the edges of the picture tube will still show impurities. Cinch down the yoke and go to the rim magnets around the edge of the picture tube. You adjust these rim magnets for good edge purity."

"How many are there?" Fuzz asked. "Admiral uses six and Motorola eight," Red replied. "Some new sets have gone back to the old arrangement in which you don't have any rim magnets, but instead a large rim coil wound around the edge of the picture tube. When you have a rim coil, you look for a pot that adjusts the amount of dc current through the coil."

"The rim-coil adjustment would be easy," Fuzz observed. "How do I adjust these purity magnets?"

"Depends," Red replied. "On some sets, the rim magnets are held by spring clips, and you just rotate the magnets in the clips. But on other sets, you can pull the magnets away or move them closer to the tube, as well as rotating them."

"That's fine, then," Fuzz agreed, "if the purity comes out OK. Suppose it doesn't look satisfactory after the adjustments are made?"

"You must have been reading my mail," Red replied. "It can happen! In such a case, you have to degauss the picture tube."

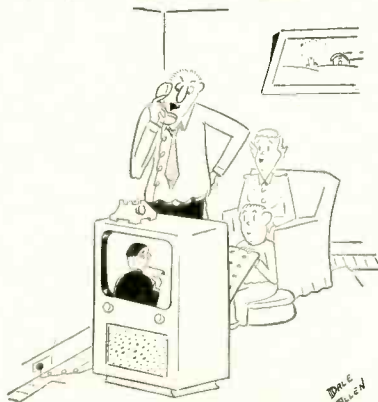
"How do I do that?" asked Fuzz.

"We'll cover that tomorrow," Red promised.

"Back to the salt mines?"

"Chop-chop," Red agreed, tossing two bits on the counter. END

(If you liked this article and want more like it drop us a line and tell us so.—Editor.)



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By **ROBERT COOPER, JR.**

CONFUSION! This one noun would appear to summarize the total state of dx during the last few months. Sporadic-E skip hit the whole country with a fury not seen since the summer of 1954. Areas such as the Northwestern States found themselves the recipients of more skip in a single 2-week period than they would normally get in a whole summer. This was especially apparent in the field of double-hop E reception over distances of 2,000 miles or more.

Station call letters even added to the problems of the dx enthusiast. The call KTCA first began to show up on channel 2 on the night of May 22, being seen over a wide area in the Mid-Atlantic States. Master call-letter lists showed this station was on channel 4 in Hawaii! Imagine the elation that must have followed this logging, only to learn later that the station really is on channel 2, but in Minneapolis, Minn. Even the FCC can be confused when issuing call letters.

During many of the better E-skip openings, dx'ers found so many stations skipping in on the lower channels that station identification was all but impossible for hours on end. The comment of Robert H. Gordon of Harrisburg, Pa., with his log of May 22 is quite typical of those received: "There were too many stations coming through at the same time—impossible to log." Believe it or not, there are times when dx can get just a bit too good!

Leon Henner of Riverdale, N. D. notes dx reception in full color on June 3 from station KTBS Shreveport, La. Although I am sure this is not a first, it is the first reported instance we have of good-quality color dx reception.

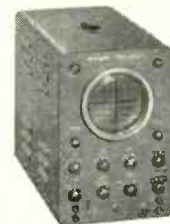
Problems with reception from television stations "south of the border" cropped up again this summer. New stations in Cuba and Guatamala were reported over wide areas. Station TGBOL on channel 3 appears to be originating from Guatamala City, Guatamala. It is reported as received on many points along the Gulf Coast.

In response to our plea for any unusual reports of reception from the south on May 1-2, dx'er Doris Johnson of Longview, Wash., notes fading signals from the southeast, channel 2, 1602-1612 with Spanish or Portuguese audio but no video that would sync in. Doris also reports that on May 8, 1101-1103, while receiving KNXT, channel 2, Los

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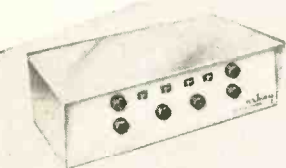
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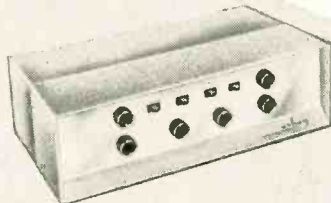
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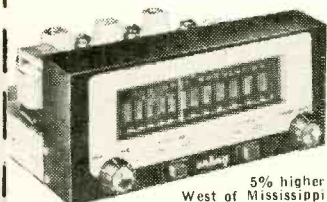
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Angeles, Calif., foreign audio overrode the Los Angeles sound. Amateur 6-meter enthusiasts report much unusual activity toward South America on May 1, 2 and 9. It is the general belief that most of this activity was a result of a combination of E- and F2-layer activity.

Still in the foreign notes department, George Palmer of Williamstown, Australia, reports skip reception over 420 miles on their equivalent to our channel 2. This is the first instance of sporadic-E TV dx reception in Australia that we know of to date.

Meteor scatter

Dx'er Ronald A. Boyd of Truro, N. S., Canada, reports trying his hand at early-morning burst reception, and finds the results well worth the effort. Seen and identified on a regular basis are: WCBS, channel 2, New York (600 miles); WMAR, channel 2, Baltimore (775 miles); KYW, channel 3, Cleveland (925 miles); WGR, channel 2, Buffalo (775 miles); etc. Have you tried your hand at meteor-scatter dxing yet?

High station totals continue to climb—dx'er Bob Seybolds has reached the mark of 300 television stations logged. Bob is the first dx'er to reach this plateau, with more than half of the total number of vhf-uhf stations in the country in his logs! Not too far behind Bob are Art Collins of Buffalo, N. Y., and Bedford Brown, Hot Springs, Ark., climbing steadily toward 300.

In Europe, E skip has also shown it has no boundaries, bringing 1,500-mile reception to Skillingaryd, Sweden (Radio and Foto Shop reporting), from CCCP3 (USSR3) Russia, Italy, BBC-England, CCCP2 (USSR2) and Hungary all through the month of May.

Predictions

September is traditionally the month of good tropics (ground-wave) reception. Dx'ers east of the Rocky Mountains will find exceptional conditions prevailing for days at a time, bringing high-band reception and uhf reception from stations 400 and more miles distant. Watch for signs of improving tropics (such as fringe-area stations losing their snow) and then check the channels for stations farther away. The early morning and late evening hours will be the most productive. Dx'ers along the Great Lakes, the Gulf Coast and Atlantic Seaboard should watch the weather map for signs of high-pressure masses moving over those areas. The leading and trailing edges of high-pressure areas often bring excellent ground-wave conditions during the month of September. Frequent checks of the uhf channels will also pay off very nicely, especially when the high-band channels are hot.

E-skip reception may hold up weakly in southern areas as late as the third week of September. Openings will occur in the late afternoon hours and

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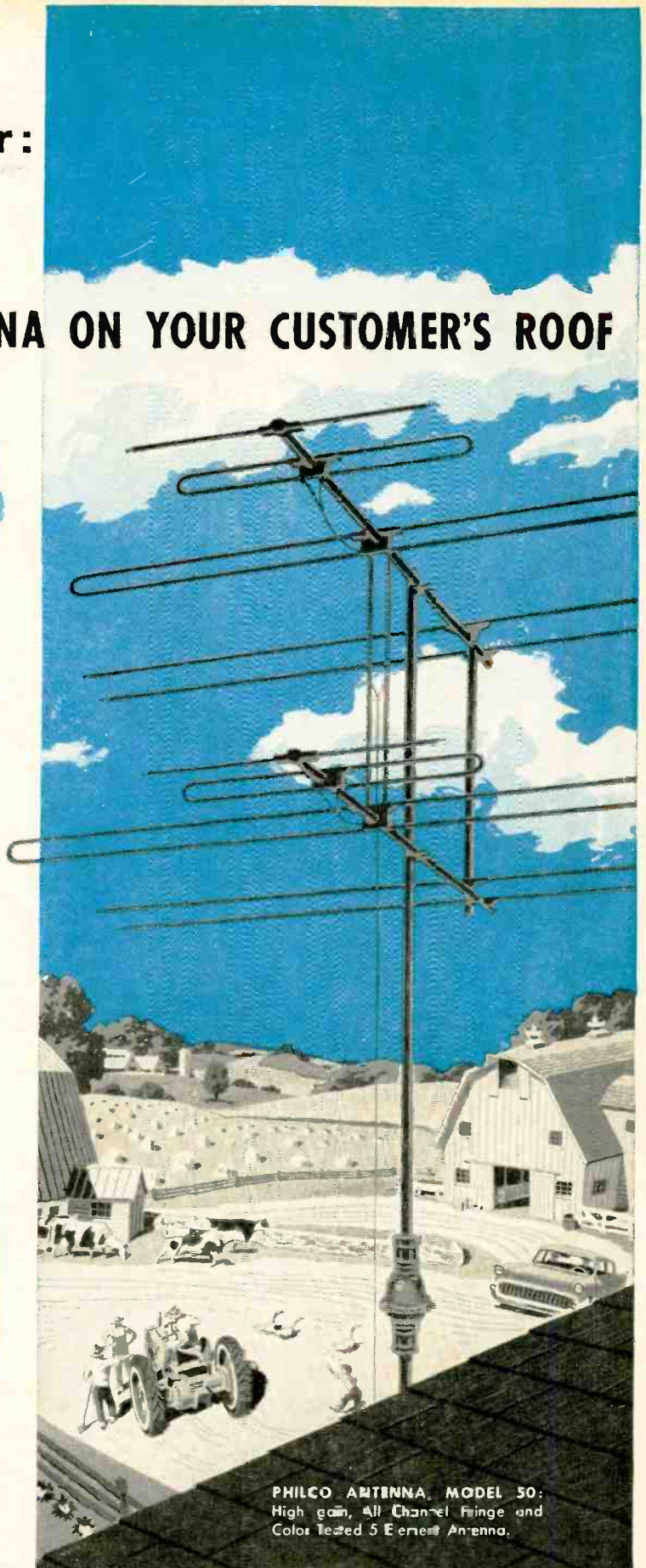
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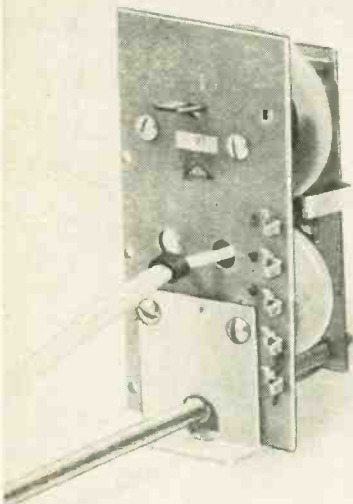
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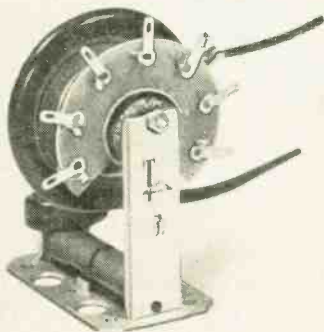


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will be small in nature and weak in strength.

No major meteor showers are predicted for September-October, although several minor ones do occur in the late evening hours, local time. North-south paths should be the most productive for meteor-scatter work during the next two months.

We still do not have any instances of true F2 reception into the United States from stations using American standards, but there is no way of telling what this fall will bring. Watch for signs of reception from South America around noon local time, channel 2. Reception from the Hawaiian Islands may be possible on channel 2 during the latter part of October, when it is noon at the mid-point of the path between you and the islands. Again, watch channel 2.

Report forms

RADIO-ELECTRONICS continues to make television dx report forms available, free of charge, to readers of this column. Simply send a postcard with your name and address to TV Dx Column, RADIO-ELECTRONICS, 154 W. 14th St., New York 11, N.Y. **END**

CORRECTIONS

In the parts list for the amplifier on page 35 of the July issue, the power transformer T1 is listed as a Chicago type PV-200. However, the voltage and current output given were not that of the PV-200, but that of an experimental transformer used in the prototype design. The designer recommended the PV-200, which has more current reserve though lower rated voltage and, therefore, due to the lower resistance of its high-voltage winding, would deliver to the plates a dc voltage approximating that of the unit used in the original model.

Fig. 3 of the article "Portable Moisture Meter" (page 78 of the April issue) specifies 3/32-inch brass rod for the probe. The correct diameter is 1/8 inch. Our thanks to Frederick H. Kuck of Dayton, Ohio, for calling this error to our attention.

Texas Instruments Inc. reports that it has discontinued manufacturing the type TI200 and TI208 transistors listed for V3 and V4 in the hearing aid on page 35 of the April issue. The designer of the hearing aid informs us that the transistors are not critical in his circuit and that G-E 2N107's can be used for V1, V2 and V3, and a 2N170 (n-p-n) for V4. He suggests temporarily substituting 5,000-ohm potentiometers for R5 and R7 and adjusting them for best output with V1 and V2 collector currents of approximately 200 μ a each. Replace the pots with fixed resistances of the same circuit value.

Capacitor C4 (not shown in the schematic) is connected across R5 in some versions of the circuit.

note:

Estimated 1 3/4 million portable TV sets to be sold in '57!

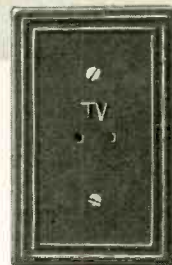
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TV SERVICE HINTS

By JAMES A. McROBERTS

THE great majority of TV repairs are routine. However, the minority include cases of particular interest. The following are typical of these intriguing problems:

Ungrounded Aquadag coating

The outer coating of Aquadag on TV picture tubes is normally grounded through springs. Failure of these springs to make contact with the coating may result in a high-voltage burn when the Aquadag is touched, since the body is in series with a capacitor of about 500 μf across the high-voltage line.

Eliminating neck shadows

Try as you may, a small amount of neck shadow will remain at the corners of the picture tube. Technicians usually attempt to eliminate these shadows by adjusting the ion-trap magnet, focus magnet and deflection yoke (shaving some of the insulation from the yoke has worked). I use magnetic bias.

Magnetize the metal band and yoke frame so the picture is deflected more to one side than the other. This can be done by charging an electrolytic capacitor through the yoke, causing a decaying pulse of current through the horizontal coil. Since the current flows in only one direction, it magnetizes the yoke frame slightly. The field shifts the electron beam slightly, usually enough to eliminate the corner shadow.

A small electrolytic capacitor—8 to 10 μf —is used to limit the strength of the magnetic bias. If a stronger field is desired, the process can be repeated. Be sure the surge voltage of the capacitor exceeds the supply voltage at the yoke terminals.

Fig. 1 shows how this process is carried out in an Olympic model 21K62. However, it may be applied to any TV receiver. This set had a shadow on the

left side of the screen. Since the elimination of a left-side shadow requires temporary reversal of the yoke leads, elimination of right-side shadow will be considered first.

Form the electrolytic capacitor if it has not been in use recently. Connect one side to ground and the other to B plus. Keep it there for 10 minutes.

Thoroughly discharge the capacitor by disconnecting it and shorting its leads. Then touch the positive side of the capacitor to the opposite side of the yoke to which the flyback transformer and B plus are connected—keep it this way for a few seconds.

When the capacitor contacts the yoke lead, the raster will shake sideways violently. When the capacitor is removed, the raster will return to a new position, shifted sideways by a fraction of an inch. If the shift is insufficient, repeat the process. Don't overdo it. If the shift is too great, apply magnetic bias in the opposite direction.

To eliminate left-side shadow, reverse the yoke terminals and repeat the capacitor charge. Return the yoke leads to their normal position and look at the picture. Do not attempt to judge the amount of shift with the yoke leads reversed—the indication will be erroneous. Repeat the process until the desired amount of shift is obtained.

Corrector-magnet vibration

Any vibration of the corrector magnets causes picture jitter. If the magnetic field varies vertically, it causes horizontal jitter; horizontal variation of the magnetic field produces vertical jitter. On the particular set—a Zenith 21K20—the motion was horizontal. A check uncovered a loose corrector-magnet mounting screw. This permitted vibration caused by sound waves from the loudspeaker.

The service call started with a com-

plaint of intermittent jitter. The controls were varied and it was discovered that turning up the volume produced jitter during loud passages.

Substituting the shop speaker and holding it away from the chassis did not produce the jitter. This indicated a microphonic component was influencing the vertical sweep. All tubes in the vertical sweep and sync sections and the focus and yoke assemblies were tapped with a rubber mallet. Finally, the corrector magnet was tapped: tightening its mounting cured the trouble.

Residual yoke magnetism

If this magnetism deflects the electron stream exactly vertically or horizontally, little harm is done so long as the positioning controls can produce a picture without neck shadows. Unfortunately, this seldom occurs when the yoke is magnetized by an external magnetic field. (A random scrape with the ion-trap magnet or a magnetized tool can magnetize it permanently.)

To demagnetize the yoke, subject it to a powerful ac magnetic field—sufficient to saturate the magnetic structure completely—and then move the yoke slowly out of that field.

An ordinary brass-cased compass needle can provide a very sensitive test for residual yoke magnetism. Orient the needle so that the scale's zero point rests under either end of the needle while the compass is away from any strong magnetic fields. (Move it a few inches; if it still points in the same direction, it is not in a strong field.) Now lower the compass into the yoke structure till it rests on the yoke (Fig. 2). Any magnetic field other than that exactly in line with the needle will reveal itself as a deflection of the needle, proportionate to the strength of the magnetic field. About 20° deflec-

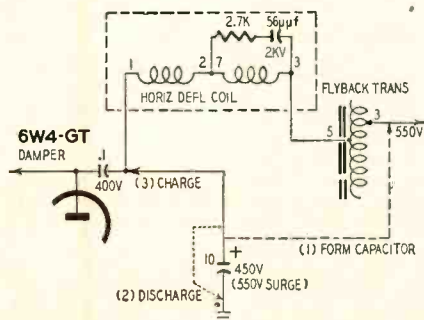


Fig. 1—Applying a magnetic bias.



Fig. 2—Deflection yoke holds compass.

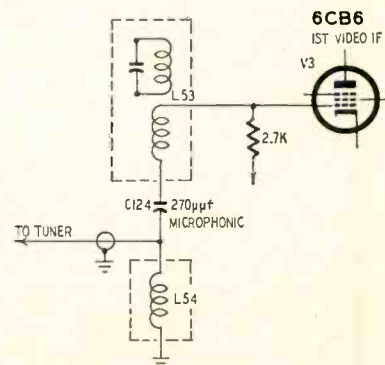


Fig. 3—Section of if input circuit.

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tion is the maximum tolerable. Fig. 2 shows the compass in position with a deflection greater than the tolerance. The picture on the screen was so far displaced that the positioning control could not center it.

Remove the compass and turn the yoke 90°. Reinsert the compass—stray fields at right angles to the first test will reveal themselves. Rotation of the yoke by a quarter turn should be tried even if the needle is apparently undisturbed when the first trial is made.

Intermittent bars

This trouble kept step with the associated sound but was broader and less sharply defined than sound bars due to improper adjustment of the sound trap in an intercarrier receiver. Jarring the chassis (Sylvania 1-518-1), and particularly jarring shield cans L53 and L54 (Fig. 3), caused flashes on the screen. Removing the speaker from the chassis proved that the trouble was

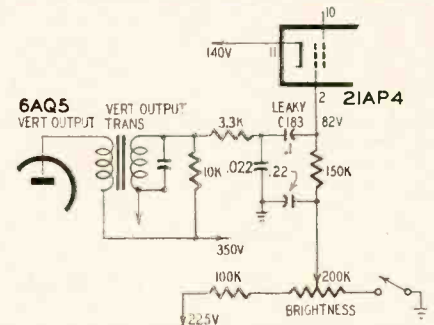


Fig. 4—Defect in retrace eliminator.

due to a microphonic part or parts shaken by the speaker, since the trouble disappeared with the removal of the speaker.

Tapping showed that C124, a 270- μ f capacitor, was sensitive to jarring. A piece of Scotch tape, fastening the capacitor to the chassis, damped the capacitor sufficiently to cure the trouble.

Poor brightness control

An RCA model 21D327 operated at a high brightness level accompanied by an oversized raster. The brightness control was practically inoperative. Signal strength, both video and audio, seemed good.

