JUNE

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor-in-chief

BUILD A LOW-NOISE NUVISTOR TV BOOSTER

Two little nuvistors make a booster with a signal-to-noise ratio that could formerly be equaled only with very expensive tubes.

MORE NEW FM STEREO MULTIPLEX SCHEMATICS

Most of the manufacturers have modified or changed their original circuits. See the latest ones, with explanations of how they work.

ALL-MASTER INTERCOM IS EASILY BUILT

Using only one 4-transistor amplifier, this unit goes into action instantly; is economical to operate. Any number of stations can be used.

THE OSCILLOSCOPE —ITS USES IN INDUSTRY

The general as well as the industrial electronics technician will find this article with its photos of waveforms useful and interesting. Describes a large number of techniques and tests.

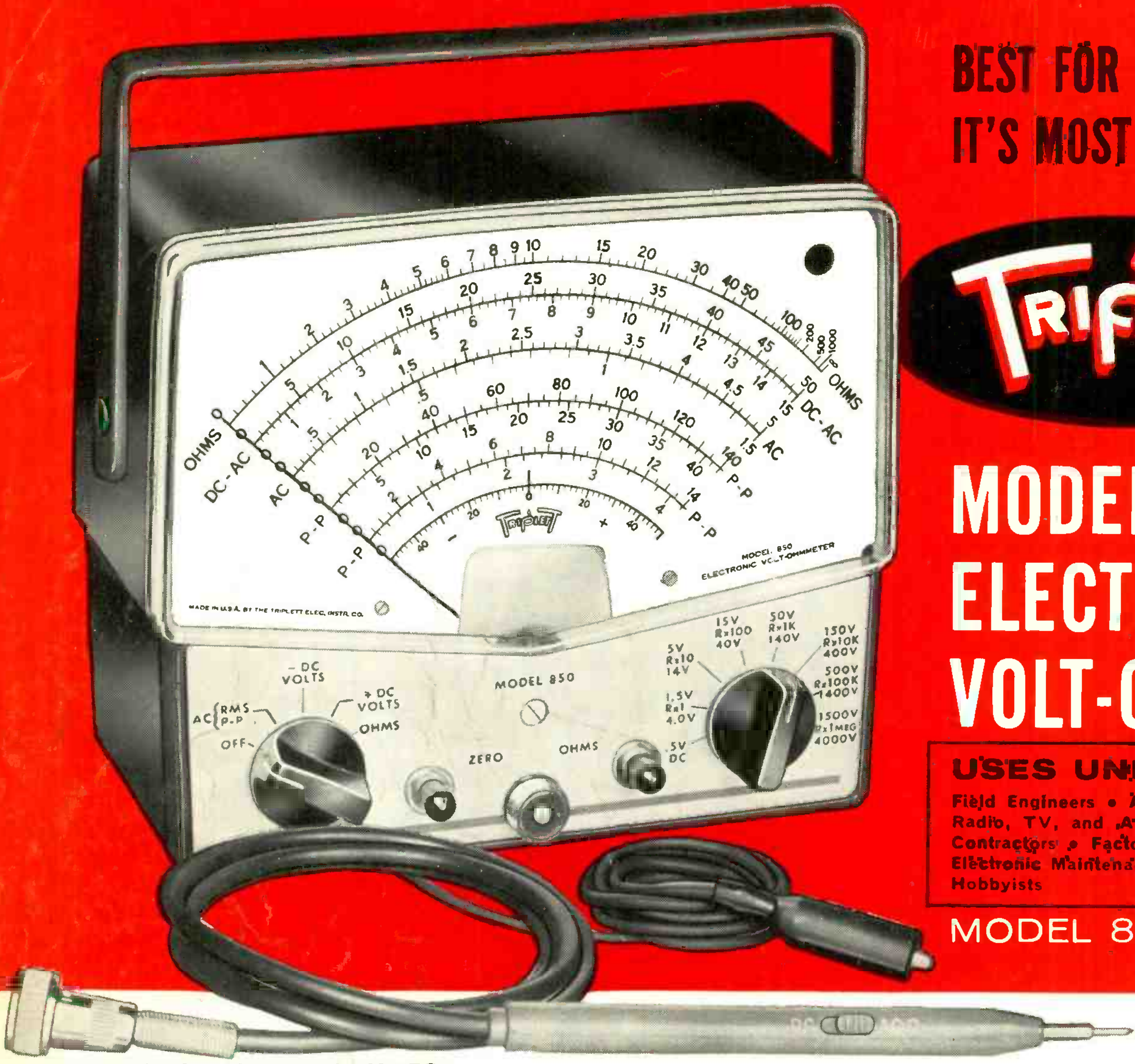
Gold Makes Better Resistors

See Page 4

50c

BEST FOR YOU— IT'S MOST VERSATILE

TRIPLETT



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Right down the line, America's music magazines have been using some well-turned phrases in editorial evaluations of the Troubador. **High Fidelity,** turning to the United States Testing Company for its report, found the Troubador to be a "precision-engineered product of the highest quality... wow, flutter and rumble completely inaudible." **Audio** said: "precise performance... an excellent buy... no acoustic feedback." **American Record Guide:** "... these (performance) figures have not been bettered by any turntable I have tested."

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Radio-Electronics

JUNE 1962
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—on the cover—

Story on page 47

Precision resistors are made with greater accuracy and reliability in a completely automated plant. Cover shows gold ends being sputtered on resistors in a vacuum atmosphere.

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News Briefs

Earth Station

The term is no longer science fiction—you can visit one in Andover, Me. Constructed by Bell Telephone, it is the US link in a worldwide communications system making use of a series of Telstar repeater satellites. Telephone and TV messages will be exchanged between the site and the satellite in orbit. The satellite will receive, amplify and retransmit the signal to similar stations in other parts of the world. Eventually, a total of 20–40 satellites, in orbit, will be needed to insure complete worldwide communications at all times.

The "earth station" consists of a radome 210 feet in diameter and 161 feet tall. Inside is a 340-ton steel and aluminum rotatable antenna structure. It consists of a horn antenna with an opening that measures about 3,600 square feet and two fair-sized houses containing transmitter and receiving equipment. The horn will scoop up about a billionth of a watt of the signal broadcast from the Telstar satellite. A maser amplifier is located at the apex of the horn. It uses a synthetic ruby as a central element, cooled to −456°F by liquid helium.

A supplementary control station located a quarter mile from the radome is where the actual work will be done. Two tracking antennas are located outside this building. A quad-helix command tracker picks up the satellite's 136-mc beacon and telemetry and will transmit commands to the satellite on about 120 mc. Once the satellite begins to transmit its broad-band communications signal and associated precision beacon, the other antenna, an 8-foot dish, will track on this signal with much greater precision. It controls the large horn in the radome through a servo system.

The Andover station will be linked to the Bell Telephone Network by conventional broad-band microwave radio relay system.

Earth station of Telstar satellite relay station at Andover, Me.

People May Be Own Power Supplies

Persons who have electronic equipment such as Pacemakers or nerve stimulators implanted in their bodies, may in the future supply their own power to the equipment, according to Francis M. Long, assistant professor of electrical engineering at the University of Wyoming.

The power supply from implanted electronic equipment has always been a problem. When external batteries are used, connections must be made through the skin, with continuous danger of infection, as well as mechanical problems and annoyances. Pacemakers (heartbeat timers) have been made completely self-contained with both circuitry and batteries implanted in the body. In these cases, an operation every 5 years or so to renew the battery is necessary.

Experiments made by Professor Long would lead to the belief that a piezoelectric crystal, inserted where it would be subject to muscular motion, could supply enough power for such equipment. The crystal could be inserted, he suggests, in such places as between the diaphragm and the rib cage, and the motion caused by breathing would act on it as a phonograph stylus does on a similar crystal in a phonograph pickup, producing small but sufficient quantities of power for certain types of implanted equipment.

New Electrostatic Recordings Are On Uncoated Tape

A new system of electrostatic recording in which the charge is injected into highly resistive tape (usually Mylar) was described at the recent IRE convention. The charges are injected into the body of the tape itself by drawing the tape over a knife-edge electrode, while its reverse side is in contact with the conducting backing electrode. As in magnetic recording, bias (dc or ac) can be used.

The playback system consists of a thin metallic "readout" electrode placed between two electrostatic shields. Tape is drawn across this as in a magnetic playback device. Potentials up to 40 millivolts are induced in the playback electrode.

After recording, and after each playback, the tape is neutralized with an "ion bath," produced by a high-voltage corona discharge from pointed electrodes, located between the recording or playback head and the pickup spool. This neutralizes any uncompensated charges that may have been produced by friction in reeling and unreeling. The process adds greatly to the life of the recording, reducing noise as well as print-through during storage.

A study of recordings now more than 3 years old leads to the belief that the new system yields a highly permanent recording, and a

(*Continued on page* 12)

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San Francisco—House of Sound, 104 9th Street
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Denver—Electric Accessories, 1620 Blake Street
Denver—Empire Radio & TV Co., 1100 Broadway
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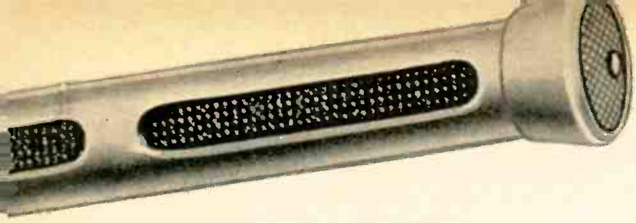

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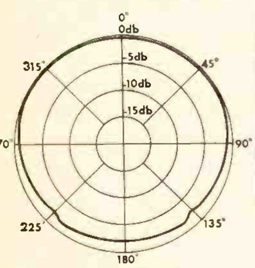

NON DIRECTIONAL MICROPHONE

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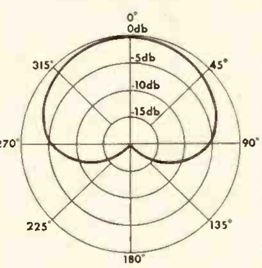

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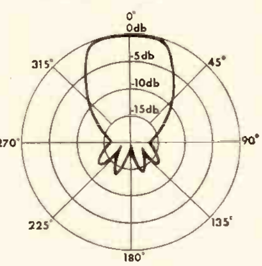

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Philadelphia—Barnett Brothers Radio, 622 Arch Street
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Charleston—Radio Labs, 475-477 East Bay Street
Columbia—Dixie Radio Supply Co., 1628 Laurel St.
Florence—Southern Electronics, 355-65 North Irby St.

SOUTH DAKOTA
Aberdeen—Burghardt Radio Supply, 102 South Second
Rapid City—Burghardt Radio Supply, 726 Jackson
Sioux Falls—Burghardt Radio Supply, 208 N. Weber
Sioux Falls—Warren Radio Supply, 196 E. Sixth St.
Sioux Falls—Warren Supply Co., 115 S. Indiana Ave.
Watertown—Burghardt Radio Supply, 621-4th St., SE

TENNESSEE
Memphis—Hirsh Electronics, 1658 Union Avenue

TEXAS
Corpus Christi—Wicks Radio Equipment, 513 Staples
Dallas—Adleta Company, 1907 McKinney
Dallas—Chandler Sound Equipment, 3407 Ross Avenue
Dallas—Crabtree's Wholesale Radio, 2608 Ross Ave.
El Paso—Midland Specialty Co., 500 W. Paisano Drive
Fort Worth—Clifford Herring Sound Equipment, 1705 West 7th Street
Houston—Busacker Electronic Equipment, 1216 W. Clay
Houston—Sterling Electronics, Inc., 1616 McKinney
San Antonia—Vandergrift Audio, 4106 San Pedra Ave.

UTAH
Ogden—Ballard Supply Co., 3109 Washington Blvd.
Ogden—Tri State Electronic Supply, 2763 Washington
Salt Lake City—Deseret Book Co., 44 East S. Temple
Salt Lake City—Electronic Sales, 175 Social Hall Ave.

VERMONT
Burlington—Radio Service Lab, 703 Pine Street
White River Junction—Electronics Supply, Inc.

VIRGINIA
Danville—Womack Radio & Supply, 513 Wilson St.
Hampton—Buckroe Electronics, Inc., 815 Buckroe Ave.
Norfolk—Cain Electronics, 14th and Monticello Avenue
Norfolk—Electronic Engineering, 4201 Hampton Blvd.
Norfolk—Priest Electronics, 6431 Tidewater Drive
Richmond—Radio Supply Co., 3302 West Broad Street
Roanoke—H. C. Baker Sales Co., Ltd., 19 Franklin Road

WASHINGTON
Seattle—Western Electronic Supply, 717 Dexter Ave.
Seattle—Seattle Radio Supply, 2117 2nd Avenue
Tacoma—C & G Electronics, 2502 Jefferson Avenue
Yakima—Lay & Nord, 112 South Second Street

WEST VIRGINIA
Charleston—Electronic Specialties Company, Delaware at Randolph
Huntington—Electronic Supply, Inc., 422 11th Street
Wheeling—General Electronics Dist., 735 Main Street

WISCONSIN
Appleton—Valley Radio Distributors, 518 N. Appleton
Madison—Satterfield Electronics, 1900 South Park St.
Milwaukee—Allied Radio, 5314 N. Port Washington
Milwaukee—Taylor Electric, 4080 N. Port Washington
Sheboygan—J. J. Koespell, South 9th at Commerce

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Export: Ad Auriema, Inc., N.Y. • In Canada, Cross Canada Electronics, Waterloo, Ont.

(*Continued from page* 6)
useful life greater than 100 years for Mylar tape records is predicted.

Sunlight's Direction May Guide Satellites

According to Heinz Gabloffsky of the Northrop Space Laboratories, a satellite may be guided through space by detecting the position and direction of the sun. The information, fed to an electronic discriminator, which might be compared with the afc system in television receivers and other electronic apparatus, would be used to correct the course of the satellite.

It is interesting to note that guidance by solar position is believed by some scientists to be a factor in the homing instinct of such insects as bees and of birds.

Viewer "Sees Double" With TV Spectacles

A miniature television receiver worn like a headset permits the wearer to either watch a display on a monocle-like reflecting lens or to look through it at the scene ahead of him.

The device, called an Electrocular, was developed by a team from the Ground Systems Laboratory of the Hughes Aircraft Co. under the direction of Dr. A. Victor Stern. It is expected to be useful to persons who may require data or a second scene to be presented to them

Dr. A. V. Stern wearing the Electrocular.

while watching the scene ahead. A plane pilot, for example, could watch certain indicators without moving his eyes from the air area ahead, a tank commander could see the scene ahead of him as televised from an observation helicopter high in the air as well as the direct view from his tank, or a surgeon could scan information on the patient's respiration, heartbeat and other data while carrying on the operation. The lens, set at a 45° angle to the eye, permits the wearer to read information on it or look straight through it without being distracted noticeably by the other view.

The device consists of a miniature electrostatic TV tube, with a prism to turn the picture 90° and project it on the lens, where it appears as a bright green image. A control unit supplies power, deflection and sync to both camera and receiver, thereby simplifying sync problems.

"Home Broadcast Stations" Give Headaches to FCC

"Peewee broadcast stations," operated by children, have been creating "mounting difficulty" for FCC field engineers who have had to track down the irregular transmissions, which interfere with regular broadcasting as well as with aviation, police and other safety services. Many of the young people have no idea that there is anything illegal in such transmission, and the commission itself has received so many letters from youthful radio enthusiasts, inquiring how they can use a purchased kit or home-assembled equipment to broadcast voice and records to the immediate neighborhood without an FCC license, that it has put out a special bulletin of instruction to these correspondents. Known as *Information Bulletin No. 17-G*, it was issued in February, and contains 2½ pages of information as to what is legal in low-power radio and what is not. It points out that while certain types of equipment can be operated without a license, such equipment is constructed under strict controls designed to prevent interference with licensed radio services. The booklet also contains information for those who wish to pursue the study of radio, either as amateurs or as a career.

Graeco-Schenectady

More than 550 terms ending in "tron" have been discovered by a British electronic magazine. These range from Accutron, an electronic watch, to Zyklotron, a high-frequency tube. Many of the terms are trademarks or company styles rather than names of electronic devices, and some (such as Shucktron, a device for removing the shells of oysters) are not electronic.

Decade Counter Uses Luminescent Panel

A joint demonstration was made by Sylvania Electric Products and Beckman Instruments of a universal EPUT (Events Per Unit of Time) and timer which uses a luminescent panel numeric display instead of the familiar numeral display tubes. This was the first time that lumi-

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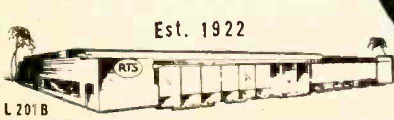

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nescent material has been presented commercially in such a device, although luminescent panels have been used for flashing signs. The completely solid-state material operates at about 250 volts and 400 cycles. The luminescent display makes readings from wide angles possible, and eliminates any confusion due to the stacked digits of the tube type display devices. Switching time is fast, the decay time of the material having a maximum of about 5 μsec.

Calendar of Events

1962 Electronic Parts Distributors Show, May 21–24, Conrad Hilton Hotel, Chicago. Attendance limited to manufacturers, distributors, representatives and their advertising agencies. RADIO-ELECTRONICS will exhibit in Room 610.

ISA National Aero-space Instrumentation Symposium, May 21–23, Marriott Twin Bridges, Motor Hotel, Washington, D. C.

IRE, AIEE, ASME, ISA National Telemetering Conference, May 23–25, Sheraton Park Hotel, Washington, D. C.

EIA Annual Convention, May 23–25, Pick-Congress Hotel, Chicago, Ill.

IRE Seventh Region Space Communications Conference, May 24–26, Seattle, Wash.

ERA Management Institute, June 10-15, University of Illinois, Urbana, Ill.

IRE Spring Conference on Broadcast and TV Receivers, June 18–19, O'Hare Inn, Chicago.

IRE National Convention on Military Electronics, June 25–27, Shoreham Hotel, Washington, D. C.

Symposium on Electromagnetic Theory & Antennas, June 25–30, Technical University of Denmark, Copenhagen.

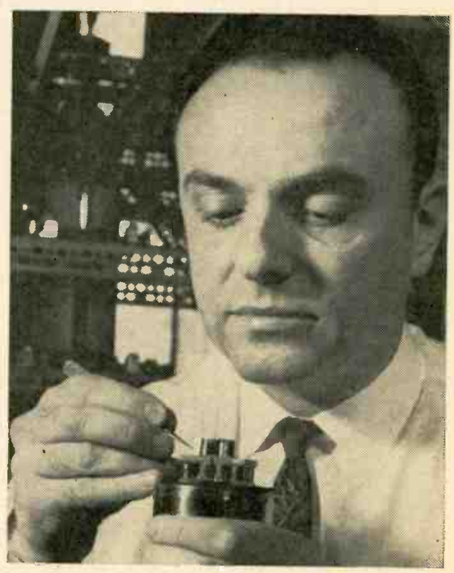
IRE, AIEE, ISA, ASME, AICHE Joint Automatic Control Conference, June 27–29, New York University, New York, N. Y.

IRE National Symposium on Radio Frequency Interference, June 28–29, Town House Hotel, San Francisco, Calif.

National Bureau of Standards Course in Radio Propagation, July 16–Aug. 3, Boulder Labs, Boulder, Colo.

Magnetic Field Improves Thermoelectric Material

The properties of a thermoelectric material may be greatly improved by placing it in a magnetic field, according to Bell Telephone scientists Raymond Wolfe and

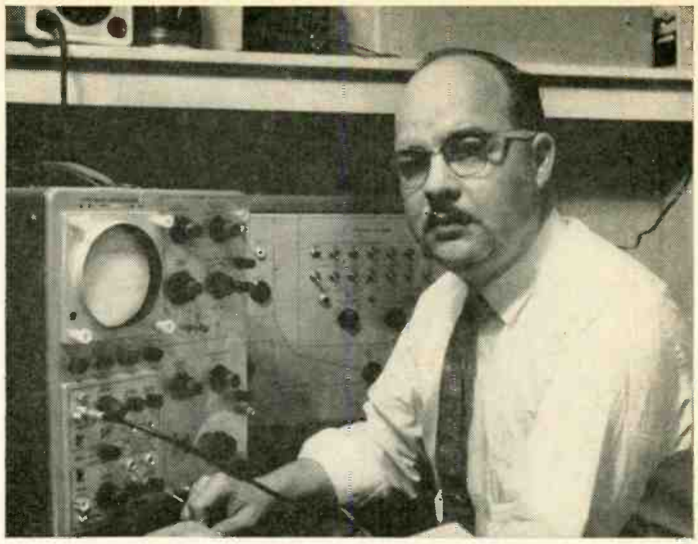


Raymond Wolfe of Bell Telephone Labs prepares to replace conventional n-type thermoelectric material with new bismuth–antimony alloy.

(*Continued on page* 18)

are you standing still in electronics while this man advances?

Find out why—and do something about it—if you have the ambition to want a career instead of just a job.



CREI graduate Mearl Martin, Jr. has progressed from Junior Technician to licensed Senior Engineer. He is now Field Support Manager, Marketing Division of Tektronix, Inc., Portland, Oregon.

LET'S LOOK AT THE FACTS. There's something wonderful about knowing how a circuit works or what a filter capacitor does. If you've ever fixed a TV set, built a radio or used a voltmeter, you've tasted the thrills of electronics.

This excitement may have led you to a job in electronics. But the glamour fades if you are stuck in the same job year after year. You'll be bored with routine and unhappy about prospects for future earnings. You'll discover, as have many men, that simply working in electronics does not assure a good future.

If electronics is the "field of opportunity," how is this possible? No question about it, electronics offers many opportunities, *but only to qualified men.* In any career field, it is how much you know that counts. This is particularly true in the fast moving field of electronics. The man without thorough technical education doesn't advance. Even men with intensive military technical training find their careers can be limited in civilian electronics.

ADVANCED TECHNICAL KNOWLEDGE IS THE KEY to success in electronics. If you have a practical knowledge of current engineering developments, if you understand "why" as well as "how," you have what employers want and pay for. With such qualifications, you can expect to move ahead.

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(*Continued from page* 14)

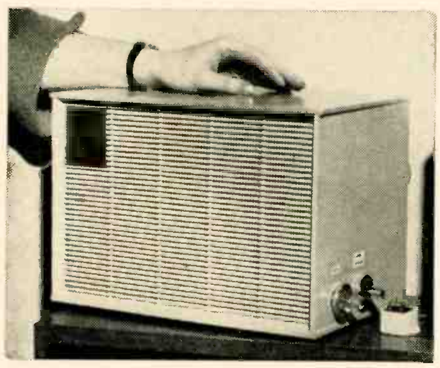
George E. Smith. They report that the figure of merit of an alloy of 88% bismuth and 12% antimony was raised from 1.2 to 2.9 × 10^{-3} per degree K, at room temperature, with a magnetic field of 17,000 gauss.

The figure of merit, or "Z", is an expression which tells how much electricity can be obtained from a thermoelectric junction and is related to the voltage produced by a given amount of heat applied to the junction, to the resistivity of the material and to its thermal conductivity. At a temperature of 100°K, a record-breaking Z of 8.6 × 10^{-3} per degree K was reported, with a field of only 1,000 gauss.

The improved material and techniques should find immediate application in low-temperature electronic refrigeration. The magnetic field technique may be applicable to other thermoelectric materials.

Pay TV With a Difference

A pay-TV system that does not mean a takeover of TV servicing was announced for Denver, Colorado by the Gotham Broadcasting Corp. and the Macfadden-Bartell Corp. when they revealed the filing of an



application with the FCC for authorization to conduct a 3-year test of the system. The different thing about the Teleglobe pay TV system is that the picture is transmitted unscrambled. Sound is piped into a separate amplifier-speaker unit via telephone lines. Therefore, no connections are made to the TV receiver and it can be serviced just as any receiver. Connections to the pay-TV audio channel have nothing to do with the TV set, as a separate amplifier speaker assembly supplied by Teleglobe (see photo) is used. When the user turns on the audio system its use is recorded electronically at the Teleglobe-Denver data processing center. The customer is then billed monthly according to what he watched.