Measurements at the socket of the 21AP4 revealed a bias of 14 volts maximum. Normally, this should have reached 58 volts. The schematic (Fig. 4) showed several possible sources of B-plus leakage that would cause this condition. None could be found with a portable multimeter.

Disconnecting the 3,300-ohm resistor, part of the retrace-elimination circuit, permitted proper operation of the brightness control and restored normal bias voltages. Retrace lines could be seen, but this was to be expected.

Since the trouble was apparently due to a defect in the retrace-elimination circuit, C183 was replaced and the trouble corrected. Later testing of C183 with a vtvm showed the capacitor to be leaky. END



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In Gernsback Publications

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Modern Electrics	1908
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Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
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Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

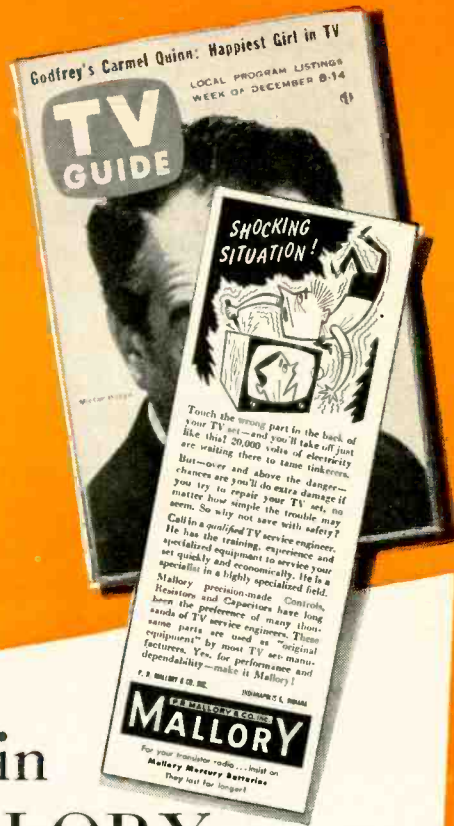
Some larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In September, 1923, *Science and Invention* (formerly *Electrical Experimenter*)

Hypnotism By Radio, by Edward H. London.
Wired Radio for Broadcasting, by Bert T. Bonaventure.
Radio for the Beginner, "Amplification," by Armstrong Perry.

One Tube Regenerative Receiver, by Bert T. Bonaventure.
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Every KRAEUTER solid joint plier has a cushion grip of thick vinyl to make your tough jobs easy. All KRAEUTER "CG" cushion grips provide easy identification—easy to locate in your tool box—ideal for departmental color coding in your plant. All KRAEUTER "CG" cushion grip pliers assure you comfort and ease on the job.

Whether you use side cutters, diagonals, lineman's or one of the other quality pliers in KRAEUTER's long line, you will find "CG" cushion grips a standard feature at regular prices.

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FOR 100 YEARS THE FINEST IN HAND TOOLS 1860-1960 NEWARK, N. J.



**new
Devices**

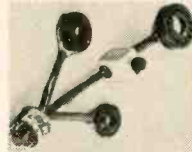


PICTURE-TUBE RESTORERS AND ADAPTERS. *Model K-101* (illustrated) locates and corrects for open cathode, heater-cathode short, open grid, control-grid-cathode short, low emission and their combinations. *Model K-201* for open grid or control-grid-cathode short.



Model T-201 enables each gun of a 3-gun color kinescope to be tested on tube testers designed for monochrome tubes. With *model T-101* each gun of a 3-gun color kinescope can be operated singly or combined.—**Perma-Power Co.**, 3100 N. Elston Ave., Chicago 18, Ill.

PICTURE-TUBE TEST ADAPTER, model C 40. Designed for use with B & K models 400 and 350 Cathode Rejuvenator Testers. For testing



and rejuvenating color TV and 110° picture tubes. Tests each color-tube gun separately.—**B & K Manufacturing Co.**, 3731 N. Southport Ave., Chicago 13, Ill.

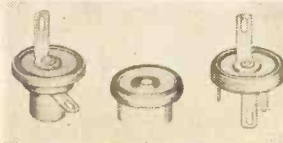
REPLACEMENT YOKE, MDF-99. 90° cosine deflection yoke replaces RCA 100586 and 101147. Used in more than 85 models



and chassis produced in 1955-56.—**Merit Coil & Transformer Corp.**, 4427 N. Clark St., Chicago 40, Ill.

YOKE REPLACEMENTS, 9 types: Y31, Y32, Y33, Y34 for G-E; Y35, Y36, Y37, Y38 for Motorola and Y39 for Zenith.—**Thordarson-Meissner Manufacturing Co.**, 7th and Belmont Ave., Mt. Carmel, Ill.

MICA CAPACITORS. Button type. Custom-built for continuous operation in the 350°C



range.—**Erie Resistor Corp.**, 639 W. 12th St., Erie, Pa.

PISTON CAPACITOR KIT, PK260. Contains a quantity of



each of 42 current trimmer models. Housed in two 8-drawer metal cabinets.—**JFD Manufacturing Co., Inc.**, 6101 16th Ave., Brooklyn 4, N. Y.

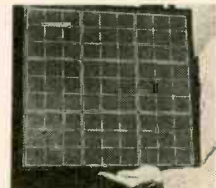
MOLDED POTENTIOMETERS, type AS. ½-inch diameter. Rated at ½-watt continuous duty. Linear taper. Locking type screwdriver-slotted shafts.—**Ohmite Manufacturing Co.**, 3630 Howard St., Skokie, Ill.

TV FLYBACK, EFR 91. Exact



replacement for Scott-Meck part No. THC-10021 used in 33 chassis and models.—**Rogers Electronic Corp.**, 49 Bleecker St., New York 12, N. Y.

SUN BATTERY. 18 x 18 inches. Consists of nine 6 x 6-inch B-60



selenium cells.—**International Rectifier Corp.**, 1521 E. Grand Ave., El Segundo, Calif.

AUTO BATTERY AND APPLIANCE TESTER, model 108



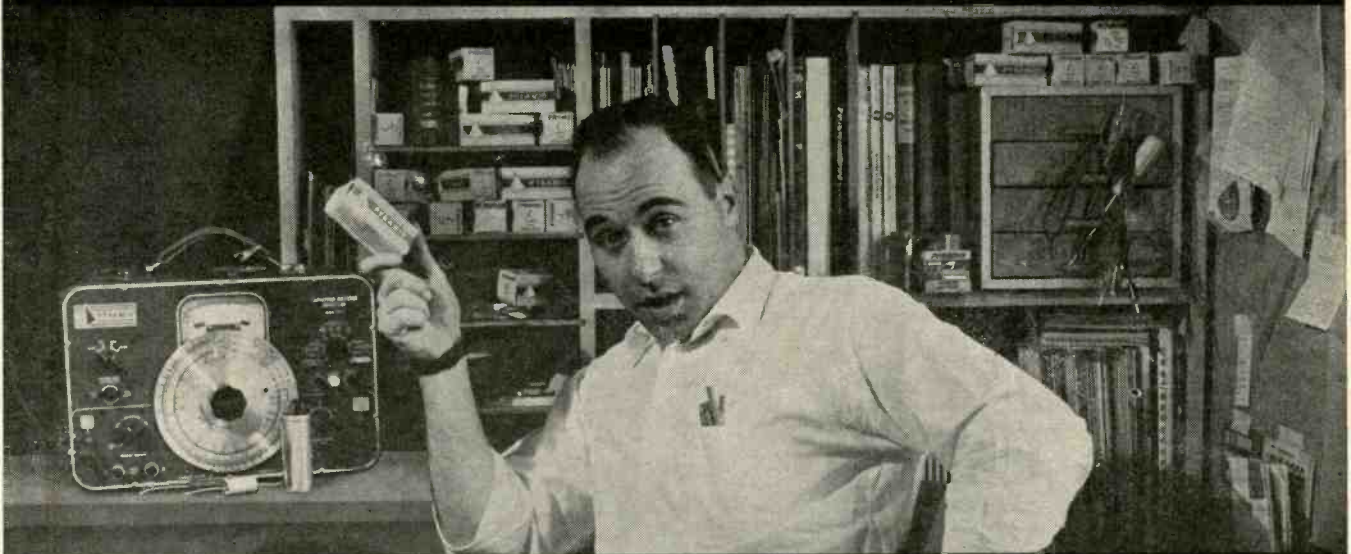
Handi-Tester. D'Arsonval type meter. Measures ac-dc volts, amps, watts and resistance.—**Electronic Measurements Corp.**, 625 Broadway, New York 12, N. Y.

BIAS SUPPLY, model BE3, improved version. Replaces batteries for alignment and age

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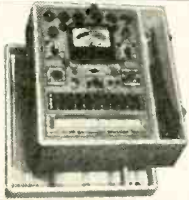
PYRAMID ELECTRIC COMPANY

1445 HUDSON BLVD., NORTH BERGEN, NEW JERSEY

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hear**



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is to
EMC**



**MUTUAL CONDUCTANCE
TUBE TESTER — EMC Model 206 P**

One of the finest pieces of tube testing equipment at a price comparing favorably with emission-type testers. This completely flexible model using lever-type switches offers extremely accurate results with ease of operation.

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Directly measures capacity, resistance and complex waveforms peak to peak. Some of the high quality features at no extra cost are: expanded scale cannot burn out . . . measures 50 mmfd to 5000 mfd . . . inductance from 1.4 henries to 140,000 henries in 4 ranges . . . 1% multipliers for voltage capacity and resistance measurements.

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EMC Model 210**

New economical transistor checker contains these high quality features:

- Checks all PNP and NPN transistors
- Measures gain in three ranges
- Measures leakage on two color "Poor - Good" Scale
- Housed in a molded bakelite case
- Supplied complete with batteries

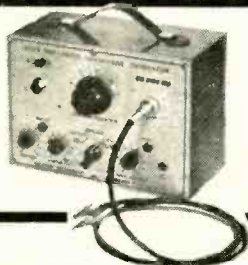
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EMC Model 800**

Lowest priced, quality color and monochrome generator available . . . easily adjusts color convergence, width, linearity, ion trap and yoke, etc.

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And Monochrome TV
EMC Model 601**



EMC Model 601 oscilloscope gives you the highest quality features ever found in this price field. Exclusive features: full 5 mc bandwidth for color TV servicing — push-pull vertical amplifier, .02 volt per inch sensitivity — 5 UPI — 5" scope tube — 60 cycle phasing control — DC positioning controls eliminates overshooting and bounce — built-in peak to peak calibration reference — 2-step compensated attenuator input — multi-vibrator sweep, from 15 cycles to over 75 kilocycles.

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NEW DEVICES (Continued)



troubleshooting.—Service Instruments Corp., 171 Official Rd., Addison, Ill.

CLAMP-ON AMMETER, model 10. Plugs into any Triplett model 310 vom. Converts vom to an ac clamp-on ammeter. Measures



ac amps, 6-300, without cutting or opening wires.—Triplett Electrical Instrument Co., Harmon Rd., Bluffton, Ohio.

CAPACITOR TESTER CT-1. Provides in-circuit test for open or shorted capacitors. De-



tects open capacitors, 50 μ f up: shorted units up to 20 μ f.—Heath Co., 305 Territorial Rd., Benton Harbor, Mich.

FLASHLIGHT CIRCUIT TESTER. Regular flashlight and continuity tester in one unit. 30-



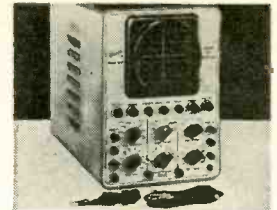
inch plug-in test cord.—A. V. Olson Manufacturing Co., 1608 Hollywood Way, Burbank, Calif.

INTERMITTENT ANALYZER, model 828. Makes TV or radio receivers more sensitive to intermittent noises caused by ca-



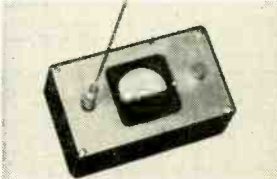
pacitors, resistors, tubes, coils, chokes and other components.—Winston Electronics, Inc., 4312 Main St., Philadelphia 27, Pa.

PORTABLE OSCILLOSCOPE, model 685. Ac and dc amplifiers; both have dc to 750 kc response and 20-mv-rms-per-inch sensitivity. Illuminated calibrated screen.—Hickock Electrical In-



strument Co., 10531 Dupont Ave., Cleveland 8, Ohio.

RF POWER METER model



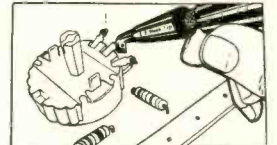
PM-1. Measures rf power. Operates with transmitters having output frequency between 100 kc and 250 mc. 0.3-volt-rms full-scale sensitivity. 200- μ a meter.—Heath Co., 305 Territorial Rd., Benton Harbor, Mich.

WAVEFORM ANALYZER, model 850. Adapts service or laboratory oscilloscope to troubleshooting TV and radio receivers



above chassis without connection to circuit.—Winston Electronics, Inc., 4312 Main St., Philadelphia 27, Pa.

TEST PROBE, E-Z Hook. Fastens over wire. Spring-loaded



insulated nylon foot holds probe in place. Fits large or small conductors.—E-Z Hook Test Products, 1536 Woodburn Ave., Covington, Ky.

TUBE CONTINUITY CHECKER, Test-A-Tube, Model 217

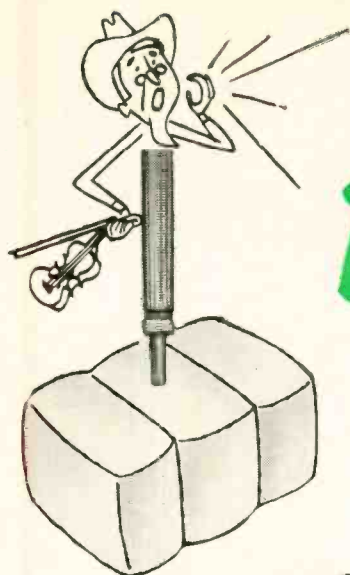


Detects burnt-out tubes in series-filament strings. Lamp, powered by internal battery, indicates continuity.—Rue Products, 1628 Venice Blvd., Venice, Calif.

LIQUID REFRIGERANT, Jiffy



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**WITH EVERY
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PICK-A-SHAFT* CONTROL
YOU GET YOUR CHOICE OF
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Select the control you want — ½-watt composition-element, regular, tapped or dual; 2-watt wire-wound; 3-watt wire-wound; or 4-watt wire-wound. Then choose from any one of the 13 shaft types. There's one for every need.

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The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction, servicing, basic Hi-Fi and TV repairs, code, FCC amateur license requirements.

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The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The "Edu-Kit" has been used successfully by young and old in all parts of the world. It has been used successfully by young and old in all parts of the world. It is used for training in many Radio Schools and Clubs in this country and Veterans throughout the world.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. Every step is carefully explained. You cannot make a mistake.

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The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore, you will construct radio circuits, perform jobs and conduct experiments to illustrate the principles which you learn.

You begin by examining the various radio parts included in the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set, you will enjoy listening to regular broadcast stations, learn theory, practice testing and troubleshooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

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You will receive all parts and instructions necessary to build 16 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable electrolytic mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hookup wire, solder, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio & Electronics Tester. The Edu-Kit also includes Code Instructions and the Progressive Code Oscillator, in addition to the F.C.C. type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, and a High Fidelity Guide and Quiz Book. Everything is yours to keep.

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You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home portable and car radios. You will learn how to use the professional Signal Tracer, the Unique Signal Injector and the Dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Statais, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The 'Edu-Kit' paid for itself. I was ready to spend \$240 for a course, but I found your ad and sent for your Kit."

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Zero. An aerosol canned refrigerant. Isolates intermittent thermal defects. Nontoxic, non-inflammable and nonconductive.—Arco Electronics, Inc., 111 S. Vermont Ave., Los Angeles 4, Calif.

SELENIUM RECTIFIER TEST-



ER, SRT-1. Checks power rectifiers in and out of circuit for quality, fading, shorts, opens, arcing and life expectancy.—Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y.

FUSE CADDY.



Fits in technician's tube caddy. Contains 15 L-C fuse types to cover most service requirements.—Littlefuse, Inc., Des Plaines, Ill.

TEST-CLIP ADAPTER.

Fits all types of banana jacks. Has spring-tension test clips for simplified testing of resistors, capacitors, diodes and similar



wire-lead type components. Banana-plug spacing adjustable from 3/4-1 1/4-inch centers.—Grayhill, Inc., 561 Hillgrove Ave., La Grange, Ill.

TUNER CONTACT CLEANER

Contains sulpher-free oil and cleaning

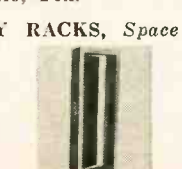


cloths for tuner and switch contact cleaning.—Standard Coil Products Co., Inc., Melrose Park, Ill.

CLOCK-RADIO KNOBS.

Four new types. 1109 for late Westinghouse; 1110, Zenith; 1111, Motorola; 1112. Philco. 7 colors.—Colman Tool & Machine Co., Amarillo, Tex.

RELAY RACKS, Space Saver.



Shallow depth saves space at installation point and still supplies necessary height and width.—Bud Radio, Inc., 2118 E. 55th St., Cleveland 3, Ohio.

PORTABLE LAMP, Multi-Lamp.



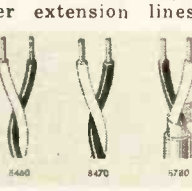
Fastens to small brackets that can be mounted wherever needed. 18- or 24-inch arms. Ball-bearing swivel. Aluminum reflector.—Moffatt Products, Inc., 4824 Triton Dr., Minneapolis 22, Minn.

HIGH-POWER DRIVERS, Model PA-HF (illustrated) 50-100



watts, 70-10,000 cycles. Watertight housing. PA-50 same mechanism as PA-HF but includes a heavy-duty multi-impedance line-matching transformer built into driver housing.—University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.

AUDIO CABLES, 8460, for speaker extension lines from



16-500 ohms; 8470, for high-power low-loss speaker extension lines; 8780, also for high-power low-loss applications; shielded. Belden Manufacturing Co., 4647 Van Buren St., Chicago 80, Ill.

AUDIO CONTROL UNIT, Kit, KT-300, or wired, LT-30. Dc for

all filaments. IM distortion below .09% at 1 volt. Harmonic distortion about 0.25% at 5 volts. Dual cathode-follower output stages. 24 equalization positions. 7 inputs.—Lafayette



Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.

INTERCOM, 6- or 12-station systems. Special feedback circuits give low distortion and high speaker damping for smooth, clear sound. Fisher



Berkeley Corp., 5633 Grove Street, Oakland 9, Calif.

INVERTERS, ATR Universal

RADIO-ELECTRONICS



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INDUCED WAVEFORM ANALYZER

MODEL 850

Top-O'-Chassis Troubleshooting . . . greatest servicing advance in years!

Perfect for Portable TV

Localizes defective stage in entire TV receiver in less than 5 minutes—without a direct circuit connection. Adapts any 'scope for spotting defects quickly by the modern, easy-to-use Induced Waveform Method. Unique, Phantom Detector Probe makes any tube a convenient test point. Just slip probe successively over each tube, then view and trace waveforms on scope from antenna thru RF, IF, audio, video & sync. Speeds servicing of TV, radios, amplifiers, instruments, industrial and laboratory equipment tool. Compatible for color. Phone jack for audio monitoring.



\$89.95 Net

INTERMITTENT CONDITION ANALYZER

MODEL 828

Pinpoints Intermittents without waiting...cooking...or freezing.

Exclusive new principle makes any TV or radio super-sensitive to intermittents and noisy components . . . without waiting for breakdowns. Saves time and bench space. Cuts callbacks by detecting borderline components before they fail. Special Wintronix Probe and capacity pickup attachments let you hear intermittents thru built-in speaker.



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AGC CIRCUIT ANALYZER

MODEL 825

AGC Troubles Won't Fool You Any More!

Saves hours by detecting hard-to-find AGC faults that may look like sync trouble, etc. Furnishes standard, adjustable r-f signal to antenna; monitors AGC action; checks AGC buss for opens and shorts; measures action of gated pulse systems; supplies AGC bias to restore operation by substitution.

SWEEP CIRCUIT ANALYZER

MODEL 820

Rapid, Dynamic Sweep Testing

\$69.95 Net



Completely troubleshoots entire sweep circuits and restores raster by substituting for defective stage. Tests all flybacks and yokes for continuity and shorts. Self-calibrating. Compatible for color.

Model 915/960 Adapter converts Model 820 to a Sync Circuit Analyzer for signal substitution of vertical and horizontal sync pulses.

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Electronic "Wonder Drugs" for Troubleshooting Pains



Here are the instruments you need to diagnose ailments fast and profitably in today's

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These four Wintronix *Analyzers* swiftly turn wasted trouble-shooting time into profitable parts replacement time on more and more jobs. Obscure radio and TV faults get tracked down fast by Winston's specialized reference signals and measurements. Like X-rays, they quickly give a complete picture of circuit operation—at far lower cost, with fewer circuit connections, and with less set-up time than with separate conventional instruments.

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4312 Main Street, Philadelphia 27, Pa.

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NOW YOU CAN BUILD THE INSTRUMENTS YOU'LL WORK WITH DAY-IN, DAY-OUT...

You asked for out test instruments in KIT form! Here they are! Two of the most advanced kits available today. The components are of the finest name brands... the step-by-step instructions the ultimate in simplification... and the completed instruments the most indispensable in your every day work.

IN-CIRCUIT CONDENSER TESTER

Model CT-1

Check in-circuit:

- ✓ Quality of over 80% of all size condensers... including leakage, shorts, opens, and intermittents.
- ✓ Value of all condensers 200 mmfd. to .5 mfd.
- ✓ Electrolytics for quality — any size.
- ✓ Transformer, socket and wiring leakage capacity.

Checks out-of-circuit:

- ✓ Quality of 100% of all size condensers... including leakage, shorts, opens and intermittents.
- ✓ Value of all condensers 50 mmfd. to .5 mfd.
- ✓ Electrolytics for quality — any size.
- ✓ High leakage to 300 megohms.
- ✓ New or unknown condensers.



Model CT-1K kit.....\$24.95

Model CT-1W wired.....34.95

Features

- Ultra-sensitive 2 tube drift-free circuitry.
- Multi-color direct scale precision readings for both quality and value... in-circuit or out-of-circuit.
- Cannot damage circuits... operates at low potentials.
- Electronic eye balance indicator for even greater accuracy.

IN-CIRCUIT SELENIUM RECTIFIER TESTER

Model SRT-1

The SRT-1 checks all power rectifiers (selenium, germanium and silicon, rated from 10 ma. to 500 ma.) both in-circuit and out-of-circuit, with 100% effectiveness.

- ✓ Quality (current emission)
- ✓ Fading (after warm-up)
- ✓ Shorts ✓ Opens
- ✓ Arcing ✓ Life Expectancy

Features:

- Will not blow fuses... even when connected to a dead short.
- Large 3" highly accurate meter... sensitive yet rugged.
- Separate meter scales for in-circuit and out-of-circuit tests with 3% accuracy.
- No shock hazards.



Model SRT-1K kit.....\$22.95

Model SRT-1W wired.....29.95

- Cannot damage or over heat rectifier being tested.

ORDER TODAY Start cashing-in on the precious time in-circuit testing will save you...

CENTURY ELECTRONICS CO., INC.

109 Roosevelt Ave., Dept. 109, Mineola, N. Y.

Please rush the instruments in the form I have checked below. It is understood that they are fully guaranteed.

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| In-Circuit Condenser Tester | In-Circuit Selenium Rectifier Tester |
| <input type="checkbox"/> Model CT-1K Kit.....\$24.95 | <input type="checkbox"/> Model SRT-1K Kit.....\$22.95 |
| <input type="checkbox"/> Model CT-1W Wired.....34.95 | <input type="checkbox"/> Model SRT-1W Wired.....29.95 |

- Payment enclosed (Century pays all shipping charges).
- Send C.O.D. I will pay upon delivery — plus charges.

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Address.....
City..... State.....

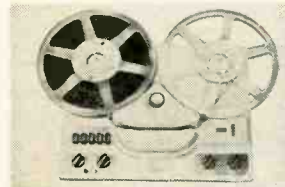
NEW DEVICES (Continued)

Inverters. For operating tape recorders, TV sets, dictating machines, etc. from dc voltages in automobiles, buses, trucks and dc districts. Provides 110-volt ac output at 60 cycles.



Wattages from 80 to 600.—American Television & Radio Co., 300 E. 4th St., St. Paul 1, Minn.

TAPE RECORDER, Model B-36. 3 motors, no rubber belts, gears or friction rollers. Sep-



arate recording and playback heads and amplifiers. 8-inch coaxial speaker. 40-12,000 cycles.—Electronic Applications, 150 E. 35th St., New York, N. Y.

LOW-FREQUENCY SPEAKER, model 18-HW. 18 inches, 10-1,500 cycles, 25 watts. 5-pound



Alnico magnet. Fundamental resonance 19 cycles — Racon Electric Co., Inc., 1261 Broadway, New York 1, N. Y.

TONE TAMER. A 2½-inch tweeter in series with a volume control for radio, hi-fi, or TV set. Remote speaker and volume



control. Set, set and tweeter or tweeter alone can be used. 20 feet of wire.—Echo Electronics Corp., 87-07 57th St., Elmhurst 73, N. Y.

TRANSCRIPTION TONE ARM, Garrard TPA/10. Adjustable length, tracking angle, stylus pressure and mounting height.



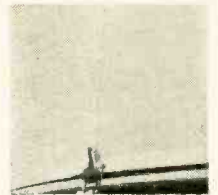
Static balance, spring loading and viscous damping provide maximum vertical freedom.—British Industries Corp., 80 Shore Rd., Port Washington, N. Y.

HI-FI TUNER, S-5E, AM, FM,



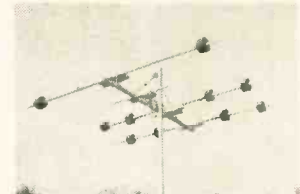
and SW. Covers 1.1-3.3 mc, 3-8.5 mc, 8.1-23 mc, 88-108 mc and 545-1600 kc. 12 x 9¼ x 7¾ inches.—Ercona Corp., 551 Fifth Ave., New York 17, N. Y.

ANTENNA, ASP 157. Attaches to auto rain gutter for temporary mobile mounting. For



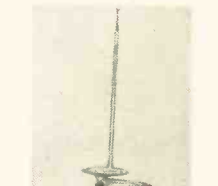
frequencies between 108-174 or 450-470 mc.—Antenna Specialists Co., 12435 Euclid Ave., Cleveland 6, Ohio.

BEAM ANTENNAS, Hy-Gain



Triple Spanners. Pretuned, matched and adjusted for 10-, 15- and 20-meter operation. Handle 1 kw on all bands.—Hy-Gain Antenna Products, 1828 N. Street, Lincoln, Neb.

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.047-600v, .1-600v, .25-600v, .01-1000v, .039-1000v, .03-1600v.....8c ea.
.047-1000v, .5-1000v, .006-1600v, .03-2000v, .005-6000v.....12c ea.
2-450v, 100-6v, 100-10v, 25-50v, 150-50v, 20-150v, 10-475v.....14c ea.
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μsec. Applications in color TV, computers, test equipment, telemetering equipment, etc.— International Resistance Corp., 401 N. Broad St., Philadelphia 8, Pa.

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RECORD FLOAT. Protects records, reduces magnetic pull between cartridge and metal turn-



table. 3-speed stroboscope on label.—CBC Electronics Co. Inc., 2601 N. Howard St., Philadelphia 33, Pa.

FLAT-TOP RESISTORS, type P. Encapsulated, wirewound, precision units. Can be mounted



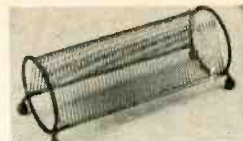
on printed-circuit boards without additional support. Resistance values to 3 megohms. Ratings from 0.1-0.4 watt.—Resistance Products Co., 914 S. 13th St., Harrisburg, Pa.

TRANSISTOR POWER SUPPLY, model A-400. Services and tests transistor circuits. Low ripple and constant internal



impedance. Ranges: 0-15 ma, 0-60 ma, 0-15 volts and 0-30 volts. 2% accuracy. metered output.—Perma-Power, 3100 N. Elston, Chicago 18, Ill.

RECORD RACK, model 2050. Dipped rubber finish. Holds 50 records of any size. Numbered



index for each record slot. 10 3/4 x 4 3/4 x 1 1/2 inches.—Vinetta Manufacturing Co., 2738 Sheffield Ave., Chicago, Ill.

ELECTRONIC SIREN and PA system combination. Transis-



torized. Can be heard for 1 mile.—Electronic Engineering Enterprises, 116 W. Indian Rd., Scottsdale, Ariz.

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MODULATED DC AMPLIFIER, model 301. For use with Recti-



tor and other milliammeter recorders. Sensitivity from 10 mv dc to 100 volts dc in 12 ranges. Frequency response up to 50 cycles.—Texas Instruments Inc., 3609 Buffalo Speedway, Houston 6, Tex.

RF PROBE, Transiprobe. Transistorized, broadband, low-capac-



itance. Powered by mercury batteries. Unity gain. 20 cycles to 15 mc. 1 db down at 50 cycles and 12 mc. Maximum input 0.3 volt peak to peak.—Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.

ANTENNA-MATCHING COIL, No. 1215. Exact replacement for late-model G-E TV sets.—Colman Tool & Machine Co., Amarillo, Tex.

TUBE PROTECTORS, models 250 and 300. To prevent initial surge currents and protect tubes in TV sets, radios and hi-fi equipment. Can be used with equipment having input wattage of 100-300.—American Television & Radio Co., 300 E. 4th St., St. Paul, Minn. END

All specifications given on these pages are from manufacturers' data.



Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.

Piano Music by Louis Moreau Gottschalk
Jeanne Behrend, pianist
MGM E-43370

Gottschalk was the first American composer-artist with an international reputation, who toured Europe and South America and was highly complimented by Liszt and Chopin. This selection of his piano showpieces, brilliantly played, explains his fame and should prove a very pleasant surprise to Americans who have never heard him or of him. An excellent recording.

BACH: Preludes and Fugues
Weinrich at Varfrukyrka organ
Westminster XWN-18427

This is Vol. 5 in the projected series which will present the complete organ works of Bach. These works are not as spectacular as the earlier Toccatas but share the same beautifully authentic color of tone, very fine definition and freedom from acoustic distortion.

The Band of Her Majesty's Royal Marines

Capitol T-10000

If you like band music or have a child playing in a band, you should have this. Not as impressive sound-wise as some other band recordings and not as progressive in music as the fare of even our high-school bands, it presents faithfully a big band as heard in a stadium or big auditorium. The band presents the music of the *Beat Retreat* and the *Tattoo Finale*, two of the big ceremonials for British military bands. Especially notable is the precision of the drum corps, the several drums so precisely in unison that the rolls are almost as distinct as if a single drum were playing.

WAGNER: Siegfried's Rhine Journey, Funeral Music, Magic Fire Music, Ride of Valkyries, Prelude and Love Death from Tristan.

Rodzinski conducting Philharmonic of London

Westminster XWN-18453

The most often played orchestral versions of the most spectacular highlights from Wagner's operas. The recording does not do as complete justice to the music as the above version of *Rites of Spring*, but it does get it across with more than adequate impact and with considerable detail.

Hi-Fi Feast for Orchestra
Quadri conducting Philharmonic Symphony of London

Westminster XWN-18451

In any contest for the best hi-fi test, demonstration and showoff recording, this one would be hard to beat. It is impossible to oversell it. The music presents just about every possible instrument and every possible test to equipment. It includes such all time favorites as *Sorcerer's Apprentice*, *Dance Macabre*, *Bacchanale from Samson et Dalila*, *Marche Joyeuse*, *Espana* and three remarkable modern compositions: *Mossov's Iron Foundry* and *Revueltas' Sensemaya and Cuauhnahuac*. The drums are terrific, the high highs magnificent and the overall sound as

spectacular in presence and realism and as clean as modern records can offer. Recommended to every hi-fi owner, dealer, salesman and those looking for a perfect gift for a hi-fi fan.

Gold and Silver
Great Old World Waltzes in High Fidelity

Paulik conducting
Vienna State Opera Orchestra
Vanguard VRS-1002

Having scored such hits with its series of the dance music of the various Strausses, Vanguard now has wisely arranged to give us the same authentically Viennese performances of eight familiar waltzes of other composers with the same gorgeous sound and results. Included are *Gold and Silver*, *Skater's Waltz*, *Waves of the Danube*, *Over the Waves* and others which most listeners will find familiar. Big drums, very sharp high highs, fine definition and high presence. Equally fine for demonstration at louder levels and for just listening at lower levels.

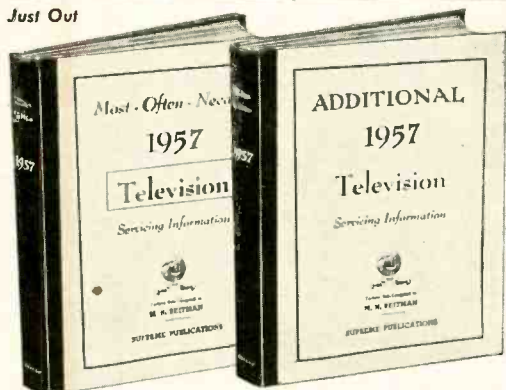
Razz MaTazz in Hi-Fi
Nickelodeon Music
San Francisco 33001

Although this was one of the earlier recordings of nickelodeon music, which we missed somehow, it is still one of the best from the standpoints of fidelity and listening pleasure. These are very close-up recordings of instruments in exceptionally good condition. The gadgets include the ordinary player piano, plus piano with xylophone and drums, a French organ, a mechanical moving-picture organ, the Regina Sublima music box, Wurlitzer orchestron, and piano with chimes. The verisimilitude on playback in the home is greatly aided by the relative lack of room resonance in the recording. Great fun, especially for the old folks who can remember those days.

Plinkety-Plank-Plunk in Hi-Fi
Mechanical Piano
San Francisco M-33010

This is a valuable and highly interesting survey of player-piano music from the 'Nineties to

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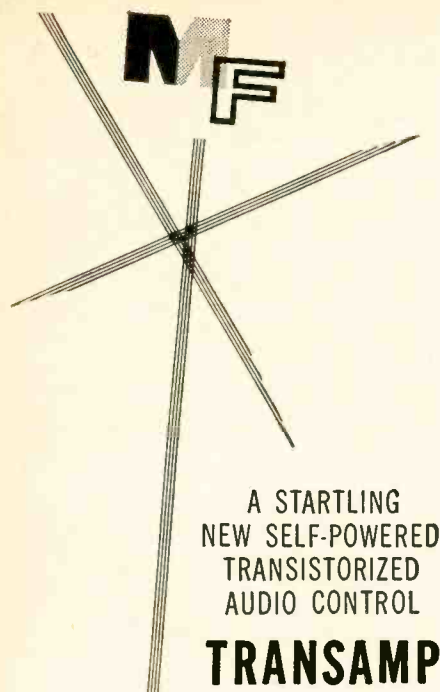
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300 mv in Aux position for 3 volts output.

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FILTERING — Rumble and Noise Filters with 12/db octave slope. Rumble: 50 and 100 cycles; Noise: 4 and 8 kilocycles.

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the present, played on an instrument apparently in original condition and presenting really virtuoso performances by some of the best known recordists and in some instances by the composers themselves—an especially valuable case is the rendition of the *Maple Leaf Rag* by its composer, Scott Joplin. Nostalgia, history and plain listening pleasure are all well served in this collection. For the few bucks this record costs plus a good hi-fi you can get the full benefit of the player piano with about 20 of the best rolls of player-piano music ever recorded. Indeed, you can improve on the original in that you can reduce the loudness if you want to spare the neighbors.

**Hot, Happy and Honky
Del Wood, piano**

RCA LPM-1437

Del Wood is a Nashville, Tenn. gal, whose honky-tonk ragtime piano is almost legendary locally and lately has achieved national attention. Her virtuosity rivals that of the old-time player piano, the spirit of ragtime is unadulterated by any modernisms whatever, and her improvisations are amusingly clever. RCA has done a really marvelous job of recording the honky-tonk piano. Del is backed by various rhythm sections from the Grand Ole Opry. The presence can be very real.

**Soiree Tzigane
Players for Hungarian National Ballet
Orchestra**

Vox VX-25-330

Here is a real treat both musically and high-fidelity-wise. Authentic gypsy music in rich performances by an augmented band of virtuosi from the outstanding gypsy bands of Budapest, with remarkable improvisations on the fiddle, clarinet and cimbalon. The sound is gorgeously round with a big bass and a clean high end, despite the high level of cutting. The spirited music should please even the highbrow.

**Mexico, Alta Fidelidad
Mexican Folk Ensembles**

Vanguard VRS-9009

More authentic folk music by highly competent performers. This presents 13 songs and dances of the Vera Cruz region performed by highly unusual ensembles of strings and punctuated in some dances with the stomping of flying feet. Most of the instruments are plucked, and present unusual transients. The voices are typically untrained but enthusiastic. The music is a representative sampling of the vintage of the country. For a field recording this is very fine.

**LIADOV: Eight Russian Folk Songs
Enchanted Lake, Kiki Mora, Baba
Yaga**

**BALAKIREV: Islamei and Oriental
Fantasy
Perlea conducting Bamberg Symphony
Vox PL 10-280**

Overshadowed by the Russian giants who preceded and succeeded him, particularly his star pupils, Prokofiev and Stravinsky, Laidov composed some delightful program music of which this recording gives an excellent sampling in stunning sound. It is notable for its fine definition and liveliness, a combination which everybody strives for, but few achieve. Should delight both the musical and the hi-fi ears. The Balakirev, an orchestral rendering of a piano work, is a nice dividend.

**The American Scene
Concert of American Band Music
Band of Her Majesty's Welsh Guards
Vox VX 25, 280**

Boosey & Hawkes publishes band music for which our thousands of amazingly good high-school bands provide an excellent market. Apparently, B & H have made a smart deal with Vox to record a dozen of their newest wares and package them with miniature conductor's scores as a sort of showcase offering that can also be used as a point of reference and comparison. An excellent idea very well executed both in musical and recording terms. It should be pleasing to anybody who likes the brass band, to music students as a sampling of modern con-

cert band music and to hi-fi fans in general for the excellent sound.

**The Big Sound on Broadway
Ray Bohr on organ**

RCA Victor LPM-1339

Some of the most popular Broadway tunes of recent years (*I Whistle a Happy Tune, Once in Love with Amy, Whatever Lola Wants*, etc.) cleverly and amusingly arranged and played on a theatre organ with a fair pedal and a good assortment of various effects. The recording is commendably clean and close-up enough to provide good definition and yet with enough liveliness to produce a high degree of presence, without the fatigue which too much echo with its attendant acoustic distortion is all too likely to produce. One of the better organ pops.

**Music of Sylvestre Revueltas
Surinach conducting
MGM Chamber Orchestra**

MGM E-3496

The late Revueltas was one of Mexico's two significant modern composers (the other was Chavez). I reviewed his delightful satire, *Ocho por Radio* last year. Here are a half dozen of his chamber works very sympathetically presented by Surinach and the MGM Chamber Orchestra, a combination that can now justly claim to be definitive in modern Latin music. Among the short works on this disc are *Homenage a Garcia Lorca, Pianos, Toccata, three Sonetos* and *Two Serious Pieces*. All are highly individualistic in tonal qualities with an authentic Mexican folk-song flavor, high good humor and some extraordinarily subtle harmonies or dissonances, as you like. The recording is bright and well defined, though likely in spots to overdrive some pickups and therefore provides an excellent test for pickup distortion. Good test material also for distortion, definition and tweeter coloration. This is the kind of music one is unlikely to hear in live performances, especially points out the value of a first-class hi-fi system as a substitute for live performance.

**DVORAK: Violin Concerto in A Minor
GOLDMARK: Violin Concerto in A
minor**

**Gimpel, violin; SW German Radio
Orchestra**

Vox PL 10, 290

The Goldmark concerto will be new even to those who have heard a great deal of music, and the Dvorak is not heard too often. Both are well worth hearing and the recording does the violin real justice—not so close up as to distract but intimate enough to present all the detail of tone and technique and with no edginess whatever.