Electronic Engineers Meet

Again breaking records of all previous conventions, the Institute of Radio Engineers was host to some 73,479 of the world's leading experts in electronics, space technology and communications at its fiftieth anniversary convention in New York City, March 26-29. A 4-day technical program saw the presentation of 265 papers in 54 technical sessions which covered everything from space electronics to artificial intelligence.

The most startling new development exhibited was the disintegration of a small portion of a stainless steel sheet with a light beam from a laser. After burning a hole through 1/32-inch steel in .0005 second, the beam continued on its way to blow up a balloon lying on a table some 10 feet distant.

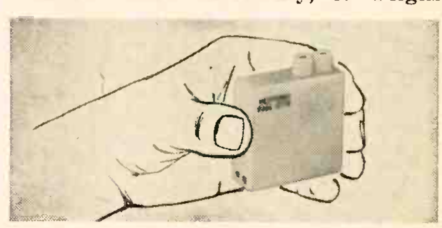
The IRE's annual electronic exhibition consisted of more than 850 separate exhibits, completely filling four floors of the New York Coliseum.

One of the important pieces of business of the convention was to continue arrangements for merging the IRE with the American Institute of Electrical Engineers. If the merger is approved by the members of both societies, this may be the last convention of the IRE. The next one would be of the Institute of Electrical and Electronic Engineers. It was remarked by one visitor that the time is ripe for such an eventuality, since among the more than 800 exhibits, there were apparently only two or three that included radio—the rest were purely electronic.

Brief Briefs

Standard frequencies transmitted by the National Bureau of Standards and the US Naval Observatory were made higher by two parts in one billion, beginning Jan. 1, 1962. The change is too small to be detected by ordinary equipment, but is significant to those using specialized apparatus.

Claimed to be the smallest cardiac pacemaker, this little instrument is 2 inches square and ⅜ inch thick. Worn externally, it weighs



only 4 ounces, including a 6-month battery. Bipolar electrodes connect it directly to the heart's myocardium, to regulate the heartbeat.

A battery that operates on sugar with a combination of catalysts, to produce current at 0.7 volt, is announced by Electro-Optical Systems of California and Sonotone Corp. of New York. Such batteries, it was stated, might theoretically be usable to produce electricity on space craft, using human waste as fuel.

Weathers Industries, Barrington, N. J., of the famous Weathers pickup, has been acquired by TelePrompTer Corp. Paul Weathers becomes director of engineering for the new TelePrompTer Div. END

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

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

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

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IN CANADA: Tri-Tel Associates, Ltd., 81 Sheppard Avenue West, Willowdale, Ontario

Correspondence

RADIATION NOTES

Dear Editor:

It must be a great comfort to know that when the needle on Mr. McCready's radiation meter (February 1962, page 39) falls rapidly, we will be dead very shortly. Mr. McCready should also say that 50 roentgens of whole body irradiation received in 6 minutes is much worse than 50 roentgens in 2 hours or a day, etc. The AEC considers less than 0.3 roentgens per *week* a "safe" working level.

Besides all that, I am dubious about a ceramic socket maintaining better than 10^{15} ohms for more than a very short time, and suggest the home builder use a mica-filled socket, cutting out a notch for pin 4 and soldering a connection directly to this pin, or sliding a bushing. TOM JASKI

San Mateo, Calif.

TRAPPING THE RADAR DETECTOR

Dear Editor:

An item "Police Move to Outlaw Highway Radar Warning Units" appeared in March 1962 on page 6.

Muni Quip Corp. currently manufactures more radar speed meters than anyone else. Users of Muni Quip Radar have available a special circuit which shuts off the radar waves until a car which is obviously speeding is spotted. By merely flipping a switch, this circuit is energized to instantly read the speed of the approaching vehicle containing the radar detector.

This is a very effective countermeasure, and renders a radar detector useless when facing traffic police who have equipped their radar speed meter with this Muni Quip feature.

President BRYCE K. BROWN
Muni Quip Corp.
Decatur, Ill.

VIDICON FOR TV CAMERA

Dear Editor:

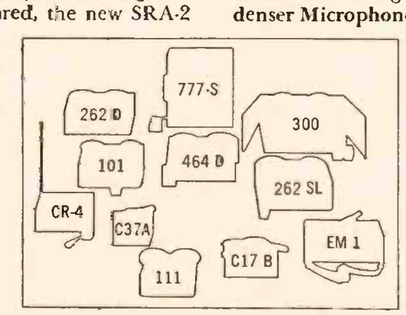
I have read, "Construct Your Own Low Cost TV Camera" in the May 1962 issue with great interest. Here's a tip that might be helpful to those building this TV camera.

The type 6198 vidicon tube specified has not been made for some time and is not readily obtained. To assure optimum results from what appears to be a well designed vidicon camera using minimum circuitry, it is suggested that a first-line vidicon tube (type 7038 or 7735A) be used.

These types are available from Allied Radio and other distributors and

(*Continued on page* 26)

▪ SONY Stereo Tape Deck 262-D—4 & 2 track stereo recording and playback tape transport to add tape to your existing hi fi system. $89.50. (Also available, not pictured, the new SRA-2 stereo recording amplifier for the 262 D. $89.50.) ▪ SONY Sterecorder 777-S—All transistorized professional 2 & 4 track stereo recorder featuring the revolutionary Sony Electro Bi Lateral Heads. The world's finest tape recorder. $725. ▪ SONY Sterecorder 300—A complete professional-quality hi fi stereo tape system with 4 & 2 track recording and playback in one portable unit. $399.50. ▪ SONY Portable 101—2 speed, dual-track, hi-fidelity recorder with 7" reel capacity. $99.50. ▪ SONY Sterecorder 464-D—Dual performance 4 track stereo tape deck with built-in recording & playback pre-amps for custom installations and portable use. $199.50. ▪ SONY Wireless Microphone CR-4—Pocket size mike and transmitter providing complete freedom from entangling microphone cables. $250. ▪ SONY Condenser Microphone C-37 A—For purity of sound reproduction, the unqualified choice of professional studios throughout the world. $295. ▪ SONY Sound on Sound Recorder 262 SL—The perfect recorder for language, music and drama students. With 4 track stereo playback. $199.50. ▪ SONY Tapecorder 111—A popularly priced, high quality bantam recorder for everyday family fun. $79.50. ▪ SONY Condenser Microphone C-17 B—Miniature size (3¼ "x ⅝" diameter) and exceptional background isolation unidirectional cardioid pattern. $350. ▪ SONY Newscaster Portable EM-1—A professional on-the-spot battery powered portable recorder with precision spring wind constant speed motor. $495. ***All Sony Sterecorders are Multiplex ready!***



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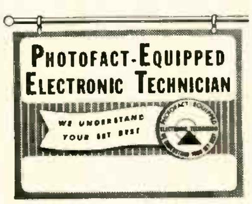

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(*Continued from page* 22)

carry the manufacturer's standard warranty and guaranty. JULIAN MCBARRON
Closed-circuit TV field engineer
Allied Radio Inc., Chicago

[While many readers may prefer a new tube, the article suggested surplus 6198's as part of a low-cost system, since they can be obtained at about half the cost of the new 7038's or 7735A's.]

DON'T FORGET MALLORY!

Dear Editor:

On page 55 of the May issue is a feature on "Replacing Japanese Transistor Radio Batteries." You listed a number of Eveready, Burgess, Ray-O-Vac and RCA equivalents of various Japanese types. But you neglected to cover any batteries made by our client, P. R. Mallory & Co. Inc.

For your information, Mallory supplies mercury, manganese and zinc-carbon batteries which will do a superior job in transistor radios. The mercury types in particular are notable for their long service, up to five times as long as zinc-carbon, and are particularly outstanding in the smaller sizes.

Here are the equivalent Mallory types for the list you published:

Size and Japanese Model	Mallory types Mercury	Manganese	Zinc-Carbon
1.5-v D cell, UM-1	RM-42	Mn-1300	M-13R
1.5-v C cell, UM-2		Mn-1400	M-14F, M-14P, M-14R
1.5-v AA cell, UM-3	ZM-9	Mn-1500	M-15R
1.5-v AAA cell, UM-4		Mn-2400	
1.5-v N cell, UM-5	RM-401	Mn-9100	M-910F
9-v 006P	TR-146	Mn-1604	M-1604
9-v W06P	TR-177		
9-v 006			M-1600

HAL M. PARSHAL
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Philadelphia, Pa.

ABOUT THAT MIXER

Dear Editor:

As always, we at Switchcraft enjoy reading each issue of your fine magazine. The February issue was no exception. One article was very interesting to our sales and engineering departments—"Spice-Can Audio Mixer."

The unusual interest was created because we have been manufacturing a miniature audio mixer, the Mini-Mix, for quite a few years.

If any readers are interested in details of this unit they can send for our *Catalog A-401.* C. J. SHULTZ
Sales Promotion Manager
Switchcraft Inc.
5555 N. Elston Ave., Chicago 30, Ill.

IMPROVED SOUND INTERRUPTER

Dear Editor:

The August 1961 issue contained an article by Elliott A. McCready titled "TV Sound Interrupter Has Only Four Parts." This circuit would work well, except for one minor detail. When the normally closed relay is opened by photocell action, the contacts place absolutely no load of any kind across the secondary of the audio output transformer. If this condition remains very

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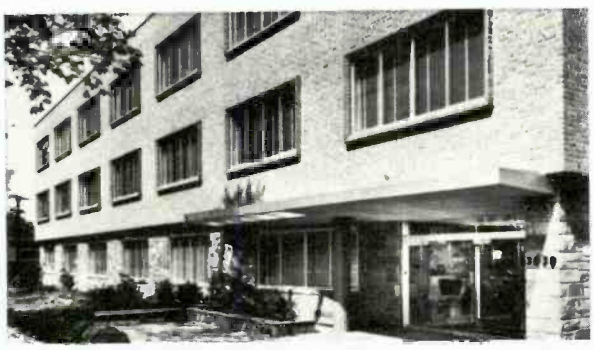

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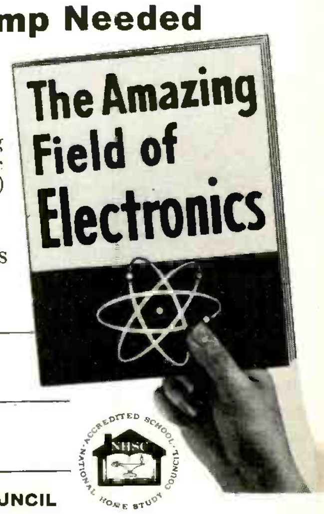

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long, the transformer may burn up.

I have studied the circuit closely and found a way out of this trouble. Fig. 1 is a diagram of your circuit. My addition calls for a relay with two sets of contacts—one set normally closed, and the other normally open. When the relay is triggered by the action of the photocell, the normally open contacts close and shunt a low-value resistor across the output transformer to pre-

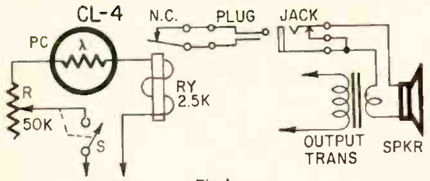

Fig.1

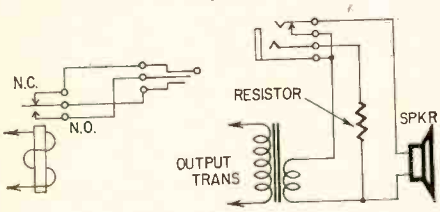

Fig.2

vent any damage to the output tube or other components associated in the circuit. The normally closed contacts act as before. ROBERT BAKER
Detroit, Mich.

[The length of a commercial should not be long enough to damage the equipment. However, some circuits are more susceptible to this trouble than others.

The relay specified (Sigma 5F-2500-S/SIL) has double-throw contacts so you don't need a new relay with double-pole contacts (Fig. 2). Use a 3-conductor plug and 3-conductor, closed-circuit jack between the relay and receiver. The arm of the relay goes to the top end of the transformer secondary and the normally closed contact goes to the top end of the voice coil. The normally open contact connects to the other end of the secondary and voice coil through the resistor.—*Editor*]

HALF-POCKET RADIO TOO BIG

Dear Editor:

I recently built the Tax radio described in the March 1962 issue. Performance was excellent, but I have been able to cut its size in half and retain almost the same performance.

The following changes were made:

For a pot I used a Lafayette VC61. It is mounted outside the case.

I replaced the variable capacitor with a transistor socket. Then I determined the value of a capacitor which would pick up my favorite station, and plugged it in.

Several capacitors for desired stations can be made up and marked with the letters of the station. JOSEPH DINI
Boston, Mass.

[Congratulations! There is certainly nothing wrong with this approach. It is probably especially useful in areas where there are only one or two stations. Guess you now have a quarter-pocket radio.—*Editor*] END

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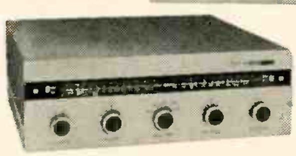

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EARTH SIGNALS ON THE MOON

. . . Coming Communications Problems Between Earth and Moon . . .

WITHIN the next few years—certainly before 1970—men will have landed on the moon, opening up a vast new world.

However, before humans actually visit the moon, they will have been preceded by electronically equipped robots, specifically designed to pre-explore the moon's inhospitable environment. Many moon-landing vehicles and machines already have been designed, and prototypes built. These robot explorers will make "soft" landings on the lunar surface, after having been propelled by rocket over the 238,000 miles separating the moon from earth. Guided entirely by electronics and telemetric control, not every one of the early lunar flights can be expected to turn out smoothly. There probably will be mislandings—not all moonshots will be successful, any more than all our first earth satellites succeeded. But we may be certain that before 1970 we will have succeeded in setting down a number of lunar robots that will make later manned landings reasonably safe.

One of the difficult problems in *precise* moon landings—possibly solved theoretically by now—is the time lag of telemetering the robots from earth. It takes 1.2 seconds for light or radio waves to span the 238,000 miles between earth and moon in one direction. Even if you could follow a rocket's flight to the moon via telescope, it would be impossible actually to see the last *important* 50 or so feet of the descent. Because light from the moon takes 1.2 seconds to reach the earth observer, he of course could not see the approach to landing till 1.2 seconds *later*. It would therefore be a most difficult operation to land a rocket robot telemetrically from earth.

There are, however, better and more precise means to soft-land lunar robots. Let us mention only one. The principles we used during World War II in the electronically operated proximity fuze—or similar ones—can conceivably operate the robot's retro-rockets, independent of earth telemetry. These means will be certain and automatic for all landing purposes. Once the robot equipment has arrived safely and intact on the moon, earth scientists can take over certain operations via telemetry. Because, in all likelihood, the robot must be able to move over small distances for orientation and exploring purposes, it will be equipped with a TV camera so that earth observers can see the machine's immediate environment. Other vital information sent via radio for the benefit of physicists, geologists and astronomers would be transmitted automatically by the robot's exploratory instruments.

While we have made innumerable radio contacts with the moon since 1946,* bouncing signals off its surface successfully, there will be some future problems which cannot be solved with certainty until we actually get to the moon.

Because lunar robot receivers must of necessity be exceedingly sensitive, interference from earth transmitters to the special moon-beamed signals intended to operate the moon robots will become critical.

Consider that the moon always turns its same side to the earth. It is known today that *all* frequencies (even broadcast waves) penetrate our atmosphere to a certain degree. But frequencies, from the vhf range down to centimeter waves, probably reach the moon in various intensities from earth transmitters "visible" to the moon. As the earth turns, many earth transmitters will contact the moon once in 24 hours.

Note also the inevitable Doppler effect of the rapidly spinning earth—1,000 miles an hour at the Equator—when it transmits vital signals to a moon robot. This complicates reception.

Earth signals will come in strongest on the moon robot's instruments when the earth station is exactly opposite to it. They will become progressively weaker as the earth transmitter nears a 90° angle *vis-à-vis* the receiver on the moon. This is because the radio waves now must pierce the vast horizontal mass of the earth's atmosphere, against the former 150 miles or so when the moon is overhead. To circumvent this, we require a number of transmitters located at different points on the earth, all connected in a radio network, if we intend to maintain 24-hour uninterrupted communication with moon robots.

Another completely unsolved problem is future radio communication on the moon. Because of its small diameter, the moon's horizon is much nearer than that on earth. The moon having no Heaviside layer, radio communication can reach only as far as the horizon, some 2 miles, if the transmitter and receiver are 10 feet above the ground.† We know nothing of the ground composition of the moon—whether it is conductive or not. Hence we cannot know until we get to it if we can communicate through ground-wave conduction as we do on earth. If we can, the problem of radioing to any distance and to the far side of the moon will become simple and inexpensive. If not, we must set up a cumbersome and expensive radio relay system.

—*H.G*

*The author first predicted echo radio signals from the moon in his former magazine, *Radio News*, in the article "Can We Radio the Planets?" in the February, 1927 issue. In January, 1946, the US Signal Corps first established two-way radio contact with the moon in 2.4 seconds, as predicted by the author 19 years before. (His forecast time had been 2.5 seconds, an error of 1/10 second.)

†See also "Radio On the Moon," *Radio-Electronics* July, 1959, and "Lunar Radio and TV Traffic," December, 1961.

Check Auto Ignition with an Ohm-Dwell Tachometer

Three-way instrument is a must when you tune up your car. Easy to build and use.

By ALEX M. SCHOTZ*

When servicing a modern automotive engine, we must be able to measure point dwell time, point resistance and engine rpm. This article describes a home-built single instrument that will do these three things.

Most dwell meters indicate how long the breaker points are closed before they open when the engine is running. They measure the percentage closed-contact time in relation to the total open and closed period. This indication is converted to degrees on the meter scale.

Converting these percentages to degrees depends on the number of lobes on the cam operating the points. The number of lobes divided by 360° gives you the number of cylinders. It is simple to convert the percentage dwell time to degrees—a four-cylinder engine has four lobes: 360° divided by 4 equals 90°, and four divided by 360° equals 1.1% per degree. For six cylinders, we get 60° or 1.66% per degree. For eight cylinders, we get 45° or 2.2% per degree.

Generally, dwell meters are set up so that, when the breaker points are closed, current passes through a meter (previously adjusted to indicate full scale), and, when the points are open, the meter reads zero. When the engine is running, the action is very rapid, and the meter needle does not have time to read either full scale or zero. Instead, it assumes a position equivalent to the average period that the contacts are closed.

Fig. 1 is a simplified diagram of the dwell meter used in the ohm-dwell-tachometer described in this article. The input leads are attached across the breaker points. They must match the ignition polarity. With the engine at rest and the breaker points fully closed, V is forward-biased through R2. This in turn causes V to conduct fully, and V then acts as a closed switch. Now R4 is adjusted so the meter reads full scale.

Then the auto engine is started and revved up to the proper rpm. Every time the breaker points open, V is cut off because it is reverse-biased by BATT 1 through R1. This stops the flow of current through the meter. The meter indicates the average closed time of the breaker points, as previously described.

C1 and R2 form a low-pass filter which bypasses the high-frequency pulses that occur when the breaker points open. R3 is a current-limiting resistor. It protects the meter against too much current flow caused by misadjusting R4. Capacitor C2, in parallel with the meter, provides electrical damping to prevent it from oscillating. The greater the capacitance, the slower the reaction time of the meter. If the input leads are reversed, the meter will give the wrong indication, because, when the points are open, the car battery's potential will forward-bias V.

When adjusting, installing or checking ignition points, a low-resistance ohmmeter is very handy.

The instrument should be able to indicate down to 0.1 ohm. To do so simply, a shunt type ohmmeter circuit is necessary (Fig. 2). The meter should have either a low internal resistance or a low-resistance shunt in parallel with a high-resistance meter. As a general rule, low-internal-resistance meters are the higher-current type.

*Outboard Marine Research Center, Milwaukee, Wis.

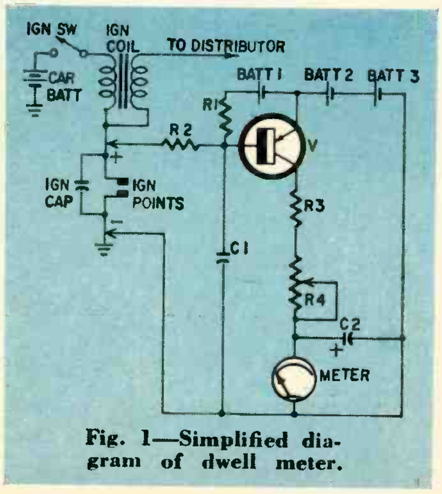


Fig. 1—Simplified diagram of dwell meter.

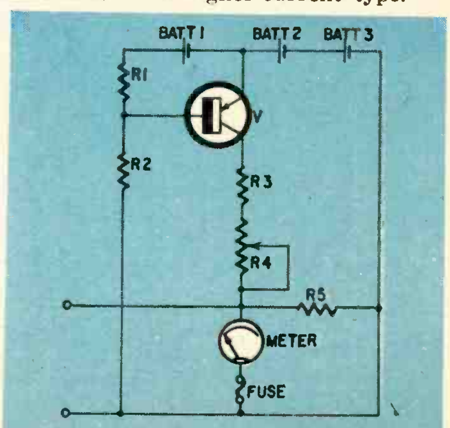


Fig. 2—Shunt-type ohmmeter circuit.

Two practical limits govern meter selection for this application—the current drain on the activator and the fact that the meter has to serve as a tachometer. We used a sensitive meter and the appropriate shunt (R5).

In this circuit (Fig. 2), V is forward-biased through R2, forcing it to conduct fully. R4 is adjusted so the meter needle is at full scale. When the two input leads are shorted, zero current goes through the meter and the needle returns to its relaxed position, indicating zero resistance.

Meter calibration

To calibrate the meter scale you'll need a low-resistance decade box with accurate resistors or have to know the meter's effective internal resistance.

With a resistance decade box, the scale can be marked off by connecting the meter's input leads across the decade-box terminals. The desired points are set on the box and then marked on the meter face at the point where the needle comes to rest.

If a decade box is not available, accurate resistance values can be calculated with the formula:

$$Rx = \frac{Rm}{\left(\frac{Mi}{mi}\right) - 1}$$

where Rx is the resistance to be measured in ohms and Rm is the internal resistance of meter. (When a shunt is used, this must be taken into account and thus the effective internal resistance value is the combination of both shunt and meter resistance in accordance with Ohm's law.) Also Mi is the full-scale range of meter in ma. (This is the effective value and once again if a shunt is used, this must be taken into account.) And mi is the meter reading in ma when Rx is connected to the input terminals.

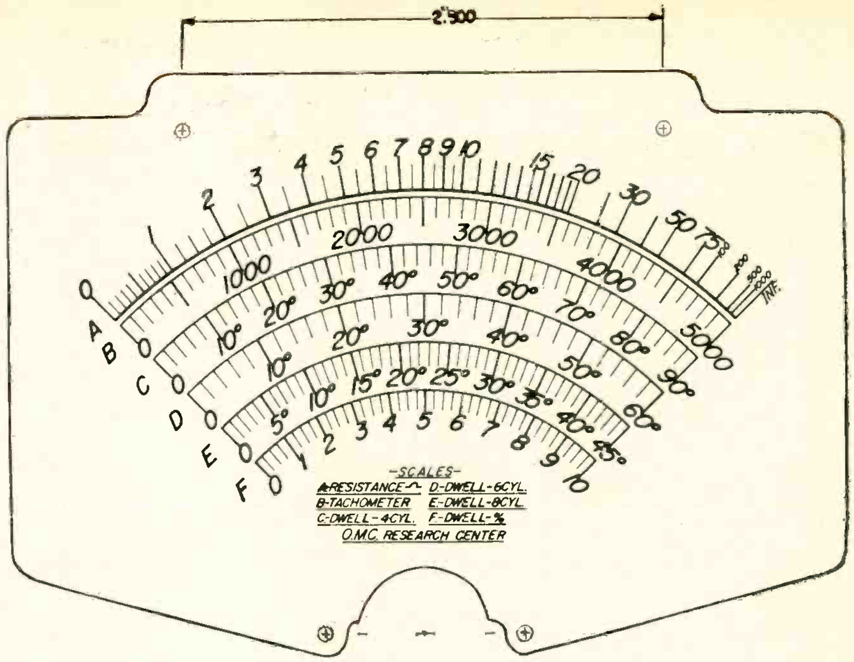
The formula can be rearranged so that meter readings are predicted with different values of resistance:

$$mi = \frac{RxMi}{Rm + Rx}$$

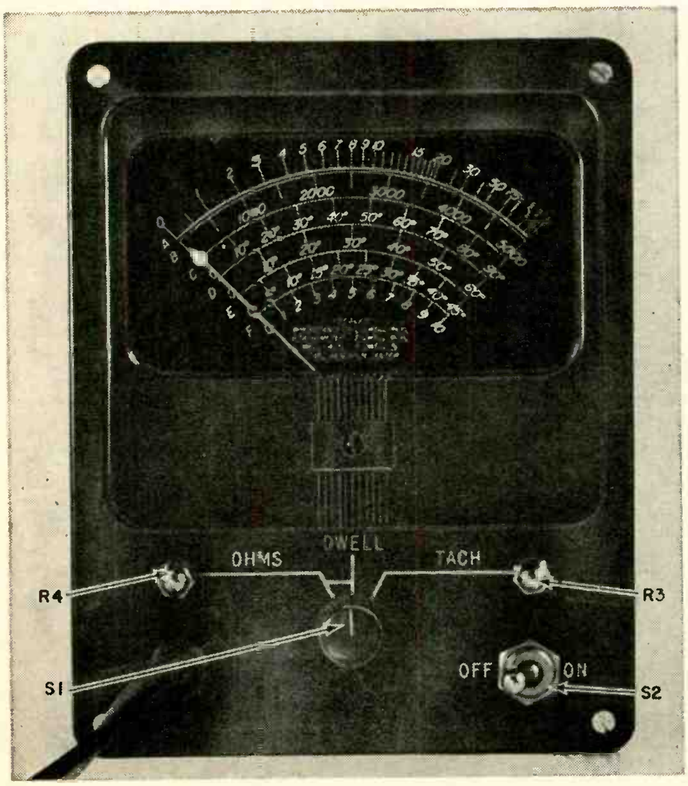
The meter I selected has a 0–1-ma movement and its internal resistance is 40 ohms. To measure resistances smaller than 0.1 ohm, a shunt (Rs) was selected to increase the current to 5 ma. The shunt's value was calculated by the formula:

$$Rs = \frac{Rm}{N - 1}$$

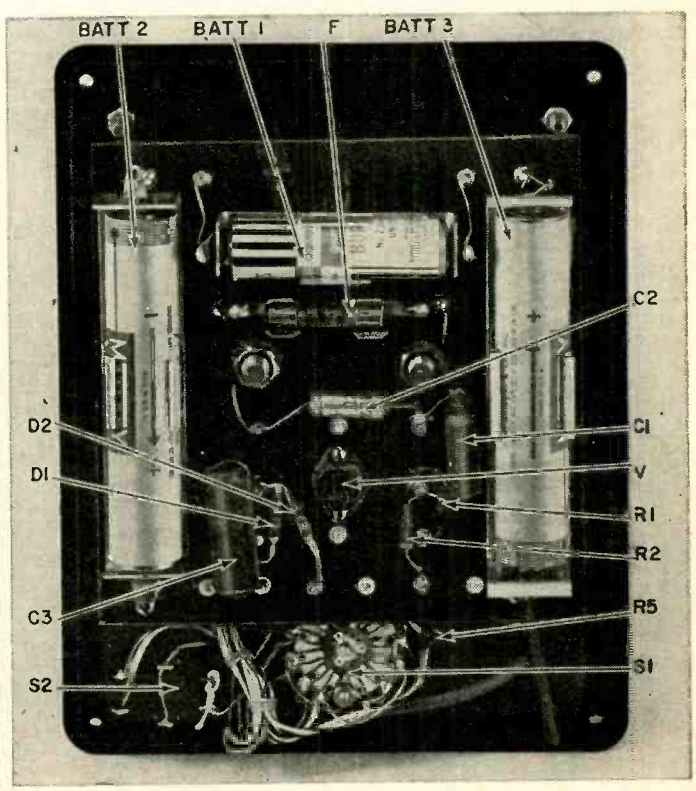
where Rs is the shunt value in ohms;



Actual size meter dial if you use the model 29 meter. It will be accurate to within 2 or 3%.



Front-panel view of the completed unit.



Inside the case. Note how most components are mounted on a phenolic board mounted on meter terminals.

N is the selected full-scale reading divided by the original full-scale reading, and Rm is the meter resistance in ohms.

Inserting the known values, the shunt's resistance is:

$$Rs = \frac{40}{\left(\frac{5}{1}\right) - 1} = 10\Omega$$

With the 10-ohm shunt, the current rating was increased to 5 ma and the effective internal resistance became 8 ohms. With these values set, 10 resistance points to be indicated on the meter dial were chosen. By inserting each of these resistances in the stated formula it was possible to mark these points on the meter face. The resistance points chosen and their matching currents on the 0–5-ma scale are shown in the chart below, with the percent of indication of full scale:

0.1 ohm =	.0618 ma	1.23 %
0.5 ohm =	.294 ma	5.88
1.0 ohm =	.552 ma	11.04
1.5 ohm =	.788 ma	15.76
2.0 ohm =	1.00 ma	20.00
5.0 ohm =	1.92 ma	38.4
10.0 ohm =	2.78 ma	55.6
20.0 ohm =	3.58 ma	71.6
50.0 ohm =	4.33 ma	86.67
100.0 ohm =	4.60 ma	92.0

By interpolation more points were indicated.

The tachometer

Many ignition technicians either have a tachometer or advocate the use of a dwell meter simultaneously with a tachometer. Those who would like to construct their own ohm-dwell meter will find a simple and foolproof circuit in Fig. 3. The schematic shows where external terminals can be brought out to replace the 13-volt internal battery supply. They can be connected to the 12-volt automotive battery.

The tachometer range designed to be used with the ohm-dwell meter indicates 0–5,000 rpm and can be applied to 4-, 6- or 8-cylinder 4-cycle battery ignitions, or 2- or 4-cylinder 2-cycle ignitions. It counts the number of ignition point closings.

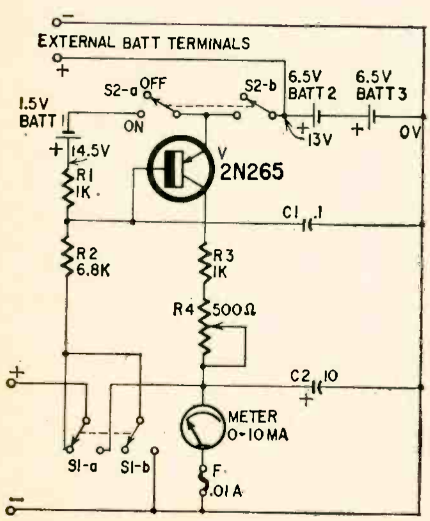
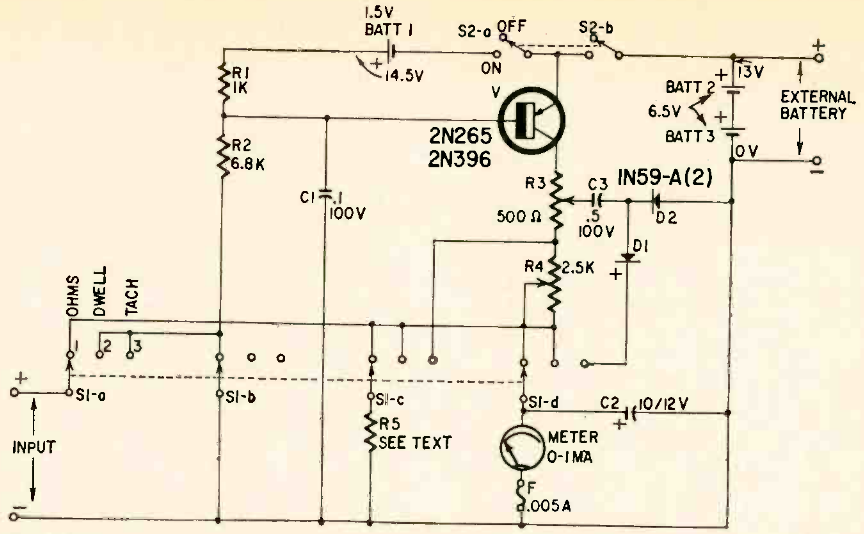


Fig. 3—Ohm-dwell meter circuit for the man who already has a tachometer.



R1—1,000 ohms
R2—6,800 ohms
R3—pot, 500 ohms
R4—pot, 2,500 ohms
R5—see text
All resistors ½ watt 10%
C1—0.1 μf, 100 volts, subminiature paper (Sprague KB104K or equivalent)
C2—10 μf, 12 volts, subminiature electrolytic (Sprague 1128 or equivalent)
C3—0.5 μf, 100 volts
BATT 1—1.5 volts, penlight cell (Burgess Z or equivalent)
BATT 2, BATT 3—6.5 volts, mercury batteries (Mallory TR-135 or equivalent)
D1, D2—1N59-A
F—.005 amp, 8AG
M—0-1 ma (Simpson model 29 or equivalent)
S1—4-pole 3-position nonshorting rotary switch (Centralab 2011 or equivalent)
S2—dpst toggle
V—2N265 or 2N396
Plastic case, 6 13/16 x 5 5/32 x 2 5/16 inches
Plastic panel, 6½ x 5 inches
Battery holder for BATT 1
Fuse holder for F
Transistor socket
Miscellaneous hardware

Fig. 4—Complete circuit of the ohm-dwell tachometer.

Breaker points are interrupted at every other revolution per cylinder on a 4-cycle engine, and at every revolution per cylinder on a 2-cycle engine. This means that on a 4-cylinder 4-cycle engine there are two interruptions per revolution, and on a 4-cylinder 2-cycle engine there are four interruptions per revolution.

Fig. 4 is the complete circuit of the combination ohm-dwell tachometer. When S1 is turned to TACH and the input attached across the breaker points with the proper polarity, V1 conducts every time the points are closed and is cut off when they are open. This puts the potential of BATT2 and BATT3 across calibrating potentiometer R3 with each ignition point closing. In essence, a pulse whose magnitude is equal to the voltage of BATT2 plus BATT3 is produced with each make and break of the ignition points. These pulses charge C3 through the meter and D1. When V is cut off, the charge on C3 leaks off through D2, thus pulsing the meter every time V1 conducts. The amount of current the meter will indicate is a function of the charging voltage multiplied by the frequency of the pulses per second. This in turn is multiplied by the size of the capacitance. If the capacitance is in microfarads, the current will be in microamps:

$$I = EFC$$

when I = current, E = voltage, F = frequency, C = capacitance.

There are limitations to the size of capacitance for this type diode pump circuit. The charging current supply should be at least 10 times the maximum the meter will have to indicate. For this reason, R4 is switched out of the tachometer circuit. To calibrate the tachometer, apply the secondary of a 12-volt filament transformer to the input and adjust R3 so the meter indicates the proper rpm for the number of point interruptions per rpm as indicated in the chart:

Points closed per rpm	Adjust meter to read	4-cycle engine
2	1,800	4 Cylinders
3	1,200	6 Cylinders
4	900	8 Cylinders

Layout and wiring are not critical and are left to the discretion of the builder. With a few additions and modifications, this instrument could measure voltage and the ohmmeter range could be extended. Switching out the meter shunt in the ohmmeter circuit extends the range approximately five times. However, the scales will not coincide. Charts can be prepared for cross reference with the information supplied here if redrawing all or some of the scales on the meter face is not desired.

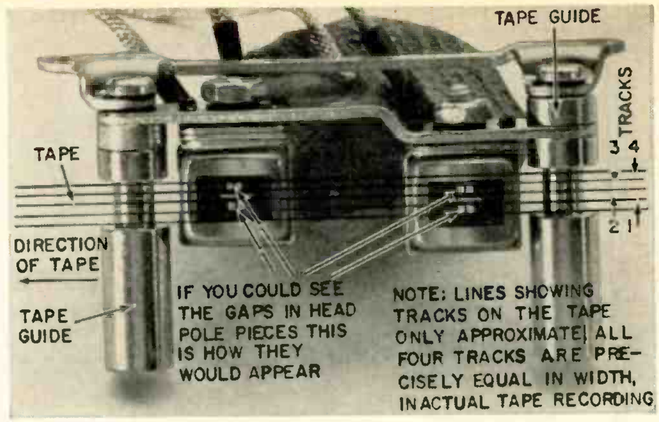
The accuracy of any instrument depends on the components used and the accuracy of the calibration method. For example, if meter accuracy is 3% of full scale, the linear response obviously can deviate as much. When it is possible to calibrate the meter at different settings of the indicating needle with an accurate transducing source, do so.

Switching from the tachometer to the dwell circuit, or vice versa, is arranged so it can be done while the engine is operating, without damaging the meter or any of the components.

Since the input impedance of the dwell tachometer is greater than 7,000 ohms, there is practically no loading effect on the ignition. When the dwell-tachometer is operated on its own power supply, this instrument will operate on all ignition voltages up through 24. END

What About the Bias Oscillator?

The part it plays in tape recording



By EARL E. SNADER*

A little time spent examining the tape recorder bias oscillator, to get a clear picture of why it is needed and how it can be serviced, should be worth while to the technician. This article describes what the bias oscillator does in the recording process, gives reasons for differences in impedances and other characteristics, and briefly, effects on output caused by too much or too little bias.

A second article will describe a number of bias circuits as used in commercial machines, and a third will be devoted to servicing bias oscillators.

A tape recorder is expected to make a recording on a tape that can be sensed by a reproducing system and changed back into sound as nearly like the original as possible.

In a magnetic tape recorder this is done by using a tape coated with fine iron particles. The recording head is an electromagnet which has been connected to the output of an audio amplifier. As the tape moves past this electromagnet, at a carefully controlled speed, each iron particle on the tape retains the magnetism that is induced when the flux from the head passes through it.

The coils of the record head are wound on a metal core specially designed to follow the varying magnetic field produced by the audio current from the recording amplifier flowing through the coils, and to concentrate this field at the particular point where the record head is in contact with the tape.

Tape recorder head gaps

There is a gap in the core of the record head where the tape touches the head. The magnetic flux in the core of the record head passes through the magnetic coating on the tape across this gap.

The width of the gap has an important bearing on tape head operation. A recording head must have a gap just wide enough to permit enough flux to penetrate the coating on the tape to leave the iron particles in a magnetized condition. Gap widths from 150 to 300 micro-inches are common.

The structure of a tape playback head is very similar to that of a recording head, except that the coils may have more turns (for greater output), and the gap may be smaller. A tape playback head often has a narrower gap so it can reproduce higher frequencies. The gap on a tape head gets wider as the head wears. One of the most common symptoms of a worn head is a noticeable drop in high-frequency response.

Gaps as small as 90 micro-inches are used in playback heads for slow tape speeds. Gap widths of around 150 micro-inches are common on machines that have been designed primarily for playback at a tape speed of 7½ inches per second. If the tape is run at higher speeds, 15 or 30 ips, the gap width of the playback head can be made larger without sacrificing high-frequency response.

Fig. 1 shows how the magnetic flux is concentrated around the gap so it can penetrate the coating of iron particles on the tape.

Up to this point, it would appear that magnetic tape recording is a very simple process, requiring nothing more than a suitable mechanism for moving tape past a recording head that has been connected to the output of an audio amplifier.

Actually it doesn't work out this way, because magnetic tape is a nonlinear recording medium. The differences in the magnetic pattern that is transferred to the tape do not correspond exactly with the differences in the magnetic flux that caused them. The amount of permanent magnetization that remains in the iron particles as a result of the flux from the recording head can be plotted on the hysteresis curve for a given type of particles and coating.

If nothing more than an audio signal is used to energize the electromagnetic recording head, the resulting magnetic pattern on the tape will never be exactly the same as the magnetic fluctuations that produced it. Such a recording will be distorted when it is played back.

A low distortion level is not important in some applications. But it is important in audio recording, and something must be done to make the magnetic pattern on the tape suitable for playback so the listener will hear an accurate reproduction of the original.

Bias plays its part

This is where bias comes in. If a direct or alternating current of the right magnitude is passed through the record head coils along with the audio signal from the recording amplifier, a magnetic pattern that will not reproduce as a badly distorted signal can be placed on the tape.

A common method of biasing the record head is to superimpose an alternating current on the audio current that is fed to it. The alternating current is at some ultrasonic frequency, and its amplitude may be as much as 10 times

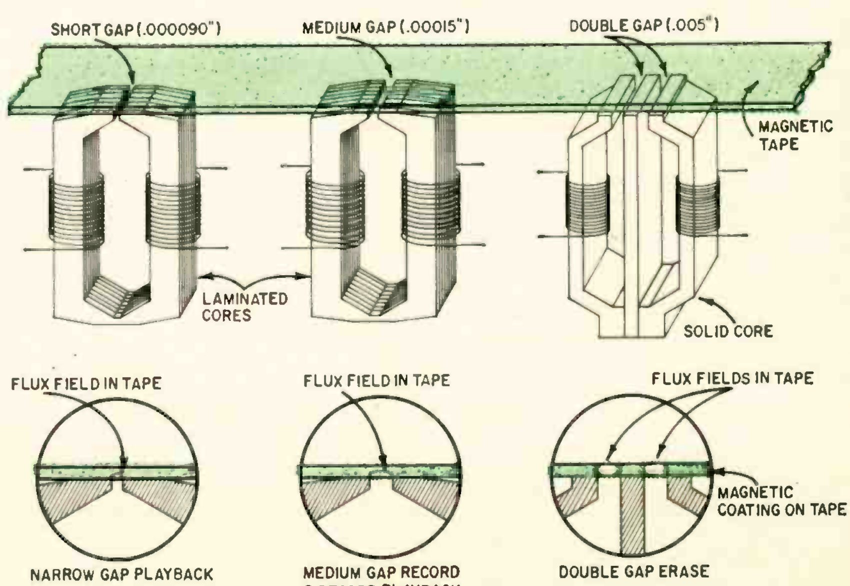


Fig. 1—Cross-section views show effect of gap length on flux field.

*Customer service, Viking of Minneapolis.

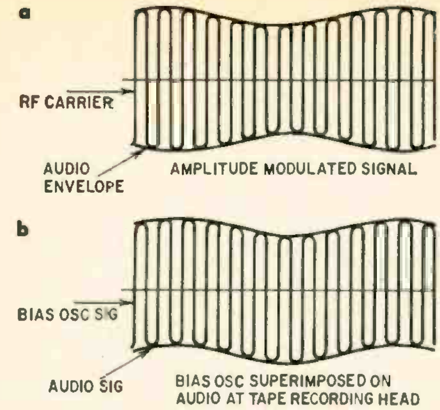


Fig. 2—The difference between an AM signal (a) and the composite signal at a magnetic tape recording head (b).

the average amplitude of the audio signal. This alternating current is generated by a fairly stable oscillator, set to operate at about 30 kc in some tape recorders or as high as 100 kc in others.

When ac at an ultrasonic frequency biases a record head, it causes each iron particle on the tape to go through a number of complete hysteresis loops as it passes the gap. The particular magnetized condition that has been induced in each particle will then remain according to the magnitude and frequency of the audio signal (on which the bias signal has been superimposed) at the moment the particle leaves the gap. This leaves a magnetic pattern on the tape that can be played back to reproduce a fairly accurate copy of the original audio signal.

It is important to note that the alternating bias current is superimposed on the audio signal from the recording amplifier. The amplitude of this current remains constant. It is not modulated by the audio signal from the recording amplifier. If the combined audio and bias signal is viewed on a scope, the bias signal will appear to be riding on the waveform of the audio signal. The difference between an amplitude-modulated signal and the composite signal at a magnetic tape recording head is shown in Fig. 2.

Factors affecting recording

A number of variable factors affect recording. The ratio, already mentioned, between the amplitude of the audio signal and the bias signal is important in determining the quality of a magnetic tape recording. The electrical and mechanical characteristics of the record head, the characteristics of the magnetic coating on the tape, the bias oscillator frequency, the tape speed and the frequencies that are being recorded are all important in the complete recording process and must be carefully controlled.

In addition to generating the alternating current to bias the record head, the bias oscillator also supplies power to the erase head. The erase head removes any previous recording that may have been on the tape before a new recording is made. The structure of the erase head is similar to that of a record head, but with a wider gap for better penetration of the magnetic coating on the tape. Its windings are designed to handle more current than the windings on some record heads. It is common practice to have two gaps in an erase head, for more efficient erasing (see Fig. 1).

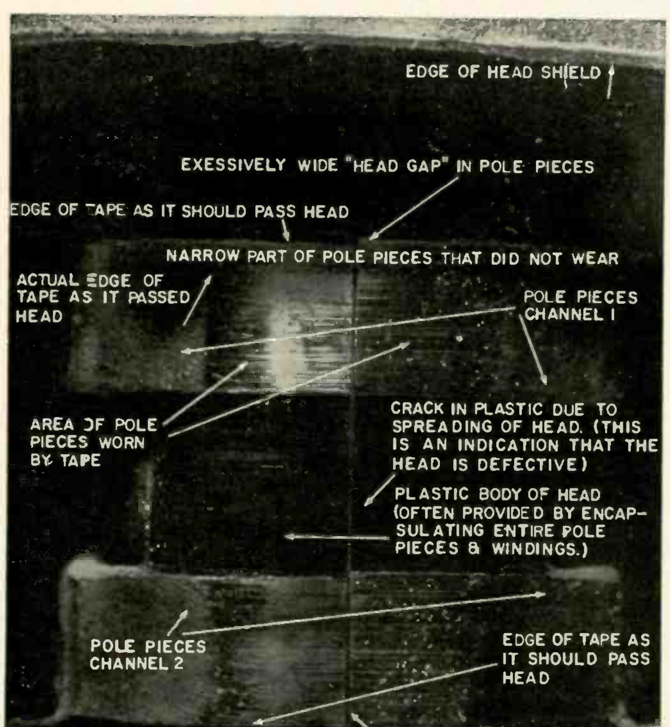
Much more power is required to drive the erase head than to bias the record head. This power must be provided either by the bias oscillator or by an amplifier that can handle the relatively high-frequency bias oscillator signal. Since power is transferred from the bias oscillator to the erase head, or from such an amplifier to the erase head, an impedance match is required. It is not as important to match impedances between the bias oscillator and the record head because only a relatively small amount of power is required here.