**MOZART: Symphony 36 (Linz)
Symphony 39**

**Winterthur Symphony
Netherland Philharmonic
Walter Goerz, conducting
Concert Hall CHS-1259**

Concert Hall is recording all the Mozart symphonies and if this is a representative sample of the series CH deserves commendation for the excellent compromise between liveliness and definition, the excellent tonal balance and the fine overall sound quality, which together produce on a fine system a very high verisimilitude of a live performance and yield an opulent version of the music.

**BACH: Orchestral Masterworks
A Demonstration Record
Chamber Orchestra of Vienna State
Opera**

Vanguard-Bach Guild SRV-105

Four of Bach's most engaging chamber works—*Second Brandenburg, Suite No. 2 in B Minor, Air from Suite No. 3 in D, Violin Concerto No. 2 in E*—in their original baroque orchestrations, fine performances and the superb sound the label is noted for. A wonderful introduction to the wonders of Bach.

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, 154 West 14th St., New York 11, N.Y.

Technicians' News



JOIN GRAND COUNCIL

The Lower Bucks County Television Service Dealers Association (LBCTSDA) unanimously passed a resolution to join the Philadelphia TV Service Grand Council.

The Council represents TV service groups within a 50-mile radius of Philadelphia. Its purpose is to see that the consumer receives expert, ethical service.

Speaking for the group, Art Margolis pointed out that this is not just a local movement and that similar organizations are forming all over the country.

GUILD MAKES AWARD

High-school students of Mineola, N. Y., were honored for their achievements in the study of electronics by the Radio & Television Guild of Long Island. Christopher Stratigos, guild president, presented a bronze plaque to William Slagle, president of the school's general organization.

The plaque was inscribed "To the students of Mineola High School who have accomplished much through the application of their electronic studies to encourage the study of all engineering and technical sciences by the young people of Long Island."

Students of the school have completed construction of a cyclotron and an electronic computer in the course of their classes during the past year.

NEW SERVICE GROUP

Northern Illinois TV service technicians and service dealers have formed the Electronics Technicians Association of Northern Illinois. The new group has about 80 members. Association president is William R. Mosley. Vice presidents are Ray Dumas, Gene Leander and Robert Stromeyer. The association meets once a month to discuss trade problems.

ELECTION IN ST. LOUIS

The Television Electronic Service Association of St. Louis, Mo., has elected Wally Hirschberg of Hirschberg Television Technicians as president. He succeeds Barney Lewis, Lewis Radio & Television, who became chairman of the board.

Other new officers are: Ralph Newberry, Southampton Electronics Co., executive vice president; Harry Haus, Jennings TV Service, first vice president; Ray Wirtel, Wellston Electronics Inc., second vice president; Fred Riechman, Teltronic Laboratories, secretary;

Robert Matteson, Matteson Radio & Television, treasurer, and Charles Luensman, Calco Electronics, sergeant-at-arms.

Howard Freiner, Walter Berganti, Vincent J. Lutz, Tom Knowles, J. G. Alexander, Russ Adelman and Nick Koclanes were named as directors.

TSA FAVORS LICENSING

The Television Service Association (TSA) of Metropolitan Washington, D. C., went on record favoring licensing of television service technicians and service dealers. The group intends to present such a proposal, for the District of Columbia, to Congress.

Recent association elections placed Robb Peters, American Parts & Service, in the association president's chair. Bernard Bognovitz, TV Boys, became vice president. Carl Johnston, Carl's Mobile TV, treasurer. Robert Trolinger and George B. Sharpe were elected to the board of directors.

LICENSING DELAYED

The Missouri State Legislature ended its session before acting on a bill to provide for licensing television service technicians. Backers of the bill expect it to be reintroduced next year.

In California a licensing bill was referred to the Interim Committee for further study. This move postpones legislative action until the next meeting of the legislature.

TUBE-FRAUD PROBE

Six men, charged with fraud and indicted for conspiracy in connection with a Bronx N. Y. Grand Jury probe of electronic tube fraud, pleaded not guilty. Five were released in custody of their council and the sixth in \$2,500 bail. The six men are Donald Purd of Ever Ready Engraving Co.; William Adamson, Wholesale Radio Corp.; Henry Schwartzman, State Electric Co.; Leonard Wachsman, Industrial Testing Laboratory; Meyer Seltzer and Samuel Levy.

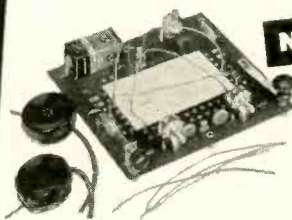
TESA, CINCINNATI MEETS WITH BBB

A meeting between representatives of the Television Electronic Service Association (TESA), Cincinnati, Ohio and a representative of the local Better Business Bureau was recently held at the Hotel Sinton. The purpose of the meeting was to promote better understanding and cooperation between TESA and the bureau. Discussion included the various types of complaints received by the bureau and ways and

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\$15⁴⁵

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Model Y-299. Net, F.O.B. Chicago... \$15⁴⁵

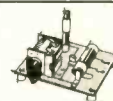
OTHER knight-kit HOBBYIST VALUES



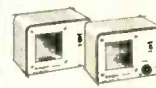
"SPACE-SPANNER" BC/SW
RECEIVER KIT
Y-243 \$15⁹⁵



"RANGER" SUPERHET
BROADCAST RECEIVER KIT
Y-735 \$17²⁵



TRANSISTOR
RADIO KIT
Y-765 \$4³⁵



2-STATION
INTERCOM KIT
Y-295 \$14⁷⁵

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Tape Recorders. Explains recorder theory, tape characteristics, how recorders work; covers motorboard mechanisms, drive motors, volume indicators, bias oscillators, amplifiers, magnetic heads, equalization circuits. 176 pages; 5½ x 8½"; illust. Only..... **\$2.75**

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TECHNICIANS' NEWS (Continued)

means of handling such complaints. Mr. George Young, BBB representative, has agreed to speak before TESA members at a future meeting.

SCOPE SCHOOL UNDERWAY

Wayne Lemons has begun his Scope School at York Radio in Jefferson City, Mo. The school is free to all technicians and refreshments are served by York Radio. The session will run once a week for 6 or 8 weeks. This is the third school to be held by Mr. Lemons in southern Missouri. All have attracted large groups and almost all those who have attended feel they picked up some ideas to help speed their servicing.

ST. LOUIS SURVEY

The Television Electronic Service Association of St. Louis has held a few short interviews with people in various professions to find out their opinions on licensing. Here are the results of the interviews:

Mr. M. Conrad—Electrical Engineer

Q—Do you believe the engineering profession would be better off if they were not required to be licensed?

A—Definitely not.

Q—Do you believe that licensing of engineers stifles competition and discourages young men from entering this field of endeavor?

A—No, it does not limit competition and it does attract higher type men to enter the field.

Miller Electric Co.— Electrical Contractors

Q—It has been said that it is not what an electrical contractor knows but who he knows that determines if he gets a license or not. Do you believe this is true?

A—No, I do not.

Q—Would you prefer not to be required to obtain a license?

A—No, I think our license law is a good thing. I would not want to operate without it.

Meyer Plumbing Co.— Plumbing Contractor

Q—It is reported that an army of amateur plumbers has been created to defeat the original purpose of legislation to require plumbers to be licensed. Is this true?

A—No, it is not true.

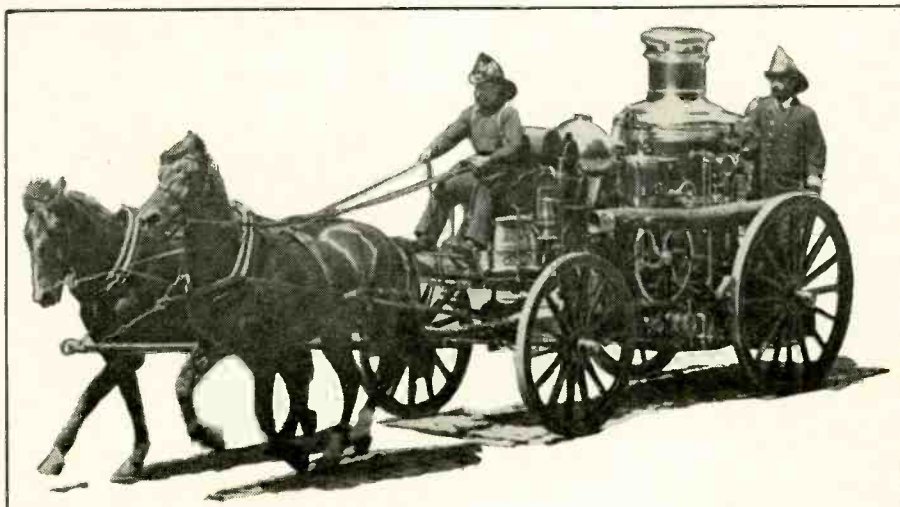
Q—Under the plumbing licensing law is it hard for a young man, just getting started, to get a job as an apprentice?

A—No, they are coming in new every day.

Q—Could a man get proper experience working as a part-time plumber on his own?

A—Absolutely not.

END



OUT OF DATE?

Maybe! But about some things, the publishers of RADIO-ELECTRONICS believe it's a good idea to remain old fashioned. For instance, we feel that when our readers buy anything advertised in our magazine by mail order, they have the right to know exactly what they are buying. For that reason, in January 1956, we established the rule that mail order advertisers must tell prospective buyers just what they're selling.

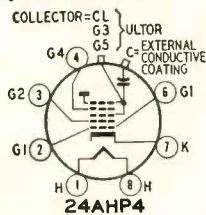
If the tubes are not new and unused, or if they are rejects or sub-standard in any way, the advertiser must say so specifically in his ad, or we will not accept it. We feel it's never "out of date" to protect our readers.

New Tubes & Semi-conductors

Among this month's releases are a number of television receiving tubes. Of particular interest is a 24-inch 110° picture tube. For the transistor booster there is a group of three high-frequency (15-120-mc) tetrode transistors.

24AHP4

A 110°, rectangular, glass picture tube of the low-voltage, electrostatic-focus and magnetic-deflection type. It has a spherical Filterglass faceplate and aluminized screen. Its minimum screen area is 332 square inches. A straight electron-gun design eliminates the need for an ion trap. The tube has a 6-volt 0.6-amp heater and is manufactured by RCA.

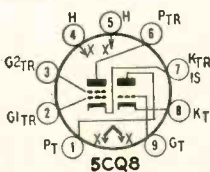


Maximum ratings in grid-drive service are:

Ultor voltage	20,000
V_{g4} (pos value)	1,000
(neg value)	500
V_{g2}	500
V_{g1} (neg peak)	200
(neg bias)	140
(pos bias)	0
(pos peak)	2
Peak heater-cathode voltage	180

5CQ8

A multi-unit tube of the nine-pin miniature type containing a medium-mu triode and sharp-cutoff tetrode. This tube, announced by RCA, may be used in many black-and-white and color TV applications, particularly as a vhf oscillator and mixer in tuners of sets utilizing a 40-mc if. It has a 4.7-volt 600-ma heater with a controlled warmup. Except for heater ratings, it is identical with the 6CQ8.



Maximum ratings in converter service:

	Triode as Oscillator	Tetrode as Mixer
V_p	300	300
V_{g2}		300
V_{g1} (pos bias)	0	0
Plate dissipation (watts)	2.7	2.8

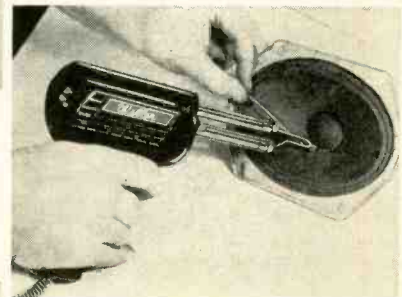
Weller soldering guns make safe repairs to Heat-Sensitive Components

A WELLER Soldering Gun gives you precise control of heat. This feature is especially important when replacing heat-sensitive components. Here are some typical applications:

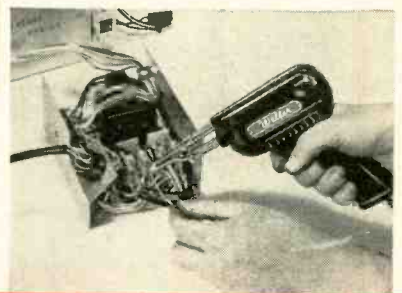


1 REPAIRING PLASTIC-MOUNTED TRANSFORMERS. Your Weller Gun gives you precise heat control for this delicate operation. Prevents melting of plastic sockets; enables you to repair loose contacts and hair-thin coil-winding wire without damage.

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3 REPLACING CRYSTAL OSCILLATOR. Controlled heat is imperative for replacing crystal oscillator in color demodulator circuits. With a Weller Soldering Gun you get perfect heat control, thus avoid damage to delicate crystal element.

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Your choice of models... ranging from 100 to 250 watts single heat and 100 to 275 dual heat types. Suitable for every kind of service operation. All models heat in 5 seconds; provide instant, trigermatic control of temperature.

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Remote Control EXTENSION SPEAKER

High-quality sound for chair-side TV listening. 4x8 speaker. Selector switch and volume controls for TV set, Personna-Tone, or both speakers. Wood veneer cabinet. Complete with cable.

List 9⁹⁵



DUAL-TONE Model DT-32
Dual Speaker VOLUME CONTROL

For auto radio sound extension. Two volume controls—one for each speaker. Volume of either speaker adjusts to any level independently. Ample cable for all cars.

List 3⁹⁵



All-Purpose DeRO-JUVENATOR

One rejuvenator replaces all! Model RU-5—universal 6-wire for use on all series or parallel filament TV sets, both electrostatic and electromagnetic. Restores brilliance and contrast to pix tube.

List 3⁹⁵



Model RU-5

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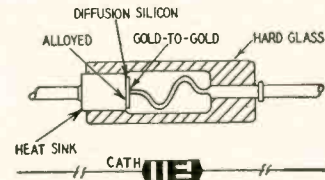
134 NASSAU RD. ROOSEVELT, L. I., N. Y.

NEW TUBES & SEMICONDUCTORS (Cont')

g ₂ input (watts)	0.6
g ₁ input (watts)	0.5
Peak heater-cathode voltage	200 200

1N645, 6, 7, 8, 9

These are diffused-silicon semiconductor rectifiers produced by Texas Instruments. Hermetically sealed in a hard glass case, they have gold-to-gold contacts and a 2-million-to-1 front-to-back current ratio.



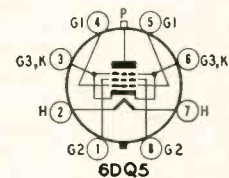
APPROX ACTUAL SIZE.
1N645, 6, 7, 8, 9

Maximum ratings are:

	1N645	46	47	48	29
Peak inverse voltage: (-65 to 150°C)	225	300	400	500	600
Average rectified forward current (25°C) (ma)	400	400	400	400	400
(150°C) (ma)	150	150	150	150	150
Recurrent peak forward current (25°C) (amps)	1.25	1.25	1.25	1.25	1.25
Power dissipation (25°C) (mw)	600	600	600	600	600

6DQ5

A high-perveance beam-power tube designed especially for use as a horizontal-deflection amplifier in color television receivers. It has a 6.3-volt 2.5-amp heater. This is also a RCA tube.

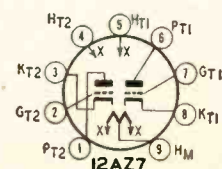


Maximum ratings as a horizontal-deflection amplifier are:

V _p (including boost)	900
(peak pos pulse)	7,000
V _{g₂}	175
V _{g₁} (peak neg pulse)	200
I _k (dc) (ma)	285
(peak) (ma)	1,000
g ₂ input (watts)	3.2
Plate dissipation (watts)	24
Peak heater-cathode voltage	200

12AZ7

This is a general-purpose high-mu twin triode of the nine-pin miniature type intended for applications in vhf television receivers, including use as a cathode-drive amplifier and frequency converter. Produced by RCA, it has a center-tapped heater for 12-volt 0.225-amp or 6-volt 0.45-amp operation.



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*Designed by Richard H. Dorf

"You're sewing with my JENSEN NEEDLE again, I see."

NEW TUBES & SEMICONDUCTORS (Contd.)

Maximum ratings for each section as a class-A1 amplifier are:

V_p	300
V_g (neg bias)	50
Plate dissipation (watts)	2.5
Peak heater-cathode voltage	200

1N1150

A full-wave silicon rectifier with a four-contact socket, specifically designed to replace type 83 tubes where long life is a primary consideration. It is made by Sarkes Tarzian.



1N1150

Typical operating characteristics of the 1N1150 are:

	Capacitor	Choke
	input	input
	filter	filter
Ac input (volts, rms)	1100	1100
Dc output (ma)	750	750
Minimum external impedance per section (ohms)	5	
Minimum filter input choke (henries)		1

Surface-barrier notes

RETMA type numbers have been given to Philco surface-barrier transistors. The SB-101 is a 2N344, SB-102 a 2N345 and the SB-103 a 2N346. These transistors are also being manufactured by Sprague under a Philco license.

3N29, 30, 31

Three germanium tetrode transistors for high-frequency application have been announced by General Electric. With a common base connection and a bandwidth of 2 mc, they are rated for a minimum of 10-db gain at 120 mc for the 3N30, 30 mc for the 3N29 and 15 mc for the 3N31.

Maximum ratings are:



	3N29	3N30	3N31
F _{min} (mc) (pwr gain 10 db)	30	120	15
Bandwidth minimum (mc)	2	2	1
V _{CB1}	7	7	7
V _{CB2}	7	7	7
V _{CE}	6	6	6
V _{EB1}	2	2	2
V _{EB2}	3	3	3
V _{BE2}	3	3	3
I _c (ma)	20	20	20
I _b (ma)	2	2	2
P _c (mw)	50	50	50
P _b (mw)	5	5	5

Other types

A 670-amp liquid-cooled germanium power rectifier has been introduced by International Rectifier Corp.

Another high-power semiconductor rectifier has been announced by General Electric. Ratings up to 140 amps per cell are available.

7034/4 X 150A and 7035/4 X 150D, beam power transmitting tubes, are offered by RCA.

END

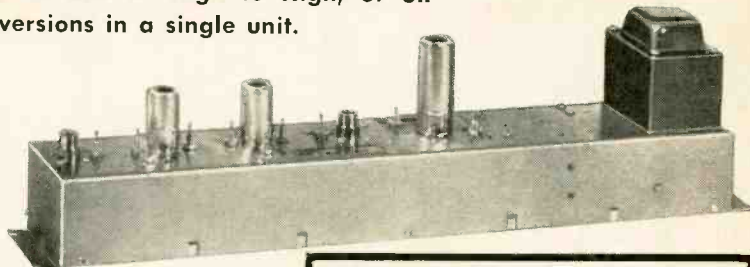
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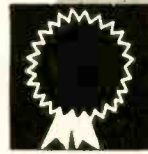
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Patents



VOLUME CONTROL CIRCUIT

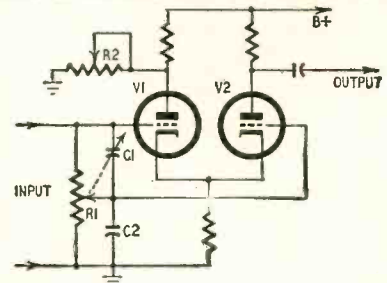
Patent No. 2,768,248

Albert S. Harris, Fort Wayne, Ind. (Assigned to Farnsworth Research Corp., Fort Wayne, Ind.)

Many volume control circuits operate with variable- μ tubes, the gain changing with grid bias. Such a circuit causes distortion because of tube nonlinearity. This new method uses the straight portion of a tube characteristic for amplification. Input is fed to both the grid and cathode of the same tube. These signals oppose each other because in any tube the grid and cathode potentials are out of phase. By maintaining a steady grid signal and varying the cathode signal, the output of the tube may be controlled as desired.

The full input is delivered to the grid of V1 (see diagram). V2 receives two signals: one at the grid from the tap on R1, the other at the cathode (from the other triode). Initially, R2 is set for maximum resistance and R1 for the full volume desired. (See RADIO-ELECTRONICS: "Transistor Radio Uses No Power Supply," April, 1955, and "Free-Power Receivers," April, 1957.)