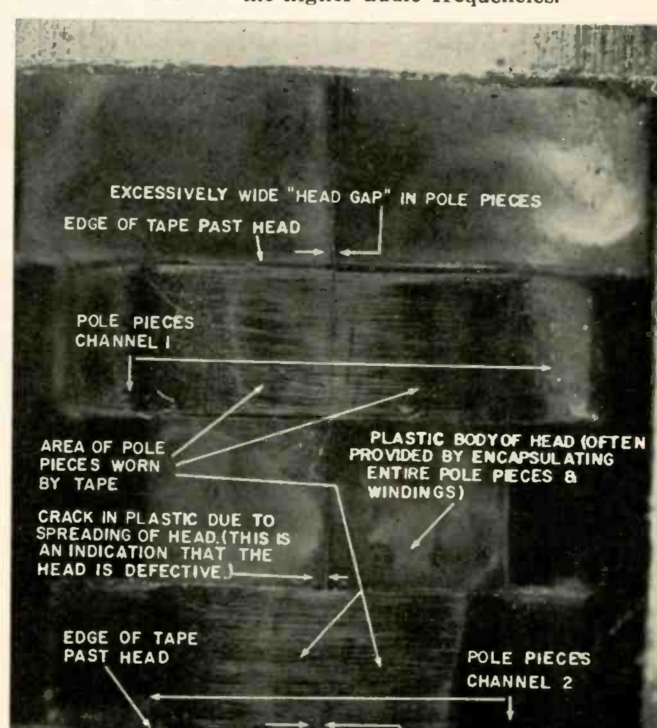
The ratio between the amplitude of the audio signal being recorded and the bias signal is fairly critical and varies with different recording heads. It is best to get specific information from the manufacturer of the tape recorder.

Clues to improper bias

There are some simple ways of judging whether a record head is getting the correct amount of bias current. Low bias causes excessive high-frequency response in the recording, a noticeable lack of low-frequency response, low output, a tendency to distort on peaks of the audio signal and a high level of background noise.

Excessive bias increases the playback output of the recorded tape, but there will be a noticeable lack of high-frequency response. This happens because an overbiased record head will partially erase at the same time it is recording. This partial erasure begins at the higher audio frequencies.





Two examples of defective and worn tape heads. The plastic body of the heads has started to spread. This causes the gap to widen and response to deteriorate. Note the abnormal wear on the head on the left. The tape was not properly centered and the upper part of the upper pole piece is not worn.

LOW-IMPEDANCE RECORD HEAD	
Inductance	.09 henry
DC resistance	140 ohms
Impedance at 1,000 cycles	565 ohms
Bias frequency	40–100 kc.
Recording bias current	0.9–1.5 ma
Recording audio current	.08 ma
MEDIUM-IMPEDANCE RECORD/PLAYBACK HEAD	
Inductance	0.3 henry
DC resistance	260 ohms
Impedance at 1,000 cycles	1,884 ohms
Bias frequency	40–100 kc.
Recording bias current	0.3–0.5 ma
Recording audio current	0.04 ma
Average output at 1,000 cycles	2 mv
Average output at 10,000 cycles	1 mv
HIGH-IMPEDANCE PLAYBACK HEAD	
Inductance	0.8 henry
DC resistance	400 ohms
Impedance at 1,000 cycles	5,024 ohms
Average output at 1,000 cycles	2 mv
Average output at 10,000 cycles	2 mv
If used for recording:	
Bias frequency	40–80 kc
Recording bias current	0.25–0.4 ma
Recording audio current	0.025 ma
Figures given above are for selected quarter-track heads. Record level 12 db below saturation, at a tape speed of 7½ ips.	
LOW-IMPEDANCE ERASE HEAD (FULL TRACK)	
Inductance	80 microhenries
DC resistance	0.3 ohm
Impedance at 60 kc	20 ohms
Erase current	300 ma
HIGH-IMPEDANCE ERASE HEAD (HALF TRACK)	
Inductance	85 millihenries
DC resistance	130 ohms
Impedance at 60 kc	20,000 ohms
Erase current	5–7 ma

Fig. 3—Typical specs of low-, medium- and high-impedance record, record–playback, playback and erase heads.

A lack of high-frequency response during playback does not always indicate that there is too much bias on the record head. A worn playback head or a record or playback head out of alignment with respect to the tape can also kill high-frequency response in playback. A clue to an overbiased condition is that the output will be high at the same time the high-frequency response is down. A worn or misaligned head causes poor high-frequency response *and* low output.

Head impedances

Record and playback heads can be classified as low-, medium- and high-impedance. Since impedance is related to frequency, a record head represents two impedances. One is the impedance of the head at audio frequencies, and is usually given for 1,000 cycles. The other is the impedance of the head at the bias frequency. Frequently this is not given and must be calculated on the basis of the inductance and dc resistance at the bias oscillator frequency. It is not too important to know the exact impedance of a head, but the technician should be able to judge whether a head is in the general classification of low, medium or high impedance. The electrical specifications of typical heads in these three classifications are in Fig. 3.

High-impedance rf transmission lines have resonant points, both in terms of line length and operating frequency. The same conditions exist in the circuit of a high-impedance erase or record head. When a parallel-tuned circuit, represented by the coil and circuit capacitances of an erase or record head, is tuned to resonance, the least amount of current flows. Resonances, then must be avoided or at least controlled in a recorder; because it will not record unless precisely the correct amount of bias current is flowing in the record head. By the same token, an erase head will not erase unless the correct amount of current is flowing in its windings. This point is most important in tape recording systems that are put together with individual components such as a separate tape deck and separate recording amplifiers.

Systems that use low-impedance heads are not as critical, because the connections to the heads are nonresonant lines. More power is required to drive low-impedance heads. It is often more difficult to control distortion levels when appreciable power is being handled. A recording amplifier for higher impedance heads can use simpler circuitry and be made to do a good job if it is designed to avoid problems of head resonances.

Resonances must be avoided or controlled in a good tape playback system just as in a good recording system. The cardinal rule, in a playback system, is to "keep the leads from the playback head as short as possible." Excessive lead length will cut down the high-frequency response from high-impedance playback heads, unless the system is deliberately designed with resonances that tend to improve the playback frequency response.

AUDIO FREQUENCY BEING RECORDED (CYCLES)	FOURTH HARMONIC (CYCLES)	BIAS OSCILLATOR FREQUENCY (CYCLES)	NEAREST BEAT NOTE (CYCLES)
7,000	28,000	30,000	2,000
7,100	28,400	"	1,600
7,200	28,800	"	1,200
7,300	29,200	"	800
7,400	29,600	"	400
7,500	30,000	"	0
7,600	30,400	"	400
7,700	30,800	"	800
7,800	31,200	"	1,200
7,900	31,600	"	1,600
8,000	32,000	"	2,000

Fig. 4—Beat notes between fourth harmonics and a 30-kc bias oscillator.

The highest-impedance heads frequently are used for playback, because they have the best output. A low-impedance playback head with a transformer to match it to the input of the playback preamp will have good high-frequency response and not be as susceptible to resonance effects. Such a system is a little more expensive because of the transformer. Also, the transformer must be carefully designed and mounted to avoid hum pickup problems.

Bias oscillator frequency

The normal operating frequency of the bias oscillator is important for determining the range of recording frequency response of a given recorder. The bias oscillator should operate at a frequency at least five times as high as the highest audio frequency to be recorded. This is because any harmonics lower than the fifth harmonic of the audio frequencies being recorded may be strong enough to heterodyne with the fundamental frequency of the bias oscillator and produce birdies in the recording.

Just as an example, let us assume that a tape recorder with a 30-kc bias oscillator is being used to record audio frequencies from 7,000 to 8,000 cycles. The fourth harmonic of 7,000 cycles is 28 kc. This harmonic can beat with the bias oscillator fundamental to produce an undesirable 2,000-cycle sound. It is possible that some trace of this 2,000-cycle beat note might become a permanent part of the recording put on the tape. Fig. 4 is a table that shows the beat notes that would appear for audio signals from 7,000 to 8,000 cycles under these circumstances.

Fifth and higher-order harmonics may be present in a recorder with the bias oscillator operating at a frequency five times the highest audio frequency being recorded, but they are usually too weak to cause serious trouble.

It might appear that all tape recorders should be designed with bias oscillators that operate at high frequencies, particularly if high fidelity is the objective. But this introduces complications of excessive radiation from the bias oscillator into other parts of the recording amplifier, losses caused by capacitance effects in parts of the circuit, and head resonances if high-impedance heads are used. Most recorders, therefore, use bias oscillator frequencies below 70-kc.

The bias oscillator in a tape recording amplifier often is more or less independent of any other sections of the amplifier except for a common power supply. It is connected to the record head at the output of the record amplifier in some kind of a shunt-feed arrangement. There are exceptions, but this is the most common system. The block diagram in Fig. 5 shows the bias oscillator in relation to the rest of the complete recording amplifier. END

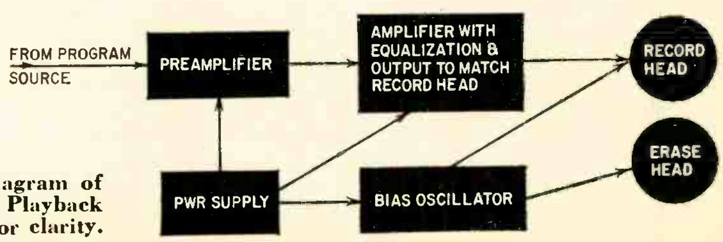
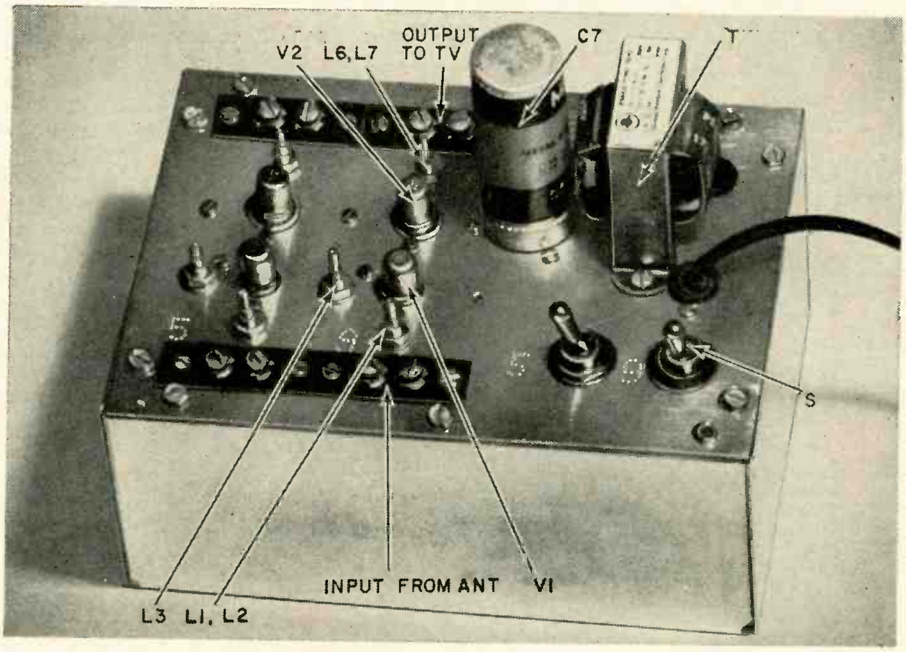


Fig. 5—Block diagram of a tape recorder. Playback section omitted for clarity.

Nuvistors cut noise in VHF TV booster

Build this unit and get frame grid-noise figure with a $2.36 tube



Completed two-channel booster. One channel (5) covers the low-band; the other (9), the high band.

By JOHN R. LANGE, K9ARA

IN FRINGE TV AREAS THE SNOW CONTRIBUTION or noise figure of a TV booster or rf stage is mainly determined by the tubes used. Most commercial TV tuners average noise figures of about 5 to 6 db on channels 2 to 6, and 7 to 9 db on channels 7 to 13. Some of the later boosters and tuners using the newer frame-grid type tubes may give noise figures of about 3 to 5 db on channels 2 to 6, and 4.5 to 6 db on channels 7 to 13.

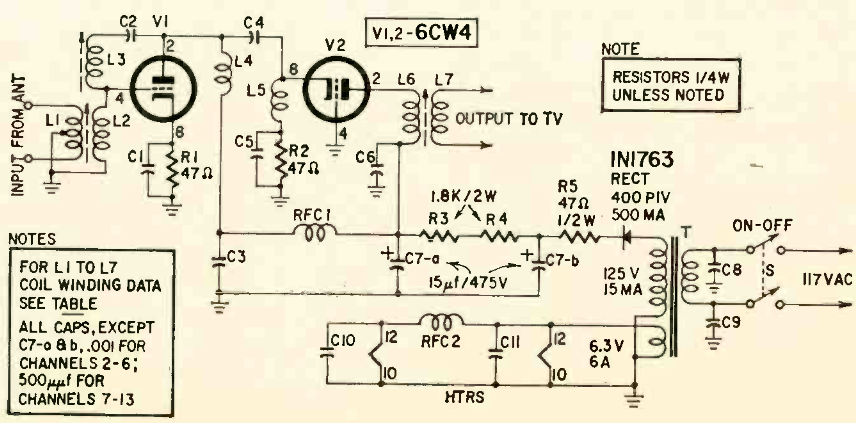
The importance of noise figure can be appreciated when one realizes that a 3-db reduction in noise figure at a quiet receiving location reduces TV snow as if the receiving antenna were stacked with another or the TV station's transmitted power doubled. My previous TV booster design, which appeared in the November 1957 issue of RADIO-ELECTRONICS, used frame-grid tube types such as the 417A, 6688 or 5847 for the input stage to get lowest possible noise figures. However, these tubes cost anywhere from $7 to $15, and the second 6AJ4 around $4.

But recently the RCA 6CW4 nuvistor has appeared. This tube gives noise figures at vhf within 0.25 db of those obtainable with the more expensive frame-grid tube types. This $2.36 tube also takes less power and simplifies the power supply requirements.

The two-channel cascode type booster shown in the photographs was built to evaluate the nuvistor for TV booster use and to improve Chicago TV reception from the two stations featuring nearly continuous local color TV programming. Total cost for parts was under $20. Noise figures are about 3.25 db on channel 5, and 5 db on channel 9. Snow reduction and color picture improvement was surprising and as good as that obtained with the previous triode-connected 6688, 6AJ4 booster.

The two-channel booster was built on a 5 x 7-inch No. 16 aluminum subchassis complete with power supply and is mounted in a 3 x 5 x 7-inch aluminum chassis base. It would be even better to use a brass subchassis since ground

Fig. 1—Circuit of the nuvistor TV booster. Only one channel is shown.



PARTS LIST
R1, R2—47 ohms, 1/4 watt
R3, R4—1,800 ohms, 2 watts
R5—47 ohms, 1/2 watt
C1, C2, C3, C4, C5, C6, C8, C9, C10, C11—.001-μf ceramic for channels 2 to 6. 500-μμf ceramic for channels 7 to 13
C7—15-15 μf, 475 volts (Mallory FP-258 or equivalent)
L1, L2, L3, L4, L5, L6, L7—see coil-winding table
RECT—1N1763, 500 ma, 400 PIV
RFC1, RFC2—see coil-winding table
S—dpst toggle
T—power transformer; primary, 117 volts; secondary, 125 volts, 15 ma; 6.3 volts, 600 ma (Stancor PS-8415 or equivalent)
V1, V2—6CW4 nuvistors
Chassis, 5 x 7 inches, No. 16 gage aluminum or brass
Case, 3 x 5 x 7-inch aluminum chassis
Sockets for tubes, Cinch-Jones 5NS or equivalent
Miscellaneous hardware

connections and the nuvistor sockets could then be soldered in. I used 2-56 machine screws to fasten down the sockets, ground lugs and standoff terminals.

Plate power is switched to either the booster peaked for channel 5 or the one on channel 9. Input and output leads are quickly shifted, using clothespin type antenna clips. Because of the modest power requirements, power could probably be taken from the TV set since only about 40 to 70 volts at about 18 ma is required for plate power. A single-channel unit could then be mounted in a small case and hidden inside the TV set. For ultimate single-channel fringe-area use, the booster could be built-in a weatherproof box and mounted up near the antenna with power being sent up externally. Fig. 1 gives the circuit for a single-channel booster. For a two-channel booster, add two more nuvistor stages. The power supply can be switched to both amplifiers. To avoid interference, switch off plate voltage of the unused channel.

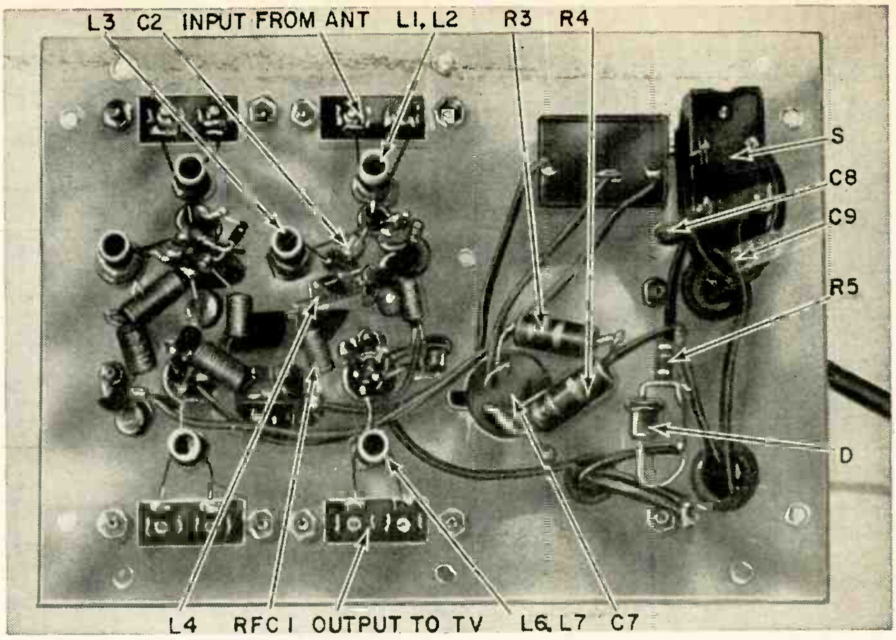
Build-it hints

Carefully bend out the two opposite tabs on the nuvistor socket horizontally and orient the plate lead, pin 2, toward the output after inserting the socket in a ½-inch diameter hole. If a brass plate is used, solder the socket tabs in place. For an aluminum plate, drill a clearance hole for a 2-56 screw in each tab and bolt the socket down.

No interstage shields are used on the subchassis. A 2-inch-wide shield inside the base, up from the floor and even with the center lines of the second-stage sockets, may eliminate regeneration in some layouts. This will help reduce coupling between the input and output coils if they are too close to each other.

Lead lengths of the input-tube cathode bypass capacitor, C1, and the grid grounding strap at pin 4 of the second stage should be as short and direct to a chassis ground as possible. Other lead lengths are not too critical if the layout shown in the photos is generally followed.

The input transformer coil has an important effect on the booster's noise figure. The coils are overcoupled past the point of maximum gain to present to the tube an impedance giving lowest noise figure. Cambridge Thermionic ¼-inch diameter forms were used. The high-frequency powdered-iron cores *(coded white)* for 30-mc and higher were used. Lower-frequency ordinary if cores will lower the coil Q and increase the noise figure.



Parts layout under the aluminum or brass chassis.

The low-band input, neutralizing, and output coils were wound tightly with No. 28 enameled wire. Apply a coat of *polystyrene* cement (used on plastic models and available at hobby shops) and let the coils dry for a day before winding the input or output windings on top in a reverse direction. Do not use regular model-airplane type cements since they lower coil Q.

Center-tap input coil L1 by scraping the enamel from about a 1-inch length of lead after the coil is half wound. Place another scraped lead in parallel and twist the two leads several times. Then coat them with solder, and wind the remaining half of the coil. The two twisted and soldered leads then come out at right angles to the coil and are soldered to a ground point. Check with an ohmmeter to make sure that windings L1 and L2 are not shorted.

Wind the coils for channels 7 to 13 with No. 24 wire. This is easy to do after the forms are mounted in the chassis. The rf chokes and interstage coils, L4 and L5, are tightly wound over a 3/16-inch-diameter rod or drill shank. By scraping the enamel off, tinning with solder and bending the leads before sliding out the rod, the choke will not be distorted when soldered into the circuit.

Booster alignment

The booster can be peaked with a TV station signal, but for best results use a sweep generator, oscilloscope and 300-ohm balanced detector pad as shown in Fig. 2 to get a properly centered overall bandpass alignment. First, however, center the input circuit response for best noise figure. This can be observed by disconnecting L6 from the circuit and temporarily replacing it with a 150-ohm resistor. Touch an rf crystal demodulator probe connected to the scope to the plate end of the 150-ohm resistor and observe a broad single-peaked curve. Center this curve by adjusting the input and neutralizing coil cores on the desired TV channel. The number of coil turns on L2 may have to be varied a turn or so if the response cannot be centered using the coil cores.

Then remove the resistor and reconnect L6. Now check overall response using the 300-ohm balanced detector probe. The curve should have the shape shown in Fig. 2-b and the core of the output transformer coil should maximize the curve center at the desired channel. On channel 2 or 3, the overall curves may be too narrow for good color TV definition. Widen bandwidth by soldering a 15,000-ohm (or lower value) resistor in parallel with L6, from the plate of V2 to C6. Bandwidth can also be widened by increasing the number of turns on L7. Gain will be lowered but there will be little effect on the noise figure. For extreme black-

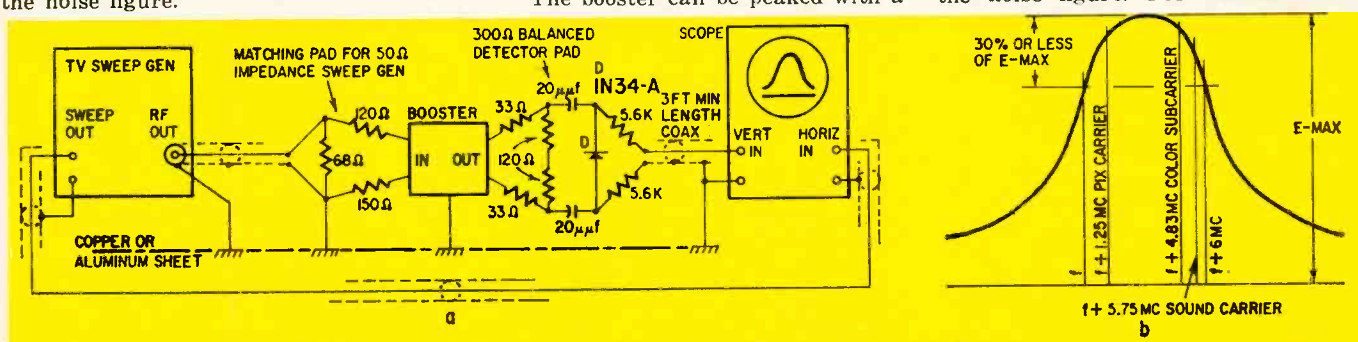


Fig. 2—Sweep alignment setup (a) and desired response curve (b).

Coil-Winding Data
All Coils Use Enameled Wire

TV Channels	L1		L2		L3		L4, L5		L6		L7		RFC1, RFC2	
	Turns	Wire No.	Turns	Wire No.	Turns	Wire No.	Turns	Wire No.	Turns	Wire No.	Turns	Wire No.	Turns	Wire No.
2	7½	28	12	28	30	28	31	24	14	28	6	28	15	24
3, 4	6½	28	10	28	25	28	27	24	12	28	4½	28	15	24
5; 6	4½	28	7	28	20	28	22	24	9	28	3½	28	15	24
7, 8	3½	24	3½	24	6½	24	7	24	4½	24	3	24	15	24
9, 10	3	24	3	24	5½	24	6	24	4	24	2½	24	15	24
11, 12, 13	2½	24	2½	24	5	24	5	24	3½	24	2½	24	15	24

Notes

L2, L3, L6 are tightly wound on ¼-inch-diameter stug-tuned coil Forms such as James Millen 69048-B with No. 19 mix core (coded white) or Cambridge Thermionic Corp PLS-6 or IS-6 with 20063-D core (coded white.)

L1, center-tapped, and L7 are reverse-wound over L2 and L6, respectively.

L4, L5, RFC1, and RFC2 are air-core tightly wound chokes, 3/16-inch diameter.

and-white fringe-area reception, high gain and narrow bandwidth may be desirable.

Bandwidth can be increased to give a flat response over several TV channels on either side of a single channel picked according to coil-winding data. Simply wind the input and output windings (L1 and L7) below, and separated 1/32 to ⅛-inch from, grid and plate windings L2 and L6. Also add 7 to 45-μμf trimming capacitors across L1 and L7. Check and align the input response first, then the overall response. When adjusting the double-tuned coils, you'll find that separation between the two windings will mainly determine the bandwidth. The capacitor will tilt the curve, and the core maximizes the curve amplitude in general at the desired frequency range. There is some interaction in adjustments.

Final test

Make final adjustments with the TV signal and TV set. Pick a time when the signal is weak, but not fading, and external interference is at a minimum. Connect the booster between the antenna and TV set. Make sure input leads, output leads and power cord are separated from each other. Use as short a lead as possible between the booster and TV tuner.

Turn on the TV set and booster and after sufficient warmup time (at least 15 minutes) adjust the output coil core for maximum picture contrast and the input and neutralizing coils for maximum picture contrast and least picture snow. Note the snow content of dark picture areas while tuning the booster. Sometimes, particularly on channels 7 to 13, wrapping a 4-inch square of aluminum foil around the input lead and sliding it along 1 to 4 feet from the booster will improve the picture. Readjust or remove the slider, however, when viewing other channels.

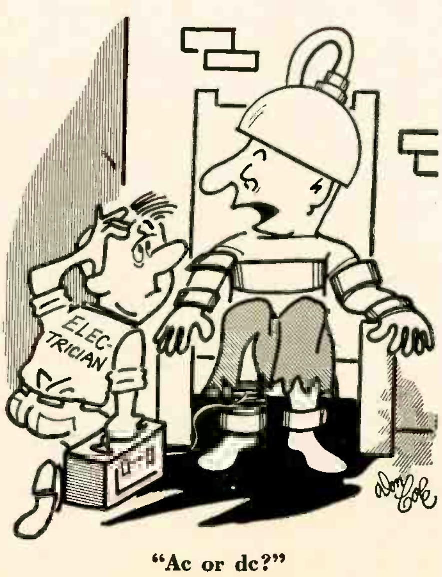
I found that reducing the size of input tube cathode bypass capacitor C1 from 500 to 50 or 100 μμf, reduced bandwidth and optimized the noise figure on channel 9. However, too small a capacitor will cause oscillation.

If the booster oscillates (indicated by a white or torn raster on the TV screen), turn off the booster and retune neutralizing coil L3 until there is no oscillation when the booster is turned on again. Oscillation may occur when the booster is located at the antenna or some distance from the TV set. It can be caused by radiation from the long output lead being picked up by the antenna. If this is happening, use 300-ohm shielded line between the booster and TV set.

If a 75- to 300-ohm transformer is connected to the TV tuner, coax can be used between the booster and TV set. For coupling to a 75-ohm coax line, cut the number of turns on L7 in half and ground one end of the coil. Persistent oscillation may require adding a 15,000-ohm or lower value damping resistor across L6, as mentioned previously, to lower the gain and increase bandwidth, particularly on channels 2 and 3.

If the booster gives little or no improvement, check operating voltages. Plate voltage should be around 70 and total current drain about 18 ma. For longest tube life in antenna-mounted units, lower plate voltage to about 40 by increasing the value of R3 and R4, with a negligible change in noise figure.

END



"Ac or dc?"

LOOK
FOR THESE FEATURES IN Radio-Electronics NEXT MONTH

HAND-HELD RADAR FOR THE FOOT SOLDIER

G. I. Joe goes electronic!

With this 10-pound instrument, the modern "dog-face" can spot enemy movements a mile away under any weather or light conditions. It audibly distinguishes between such targets as tanks or personnel.

ELECTRONIC IGNITION IN YOUR CAR

Start easier, improve engine performance, save gas with this all-solid-state system. It's easy to build, easy to install.

BOAT-ELECTRONICS—WHAT'S NEW

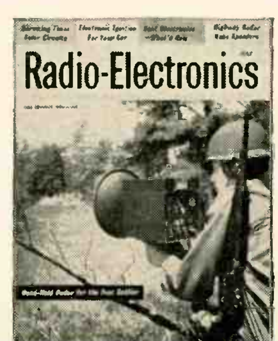
Veteran marine service technician Elbert Robberson reviews the new 1962 electronic aids for small boat owners.

SERVICING THOSE COLOR CIRCUITS

Color TV circuits aren't as complex as they're painted. Common sense makes handling them much easier. This article lights the way.

HIGHWAY RADAR NABS SPEEDERS

A highway radar maintenance man answers your questions. Tells you how accurate highway radar is, whether or not it can be confused. Gives you the lowdown on radar detectors. A very timely feature for Summer drivers.



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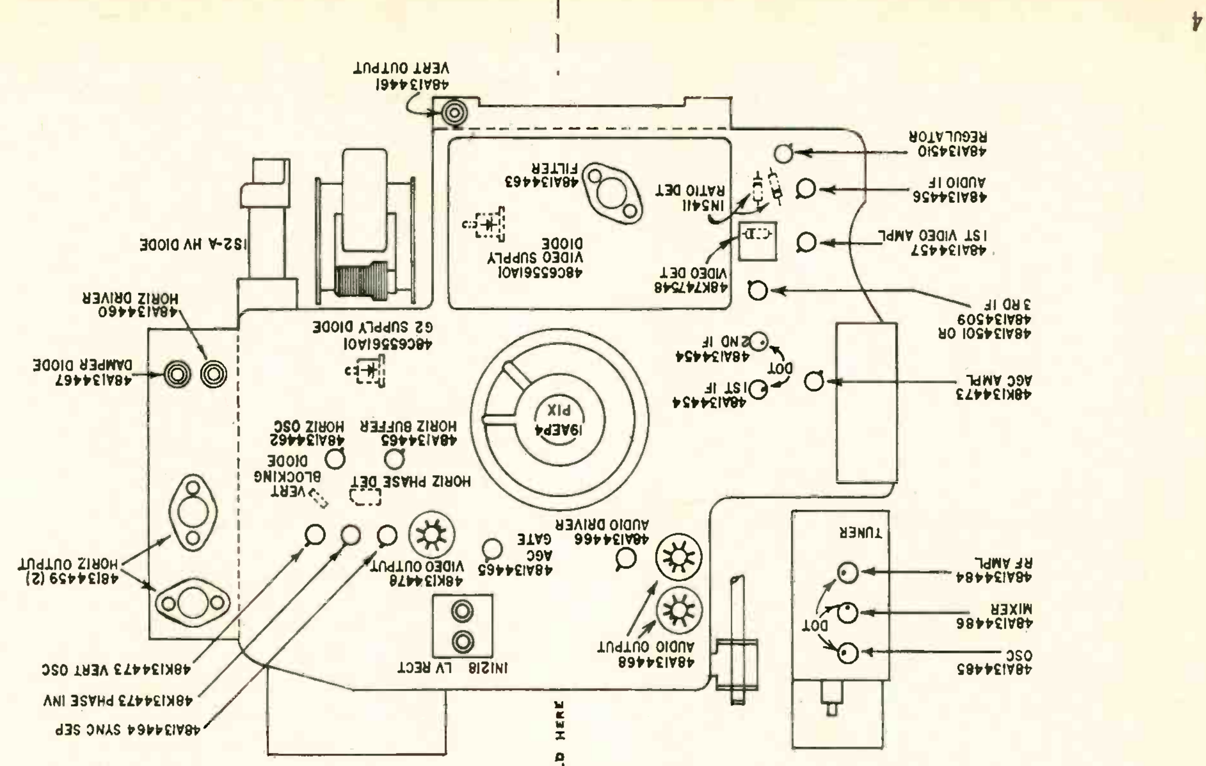


MODELS 19P1-1, 19P1-2

TRIM HERE AFTER FOLDING

Radio-Electronics

TUBE LAYOUTS IN TV SETS

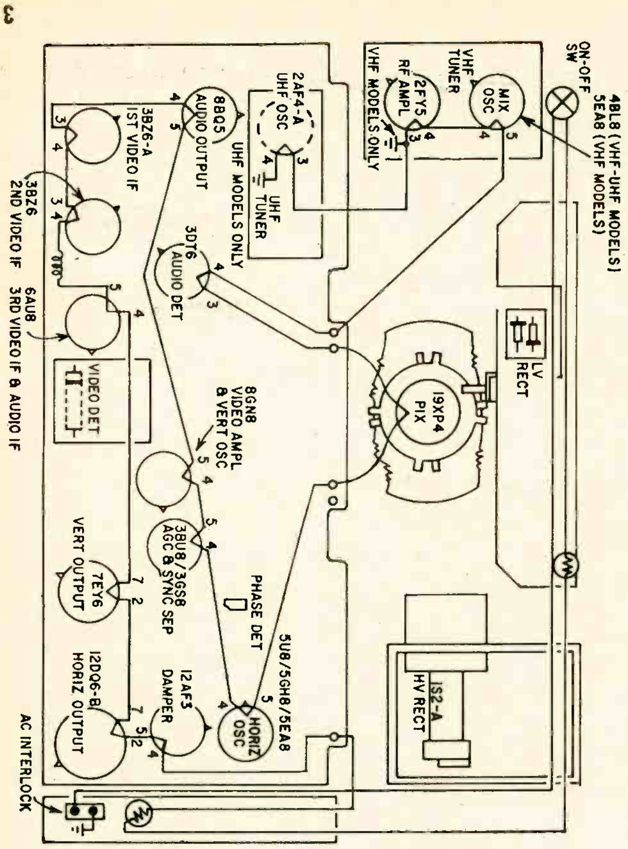
Compiled by Larry Steckler, Associate Editor

MOTOROLA 1961-1962

HOW TO FOLD

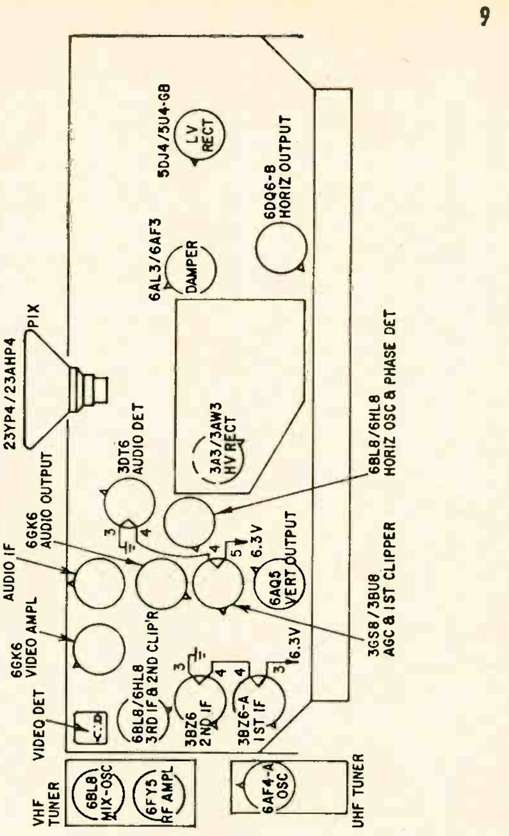
Fold the top down and back, keeping the cover facing you. Then trim the right and left edges. Now staple the booklet along the vertical center fold, about ¾ inch from the top and bottom. Now fold from left to right, keeping the cover facing you. Trim a fraction of an inch off the top and trim the bottom to size and you're finished. You now have another useful piece of service data, exclusive with RADIO-ELECTRONICS.

3



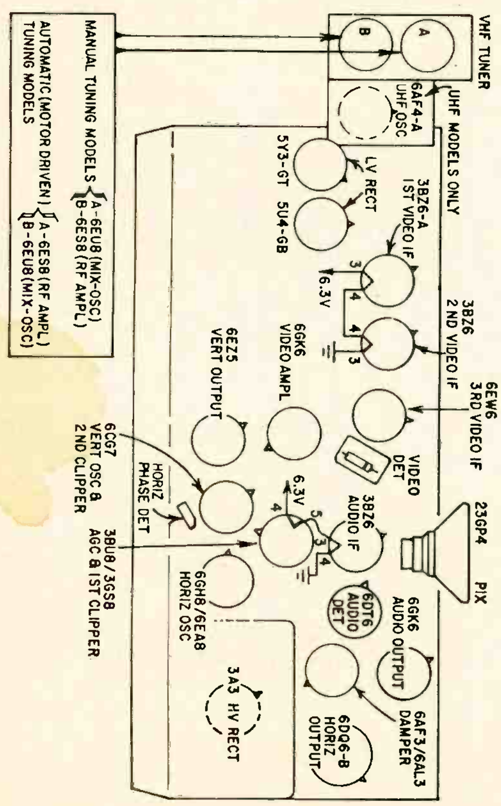
CHASSIS RTS-433, TS-440

6



CHASSIS STS-570, ST-570

CHASSIS WTS-569, STS-569



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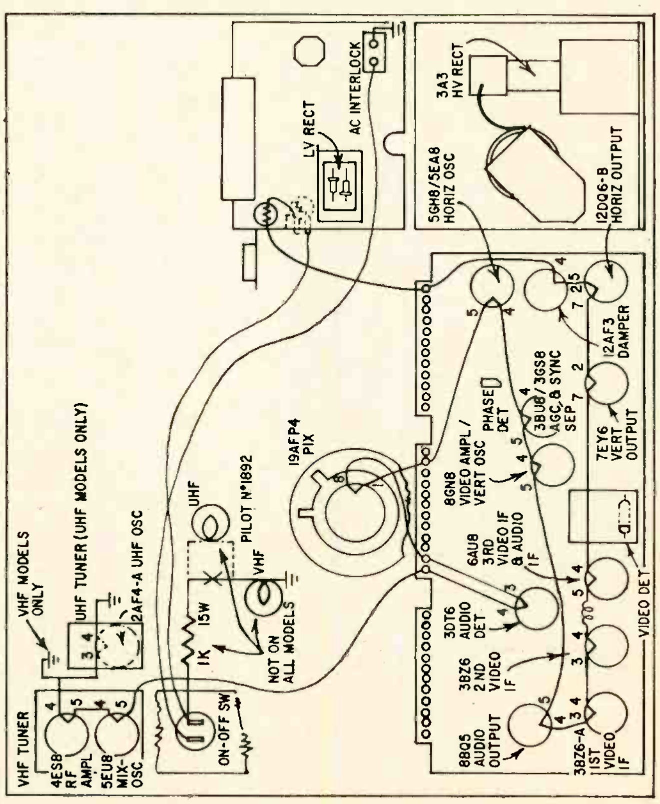
CHASSIS TS-STS, WTS-435



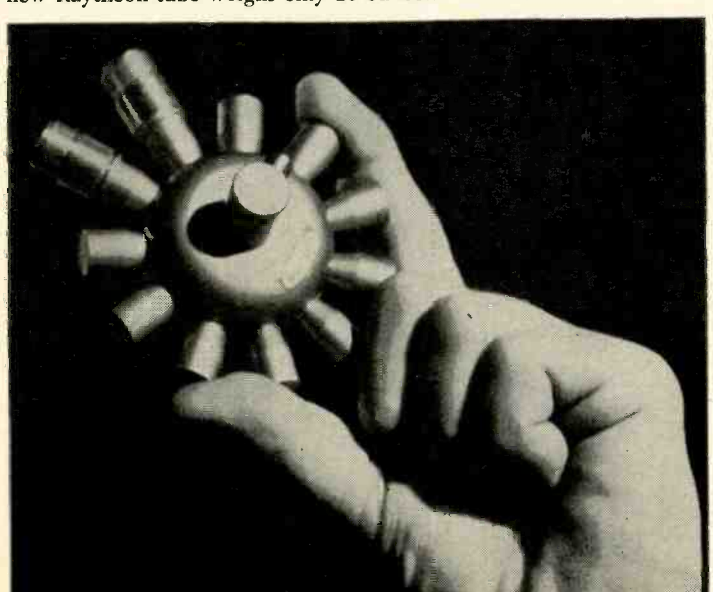
7

What's New

LASER PACKS A WALLOP. The intense beam of light was powerful enough to burst a balloon 10 feet away. Fragments of the balloon are just starting to drop to the floor. In another test the laser beam was used to punch a hole through a sheet of stainless steel. The laser fired a 1/2000-second burst of light. Both demonstrations were conducted at the IRE show.

RUNAWAY MISSILES AND SATELLITES are destroyed when these musical rods are triggered with the right combination of tones. If the correct five tones are not received, nothing happens—this keeps stray signals from triggering the destruct mechanism and killing an astronaut or destroying a valuable missile. The tuning rods are made by Raytheon and are part of a command receiver supplied by Thompson Ramo Wooldridge to missile manufacturers.

SPACE COMMUNICATIONS SYSTEMS will make good use of this Amplitron. It delivers 25 watts at 2300 mc and is well suited for telemetering packages, voice and facsimile transmission from space, or in equipment where light weight and small size are important. This new Raytheon tube weighs only 16 ounces.



SOLDERING TWEEZERS should be an excellent tool for semiconductor circuits. Separate 6-watt element in each arm applies heat to the transistor, diode, or other semiconductor lead directly. Solders fast with a minimum of heat. The Oryx-made tool is imported from England.

unusual oscilloscope techniques

Some methods used in industry could be valuable in TV Service

By ROBERT G. MIDDLETON

SCOPES IN INDUSTRY ARE BECOMING almost as universal as voltmeters. The quality-control department in a semiconductor plant is full of them. With suitable adapters we can display a complete family of plate characteristics for a tube or collector characteristics for a transistor. Although we do not usually think of a plate-characteristic plot as a waveform, the ingenuity of electronic engineers has translated the oscilloscope virtually into an electronic computer which performs instantaneously analyses that would require hours or days to complete with point-by-point measurements, graph paper and slide rule.

Auto electricians now use the scope to check engine ignition systems, which used to be checked with a screwdriver within recent memory. Special probes reduce the high-tension spark voltage for the scope. The low-tension waveforms in the ignition system are also displayed concurrently or consecutively. The scope operates as a voltmeter, showing instantaneous voltage values as waveforms on a linear time base. The up-to-date auto mechanic is as familiar with oscilloscope operation as with hex wrenches and hydrometers.

The oscilloscope finds vital application in the manufacture of ferrite cores to operate as ultra-speed memories in computers. For example, Fig. 1 shows the drive and switching-time waveforms for a fast-response computer type core. This type of memory product provides a clear–write and read–restore memory cycle at rates to 1 mc. If a permanent record is required, special cameras are used to photograph the screen pattern.

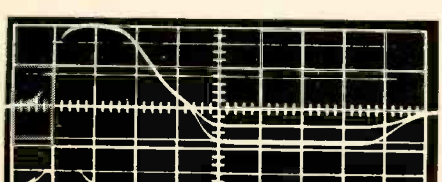


Fig. 1—Drive and switching time waveforms show the extremely fast response of a computer type ferrite core. Time is 0.02 μsec per division. ***Ampex.***

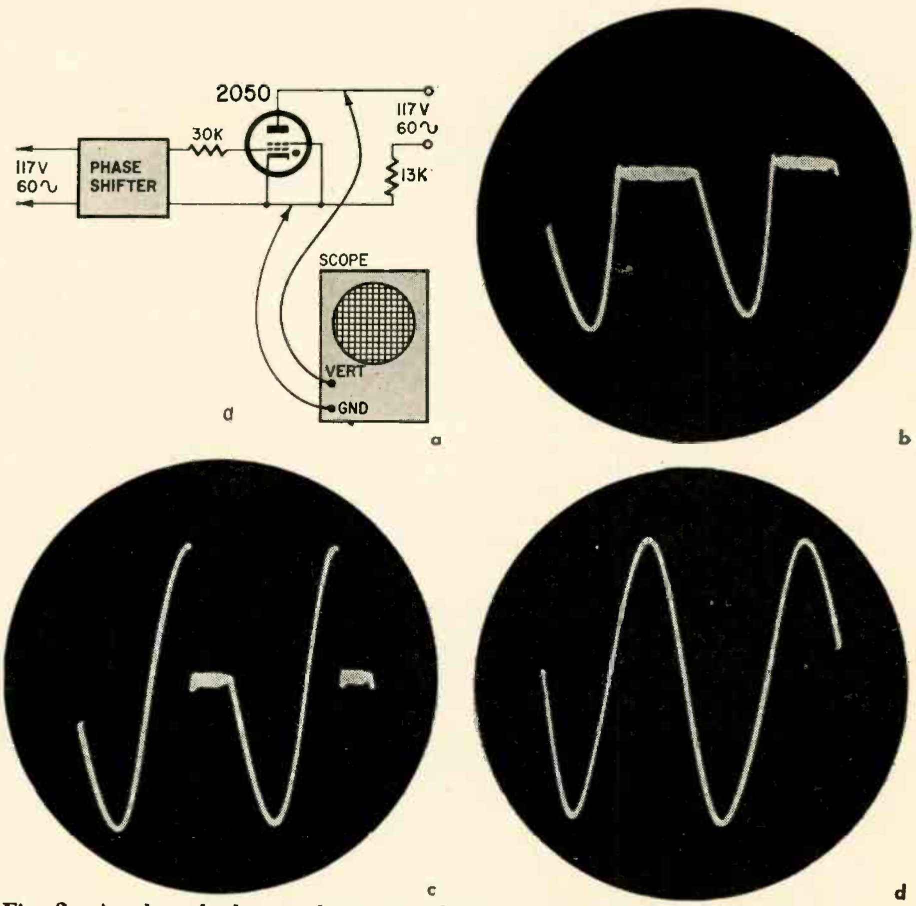


Fig. 2—Anode-cathode waveforms for thyratron rectifier circuit. a—Where scope was connected. b—Full anode current. c—Medium anode current. d—Zero anode current.

Varieties of scope patterns

Of course, there are many types of scope patterns in practical electronics work. Some are well known, others are just beginning to be generally recognized. Let us look at some of the more important pattern characteristics to see why they are so informative in electronic test procedures.

Patterns displayed on a linear time base are both familiar and of general utility. Fig. 2 is an example. This display shows a thyratron rectifier circuit operating at three different conduction angles. Both grid and anode are supplied with ac. Average plate current is controlled by a phase shifter

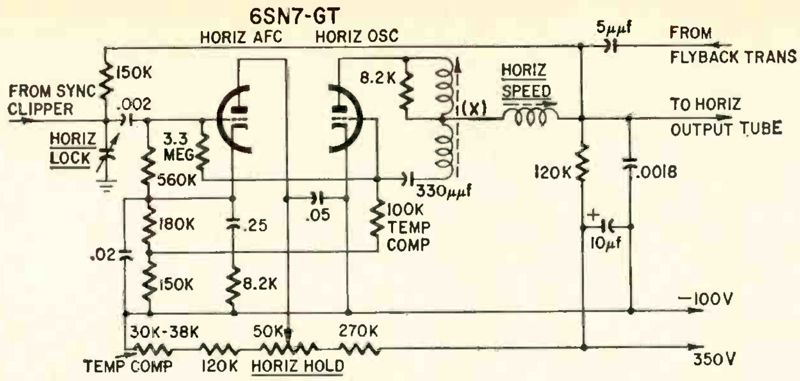


Fig. 3—Pulse-width afc circuit is checked with scope at X.

in the grid circuit. Thus, although the grid does not control the amplitude of the anode current, it does control the angle of current flow. Thus it controls the average anode current. Current flows only during the horizontal intervals of the anode voltage waveform. The horizontal interval appears somewhat fuzzy because of plasma oscillation during conduction by the tube.