As R2 is reduced, a smaller output voltage becomes available across the V1 cathode load. This output cannot exceed the input. Therefore, R2 can be used as a volume control. As it is reduced,



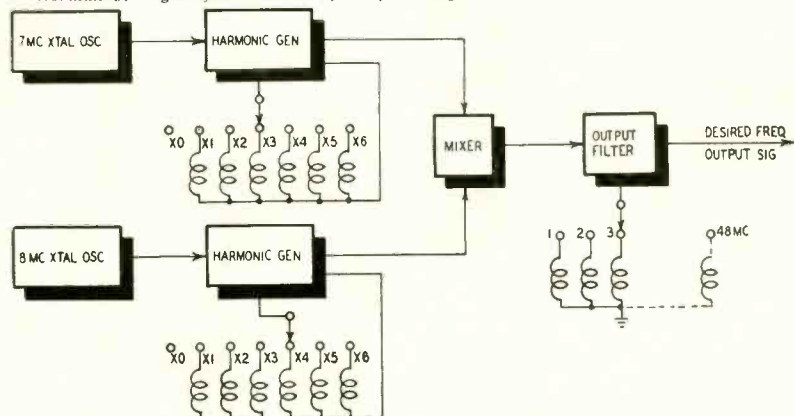
it delivers less cathode input to V2 to oppose this tube's grid input.

For a/c, a tube may be substituted for R2. Tube bias would be controlled by signal strength. With a stronger signal, the tube resistance (represented by R2) would become lower and increase the cathode signal to V2. In turn this would tend to lower the tube's output to compensate for the rising input voltage.

MULTIPLE FREQUENCY CRYSTAL OSCILLATOR

Patent No. 2,773,187

Norman J. Regnier, San Leandro, Calif. (Assigned to Hoffman Electronics Corp.)



Crystal oscillators suffer from one big disadvantage: A crystal has only one fundamental frequency, so a great many crystals may be needed. In this new circuit, harmonics of crystals are combined to provide many output frequencies.

The diagram shows the basic arrangement. Any desired harmonic (up to the sixth) may be generated from each crystal. These two signals are added or subtracted as required, and the mixer output is filtered and tuned to the desired signal.

The output is an integral megacycle ranging from 1 to 48 mc. The highest frequencies are listed below, together with the manner in which

each is obtained. This table can be extended down to 1 mc.

Desired Frequency	7-mc Harmonic	8-mc Harmonic
42	6	0
43	5	1
44	4	2
45	3	3
46	2	4
47	1	5
48	0	6

In each case the harmonics were added. For some frequencies it is necessary to subtract.

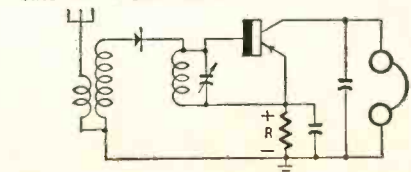
TRANSISTOR POWER FROM LOCAL RADIATION

Patent No. 2,777,057

Jacques J. Pankove, Princeton, N. J. (Assigned to RCA)

Transistors require so little power that in many cases they can operate from radiation picked up from local broadcast stations. The signals at the grid and cathode of V2 are 180° out of phase and, therefore, these signals oppose each other.

The antenna is broadly tuned so that all signals over a wide frequency range may be utilized to power the transistor. A diode rectifies the voltage which appears across R with polarity as shown. Therefore the emitter is biased positive and the collector goes negative as required. Signals from



HEY! LOOK!! \$2500

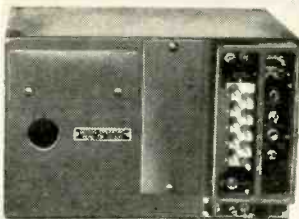
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30 watt crystal controlled on 10 preselected channels in range of 20-27.9 Mc. F3 emission. Operates from 12 V. or 24 V. DC (dynamotor not supplied). Tubes and meter included, worth the price of entire unit. Size 18" x 10" x 12". Excellent to new condition. Ship. wt. approx. 100 lbs. ea. Price \$9.95 each



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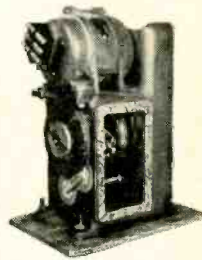
2.3 H.P. 2 cy. horizontal engine mfg. by or for Jacobsen. Ball bearing crankshaft. Weighs only 8 1/2 lbs. Attach your own spark coil and battery. Ideal for air propelled boats, models, etc. Shipped less coil, spark plug, battery and propeller shown. Engine only \$12.95 ea. Propeller and hub.....\$15.00. Ship. wt. 4 lbs.

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Provides torque amplification and ease in rotation of input shaft. Rotating power applied to input shaft is reproduced in any direction on the output shaft. Torque supplied entirely by a 1/40 HP 110 V. AC motor; through gear and planetary drive hookup. Speed varies directly with rotation of input shaft with noticeable loss of accuracy. Motor requires capacitor of .85-120 mfd. for starting. Designed for use on gun control devices and cost the Govt. hundreds of dollars to mfg. in cast aluminum case. Size: 12" h. x 5 3/8" w. x 7 1/2" d. Wgt. 23 lbs.



Packed in original wood box. Shpg. wt. 45 lbs.

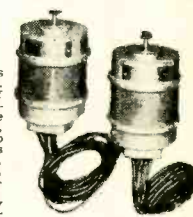
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5F	5	6.0-6.8	3.4-3.6	\$5.00	\$10.00
5DC	5	6.0-6.8	3.4-3.6	5.00	10.00
5CT	5	6.0-6.8	3.4-3.6	5.00	10.00
6C	8	8.9-7.5	4.5	7.50	15.00
7C	18	8.9-9.2	5.8	10.00	15.00

110 V. 400 Cycle Units

Size Type	Approx. Weight (lbs.)	Approx. Length (inches)	Approx. Diameter (inches)	Price New (Cases may be slightly nicked)
5F	5	6.0-6.8	3.4-3.6	\$3.50
5G	5	6.0-6.8	3.4-3.6	3.50
5DC	5	6.0-6.8	3.4-3.6	3.50

CT—Control Transformer; D—Differential Motor; DG—Differential Generator; F—Motor (Follower); G—Generator. Mfgd. by Bendix, Ford Instrument Co. and General Electric. Specify. Bendix, Ford & GE in stock.

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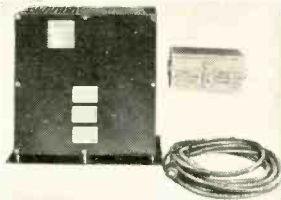
OAV-1 TEST SIGNAL GENERATOR...\$19.95

This signal generator was used to provide a test signal of constant frequency for operation and alignment of IF amplifier stages in the CG-46 ACQ type receivers. The generator covers the range between 150-250 megacycles. Amplitude modulated square wave output is obtained at frequencies of .1, 1, 10 and 100 kc. depending on the position of the freq. mod. pulse switch. A 15 Mc. signal is also provided by a second osc. stage. Power is supplied by internal 115 V. 60 cycle AC supply connected to source by cord provided. Brand new with instruction book. Ship. wt. 62 lbs.....\$19.95



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Price—\$12.50 ea.

Receiver R-1/ARR-1—\$1.95

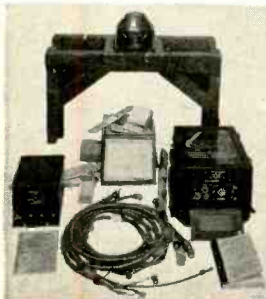
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See Nov. 1944 Electronics for Full Description

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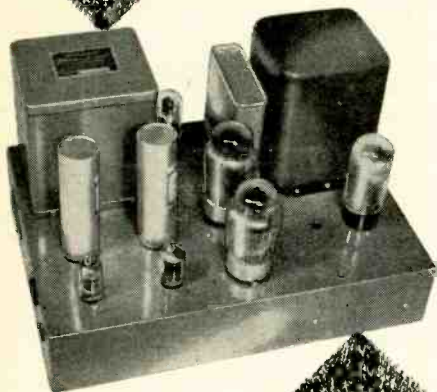
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High performance capabilities of the Genalex circuit and the TO-340 output transformer are completely covered in the article "60-Watt Amplifier Uses New KT-88's" in the August issue of Radio-Electronics.

For the ultimate in high fidelity reproduction, make sure you get an Acrosound transformer. Look for it in quality amplifiers and kits . . . or use it to convert your present amplifier to Ultra-Linear operation.

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PATENTS (Continued)

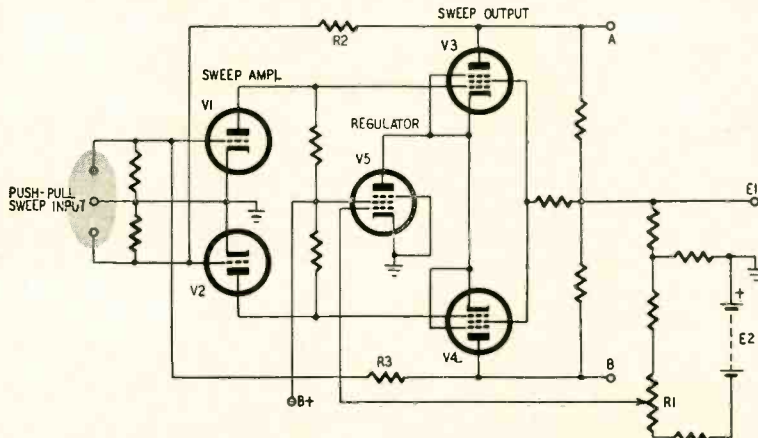
ACCELERATION VOLTAGE COMPENSATION

Patent No. 2,777,018

Alfred W. Russell, Waldwick, N.J. (Assigned to Allen B. Du Mont Laboratories, Inc. Clifton, N. J.)

An unregulated acceleration voltage on a cathode-ray tube is apt to cause deflection difficulty. Electron-beam "stiffness" increases

crease, V5 bias (obtained from R1) goes more positive. This tube acts as cathode load for the last stage V3, V4. Therefore, amplifier gain



with accelerator voltage. This new deflection amplifier includes means to compensate for this difficulty.

The amplifier has two push-pull stages and a control tube V5. E1 is the unregulated acceleration voltage for a cathode-ray tube (not shown). If, for any reason, it should in-

crease, V5 bias (obtained from R1) goes more positive. This tube acts as cathode load for the last stage V3, V4. Therefore, amplifier gain

will rise. Deflection output will increase to compensate for the added beam stiffness resulting from a larger E1 (which speeds up the beam and makes it harder to deflect).

E2 is the amplifier power supply. R2, R3 are feedback resistors. The deflection output terminals are A and B.

STABILIZED DISCRIMINATOR

Patent No. 2,755,378

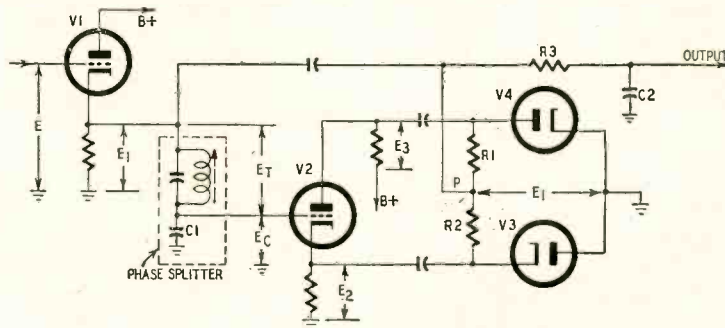
Harris Stover, Cedar Rapids, Iowa (assigned to Collins Radio Co., Cedar Rapids, Iowa)

The conventional FM detector needs at least two adjustments which can be difficult because they interact. This one has a single tuning circuit which cannot be detuned by variations in previous stages (see diagram.)

Cathode follower V1 is coupled to a phase

Ec feeds a phase inverter V2 which supplies 2 voltages: E2, in phase with Ec; E3, out of phase with it. These are applied to the discriminator stage composed of V3, V4.

When the frequency of signal E drops, the splitter becomes inductive. Now Ec lags by more



splitter (shown in dotted box). The parallel tank is tuned to make its net inductive reactance equal the capacitive reactance of C1, at center frequency. When this is done, maximum current flows through the splitter when there is zero deviation and Ec will lag E1 by 90°. Note that E1 also appears (through a capacitor) between point P and ground.

than 90°, and the output goes negative. When the signal frequency rises, the splitter will become capacitive, and the output will therefore go positive.

C2, R3 form a filter to keep high frequencies out of the output circuit while permitting the low discriminator variations to pass, in accordance with standard de-emphasis practice. END



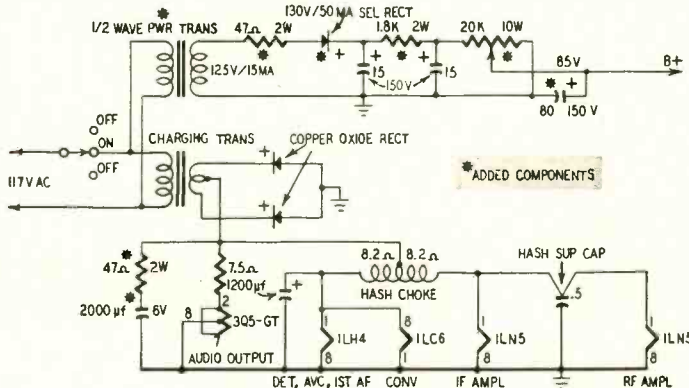
Question Box



STRAIGHT AC FOR G-E 250

I have a model 250 G-E portable ac-battery radio using a 2-volt storage cell and vibrator for dc operation. Can I convert it for straight ac operation

vibrator and vibrator transformer and add the components marked with an asterisk in the diagram. The half-wave power transformer (Stancor PS-8415



and eliminate the vibrator and storage battery?—C. M. P., Denver, Colo.

The G-E model 250 battery-ac portable is easy to convert for straight ac operation. Simply remove the battery,

or equivalent) rectifier and other components needed in the conversion can be fitted readily into the space that was formerly occupied by the vibrator supply.

RADAR INTERFERENCE

I live about three blocks from one of the radar towers at New York International Airport. The screen rotates approximately once every 8 seconds and on every rotation it produces a loud "blip" on all frequencies on my AM and FM sets. Please print a circuit to eliminate this trouble.—J. T. M., Jamaica, N. Y.

The interference is caused by the surveillance radar at the airport. This equipment operates with a 1300-mc carrier pulsed at 360 cycles per second. The system radiates 1.25 megawatts (1,250,000 watts) of power in a very narrow beam rotating at 6 rpm. You hear a 360-cycle beep each time the radar beam is aimed in your direction.

Radar engineers at the airport report that your problem is a common one that is very difficult to solve. They have the same trouble with their vhf and uhf receivers. Adequate shielding seems to be the only solution.

Try disconnecting the antenna from the sets and see if the interference level drops. If it does, then some of the interference is riding in on the antenna and the rest is coming in on the power line or being picked up by direct radiation through space to one or more of the audio grids.

The first step is to prevent the signal from entering the set through direct pickup or via the power line. Try shielding the inside (or outside) of the receiver cabinets with fine copper mesh or aluminum foil with mesh over the

back and ventilating holes. Make sure that all surfaces are bonded together and grounded to a good external ground. (On ac-dc sets you must be especially careful that the shield does not contact the chassis.)

Try a good line filter such as the Meissner 15-7515 or Cornell-Dubilier IF-18 with the shortest possible line cord to the set. (These and similar high-grade filters are expensive so you had better make arrangements to return yours to the dealer if it does not attenuate or eliminate the interference.)

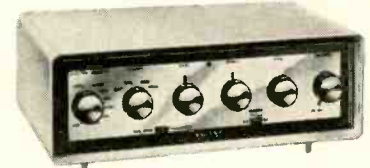
Install shields on all voltage-amplifier tubes and bypass each grid and cathode to ground with a miniature ceramic capacitor of around 50 μ f or smaller. Make the connections directly between the tube pins and ground with the shortest possible leads. These capacitors minimize the possibility of grid rectification of the signal in the audio circuits.

If disconnecting the antenna attenuates the signal, then a 1300-mc trap will be useful. Reconnect the antenna and try a half wave length shorted stub as a trap across the set's antenna terminals. For 1300 mc the trap will be approximately 3.75 inches long. (See "TV Service Clinic" in the May, 1957, issue.) Start with a 4-inch length of 300-ohm ribbon (or coax if the set has a 72-ohm input) and use a razor blade—or thumbtack for coax—to short the stub at the open end while listening to the interference. Move the short-

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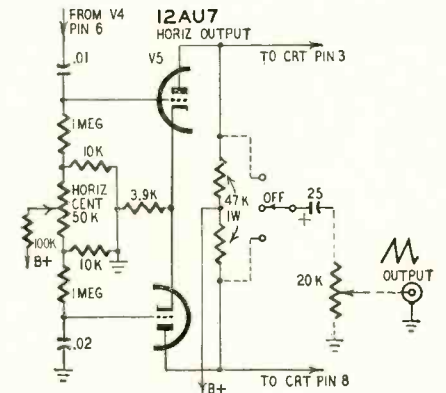
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QUESTION BOX (Continued)

ing point closer to the set in steps of about 1/16 inch until you find the point of minimum interference. Cut the line and solder the conductors together at this point.

SAWTOOTH FROM SCOPE

The article “Scope Delivers Audio Test Signal” in the December, 1956, issue shows how the horizontal sweep circuit of a Heathkit model O-8 scope can be tapped to supply either positive- or negative-going sawtooth voltages. My scope, a Heathkit model OM-2, does not have the 6J5 phase splitter. Please show how sawtooth test voltages can be tapped off my scope.—J. J., Gothenburg, Sweden

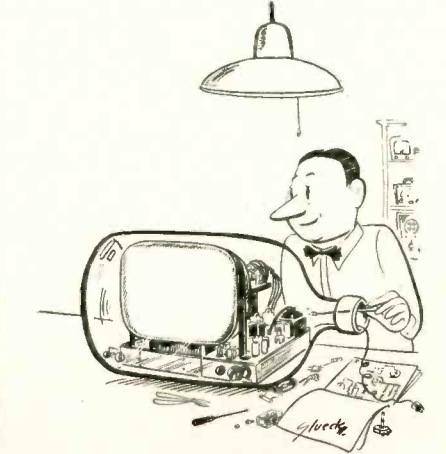


In the original circuit application, the signals were taken from plate and cathode of the phase splitter. In your scope a 12AU7 cathode-coupled phase inverter is the first stage supplying signals of both polarities. The diagram shows how the signal can be tapped off the plates. The added circuitry is shown in dashed lines.

RATCHET RELAY

I'm building the radio-controlled model boat from plans in the July, 1953, issue. I can't find the Lionel reversing relay specified in the parts list. Can you help me?—R. W. W., Mineola, N. Y.

The reversing relay specified was used in type 00 gauge model locomotives and is no longer available. A suitable substitute is available from Madison Hardware Co., 105 E. 23d St., New York, N. Y. Ask for the “reversing unit for model boats.” END



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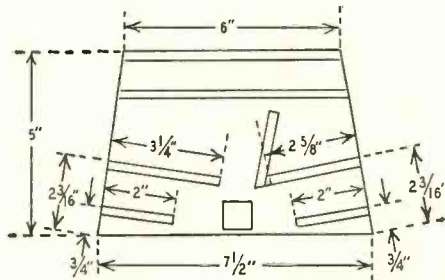
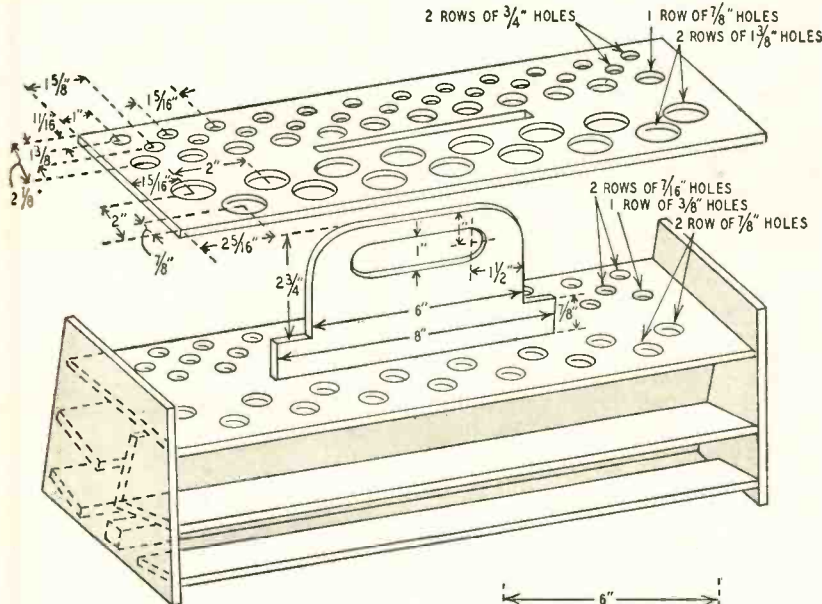
try
This
one



TUBE AND TOOL CARRIER

How much time does it take to change a tube? In some shops it requires these motions: First, the suspected tube is pulled from the chassis, the number is read and a trip made to the shelves to get a new tube; then it is carried to the bench, removed from

With hinged drop doors on the sides to hold the contents in place if it should accidentally be tipped, the carrier can also be used as a tube caddy for home calls. Of course, since the tools in the carrier are the bare minimum, additional ones would have to be taken



the carton and inserted into the set. If the new tube does not cure the trouble, it is removed from the set, recartoned and carried back to the shelves.