Next, let us look at Fig. 3. This is a pulse-width automatic-frequency-control (afc) circuit. It is commonly checked with a scope at X. Typical patterns are shown in Fig. 4. They are traced on a 5,250-cycle sawtooth linear time base and three complete cycles are displayed.

A visual-response curve, on the other hand, is usually displayed on a 60-cycle sine-wave time base. Fig. 5 shows a typical frequency-response curve for a video amplifier. The video amplifier should not be confused with the i.f. amplifier. The video amplifier in a TV receiver is the section between the picture detector and the picture tube. Beginners sometimes ask about the prominent "marker" which appears around zero frequency. This is not actually a marker though it can be regarded as such. The pseudo marker is a byproduct of practical demodulator probes, which have incomplete demodulating and filtering action at very low frequencies.

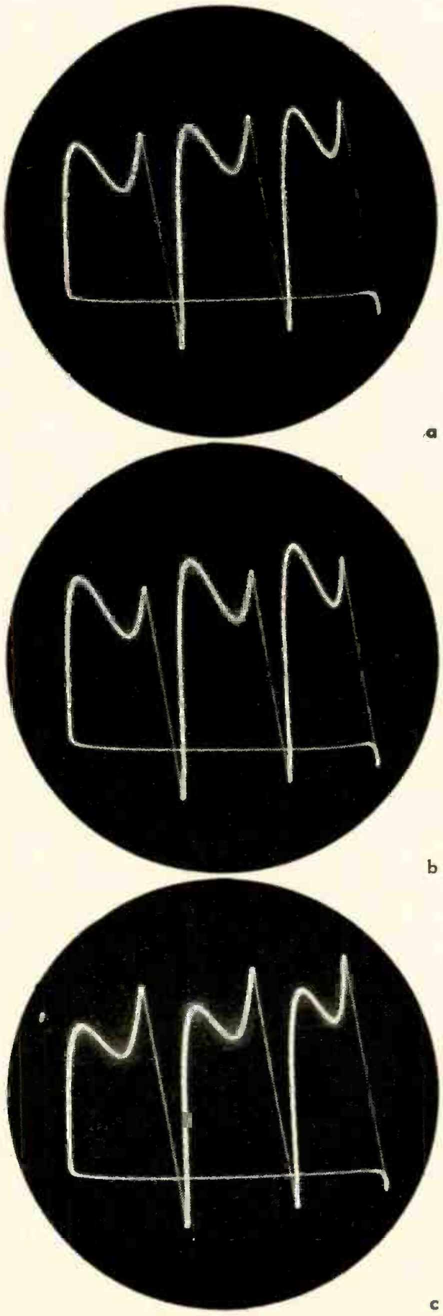


Fig. 4—Waveforms at X in Fig. 3. a—Normal. b—Pulse peak too low. c—Pulse peak too high.

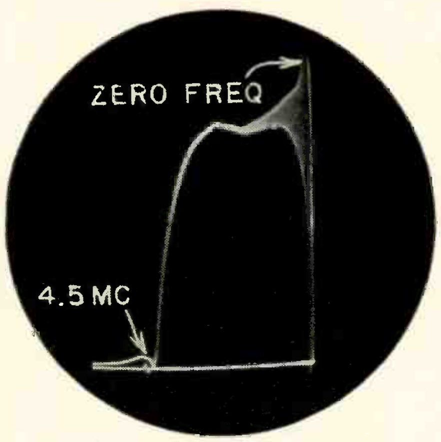


Fig. 5—Appearance of a typical video response curve.

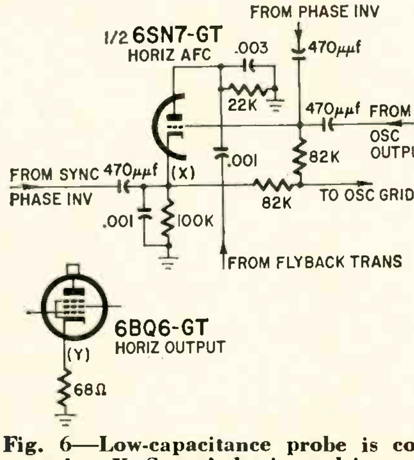


Fig. 6—Low-capacitance probe is connected at X. Scope's horizontal input is connected at Y. If the horizontal output tube's cathode is grounded, the waveforms in Fig. 7 will not be seen unless a small resistance is inserted.

Cyclogram displays

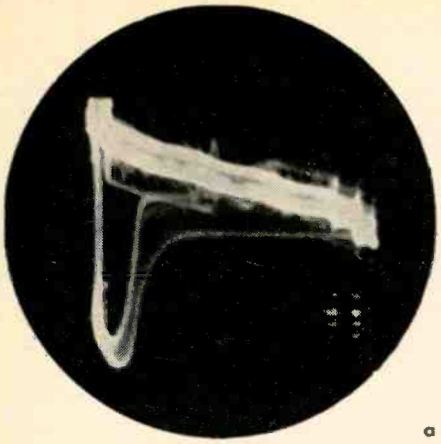
Less familiar to many of us, perhaps, is the cyclogram type of display, which is highly useful in industrial work and could be used much more in TV service. Note the partial afc and horizontal output circuits in Fig. 6. We get a cyclogram display by connecting the vertical input lead of the scope at X and the horizontal input lead at Y. Use a low-capacitance probe at X to avoid waveform distortion caused by circuit loading. In a cyclogram pattern, a signal voltage from a circuit is "swept" by another signal voltage from the same circuit (or equipment section). The ground lead from the scope is connected to the receiver chassis or common ground bus of the equipment under test.

Thus, a cyclogram is really two waveforms in one integrated pattern. The horizontal excursion of the beam is no longer a uniform time–axis function but has become a signal-voltage function. To put it another way, the signal information is developed both vertically and horizontally on the scope screen. The total information provided is not only doubled, but new data are displayed concerning instantaneous relationships between the two signal voltages. Of course, reading cyclograms is somewhat more difficult than reading simple patterns displayed on linear time bases.

When various circuit faults occur, the normal cyclogram pattern changes (Fig. 7). Note how different capacitor defects cause characteristic changes in the cyclogram pattern. We see that many circuit troubles show up clearly as distortions of the cyclogram pattern. Although unfamiliar to most of us, cyclogram patterns are actually easier to work with than ordinary sawtooth time-base displays.

Cyclograms are easier to use because no scope synchronizing adjustment is required. We switch off the sawtooth time-base function in a scope when displaying cyclograms. We do not use the sync controls of the scope. A cyclogram pattern is *automatically* locked on the screen at all times.

A cyclogram has two amplitudes, or peak-to-peak voltages; a certain vertical amplitude and a certain horizontal amplitude. Changed amplitudes in either direction are indications of circuit trouble, just as are pattern distortions. Hence, we calibrate a scope *both* vertically and horizontally when working with cyclogram patterns.



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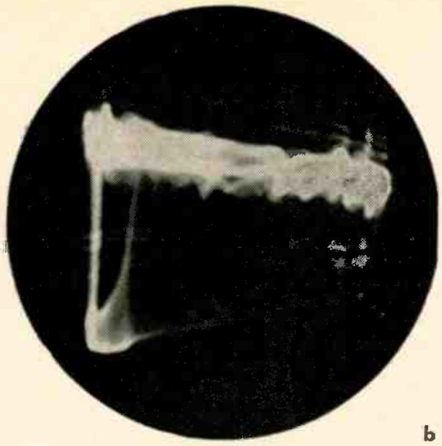

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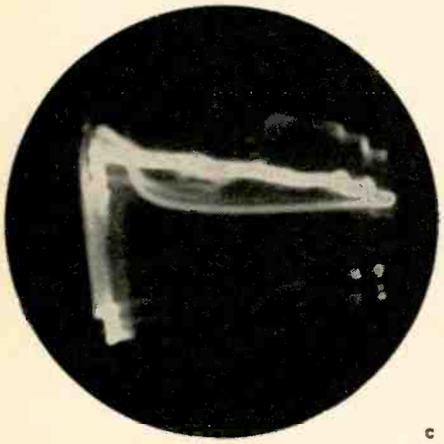

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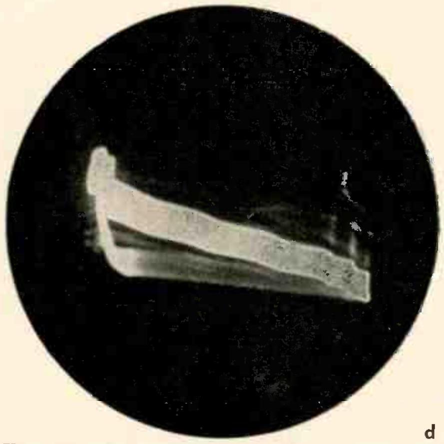

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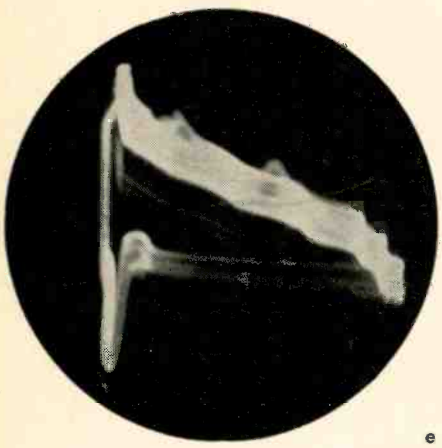


e

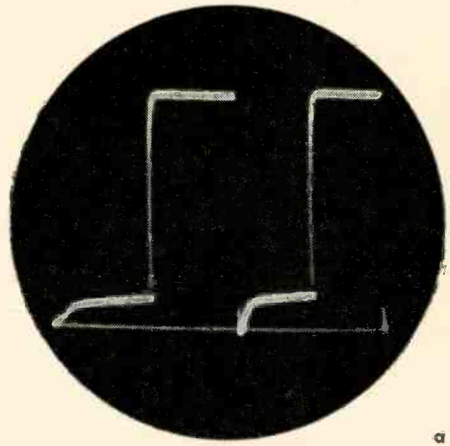
Fig. 7—Comparison of afc cyclograms for various open afc capacitors. a—Normal cyclogram at afc cathode. b—Grid-coupling capacitor to inverter is open. c—Plate-coupling capacitor to flyback is open. d—Cathode-coupling capacitor to phase inverter is open. e—Grid-coupling capacitor to oscillator is open.

All cyclograms obey electrical laws, which the electronic technician should keep in mind. First, we can obtain cyclograms between any two points in a circuit and such patterns may or may not enclose an area. If an area is outlined by the pattern, we know that there is reactance between the two test points. If a straight or curved line which encloses no area is displayed, we know that there is no reactance, but only resistance, between the two test points.

The resistance in an electronic circuit may be linear or nonlinear. Ordinary composition and wirewound resistors are linear. In other words, they produce a straight-line cyclogram when tested by any ac voltage, whether sine-wave, square-wave, sawtooth, pulse or other voltage waveform. On the other hand, transistors, semiconductor diodes, and class-B amplifier stages are examples of nonlinear resistance. Nonlinear resistance produces curved-line cyclograms.

Another important characteristic is the brightness variation in the pattern. This is true of patterns displayed on a sawtooth time base, as well as of cyclograms. In Fig. 8 the leading edge of the square wave (displayed on sawtooth sweep) is much brighter than the trailing edge. This shows us that the rise time is greater on the leading edge than on the trailing edge.

Again, in Fig. 8 observe that the cyclogram pattern brightness starts with a "sunburst" display and then diminishes clockwise around the cyclogram. A *small* change in pattern shape can be accompanied by a *large* change in brightness variation. Circuit trouble is indicated by the abnormal brightness variation.



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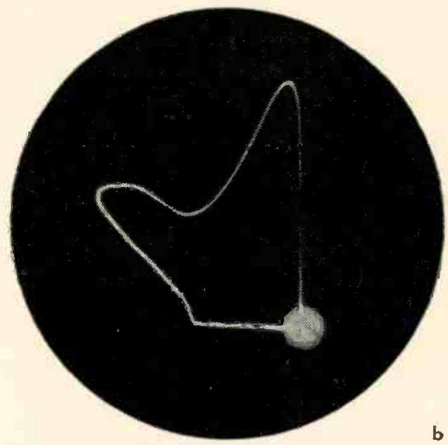

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Fig. 8—a—Leading edge of square wave has a comparatively slow rise time. b—Cyclogram starts with sunburst display and traces area contour with diminishing brightness clockwise.

We've kind of run out of space, so we'll stop here. A later article will show you just what scope patterns on a differential-input scope look like and we'll spend a little time with some interesting dc waveforms. END

Beginning with our next issue, *Radio-Electronics* will gradually introduce a new, larger type, aimed at making articles easier and quicker to read. Watch for the new style! We will welcome comments from our readers as to the new typography and any other features in our makeup and layout which you feel might be improved.

COVER STORY

automation makes golden resistors

Noble metal under end-caps is key to automated production, increases reliability and cuts noise

By ERIC LESLIE

WHEN IT BECAME NECESSARY TO TURN out high-quality, absolutely reliable resistors in almost astronomical quantities for the Armed Forces and the Bell Telephone System, Western Electric engineers were faced with some completely new production problems. The resistors had to be of the deposited-carbon type, of the reliability required for missile applications, and were required in quantities of several tens of millions, annually. Old methods simply would not work, and a completely automated production line was set up.

One of the special features of the line is that both production and quality are controlled by computers, so that reliability is maintained at all points *during production*, rather than by final inspection. The resistors are made by depositing a thin layer of carbon on a ceramic core. The traditional method of terminating such resistors has been to apply a silver paste to the ends, a process which included several hours of baking. This is out, for high-speed automatic production, and it was decided to apply a thin layer of the noble metal, gold. To do so, and to do it in the time which could be allotted to this part of the job, required a machine almost as complex as the sealing machines used in making vacuum tubes. There are no less than 36 of the bell-jar "stations" in the machine shown on the cover.

When the resistors are ready for terminating, the carbon has already been deposited. They are then held in masks —disc-shaped objects through which one end of a resistor can be seen projecting in the cover picture—under a bell-jar from which all the air has been pumped, and a very low-pressure atmosphere of argon substituted. Disc-shaped gold cathodes above the resistors are used to supply the gold, which is actually eroded, or "sputtered" off the metal onto the ends of the resistors. A high voltage at low current (1,500 to 3,000 volts at 20 to 50 milliamperes) is applied to the cathode, and small particles of gold are knocked loose from the surface of the cathode by impinging argon ions and deposited on the resistor ends.

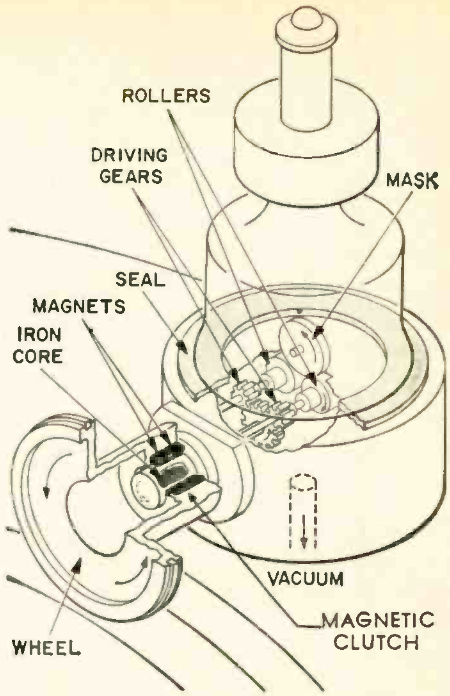
About ten-millionths of an inch of gold is deposited on the carbon. The discharge of high-voltage electricity is what creates the flickering reds and purples inside the tube.

The gold that doesn't reach the resistors is deposited inside the bell-jar and has to be removed periodically. The gold deposited inside the glass can also be seen in the cover picture.

The caps to which the resistor's wire leads are attached are also flashed with gold. They are put on the resistor on a machine that caps both ends at the same time, with enough force to weld the gold plating of the cap to the gold on the ends of the core. This makes about as low-noise and reliable a contact as is possible to design.

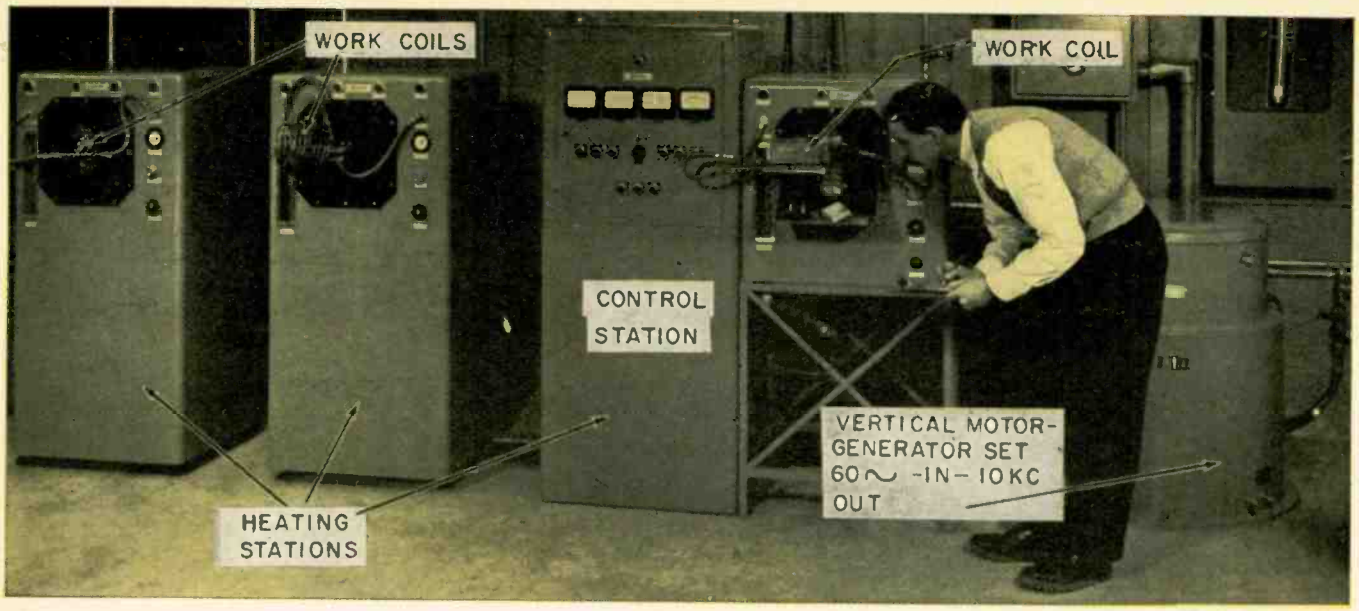
Only one more operation is needed to make a full-fledged resistor out of our carbon-coated core. Enough of the carbon must be removed to give it a precise value. This is done on a helixing machine, which cuts a spiral from end to end of the resistor, removing the carbon from a spiral strip. Only one or two turns may be cut for a low-resistance unit, leaving most of the carbon on the resistor. More turns are cut for higher ohmages, till for very high resistance units only a narrow several-turn spiral of carbon remains on the unit. A computer-controlled bridge balances when the desired resistance is reached, disengaging the lathe which removes the carbon. The bridge also senses any nonlinearity that would be caused by chipping or thin spots in the carbon coating, and rejects any resistors showing such faults. The computer control also rejects any resistor that reaches its value before 75% of its length is used, or fails to reach the value in the full available length.

Only finishing operations, such as placing the resistor in its insulating coat, checking it for leaks, etc., are required, once it has left the helixing machine. END



Actual assembly-line unit, showing how it is rotated for even coating.

A prototype unit. The disc cathode can be seen in a bell-jar at right. The mask and a sputtered resistor are lying on top of the base. In the actual machine, the handwheel at left is replaced by a rubber-tire wheel, which rolls along a track to rotate the resistor and mask while being sputtered.



Photos by Robotron

induction heating turns the trick

How would you handle this job—heat only the threads on a steel shaft

By DELLROYE D. DARLING

You are an industrial electronic technician. Or maybe you're a methods engineer. (This is a high-class term for a jack-of-all-trades.) The boss comes to you with a problem. He says, "Sam, we've got two hundred thousand shafts, and each one has a threaded section on one end. In the machine where these shafts will be used, a nut will be constantly running on and off the threads. We'll have to harden the threads so they don't wear out".

You know how to harden steel. You heat it up to a red heat, and then plunge it in a "quench" bath to cool it quickly. In some operations it doesn't matter too much how you heat the steel. You can use an oven, or a direct flame, or any other method. But your boss is a mindreader.

He says, "We've got to do this hardening real quick, to make money, and we can't use an open flame because the steel will absorb carbon from it and become brittle. Besides, a flame will probably heat too deep and change the character of the steel in the core of the shaft, which has to stay tough."

Now you know! If you can't use a flame or an oven, and you want lots of heat real quick, there is only one answer: induction heating! Being a good electronics man, you know that induction heating will allow you to heat these shafts quickly to the required temperature, and with this type of heating you can control not only the area to which the heat is applied, but also the depth. That will leave the core of the shafts unchanged after the hardening takes place.

So you tell the boss "Look, give me a day to check and I'll tell just what equipment you need".

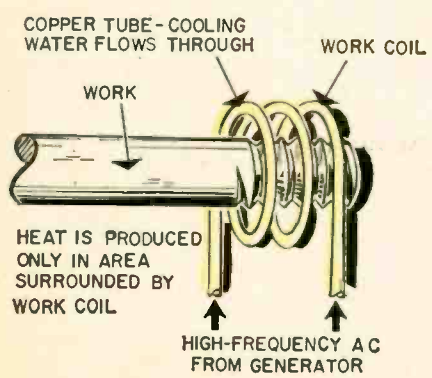
Back in the cubby hole they call your office, you pull out a sheet of paper and lay out the problem.

1. You must heat only the part of the shaft that is threaded.
2. You must heat only the surface of the threads, so they will retain their strength.
3. You must do all this in a very short time.

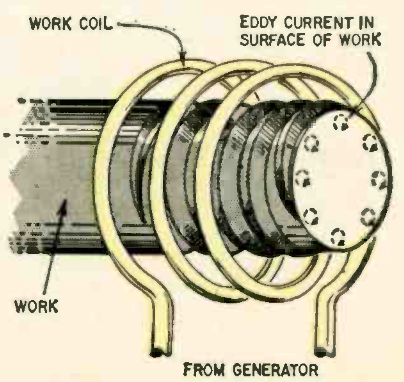
With induction heating, No. 1 is no problem. You know that induction heating produces heat by passing electric current through the steel. However, no actual electrical connection is necessary to the work, because the currents (called "eddy currents") are induced in the work by an expanding and collapsing magnetic field produced by a coil placed around the work.

Heat will be produced only where these eddy currents flow, and they will be confined to the general location of the work coil. By shaping the coil correctly, considering the shape and size of the work, heat will be produced only where you want it.

No. 2 on the list isn't a serious problem either. "Skin effect" that causes so many problems in high frequency ac circuits is an ally in the induction-heating business. High-frequency ac currents tend to flow in the



Physical arrangement of the heating coils and the work to be heated.



At higher frequencies eddy currents flow only in the surface of the work.

surface of a conductor. The higher the frequency, the closer to the surface the current will flow. The same is true for the eddy currents induced in the work by an induction-heating work coil. So, all you have to do to control the depth of heating is select a suitable frequency. (Of course, if you apply the heat for too long, it will "soak" into the work, so *time* has something to do with depth of heat penetration, too.)

This "skin effect" is one of the big advantages of induction heating, especially for a job like this one at hand. Flame heating heats from the surface inward, but to heat the surface of a piece of work quickly, without allowing the heat to soak in, requires a very intense flame. If you apply this intense flame to something like these threads, the outer edges of the threads will likely burn before the root has a chance to heat. Induction heating will produce heat to the required depth over the entire surface of the threads, without burning.

From theory into practice

So far you have solved the boss's problem in a theoretical sense. Now for the practical part: choosing a suitable machine for the job. There are several important factors that govern the type of machine to be used for a particular application. Let's make another list.

1. **Output frequency.** Induction heating is done with frequencies all the way from 60 cycles to 450 kc or even higher. The lower frequency machines are used to heat large masses to a considerable depth. High frequencies are used to heat small pieces, or for operations such as surface hardening, etc., that require shallow penetration.

Up to about 10 kc, the most satisfactory equipment is mechanical. Package motor-generator sets are available with outputs of up to 10 kc and power ratings as high as 1200 to 1500 kw. However, beyond 10 kc an ac generator must have so many poles, and run at such a high speed, use of a mechanical generator becomes impractical.

When higher frequencies are required, vacuum tube oscillators are usually used. These are actually very simple oscillator circuits, although the control equipment used with them may be complex. Most large vacuum tube generators operate in the range of 400 to 450 kc, with output power up to 100,000 watts, or more.

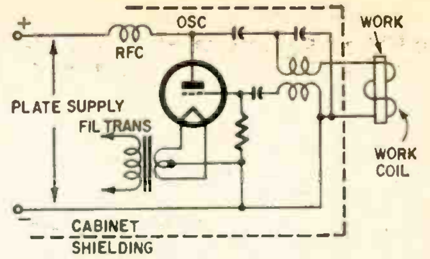
This thread hardening job needs shallow penetration, so 450 kc will be about right. That means you will need a tube-type generator.

2. **Power output.** We already know the upper limits of output power for both types of generator. Now, what power will we need to heat these threads? Well, now we're into the economics of the problem. In induction heating, as anywhere else, kilowatts cost money, and quite a lot of money, too. When speed isn't important, a small machine, at a lower price, may fill the bill. But, in a production shop time is money, too. Usually, a larger capacity machine will more than pay for itself in time saved per unit produced.

These threaded shafts are small, but we need rapid heating both for shallow penetration and high-speed production. Ten kilowatts will probably be adequate, although a test run is usually the best way to determine the power required for a particular job. (Most of the companies that build this equipment have facilities for test runs, and are happy to make them.)

You will also have to make sure that adequate line power is available. A 10-kw tube-type heater will need about 20 kva of three-phase power, at 230 or 460 volts.

3. **Cooling.** High-power tubes such as those used in induction heating generators may be either air or water cooled. However, since water is used to cool the work coil, most generators use water-cooled triodes in the oscillator circuit. Our 10-kw unit will need about 5 to 10 gallons per minute to cool the tube, plus some additional water for the work coil. You will have to make sure an adequate water supply is available at the work location.



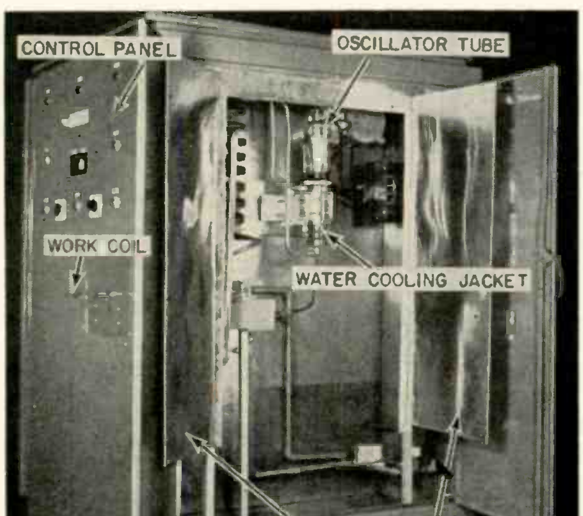
One type of induction heating generator circuit. This is a conventional feedback triode oscillator.

4. **Controls.** Naturally, the generator unit will have to have fuse or circuit-breaker protection. But it will also need special safety devices, such as an automatic shutdown if the cooling water supply should fail. Protection against tube burnout caused by excessive grid or plate current, and safety interlocks to shut off high voltages when the cabinet is opened. The Federal Communications Commission requires proper shielding so the unit won't radiate interference.

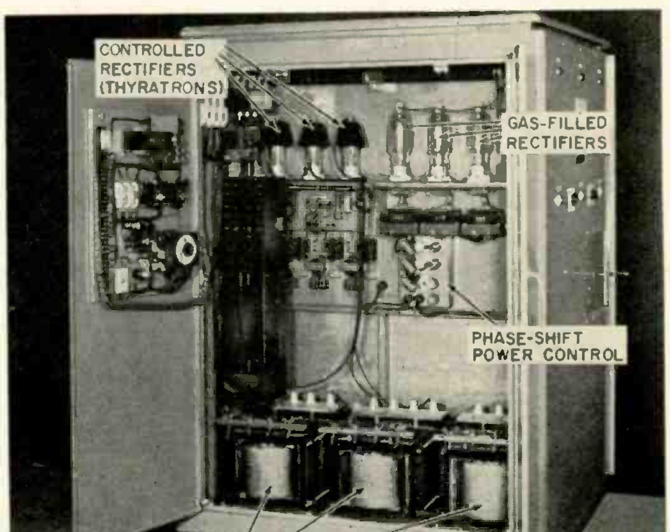
All these requirements will be met by any unit made recently by a reputable manufacturer. Used equipment should be checked carefully to make sure it has proper protection and control facilities.

So, there is the answer to the boss's problem. He needs a vacuum tube generator with a 10-kw output, working at about 450 kc. It will need a water supply, and a three-phase power line. The work coil and material handling equipment will have to be specially designed for the job, of course, but the induction heater manufacturer will be happy to take care of that.

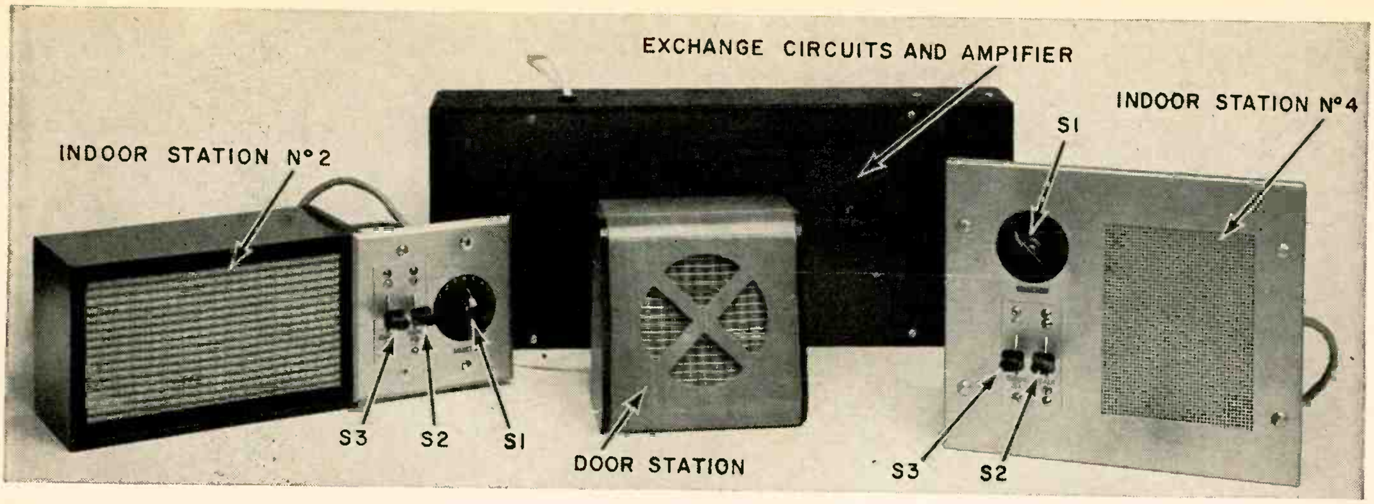
Well, another problem solved. Type it all on a sheet of paper and put it on the big man's desk EARLY next morning. If he's in the right mood maybe it will get you that raise. END



A 20-kw tube-type induction heating generator.



Rear view shows controlled 3-phase bridge rectifier used to adjust power output from generator circuit.



7-station intercom uses 1 master

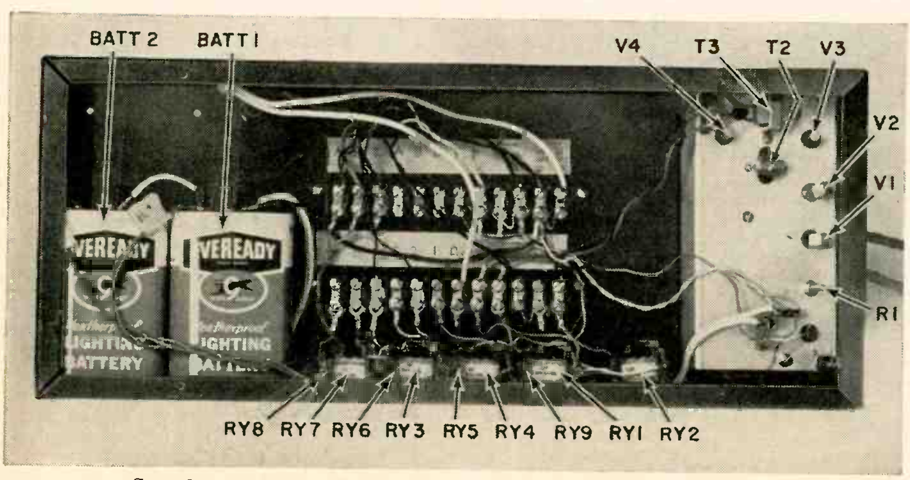
BUILD *this all-transistor setup. Binary-type switching makes 7-station, all-master system practical*

By **ROBERT D. HOCHBERG**

The two most disturbing problems in home intercommunication systems are that substations can't call other substations, and that most people just don't have the patience to wait for the amplifier tubes to warm up. The common and quite expensive solution to these problems has been to use all-master systems requiring multiconductor cables and ac sources at each station location, and to allow the five or more amplifiers to operate continuously. The intercom system described here solves these problems by combining the economy of the master–sub systems with the versatility of the all-master systems.

•It provides for calls between any two of its seven stations. •It uses a single, transistor amplifier. •It partially solves the multi-cable problem with a binary type coded signaling system. •It provides for a station located outside the front door. •It needs no outside power, though the batteries may be replaced by a well-filtered power supply if desired. Even then, the unit will require ac power at only one location.

In purpose, this intercom is similar to "Intercom Super Duper Model I" (RADIO-ELECTRONICS, January 1961). In approach, however, the two are quite different. The Model I uses six vacuum tubes, three of which are in the relay exchange circuit. The proper connections are made through rather critical biasing of the relay control-tube grids.



Switching relays and transistor amplifier are inside this case.

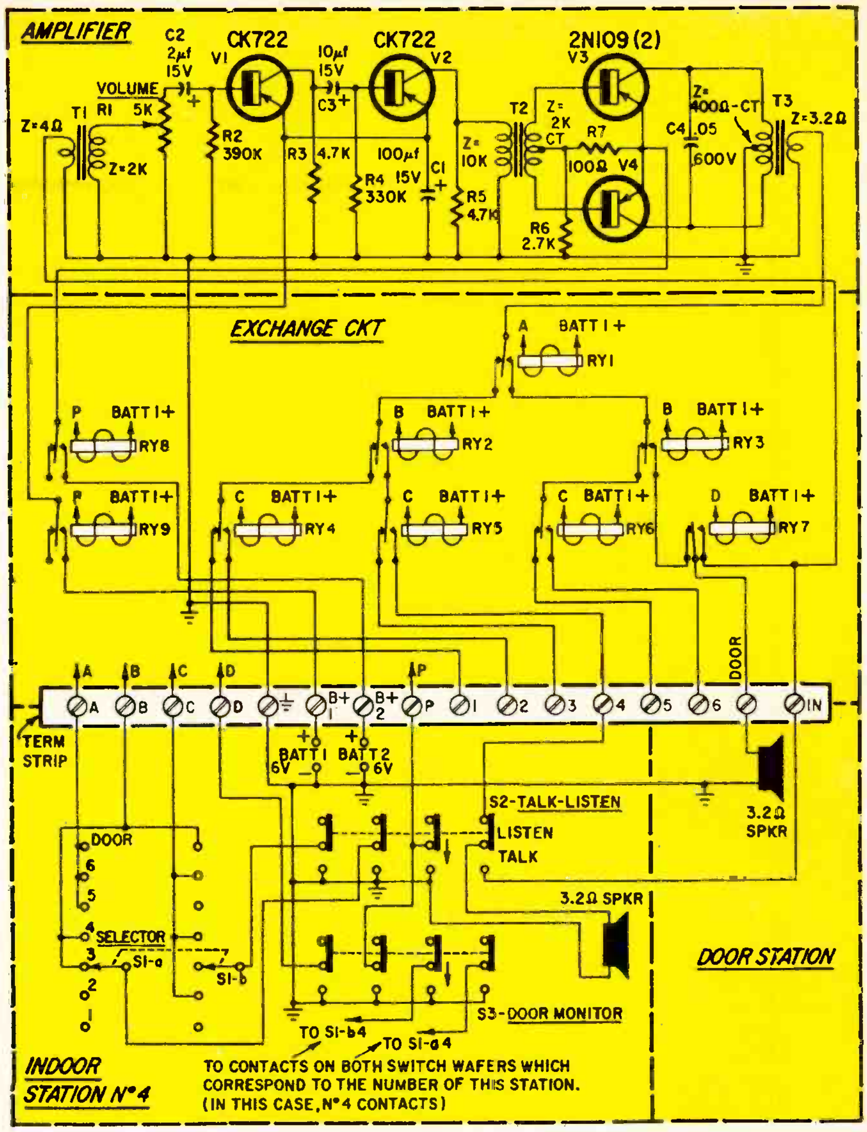
My unit uses just four low-drain transistors—which draw current only when the unit is in operation—and an exchange circuit which has no tubes or transistors.

The heart of the system is a control cabinet containing the amplifier, exchange relays and batteries. It can be located in an attic, under a stairway or in just about any other accessible but out-of-sight location. One of the two batteries controls the exchange relays and the first two amplifier stages. The other battery controls only the output stage of the amplifier. With this arrangement, both batteries should last about the same length of time. Cables run from the control cabinet to each of the masters. Each master unit uses one speaker which doubles as a microphone, one two-pole seven-position selector switch, and two four-pole double-throw lever switches as function selectors.

The binary exchange circuit

As shown in the schematic, the hot amplifier output lead is connected to the armature of RY1, an spdt relay. Depending on the position of the armature, the signal may be fed either to RY2 or RY3. (Since RY1 and RY2 are activated by the same signal, a single two-pole double-throw relay may be used instead.) From RY2 the signal may be sent to RY4 or RY5, and from RY3 it may be sent to RY6 or RY7. (Here a three-pole double throw relay may be substituted for RY4, RY5 and RY6). RY4, RY5, RY6 and RY7 channel the signal to masters 1,2,3,4,5,6 and DOOR. Thus, by energizing the proper

R1—pot, 5,000 ohms
R2—390,000 ohms
R3, R5—4,700 ohms
R4—330,000 ohms
R6—2,700 ohms
R7—100 ohms
All resistors ½-watt 10%
C1—100 μf, 15 volts, electrolytic
C2—2 μf, 15 volts, electrolytic
C3—10 μf, 15 volts, electrolytic
C4—.05 μf, 600 volts, ceramic disc
BATT 1, BATT 2—6 volts (NEDA 915, specify type with binding posts)
RY1, RY7—spdt sensitive relay (Sigma 11F-1000-G/SIL or equivalent)
RY2, RY3—spdt sensitive relay (Sigma 11F-1000-G/SIL or equivalent) (These two units can be replaced with a single relay bearing dpdt contacts.)
RY4, RY5, RY6—spdt sensitive relay (Sigma 11F-1000-G/SIL or equivalent) (These three units can be replaced with a single relay bearing 3-pole double-throw contacts.)
RY7, RY8—spdt relay sensitive (Sigma 11F-1000-G/SIL or equivalent) (These two units can be replaced with a single relay bearing dpdt contacts.)
*S1—rotary switch, 2 poles, 7 positions (Mallory 3229J or equivalent)
*S2—lever switch, 4 poles, double throw (Centralab 1457 or equivalent)
*S3—lever switch, 4 poles, double throw (Centralab 1457 or equivalent)
T1—output transformer: primary, 2,000 ohms; secondary, 4 ohms (Universal output transformer used in reverse)
T2—driver transformer: primary, 10,000 ohms; secondary, 2,000 ohms, ct (Lafayette TR-98 or equivalent)
T3—output transformer: primary, 400 ohms, ct; secondary, 3.2 ohms (Lafayette TR-109 or equivalent)
V1, V2—CK722
V3, V4—2N109
*Speaker, 3.2 ohms, 5-inch diameter
Speaker, 3.2 ohms, 5-inch diameter (for door station)
*†Case, for remote station, 7 x 5½ x 3 inches (Lowell P35X or equivalent)
*†Panel, for remote station, 8¾ x 7¼ inches (Lowell C5XD or equivalent)
†Case, for door unit, 7 x 5½ x 3 inches (Lowell P35X or equivalent)
†Panel, for door unit, 8¾ x 7¼ inches (Lowell C5RX or equivalent)
Chassis, for amplifier, 1¼ x 6⅛ x 3 inches
Case, for amplifier and relays and batteries, 16 x 6½ x 3 inches or larger
***For each indoor remote you will need one of each of these components.**
†These units are made by Lowell (Lowell Mfg. Co., 3030 Laclede Station Rd., St. Louis 17, Mo.) as well as other manufacturers. The units specified have a brushed-brass finish. A variety of other arrangements are available, in assorted colors. It might be wise to get the manufacturers catalog and select units to suit your decor.



Circuit of the intercom amplifier, switching circuits, a remote station and the door station.

exchange relays, the output signal may be fed to any desired station.

Now let's assume someone at Station 4 wants to call someone at Station 6. He sets his selector switch to 6 and depresses his talk button. Three things happen: First, his speaker is connected across the input of the amplifier and disconnected from its normal position on its output relay. Second, P is grounded, energizing the two relays which supply current to the amplifier. Finally, leads A and C are grounded through the selector switch, activating RY1, RY4, RY5 and RY6 in the control cabinet. These channel the output of the amplifier to the speaker of Station 6.

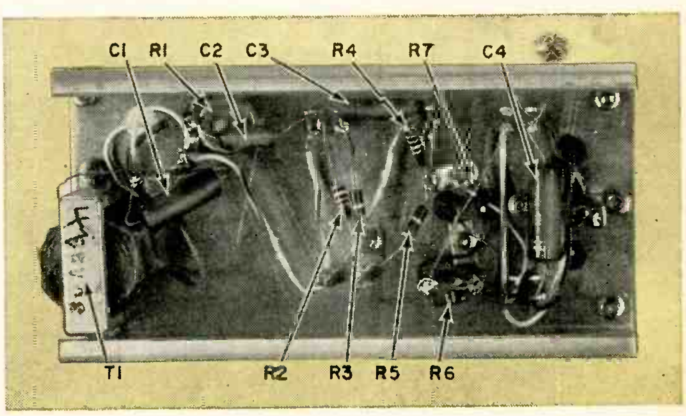
If the doorbell rings, the person answering switches the nearest station to 7 and depresses the talk button to be heard outside the front door. To hear a reply, he has merely to push his DOOR MONITOR button. This sends power to the amplifier, connects his speaker through the exchange relays to the amplifier output, and connects the door station through RY7 to the amplifier input. The DOOR MONITOR button eliminates the need for any controls on the front-door unit.

By now you should be familiar enough with the switching circuit to see that only one two-way conversation can be handled at a time. However, this disadvantage is balanced by the facts that only eight-conductor cables are needed from the masters to the control cabinet, and that there is only one amplifier to power.

The greatest advantages of the binary exchange circuit are in a system with many stations. This 7-station system requires 3 wires to operate the exchange relays. A 64-station, all-master system would require only 6 wires to operate the relays. There is, though, a practical limitation—a 64-station system would require 63 spdt relays.

Transistor amplifier

The four-transistor amplifier uses CK722's for the first two stages and 2N109's in the push-pull output circuit. Its reproduction fidelity is equal to that of most three-tube intercom amplifiers. (If desired, the unit can be made into an interesting and good-sounding phono amplifier simply by removing the input



Closeup view of the underside of the amplifier chassis.

transformer and connecting a magnetic cartridge in its place.)

The amplifier is built on a 1¼ x 6⅛ x 3-inch aluminum chassis which is placed in the control cabinet after assembly. Follow the schematic, keeping output leads as far as possible from the input. Mount the transformer cores at right angles to one another to minimize inductive feedback. Be careful when soldering to the transistor sockets. Beads of solder may form between the closely spaced prongs.

Use heavy wire (preferably two lengths of No. 18 run parallel) in the circuit connecting the amplifier to BATT 2, and keep BATT 2 as close to the amplifier as possible. The use of light wire or an attempt to use just one 6-volt battery may cause the amplifier to oscillate.

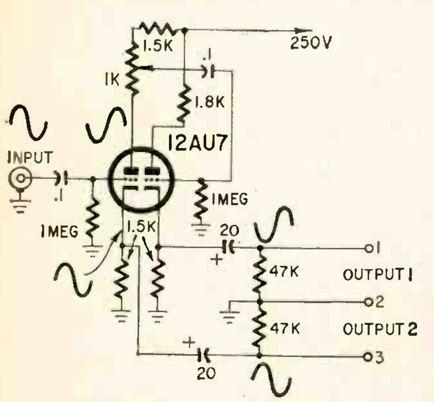
Bend the relay springs a little so the relays will pull in even after the batteries start weakening. Mount all relays on an insulator such as wood or Plexiglas. Because their armatures are internally connected to their mounting brackets, assembling the relays on a metal chassis would, in effect, connect all the armatures together. As was stated earlier, dpdt and three-pole double-throw relays may be used instead of the parallel spdt units. However, multicontact relays as sensitive as the spdt types used here (50 mw) are expensive.

All connections to the control cabinet are made by running the cables in through holes in the top and fastening them to the barrier strips inside. Two adjacent terminals should be used for each of the A, B, C, D, P and input and ground wires to reduce congestion at the barrier strips. Leads from the relays to the amplifier are routed by way of the terminal strip to facilitate later removal of relay bank or amplifier. END

DUAL CATHODE FOLLOWER

Sometimes we need a way of reversing the polarity of a low-impedance signal or supplying two equal signals 180° out of phase from low-impedance sources. Here is a circuit from *Revista de Information Electronica* (Madrid, Spain) that does the trick.

Phase relationships are shown on



the diagram. The input triode is a phase splitter and cathode follower. The 1,000-ohm potentiometer is used to balance the outputs. Balance can be checked with an audio vtvm or scope.

SW PROPAGATION FORECAST

May 15–June 15 **By STANLEY LEINWOLL***

Scientists of the Central Radio Propagation Laboratory (CRPL) of the National Bureau of Standards have after 5 years of research, successfully applied digital computer techniques in preparing the world contour maps that are used to predict short-wave radio propagation conditions.

These new methods, which will be available for general use in several months, are expected to increase the accuracy of high-frequency propagation predictions. The data in the tables below, derived from the basic contour maps published regularly by the CRPL, show the optimum frequency in megacycles for propagation of short-wave signals between the locations shown during the time periods indicated.

To use the tables, select the one most suitable for your location, read down the left side to the region in which you are interested, then follow the line to the right until you are under the appropriate time. (Time is given at the top of each table in 2-hour intervals from midnight to 10 pm, *in your local standard time.*) The figure thus obtained is the optimum working frequency, in megacycles. The best band for the particular service in which you are interested is the one nearest the optimum working frequency.