Think of the time this process could waste during the period of a year!

This tube and tool carrier holds 94 tubes and saves much of this waste motion. To replace a tube one simply takes it out of the carrier and inserts it into the set. If the new tube is not needed, it is simply replaced in the carrier . . . all over in a few seconds.

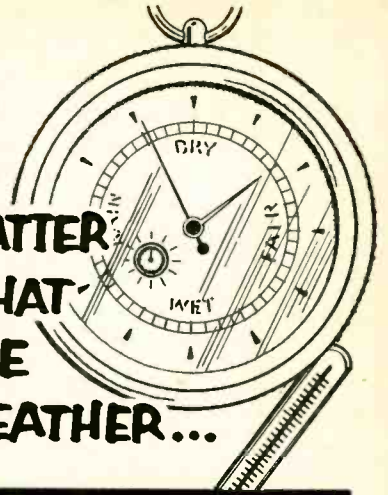
Further, the carrier holds most of the important hand tools and an assortment of resistors, capacitors, pots, etc. This makes the unit very convenient for working on consoles. With a multimeter and the carrier most sets can be serviced right where they sit and there is no need to make several trips to the bench for the different items as they are needed.

along in a separate toolbox so they would be available if needed.

For shops that handle both radio and TV work, several of these carriers can be made and stocked with the appropriate tubes and parts for the job. For instance, one carrier could be reserved for auto radio service and it could contain all tools, vibrators, suppressors, capacitors and tubes commonly needed so they could be taken to the car in one trip. Another could be assigned to table radios to permit rapid interchange of tubes. If such an arrangement is adopted, different colors could be used to paint the carriers to identify them.

Construction is easy. The top pieces which hold uncartoned tubes must be drilled on the same centers to assure that they will accept a tube in each hole. First, lay out one piece to the dimensions shown on the drawing, then

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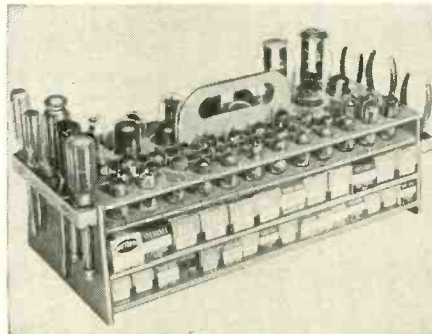
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TRY THIS ONE (Continued)

clamp the other piece under it and drill through both with a 1/8-inch drill. This pilot hole guides the larger drills. Also be careful when making the cutout for the handle as it must be a tight fit to assure a rigid carrier.

Small brads hold the carrier together. Assemble the three top pieces first, then add the ends and the shelves. The tool holders are 1/4 x 3/4-inch strips drilled and cut out to fit the individual tools. They are attached when the rest of the carrier is completed. These holders are simple to make and no details are shown on the drawing.

After painting, determine which



tubes will be used most and assign a space to each. Then scratch the tube numbers alongside the assigned holes. This makes it easier to locate tubes and identify missing ones. If the tube numbers are selected carefully, the carrier should not ordinarily require filling during a day's work. When a tube is used from the shelves, reinsert the empty carton numbered end first. This will hold the cartons in place on the shelves and make it easy to find the empty cartons when refilling the carrier.—S. L. Karal

SOLDERING PAD

An asbestos shingle tacked to one corner of the workbench makes an excellent spot on which to "park" a hot soldering iron. It prevents scorching the bench top and is a handy pad for use when soldering small parts together.—John A. Comstock

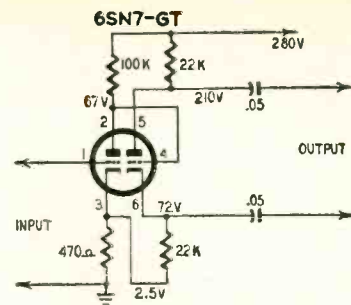
MORE GAIN FOR WILLIAMSON AMPLIFIERS

The split-load phase inverter used in Williamson amplifiers can be modified to give an increase in gain of about 50% by changing one connection. No detrimental effects were noticed and the amplifier characteristics remained unchanged.

The diagram shows the modified circuit. The first half of the 6SN7 acts as a straight voltage amplifier, directly coupled to the grid of the second half. The low side of the cathode load of the inverted triode is tied to the first cathode.

Gain, measured from the input to either side of the inverter output, was 14. This modification increased the gain by 7.

Maximum output for each side runs

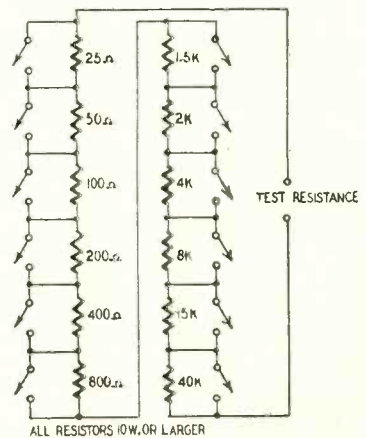


about 30 volts and the trick connection has no effect on this factor. A slight degree of positive feedback obtained by coupling the cathodes causes the increase in gain. At the same time, the advantage of negative feedback from the output stage is retained.—Bill Kerns

HIGH-WATTAGE SUBSTITUTION BOX

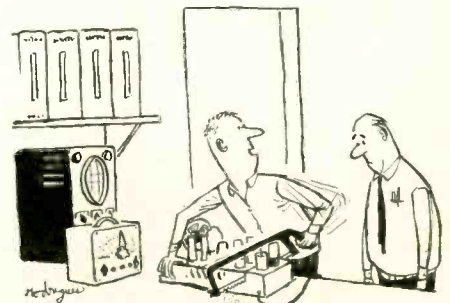
Resistor substitution boxes are invaluable in service and design work. However, most are rated at 1 watt, which limits their usefulness. A higher-wattage unit can be constructed with only twelve 10-watt resistors. It will supply resistances from 25 to 72,075 ohms in 25-ohm steps.

All resistors are in series and each one has a spst switch across it. (see diagram), allowing any resistor to be inserted or removed from the circuit.



Simple addition will show what resistors to insert to get the desired value. The minimum power rating is 10 watts, becoming proportionately greater when two or more resistors are in series.

The complete unit can be built in a standard 4 x 8 x 2-inch chassis with a bottom plate to make a compact and handy instrument.—John A. Dewar.

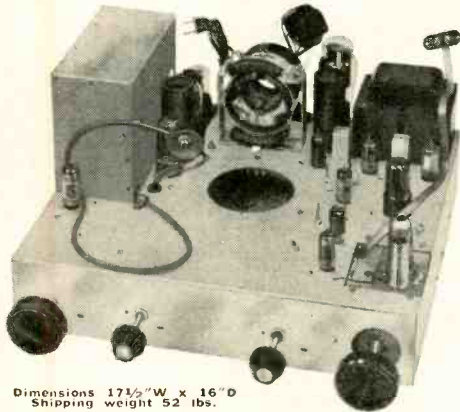


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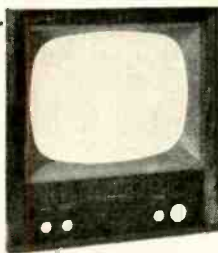
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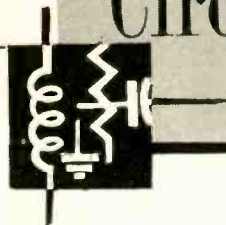


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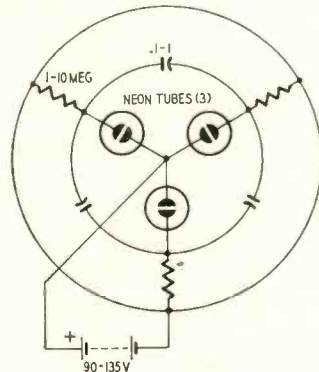
radio-electronic Circuits



NEON NOVELTY BLINKER

The diagram shows how three neon lamps, three capacitors and three resistors can be arranged so the lamps fire sequentially in either direction as desired. This arrangement makes a beautiful classroom demonstration of time constants and ring oscillators, and can be applied to window displays, electronic toys, signals on model railroads and many other uses.

All capacitors and resistors are chosen to have equal values. For example: all resistors, 5 megohms; all capacitors .05 µf.

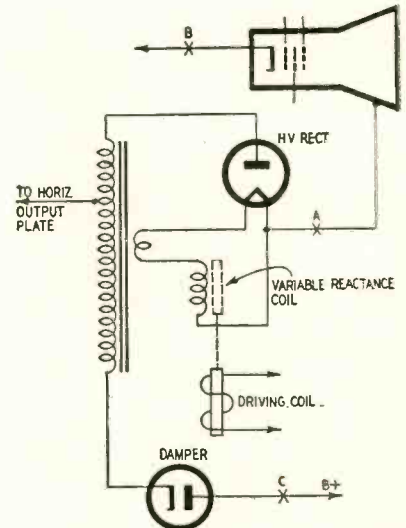


The capacitors are connected in a delta and the resistors and lamps are in a star or Y arrangement. Around 90 volts—from a battery or any convenient dc source—is applied as shown, causing the lamps to fire in sequence. To reverse the firing order, touch your fingers to one of the lamps and release it at the proper time in the cycle.—Robert G. Middleton and Alvin F. Rymsha (independently)

HIGH-VOLTAGE REGULATOR

Invented by John D. Burke, RADIO-ELECTRONICS author and former American TV service technician, now living in Hamchurch, Essex, England, this circuit appeared in *Wireless World*. It is intended for lengthening the life of high-voltage rectifiers in horizontal flyback systems and for increasing the possible current output and range of the C-R tube's brilliance.

According to Mr. Burke, about one-quarter of all service calls (in Britain, that is) involve replacing the high-voltage rectifier. He maintains that breakdowns resulting from open or shortened heaters and loss of cathode emission are caused by the rectifier heater growing cooler just when the picture makes heavy demands for C-R tube beam current. This appears to be inherent in flyback systems.



To combat this effect the new regulator device has a coil in the rectifier's heater circuit, the reactance of which is varied by the C-R-tube beam current so that an increase of beam current causes an increase of heater current and vice versa.

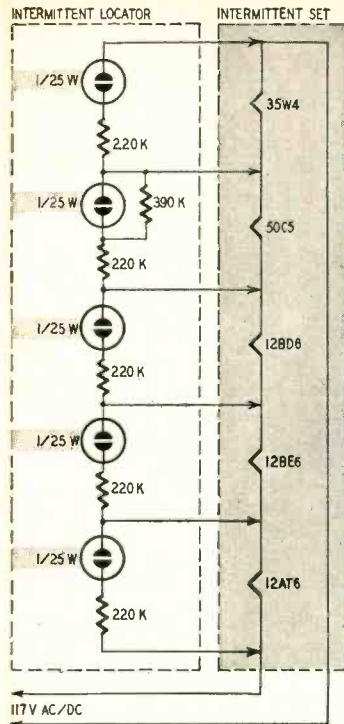
One such circuit, illustrated by the diagram, uses a moveable armature which is pulled into a driving coil by increasing C-R-tube beam current (against the action of a spring or gravity). This armature is mechanically coupled to a moveable core in the variable-reactance coil in such a way that increasing beam current reduces the reactance. The driving coil can be connected into the beam current circuit at A, B or C marked with a cross.

INTERMITTENT LOCATOR

Often a tube in a series-heater string will develop an intermittent heater so sensitive that any slight mechanical or electrical shock will restore it to normal operation before you can locate the defective circuit. This is particularly trying because it may be hours or even days before the trouble returns.

The diagram shows an inexpensive intermittent locator that is safe and easy to use. Type NE-2 or NE-51 1/25-watt neon lamps are wired in a string with individual series resistors. A shunt resistor of about 390,000 ohms is paralleled across the indicator lamp used for 50-volt tubes. This prevents the lamp from glowing on a good tube. Test leads with insulated miniature clips are wired to the lamps and connected across individual heaters.

Check the operation of the intermittent locator by connecting it to a



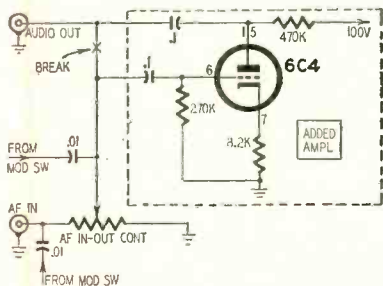
set with a series-string heater circuit and removing and replacing the tubes one at a time with the set turned on. Corresponding indicator lamps will glow as each tube is removed and go out when it is replaced.

In use, the locator is connected to the intermittent equipment that is allowed to operate continuously until it stops. One of the lamps will light and show which heater is open.—Arden Van Sickle

MORE AF OUTPUT FROM RF SIGNAL GENERATORS

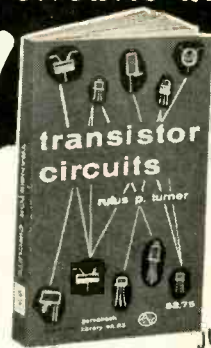
Most rf signal generators on the present-day market modulate the rf signal with a 400-cycle audio oscillator. Many of these generators provide front-panel terminals where the audio output is independently available. Although this audio signal may vary in voltage up to several volts, it is usually too small for such applications as impedance and distortion measurements.

A simple method of increasing the audio output is to add a linear voltage-



amplifier stage between the oscillator and output jack. The diagram shows such an amplifier added to the Heath-kit SG-8. The circuit is efficient and introduces a minimum of distortion, approximately 2% at 1-volt maximum input. Output is 6.5 volts for 0.5-volt input. Power requirements are small and usually obtainable from the instrument power supply.—Warren J. Smith END

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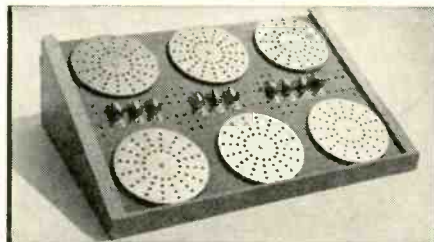
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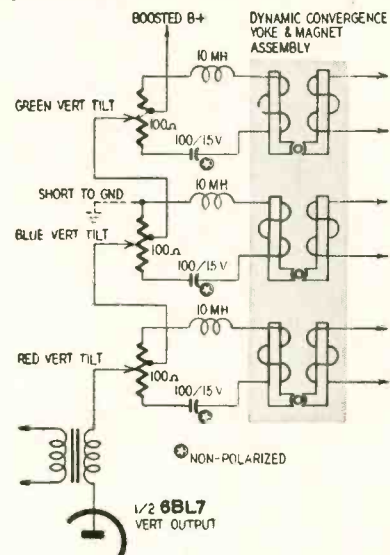
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Technotes



SHORTED TILT CONTROL

The 7.5-ohm resistor fuse in a Motorola TS-902 blew out as fast as it could be replaced. This fuse protected the B-plus power supply so it was suspected that an electrolytic capacitor had gone bad or that a selenium rectifier had conked out. The electrolytic cans were cool and the seleniums checked OK. An ohmmeter check at the filter output showed suspiciously low resistance. The B-plus lead was disconnected and the



ohmmeter indicated trouble down the line. The filter system was first suspected because another receiver of the same type had previously given this trouble.

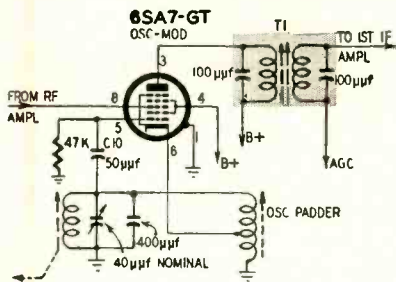
A low-ohms ohmmeter was then used to run down the trouble. By going step by step in the direction of progressively lower readings, a short was soon localized in the blue vertical tilt control (see diagram). Replacing the control cleared up the trouble.—Robert G. Middleton

WESTINGHOUSE V-2287

The 19-inch picture tube used in this set may settle, due to its weight, and the neck of the tube will become off center in the convergence assembly. In some cases the neck may come to rest on the blue beam convergence magnet and shatter the ferrite core. To correct this the picture tube itself should be more tightly clamped to its mountings. The convergence assembly should then be centered on the neck of the tube before convergence adjustments are begun. The convergence coil and core assemblies should all be adjusted to be flush with the neck of the tube.—Westinghouse Service News

MOTOROLA 705 AUTO RADIO

The complaint was intermittent drift on stations, producing a static like noise. Placing a vtvm on the 6SA7 oscillator grid showed a change in bias voltage when the set started to pop and drift. Oscillator grid leak capaci-



tor C10 was found to have an intermittent short. Replacement cleared up most of the static.

I then found a defective first transformer T1. Replacing this cured the trouble. The B-plus section was arcing to ground, causing the intermittent static.—G. P. Oberto

RCA KCS96

Failure of the high-voltage fuse is usually caused by a condition in the horizontal circuit that results in abnormal current through the fuse. In this chassis, however, the vertical output circuit should also be checked if the cause of fuse failure cannot be readily determined.

The plate and screen currents of the vertical output tube flow through the high-voltage fuse and can cause fuse failure if the vertical output tube or associated circuit cause abnormally high current through the fuse. When the high-voltage fuse fails for no apparent reason, the possibility of an intermittent condition in the vertical output tube or circuit should not be overlooked.—RCA Television Service Tips

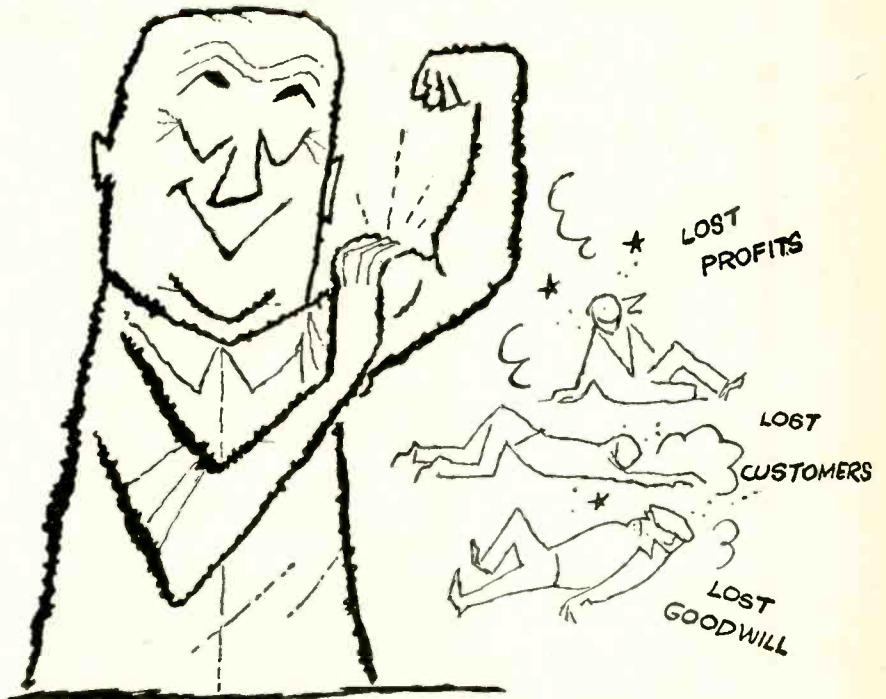
VANISHING VOLTAGE

A Du Mont RA109 came into the shop with an unusual condition. The set acted normally until the sound started. A few seconds later the filaments of both 5U4's slowly faded out. No other tube filaments were affected. This happened each time the set was turned on. Changing the rectifiers made no difference.

An ac meter placed across the 5U4 filament pins showed that the voltage dropped from 5 down to 2 after the warmup period.

Trouble was suspected first in the power transformer and second in the B-plus supply. A thorough check of that circuit showed nothing but, with the ¼-amp fuse removed, the 5U4's remained lit and normal sound was obtained.

By elimination we found that replacing one of the two 6BG6 horizontal output tubes cleared the trouble, giving both normal picture and sound. Unfortunately, the defective 6BG6 cracked on removal and we could not determine why and how the tube could affect the



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(Continued from page 150)

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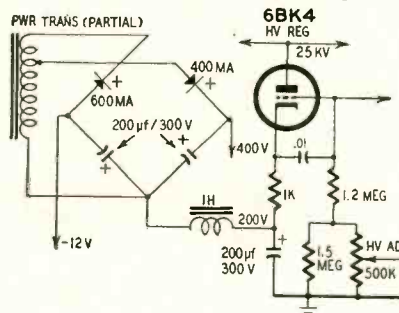
5U4 filaments and not blow the fuses.

—Frank Salerno

(If there was an internal short in the 6BG6 causing the plate to draw an unusually large amount of current from the power transformer, the transformer could become saturated, causing a drop in all secondary voltages. This would not necessarily draw enough current to blow the fuses in the set. The 5U4's, drawing 6 amperes for the filaments, would show visible effects of this while you might not be able to notice any change in other tubes drawing much less current.—Editor)

TRAVELING DOTS

It was a Hoffman 703. The set could be converged but not for long. The red dots would soon start to drift. If the set was turned off for a while, convergence would be fine when it was turned on again. Then it would slowly start to drift off again. Checking in the



shop turned up B plus that dropped as the receiver operated. We traced this to a selenium rectifier in the power supply. With a new rectifier the voltage held steady and convergence was normal. The drift was caused by a change in the picture-tube voltage when the B plus to the cathode of the regulator tube dropped.—Robert G. Middleton.

RAPID LINE CHECK

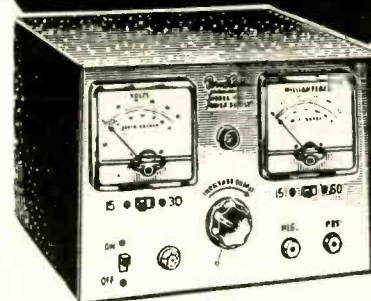
To save a lot of time and effort in checking for open transmission lines and avoid lowering the mast to check continuity try this: When installing an antenna put a 300-ohm, 5-watt vitreous-enameled resistor across the antenna terminals. We find that it stands up under all kinds of weather conditions and because of its inductance a low value can be used. The first time that this antenna line has to be checked it will take no more than a few minutes with an ohmmeter.—H. Lawrence

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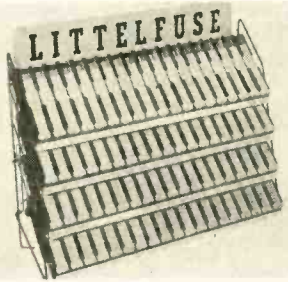
Business and People

Raytheon Manufacturing Co., receiving and cathode-ray tube operations, Newton, Mass., was recently host to a group of 12 Raytheon bonded electronic technicians from the East Haven, Conn., area. The group, sponsored by J. V. Electronics, Raytheon's East Haven distributor, visited the



company's tube plants in Quincy, Newton, Waltham, Bedford and Wayland, Mass. In the evening they were treated to a dinner and Boston Red Sox ball game. In the photo, Raytheon's assistant distributor sales manager, J. Hickey, shows the group the second edition of the company's transistor applications book.

Littelfuse Inc., Des Plaines, Ill., designed a new dispenser-display for distributors. As a result of a field survey, the display incorporates many desirable



features recommended by distributors for easy up-keep and inventory control. The dispenser will hold 7,600 fuses in a minimum space—more than any other available dispenser.

Wen Products Inc., Chicago manufacturer of soldering guns and power tools, reports that the first-prize winner in its recent sales contest, Wilmington Hardware, Wilmington, Calif., sold over \$900 worth of items in three months using the Wen Self-



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BUSINESS AND PEOPLE (Continued)

Merchandise Display Board. Dwayne O. Larson (left) owner-manager of Wilmington Hardware, is shown discussing the merchandiser with Jim Jarosch, power-tool buyer.

General Cement Manufacturing Co., Rockford, Ill., launched a year-long "Profitunity" program to promote specially priced and packaged items for radio-TV service technicians.



Each month a different product or kit will be on sale. Photo shows the G-C TV and Furniture Beauty Kit, which was featured to inaugurate the program in July.

L. F. Holleran, general marketing manager of the RCA Electron Tube Division, Harrison, N. J., has become manager-distributor products in a reorganization of the division into separate units for engineering, manufacture and sale of industrial and entertainment electron tubes. John B. Farese, manager-personnel, becomes manager—entertainment tube products; C. E. Burnett, manager-cathode-ray and power-tube operations, becomes manager—industrial tube products.



John M. Glynn (left) and Joseph R. Richmond were promoted to assistants to Tom Crawford, sales manager of Tobe Deutschmann Corp., Norwood, Mass. Glynn was formerly sales admin-



istrator, and Richmond sales expeditor and director of distribution and jobber relations. The company also announced the appointment of Robert L. Stone, a former field and project engineer, to assistant manager of the Engineering Division.

Louis R. Burroughs was elected vice president for broadcast and recording equipment at Electro-Voice, Buchanan, Mich. With the firm since it was founded in 1927, he had been chief engineer.



Wayne L. Steinbarg was honored at a surprise dinner commemorating his 24 years of service with Cornell-Dubi-



lier, South Plainfield, N. J. At the same time he was appointed special field representative for the company. Leroy E. Menut, left, toastmaster of the banquet, is shown congratulating Steinbarga on his promotion.

Douglas M. Conside joined Hughes Aircraft Co., as director of marketing for Hughes Products Group, with headquarters in Los Angeles. He previously operated his own marketing consultation firm and prior to that was merchandising manager for P. R. Mallory Co.



William H. Attshuler was appointed vice president of manufacturing at Jensen Industries, Forest Park, Ill. Previously he held a similar position with Shure Bros.



Joe E. Morin (left) was promoted to general sales manager of Howard W. Sams & Co., Indianapolis. He had been manager of the new Industrial Division.



In his new post he succeeds J. C. Keith who resigned as vice president in charge of sales to serve as a merchandising consultant for the company.

John Messerschmitt (left) of Renewal Tube Sales Division of Amperex Electronic Corp., Hicksville, N. Y., was named assistant to Frank Randall, vice



president and general sales manager of the company. George Elliot, former office manager, was appointed manager of export and tube industry sales.

Sam W. Archer, assistant operations director of United Motors Service Division of General Motors Corp., Detroit, Mich., was promoted to assistant general sales manager-merchandising. END



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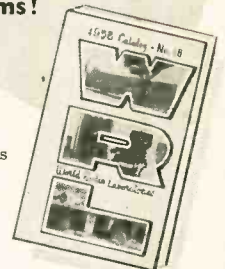
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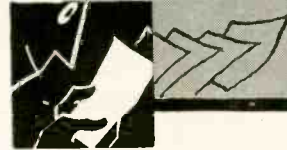
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technical Literature



WIRE AND CABLE

Catalog No. 857 contains many additions to this manufacturers line, including audio cables, mike cables and hook-up wire conforming to MIL specifications. Products are grouped according to use and applications.

Belden Manufacturing Co., 4647 W. Van Buren St., Chicago 80, Ill.

ELECTRONIC PARTS

Two-color electronic parts Catalog 6A100 lists tubes, vibrators, auto aerials, speakers, auto radio components and all parts for Autronic Eye, automatic headlamp control. Parts are alphabetically listed by make of car and indexed.

Delco Radio Div., General Motors, Kokomo, Ind.

SPEAKERS

Illustrated Catalog Q-N 57 lists 114 replacement, outdoor, public address, intercom and hi-fi speakers and rear seat auto speaker kits. Specifications including type, field, power handling, dimensions and prices are given.

Quam-Nichols Co., Marquette Rd. and Prairie Ave., Chicago 37, Ill.

TRANSISTOR APPLICATIONS

Volume II of Raytheon's Transistor Applications book is now available. It contains 60 pages of new transistor circuits with full construction details. A transistor interchangeability chart is also presented.

Raytheon Manufacturing Co. From local Raytheon Distributors. 50c.

AUTO-RADIO PARTS

This colorful 28-page Auto-Radio Replacement Guide and Catalog includes transformer and coil replacement data for 46 makes of auto radios.

Merit Coil & Transformer Corp., 4427 N. Clark St., Chicago 40, Ill.

MASTER INDEX

This 48-page booklet gives a complete cross index to material in all Supreme Publications' Television and Radio Service Information manuals.

Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. 25c.

WALL CHART

A revised edition, M-726 Ceramichart, has just been published. Two colors. Shows where each type of ceramic capacitor is used in typical circuits and color coding of the units.

Sprague Products Co., 125 Marshall St., N. Adams, Mass. 10c. Free at local distributors.

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A comprehensive, illustrated *Catalog No. 1957-C8* from a firm that specializes in relays. Some of the many types listed are: actuator, differential, polarized, mercury wetted, rotary and telephone relays.

Relay Sales, Inc., Box 186, W. Chicago, Ill.

MARINE RADIO

ST-69, a 4-page illustrated leaflet, contains a detailed description of various types of marine radio equipment.

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y.

TRANSISTOR CHART

Wall chart shows applications, maximum ratings and typical characteristics of 56 types of germanium-junction alloyed transistors. An interchangeability chart is also presented.

General Transistor Corp., 91-27 138th Pl., Jamaica 35, N.Y.

GENERATING PLANTS

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D. W. Onan & Sons Inc., 2600 University Ave., S. E. Minneapolis 14, Minn. Ask for Blue Book.

EQUALIZERS, WAVE FILTERS

Illustrated *Catalog No. 12-EB* lists standard networks which may be used to build up almost any type of af response characteristic. Principal uses are in the fields of sound recording, television and broadcasting, telecommunications, scientific research and motion pictures.

Cinema Engineering, 1100 Chestnut St., Burbank, Calif.

AUDIO GLOSSARY

In this 12-page glossary 99 hi-fi and tape recording terms are presented. Among the terms defined are: frequency response, binaural recorder, signal-to-noise ratio, crossover network and VU meter.

Minnesota Mining & Manufacturing Co., Dept. M7-177, 900 Bush Street, St. Paul, Minn.

TRANSFORMERS

A one-sheet circular lists four special-purpose transformers and describes Ultra-Linear output, vibrator and power transformers.

Acro Products Co., 369 Shurs Lane, Philadelphia 28, Pa. END

CORRECTION

There is an error in Fig. 3 of the article "Harmonic Analysis Made Easy" on page 89 of the June issue. Ordinates 0 and 6—the beginning and the end of the square wave—are both given at the maximum value of the wave or 25. This makes the dc component 16.7 rather than the 15 which it obviously is from the graph. (These should have been both shown as the average of the square wave at the point or 15.) We thank Mr. Arthur Hogrefe of New Cumberland, Pa., for the correction.

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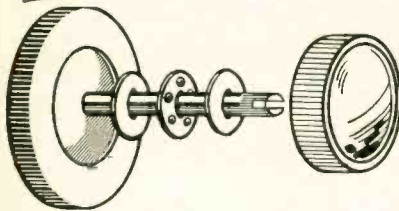
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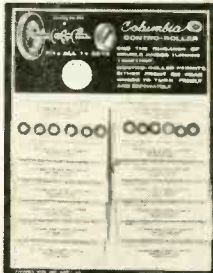
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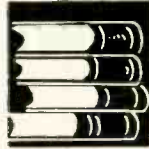
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Books



THE QUEST FOR QUALITY, by Norman H. Crowhurst. Norman Price, Ltd., 283 City Rd., London, England. 5½ x 8½ inches, 80 pages, 6 shillings.

Many facts not always found in a hi-fi publication are presented in clear, everyday language. The book aims at artistic as well as technical phases of hearing, stereophonic methods and the principles of acoustics and, also, how to conduct audio tests and make measurements without elaborate equipment.

Important chapters include distortion, dynamic range, transient response and equalization. There are practical schematics on expansion and compression circuits. One chapter shows how to select elements and match them up to complete a hi-fi sound system.—IQ

RADIO-TELEVISION & BASIC ELECTRONICS, by R. L. Oldfield. American Technical Society, Chicago, Ill. 8½ x 5½ inches, 342 pages, \$4.95.

This book, written for both the beginner and advanced student, covers a wide range of material. Starting with a short history on the development of electronics, it continues through such topics as ac and dc, electron tubes, amplifiers, acoustics, transmitters, AM, FM and TV receivers, hi-fi systems and transistors.—LS

METALLIC RECTIFIERS, by Leonard R. Crow. Howard W. Sams Co., Inc. Indianapolis 5, Ind. 5½ x 8½ inches, 280 pages. \$3.

The metallic rectifier is an important item in power supplies and ac meter instruments. It has other applications like arc suppression and peak clipping. This book describes in detail the operation and application of the big 3 in metallic rectifiers: copper-oxide, selenium and magnesium-copper sulfide.

In addition to rectifiers themselves, the author discusses rectifier circuits, voltage multiplication and ac meter requirements. The coming miracle in rectifiers, the silicon junction diode, is covered briefly in the final chapter.—IQ

ELECTROMAGNETIC MACHINES, by R. Langlois-Berthelot. Philosophical Library, 15 E. 40 St., New York, N. Y. 5½ x 9 inches, 535 pages, \$15.

Deals with questions common to the different classes of electromagnetic equipment, including transformers and rotating machines. Written for students, lecturers and technicians concerned with these devices.

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BOOKS (Continued)

L-C OSCILLATORS, edited by Alexander Schure. John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. Booklet No. 166-13. 5½ x 8½ inches, 66 pages. \$1.25.

This booklet on topics relating to tanks and tube oscillators includes many mathematical analyses and circuit descriptions. Medium and low frequencies receive the bulk of attention, with a few pages devoted to very high frequencies.

Some sections may puzzle readers. At one point there is mention of radiation from a modern 1-mc radio or TV transmitter. TV at 1 mc? A distinguishing feature of the Colpitts as against the Clapp oscillator is the fact that the latter uses a pentode, according to the author.—IQ

TRANSISTOR ENGINEERING REFERENCE HANDBOOK, by H. E. Marrows. John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N. Y. 9 x 12 inches, 288 pages. \$9.95.

An extensive compilation of data sheets from the various transistor manufacturers. In this single source we can find all important factors and curves relating to design and construction of transistor devices. Special types such as the fieldistor, field-effect transistor and avalanche types are included. The handbook also lists transistor batteries, thermistors and components.

This is a rapidly moving field and new types are being announced all the time. Many recent transistors are not found here and others that have become obsolete are still included. However, the technical data are basic and will be found useful by technicians, experimenters and designers.—IQ

TRANSISTORS IN RADIO AND TELEVISION, by Milton S. Kiver. McGraw-Hill Book Co., New York, N. Y. 9½ x 6½ inches, 324 pages, \$6.50.

A guide for radio and television technicians written in clear language and generously illustrated, the text begins with modern electron theory and continues through operation of point-contact, junction and other transistors. A number of transistor circuits are then analyzed and new developments and transistor servicing discussed. The book closes with a chapter of experiments with transistors.—LS

PHYSICS FOR EVERYBODY, by Germaine and Arthur Beiser. E. P. Dutton and Co., 300 4th Ave., New York, N. Y. 8½ x 5½ inches, 191 pages. \$3.50.

A tour of physics, covering topics such as electricity, alternating current, electronics and cosmic rays, for the layman.

SATELLITE! by Erik Bergaust and William Beller. Hanover House, Garden City, N. Y. 8½ x 5½ inches, 287 pages, \$3.95.

An earth satellite is soon to be launched. Electronic devices will play a major part in its operation. Among

those covered in this book are photon counters, radar tracking, doppler-radar system, telemetering systems and possible use of satellites as microwave relay stations. It is written with the layman in mind—brief, easily understood, without long technical discussions.—LS

INTRODUCTION TO PRINTED CIRCUITS, by Robert L. Swigget. John F. Rider Publisher, Inc., 116 W. 14 St., New York, N. Y. 5½ x 8½ inches, 101 pages. \$2.70.

Printed circuits are the key to the automation program of the electronics industry. As such they are becoming more widely used. This book describes each type of printed circuit in electronic equipment today. Their characteristics, functions and servicing techniques are discussed.

ELECTRICAL PRODUCTION OF MUSIC, by Alan Douglas. Philosophical Library, 15 E. 40 St., New York, N. Y. 5½ x 8½ inches, 223 pages. \$12.

A radio or phonograph reproduces music; an electric organ produces music. Many methods of producing music electrically are discussed. Advantages, disadvantages and limitations of electrical systems are examined. Written for those interested in the making or appreciation of music and electronic amateurs and specialists.—LS

INSTRUCTIONS FOR AUTO RADIO REMOVAL, 1st Edition. Howard W. Sams and Co., 2205 E. 46 St., Indianapolis, Ind. 5½ x 8½ inches, 103 pages. \$2.95.

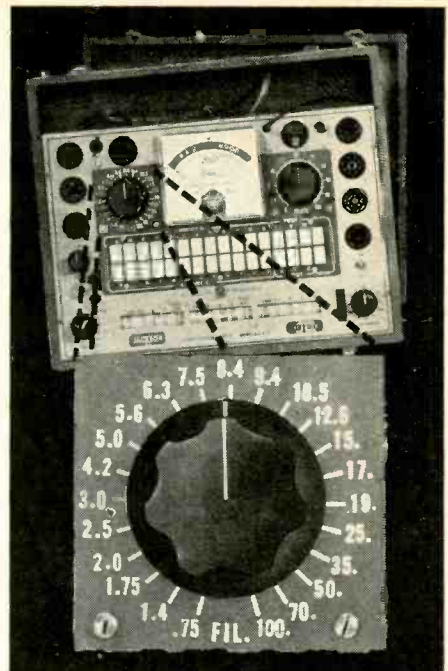
Removing a radio from a car has always been a problem, mainly due to lack of information. Here 22 of the 1955 model cars are listed with complete instructions for removing the radio. Detailed diagrams and photos point out all mounting bolts and indicate whether the radio drops down, lifts up or pulls straight out. A list of necessary tools is provided.

THEORY OF LINEAR ANTENNAS, by Ronald W. P. King. Harvard University Press, 44 Francis Ave., Cambridge 38, Mass. 6½ x 10½ inches, 944 pages. \$20.

A systematic and comprehensive survey of linear antennas and arrays of linear antennas. For the engineer and advanced student.—LS

MARINE RADAR, by D. G. Lang. Pitman Publishing Corp., 2 W. 45 St., New York, N. Y. 4¾ x 7¼ inches, 229 pages. \$4.75.

Radar, an important but complex unit aboard ship, is described here for service technicians. Components and circuits are covered in the first part of the book. Topics include wave shapers and generators, transmission lines, cavity resonators and antennas. Use and testing of a complete receiver are discussed. For self-study readers, questions appear at the end of each chapter.—IQ



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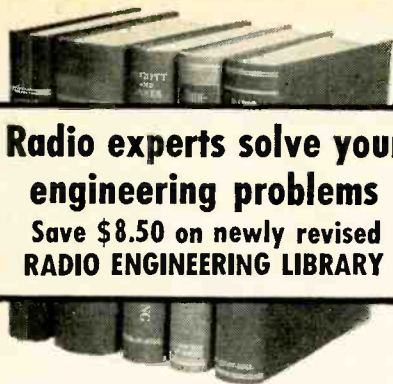
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BOOKS (Continued)

FOUNDATIONS OF RADIO, by M. G. Scroggie. Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. 5½ x 8½ inches, 349 pages. \$10.

This well-known authority has a remarkable way of explaining hard things the easy way, and without mathematics. Assuming no previous knowledge of the subject, he does an excellent job on the basic topics of radio: transmission lines, circuits, tubes, transistors, vectors, etc. Beginners and technicians will find this a worth-while book.

The first chapters are for beginners. They show proper use of symbols, abbreviations and schematics. Elementary principles of capacitance, inductance and ac circuits follow. More advanced chapters include C-R tubes, super-heterodyne principles, antennas, and others.—IQ

PULSE AND DIGITAL CIRCUITS, by Jacob Millman and Herbert Taub. McGraw-Hill Book Company, New York, N. Y. 9½ x 6½ inches, 687 pages. \$12.50.

This text for senior and graduate engineering students provides a description and analysis of circuits and techniques common to the newer fields of electrical engineering. Beginning with linear networks, the book continues through subjects such as waveforms encountered in pulse circuits, basic non-linearity of tubes and semiconductors, and waveform-generating circuits. These basic building blocks are then assembled into pulse and digital systems like radar, television and digital computers.—LS

RADIO AMATEUR'S HANDBOOK, 34th Edition, by Headquarters Staff of American Relay League, West Hartford, Conn. 6 x 9 inches, 576 pages text plus 32-page vacuum-tube and semiconductor section, 136-page catalog section and index. \$3.50.

This newest edition of the best known radio book covers a large amount of new equipment in all categories.

A chapter on semiconductors is included in the basic-theory sections. Transmitters designed for the novice will be found and the tube supplement has been completely rewritten. All changes necessary to bring the text up to date have been made.—LS

SCATTER PROPAGATION, Theory and Practice, by Ira Kamen and George Dondulakis. Howard Sams & Co., Inc., 2205 E. 46 St., Indianapolis, Ind. 5½ x 8½ inches, 197 pages. \$3.

After an introduction to scatter propagation, telling what it is and why it is used, the book breaks down into two-chapter sections. Chapters 2 and 3 discuss ionospheric communications systems and ionospheric scatter system equipment, respectively; Chapters 4 and 5 are entitled Tropospheric Propagation and Tropospheric Propagation Equipment.

As would be expected, more space is given to tropospheric communications,

which are adaptable to broad-band systems and multichannel links. Chapter 3 contains much information on the "how" of scatter propagation. A number of schematics are shown in Chapter 5 and the discussion is highly practical. A further chapter deals with scatter systems and the technician whose interest is in maintenance rather than in design and installation. A final chapter describes the DEW line and other northern scatter and radar setups.—FS

UNDERSTANDING HI-FI CIRCUITS, by Norman H. Crowhurst. Gernsback Library, Inc., 154 W. 14 St., New York 11, N. Y. 5½ x 8½ inches, 224 pages. \$2.90.

To understand fully and evaluate, one must first analyze and compare. Mr. Crowhurst uses these two methods to present the true facts of high fidelity. For example, the chapter on output stages shows the differences between transformer and R-C coupling, fixed and automatic bias, triode and pentode, Ultra-Linear and cathode follower. Input stages, equalizers, loudness controls, feedback, inverters, etc. are equally clearly explained. A chart gives typical values of distortion, efficiency and drive for each type of circuit. Each chapter includes data and charts to show the merits and features of each circuit.

If you are puzzled by the claims and counter-claims of audio designers and hi-fi listeners, this book will give you the low-down on hi fi.—IQ

TECHNICIAN'S HANDBOOK, CBS-Hytron Technical Service, 100 Endicott St., Danvers, Mass., 5¼ x 9 inches, 450 pages. \$1.50.

This is the first edition of a combined tube and semiconductor manual. Tubes are listed numerically and alphabetically with full data on common types. Seldom-used types are cross-indexed in charts, grouped as diodes, mixers, etc.

Crystal diodes, silicon power rectifiers and transistors are listed separately. Special purpose tubes are grouped by function: power triode, gaseous diode, rectifier, uhf, etc. The appendix deals with ratings of rectifiers, TV deflection tubes, series-string heaters and color codes. The binding is loose-leaf and supplementary sheets on new tubes and transistors will be supplied.—IQ

HANDBOOK OF SOUND REPRODUCTION, by Edgar M. Villchur. Radio Magazines, Inc., P.O. Box 629, Mineola, N. Y., 6 x 9½ inches, 217 pages. \$6.50.

For the serious student of high-fidelity the various aspects of sound are covered first. This is followed by a complete discussion of the types of equipment needed for hi-fi sound, including speakers, baffles, power amplifiers, tone controls, equalization, power supplies, pickups and methods of testing and measurement.—LS END

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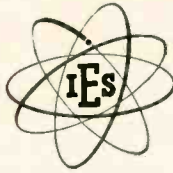
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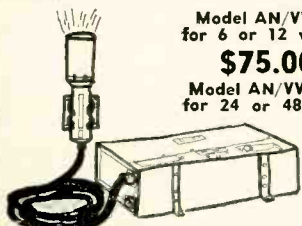
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The best-looking, best-performing tuner kit your money can buy. Covers 88 to 108 mc; features AFC (with special disabling circuit); pre-adjusted RF coils; pre-aligned IF's; cascode broad-band RF amplifier; drift-compensated oscillator; illuminated lucite pointer. Sensitivity is 10 microvolts for 20 db of quieting across entire band. Ideal for use with Knight-Kit 20-Watt Amplifier or any amplifier with phono-tuner switch. 13 x 8 x 4". Complete, ready for easy assembly. Shpg. wt., 12 lbs.

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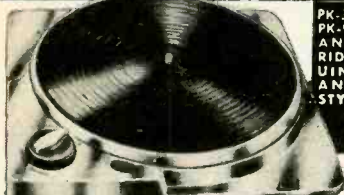


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COMBINATION DEAL



PK-90

LATEST IMPROVED MODEL PK-300 TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within $\pm 7\%$ using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transference. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13 1/2" x 14" and requires 2 3/4" clearance above and 3 3/4" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs. **Net 49.50**

PK-90 VISCOS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidentally dropped. Low frequency resonance, skidding and groove-eating all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure. This tone arm is a quality companion to the PK-300 with matching finish. Shpg. wt., 2 1/2 lbs. **Net 15.95**

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- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL



The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. ANTENNA INPUT: FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. CONTROLS: 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. DISTORTION: Less than 1% rated output; FREQUENCY RESPONSE: FM, ± 5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. SENSITIVITY: FM, 5 μ v for 30 db quieting; AM, Loop sensitivity 80 μ v/meter. SELECTIVITY: FM, 200 KC bandwidth, 6 db down 375 KC FM discriminator peak to peak separation; AM, 8 KC bandwidth, 6 db down. IMAGE REJECTION: 30 db minimum. HUM LEVEL: 60 db below 100% modulation. TUBE COMPLEMENT: 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. SIZE: 5 1/2" high x 9 3/4" wide x 9 3/4" deep (excluding knobs). CONSUMPTION: 30 watts. For 110-120V 60 cycles AC. Less metal case. Shpg. wt., 9 lbs. **Net 34.95**

ML-100—Metal cage for above, shpg. wt., 3 lbs. **Net 5.00**

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IMPORTED 12" HI-FI COAX. SPEAKER

- FREQUENCY RANGE 30-15000 CPS
- HANDLES 20 WATTS OF POWER
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- POWERFUL TSK-5 MAGNETS
- SPECIAL SHEEPSKIN-EDGED CONE

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Reg. Price
44.50
Net
29.50

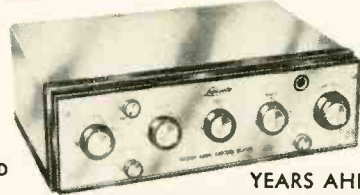
LAFAYETTE HI-FI LP TEST RECORD



Ideal for audiophile who is building a bass reflex speaker enclosure, or wants to check the components already in use. Two-side, 12" LP record covers cartridge and stylus test, turntable rumble test, average and minimum recording levels, stylus and tone arm resonance check, equalization checks, sound effects, tuning bass reflex enclosures, and a group of delightful music box selections. Specially recorded with painstaking care at 33 1/3 RPM, and master cut on a mechanism that produces the quietest grooves in the industry. Complete with instructions for use and colorful protective envelope. Shpg. wt., 1 lb. **PR-10** **Net 2.25**

New!

LAFAYETTE MASTER AUDIO CONTROL CENTER WITH BINAURAL CHANNEL AND DUAL VOLUME CONTROL



\$39.50
IN KIT FORM
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\$59.50
WIRED & TESTED
LT-300

YEARS AHEAD OF EVERY
OTHER PREAMPLIFIER CONTROL UNIT

The Lafayette Master Audio Control Center is not only the finest high fidelity preamplifier, characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound.

FEATURES

- Incorporates an extra channel and dual volume control for binaural reproduction.
- DC on all tube filaments for minimum hum, and negative feedback in every stage.
- IM distortion and harmonic distortion so low, it is practically unmeasurable at normal operating level. IM is below 0.09% at 1V; HM approximately 1/4 of 1% even at 5V.
- Dual cathode follower output stages.
- High gain for low level pickups.
- Separate turnover and roll-off controls —24 positions of equalization.
- Printed circuit construction.
- Tasteful styling, brilliantly executed.
- Designed for ease of installation and operation.

SPECIFICATIONS

INPUTS: 7 inputs accommodate every type of phono, tuner and tape. CONTROLS: 9 front and 2 rear panel controls make for utmost versatility. FREQUENCY RESPONSE: Uniformly flat frequency response over the entire audible spectrum. TAPE EQUALIZATION: Tape head playback equalization both NABT and adjustable. SENSITIVITY-GAIN: 54db on magnetic input (2mv input produces 1V output); 14db on radio tape and auxiliary inputs (0.2V produces 1V output). HUM & NOISE: 80db below 3V output at full gain on radio, tape and auxiliary inputs; better than 60db below effective program level at full gain with 10mv input. TUBES: 3 premium type ECC83 tubes plus 2 selenium rectifiers. POWER SOURCE: 105-125V 50-60 cycles AC. SIZE: 12 3/4" L x 3 3/4" H x 8 3/4" D from front panel to ear jacks—knobs project 1". Shpg. wt., 10 1/2 lbs.

FOR FURTHER DETAILS WRITE FOR BULLETIN ST-74.

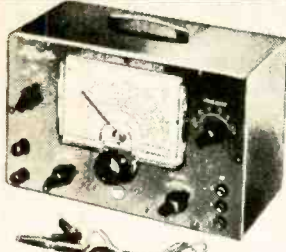
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22.50

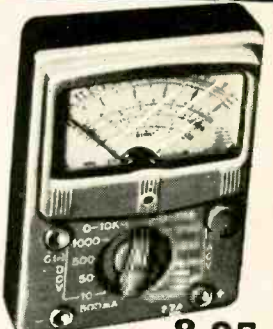
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NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both DC and AC

- 160 ua 3" METER
- 1% PRECISION RESISTORS
- SILVER CONTACT SELECTOR SWITCH



FULL SCALE RANGES
 DC Volts: 0-10; 0-50; 0-500; 0-1000 Volts - AC Volts: 0-10; 0-50; 0-500; 0-1000 Volts-DC Current: 500 ua and 500 ma - Resistance: 0-10K; 0-1 Meg - Decibels: -20 to +22; +20 to 36 db (0 db - 0.775 V) - Capacity: 250 mmd to .2 mfd - .005 mfd to 1 mfd - Output Ranges: 0-10; 0-50; 0-500; 0-1000 volts

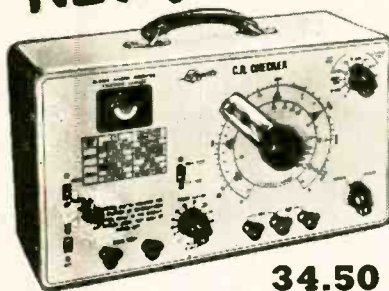
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Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with per volt on both AC and DC. Single selector switch, 1% accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Complete with test leads and batteries. Shipping weight 4 lbs. **RW-27A** Complete 8.95

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COMPLETELY WIRED AND TESTED



- TWO INSTRUMENTS IN ONE
- CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CONDENSERS
- 4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD
- CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS
- 2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001-.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 0-1000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control from 0 to 50%. Operation is simple and accurate. Attractively finished steel case with etched panel and rounded corners. Measures 14 1/2" L x 8 1/4" H x 5" D. Shpg wt. 19 lbs.

34.50

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MODEL LC-4 NET 34.50

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- COMPLETELY WIRED AND TESTED
- CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION
- DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS

A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and, 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9 3/4" L x 7 3/8" H x 5 1/4" D. Shpg. wt. 10 lbs.

MODEL LC-15 NET 21.50

21.50

Lafayette Import Special! TRANSCRIPTION TYPE MANUAL PLAYER

- MAGNETIC BRAKE FOR FINE ADJUSTMENT OF EACH SPEED
- 4-POLE, HEAVY DUTY TRANSCRIPTION-TYPE MOTOR
- STYLUS WEIGHT ADJUSTMENT SCREW ON TONE ARM

Complete Turntable and Tone Arm Assembly at the lowest price Ever for Such High Quality

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10" diameter, heavy turntable is supplied with a rubber traction mat for positive grip of record. Stylus pressure adjustment can be made easily and quickly with the conveniently located adjusting screw on the underside of the tone arm. Mounting plate is also equipped with pickup rest and ON-OFF switch. Dimensions of mounting plate: 12-15/16" left to right, and 10 1/2" front to rear. Requires 2 3/4" clearance below motor board and 3" above. Supplied with AC line cord, two plug-in heads, output cable for connection to amplifier and 45 RPM adapter. For 105-120 volts, 60 cycle AC. Shpg. wt. 12 lbs. Less cartridge. (NOTE: For protection in shipping, tone arm to separate. Just fasten to mounting plate.)

- PK-160 Manual Player Net 25.95
- PK-164. Same as above except equipped with genuine GE triple-play magnetic cartridge and dual diamond-sapphire stylus Net 36.50
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- PK-163. Shpg. wt., 1 lb. Net .95



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with TWO PLUG-IN HEADS

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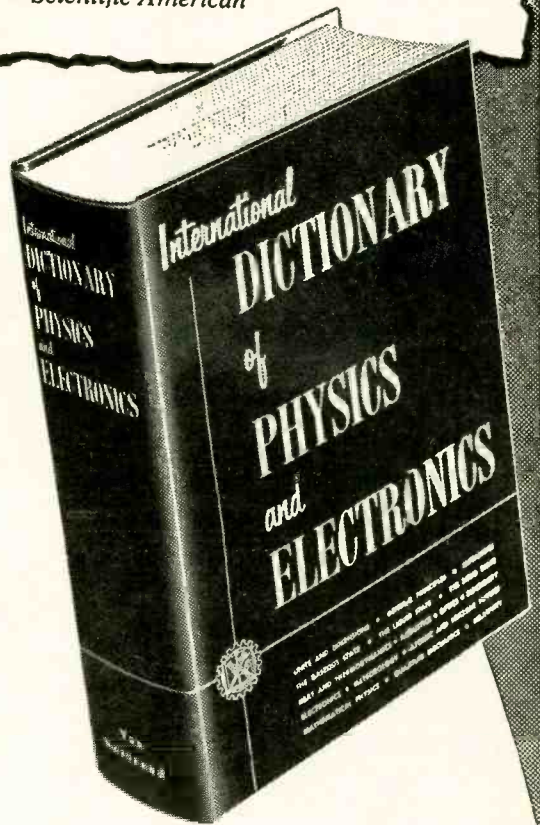
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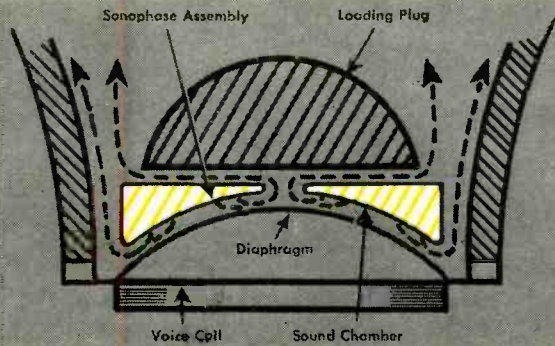
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The Avedon Sonophase Throat Design

The unique throat design illustrated here overcomes a problem common in conventional high frequency drivers. This is diaphragm deformation at high frequencies, occurring at frequencies above 5 kilocycles. Piston action is destroyed, the phase is shifted and the result is destructive interference.

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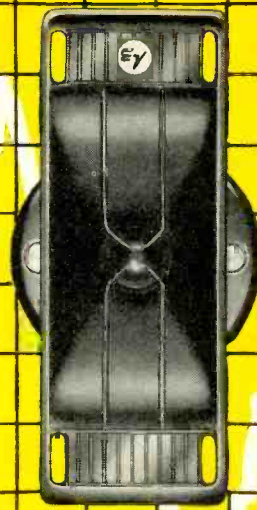
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This is the Electro-Voice development which is used in all E-V horns to disperse sound equally in all lateral directions from a single point source. This is especially important in stereophonic reproduction to preserve the undistorted depth and width of the original sound. Diffraction horns insure balanced levels of both right and left stereo speakers. These drawings tell the diffraction horn story:

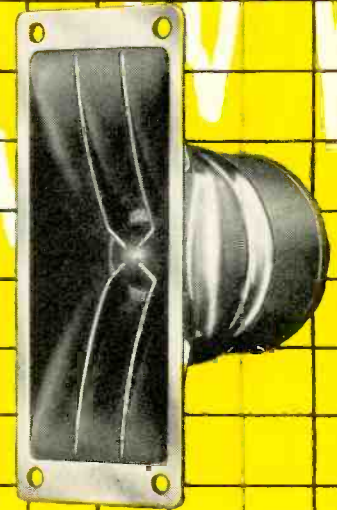
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T350 Ultra-Sonax



T35 and T35B Super-Sonax

Specifications	T35	T35B	T350
Frequency Response:	± 2 db 2 kc—19 kc	± 2 db 2 kc—18 kc	± 2 db 2 kc—21 kc
RETMA Sensitivity			
Rating:	57 db	54 db	60 db
Magnet Weight:	7 oz.	4 oz.	1 lb.
Gauss:	13,500	9,000	20,000
Size:			
Horn:	5 1/4 in. long x 2 in. wide		7 1/2 in. long x 2 1/8 in. wide
Pot Diameter:	2 1/4 in. maximum		3 1/2 in. maximum
Depth:	3 1/4 in. overall	3 in. overall	4 1/2 in. overall
Shipping Weight:	3 lbs.	3 1/2 lbs.	9 1/2 lbs.
Net Price:	\$35.00	\$22.00	\$60.00

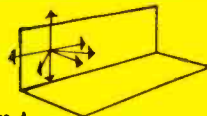


Figure A

Figure A—This shows how sound disperses equally in all directions from a single point source.

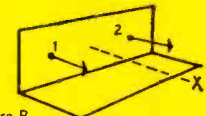


Figure B

In Figure B two sound sources are shown. On the axis, at point "x," double the sound power results as the resultant pressures are in phase.

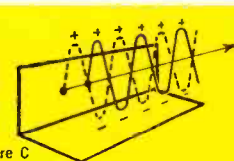


Figure C

But in Figure C, if the distance between the two sources is 1/2 wavelength or greater, the sound from the two sources will be considerably out of phase for points off the axis, resulting in decreased sound pressure.

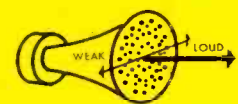


Figure D

Figure D will show the deficiencies in horns of wide lateral dimensions compared to the wavelength being emitted. Any horn mouth can be considered as a group of small point sources of sound. They must beam the sound down the axis by their very nature.

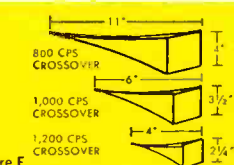


Figure E

Figure E shows representative horns, illustrating that horns must have a certain length, as well as cross sectional area along this length and at the mouth to load the driver diaphragm down to the lowest frequencies to be reproduced. The lower we go, the longer must be the horn and the greater the mouth area.



Figure F

Figure F shows that narrowing the horizontal area and extending the vertical dimension of the horn mouth preserves the loading area necessary for good low end response, disperses the sound perfectly in the horizontal direction where it is so necessary, and keeps interfering reflections off the floor and ceiling.

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I should say so. If anyone did you do to it, does?

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