For example, a resident of San Francisco would use the Western USA table. At noon, Pacific Standard Time, signals to and from the Far East would be optimum in the 13-mc band. A radio amateur would be most likely to establish communications in the 20-meter (14-mc) band, while a listener would first try the 11-mc broadcast band, and follow this with the 15-mc band.

The tables are designed to serve primarily as a general guide, since day to day variations in receiving conditions can be considerable. At certain hours, propagation over some of the paths given in the tables may be extremely difficult, or impossible. This will depend on the type of service, antenna characteristics, radiated power of the station, etc. The curves from which the data in the tables in derived are based on an effective radiated power of 10 kw.

EASTERN US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	8	8	8	10	11	12	12	13	13	13	12	10
East Europe	8	8	8	9	10	11	12	12	12	11	9	8
Central America	12	10	11	13	15	15	16	17	16	15	14	13
South America	12	9	12	15	17	17	17	17	17	16	14	13
Near East	8	7	8	10	11	12	12	13	13	12	11	10
North Africa	8	7	8	11	12	13	13	14	14	14	12	10
South & Central Africa	7	9	10	13	15	16	16	16	15	14	8	8
Far East	9	8	8	8	10	11	11	11	12	12	11	10
Australia & New Zealand	12	11	11	10	10	10	9	15	18	18	18	15

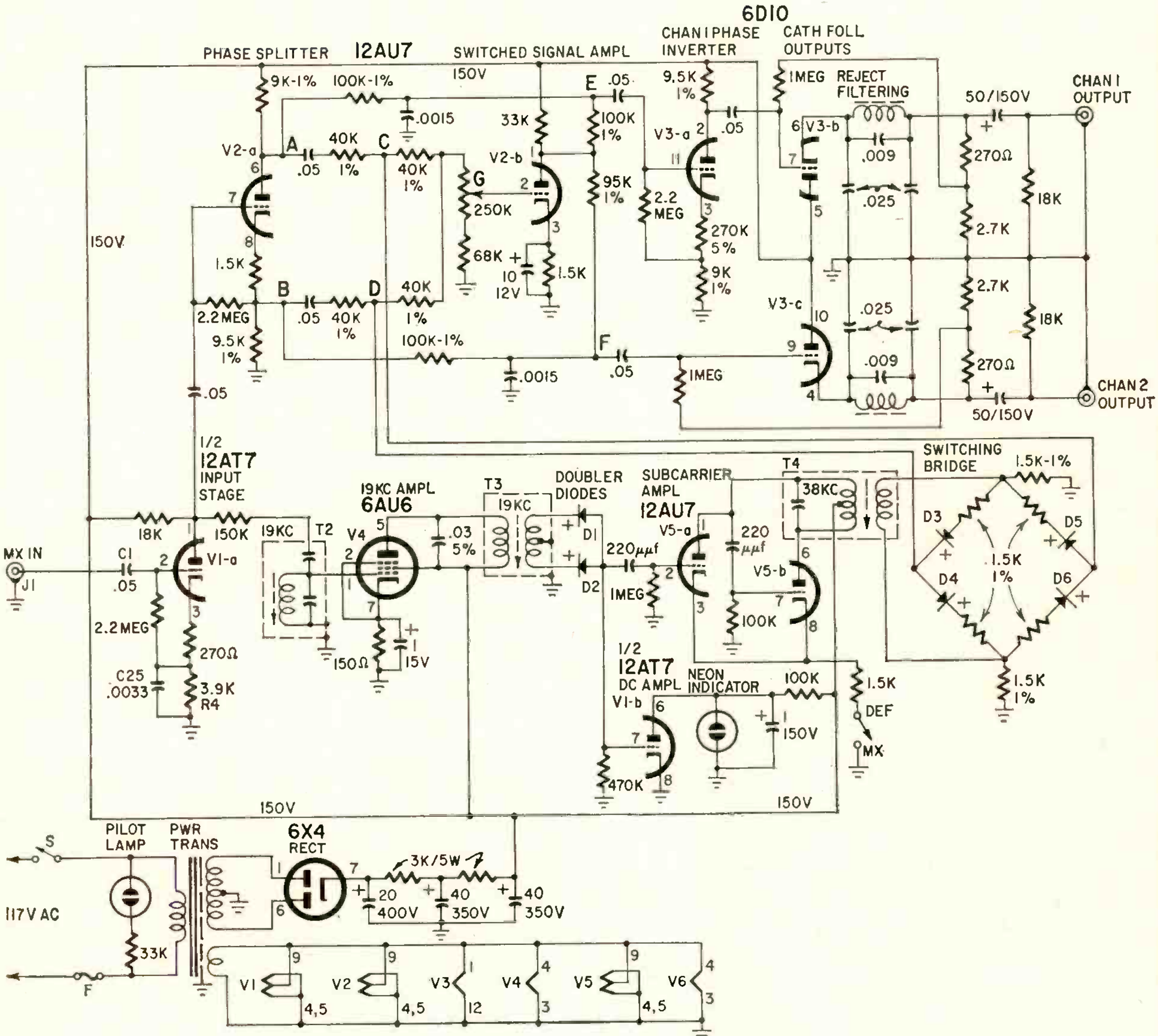
WESTERN US to:												
West Europe	8	7	9	11	12	12	12	13	13	11	10	8
East Europe	8	8	8	11	11	12	12	12	11	10	10	10
Central America	13	11	10	13	15	15	16	17	17	16	15	13
South America	9	10	15	16	17	17	17	17	15	14	13	13
Near East	8	9	10	11	12	13	13	13	11	11	9	9
North Africa	7	9	11	12	12	13	13	13	12	11	10	8
South & Central Africa	8	10	12	13	13	14	14	15	15	13	10	8
Far East	9	7	9	12	11	12	13	13	13	14	13	11
Australia & New Zealand	12	12	10	10	10	16	18	19	18	17	13	13

CENTRAL US to:												
West Europe	8	8	8	10	11	11	12	12	11	10	9	9
East Europe	7	7	7	8	10	10	10	10	10	9	9	9
Central America	13	11	12	15	17	18	19	19	19	18	15	13
South America	10	8	10	15	16	17	17	17	16	16	14	12
North Africa	7	7	8	10	11	12	12	12	12	11	10	9
South & Central Africa	9	8	10	13	13	14	14	13	11	8	8	9
Far East	13	13	9	9	12	12	13	14	14	14	14	14
South Asia	12	9	8	9	12	12	12	12	12	13	13	13
Australia & New Zealand	13	13	11	10	10	14	19	20	20	20	20	16

*Radio-frequency and propagation manager, RADIO FREE EUROPE.

MORE circuits for FM STEREO

By NORMAN CROWHURST

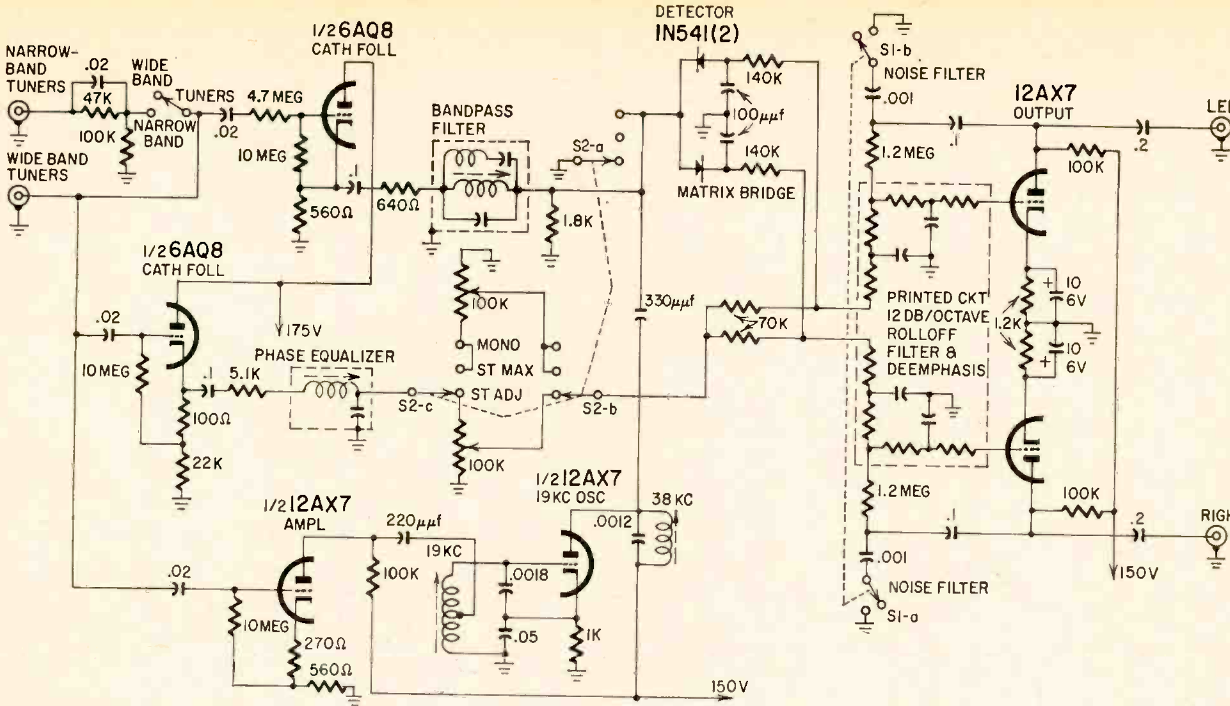


THE HEART OF THE EICO MX99 IS A MODified "switching" circuit. First the input is fed to a stage giving about 13.5-db gain with an input impedance of about 10 megohms. C25 provides compensation at the extreme high end (from 20 kc up). C1 isolates the dc voltage due to R4. The composite signal is fed to V2-a, a phase splitter, to produce antiphase signals at A and B. The 19-kc pilot is separated by T2 and amplified by V4. Then it is frequency-doubled by D1 and D2 connected to T3's secondary to produce a pure 38 kc.

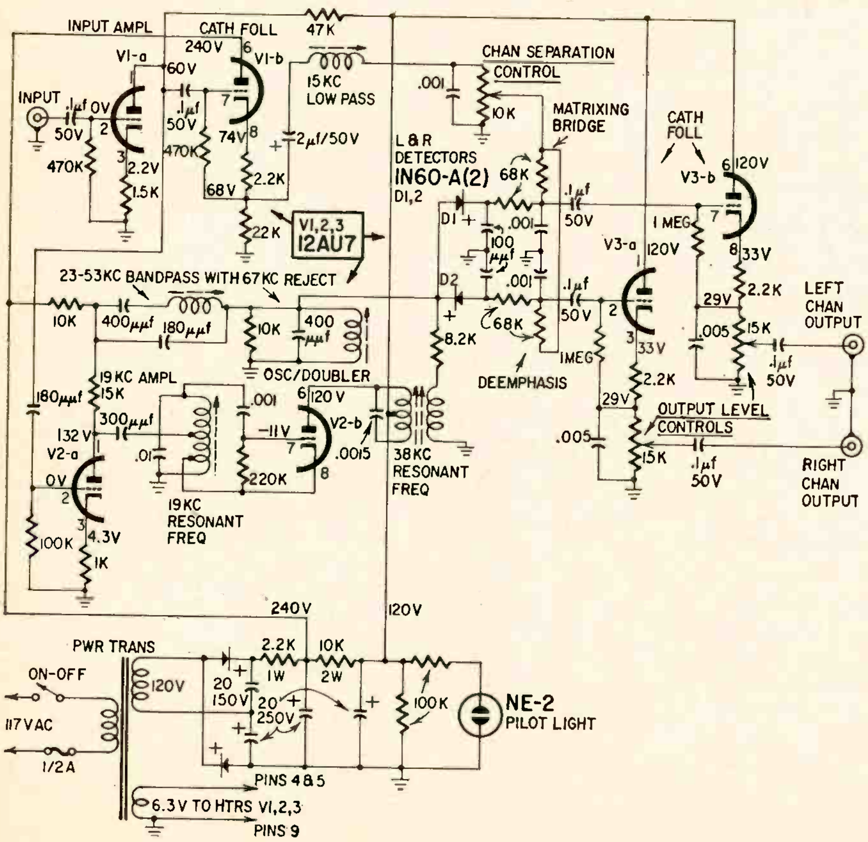
This is amplified by V5 and fed to the switching bridge through T4. The switching bridge short-circuits points C and D to ground during alternate half-cycles of the 38-kc regenerated subcarrier. So the grid of V2-b (G) is fed with composite signal, reversed in phase every half-cycle of the 38-kc subcarrier.

Here it is amplified and combined separately with the voltages at A and B, to produce left and right outputs at E and F. When the bridge momentarily short-circuits point C, the signal fed to V2-b grid comes from point B. When this is phase-reversed (in V2-b), it will cancel the signal directly from B to F, so that F has zero output, while E receives an augmented output during this half-cycle of 38 kc.

The nulling action at points E and F also nulls the 67-kc SCA (Subsidiary Communications Authorization) subcarrier if it is present, without any need for a frequency-selective filter. V3-a is a phase inverter to reverse the phase of output E, because the two channels are in phase opposition at E and F. V3-b and V3-c are cathode-follower outputs, with filtering included to reject the switching products resulting from combining A, B and amplified G (which is square-wave switched) at E, F. The voltage change on D1 and D2 when 19 kc is present is used to change the bias of V1-b and thus light the neon to indicate that stereo is being received.

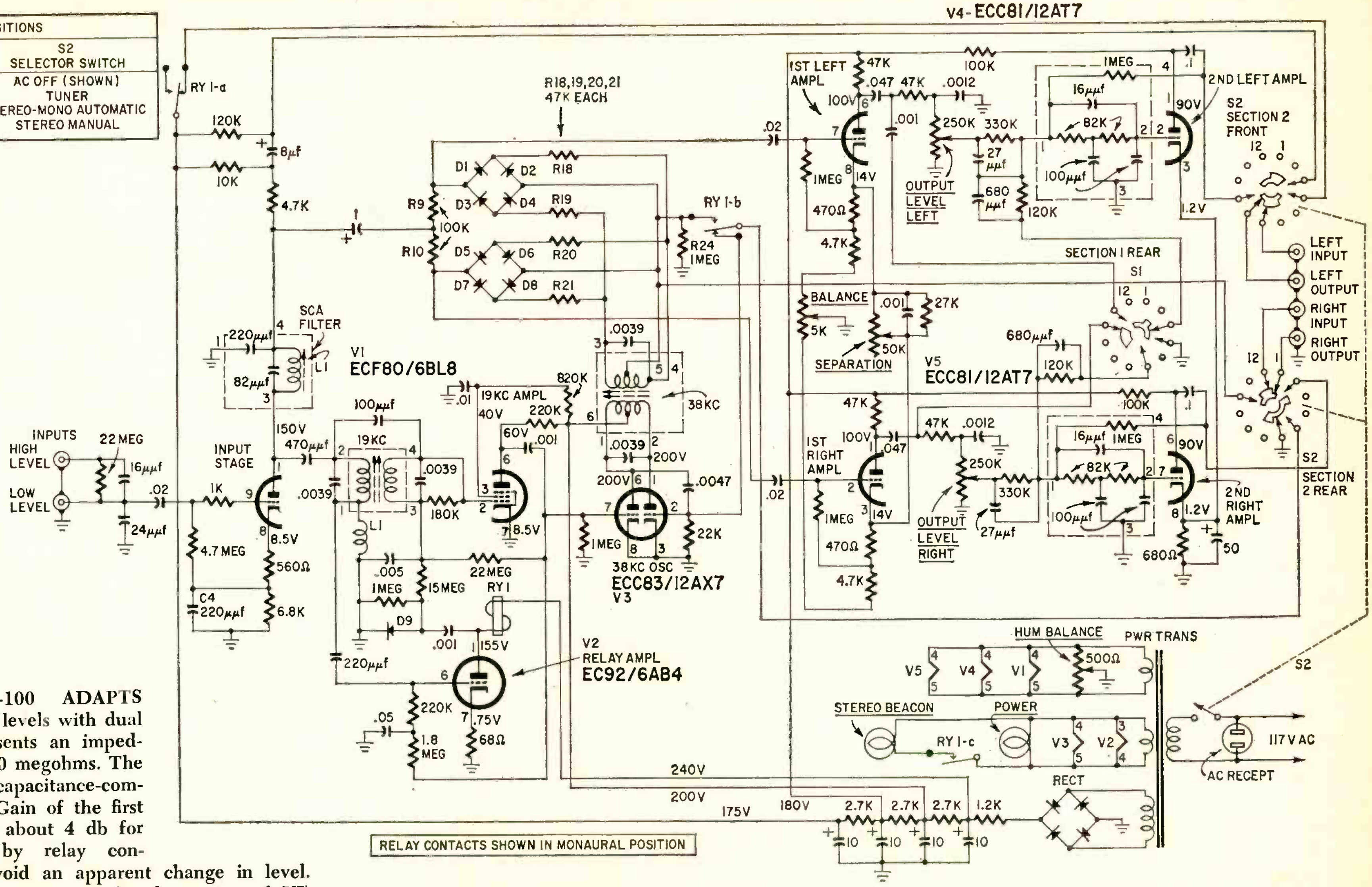


THE PACO MX100 HAS INPUTS with and without compensation, to accommodate narrow- or wide-band tuners. The input then feeds three stages in parallel, two cathode followers and an amplifier. One of the cathode followers feeds a low-pass filter with phase equalization or adjustable response. The other feeds a bandpass filter to select the L − R sidebands. The amplifier stage locks the 19-kc oscillator, which has a 38-kc tuned circuit in its plate. This plate is capacitance-coupled to join the output of the bandpass filter in feeding oppositely phased diodes to demodulate the L − R signal. The low-pass filter terminates in a semi-fixed or a fully adjustable separation control that varies the L + R fed to the matrixing bridge. The outputs from the matrixing bridge feed the grids of the output amplifier stages through printed circuit filters providing de-emphasis and 12 db/octave rolloff (above 15 kc).



HEATH'S AC-11 ADAPTER HAS A conventional linear input amplifier stage, which feeds a further amplifier stage for the 19-kc selector circuit, and a cathode follower to feed the composite audio into its matrixing arrangements. The further amplifier stage synchronizes a 19-kc oscillator, whose plate circuit has a 38-kc tuned-circuit transformer, coupling into the L − R detector circuit. The output from the cathode follower feeds a low-pass filter (15 kc) with a separation control on its L + R output, and also a bandpass filter with SCA reject of conventional design, also feeding into the L − R detector circuit. This uses oppositely phased diodes which feed the matrixing bridge. Mixes of L + R and L — R from the matrixing bridge feed the cathode-follower outputs. A capacitor directly across each bridge output provides de-emphasis.

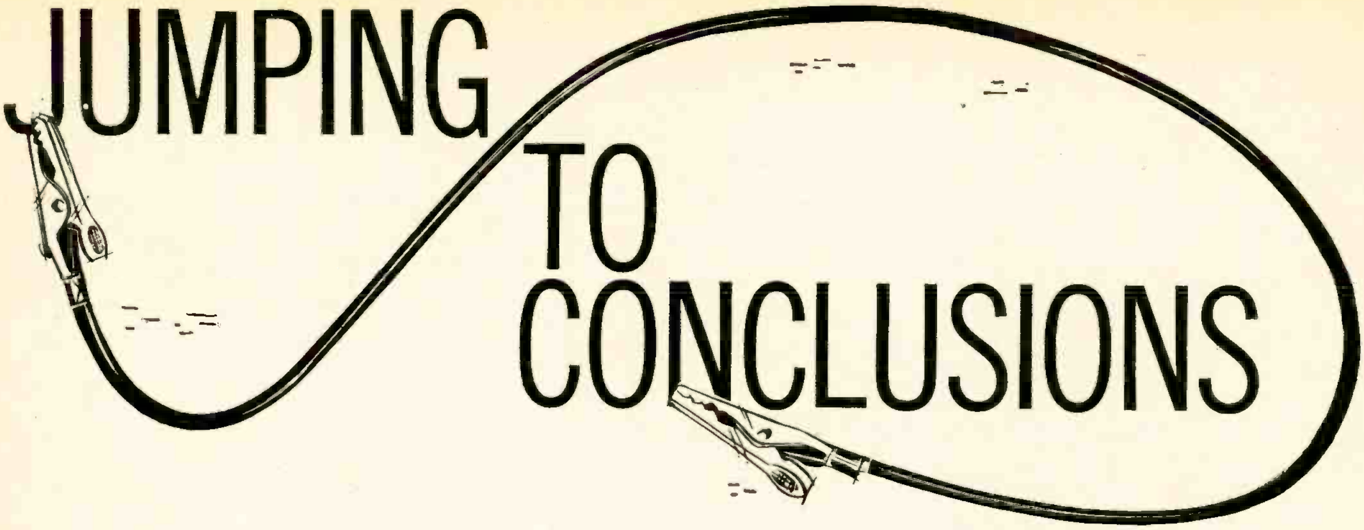
	S1 FILTER SWITCH	S2 SELECTOR SWITCH
	SWITCH POSITIONS	
1	OFF (SHOWN)	AC OFF (SHOWN)
2	1	TUNER
3	2	STEREO-MONO AUTOMATIC
4		STEREO MANUAL



FISHER'S MPX-100 ADAPTS for different input levels with dual inputs. Each presents an impedance better than 20 megohms. The voltage divider is capacitance-compensated by C4. Gain of the first stage is increased about 4 db for stereo listening by relay contacts RY1-a to avoid an apparent change in level. The plate-circuit input stage (triode section of V1) filters out SCA in coil L1. The 19-kc pilot is fed to the pentode section, which applies it to synchronize V3, the push-pull 38-kc oscillator. At the same time, changes in operating conditions due to the 19 kc, alter bias on V2, triggering relay RY1. With S2 set to STEREO-MONO AUTOMATIC, contacts RY1-b short one grid of oscillator V3 in mono, leaving the switching-bridge ground connection "open" (through R24).

In stereo, the same contacts short the right side of the bridges to ground and allow the oscillator to operate, delivering a switching voltage through current-limiting resistors (R18 through R21) to the bridges. This short-circuits the signal fed through R9 and R10 to V4 and V5 on alternate half-cycles, separating left and right to these two channels. Common-cathode connections, with adjustments, provide separation and balance control. After level controls, feedback filtering over the second half of V4 and V5, right and left output is delivered to the output jacks. The switching is such that, in the "off" position (shown), left and right inputs are connected directly to left and right outputs.

For mono, opening the ground connection at the right side of the bridges stops the switching operation, and allows the same signal to be fed to both V4 and V5 simultaneously, through R9 and R10.



JUMPING TO CONCLUSIONS

Twelve ways to use jumpers to speed TV repairs

By MIKE WAYNE

EXPENSIVE TEST APPARATUS IS NEEDED for many jobs in the TV service shop. Sometimes, though, properly used inexpensive equipment is faster and more accurate than the electronic wonders. This is true of the jumper wire, not very expensive at best, but a most versatile piece of test equipment. Besides the obvious uses of substituting parts, connecting test speakers, etc., there are many other ways to use this piece of wire with a clip on either end. Let's look at a few examples.

No high voltage

The horizontal amplifier tube is red hot. You suspect the oscillator, but is it the primary cause? A faulty phase-detector circuit could be causing the oscillator to run off frequency or not at all. Take a jumper and ground the sync input grid (Fig. 1). High voltage come back on? Then you have trouble in the phase detector. Better check the diodes or coupling capacitors. (Incidentally, you can ground the grid from the top of the chassis if you use a test adapter socket.)

Unstable horizontal oscillator

Let's now suppose you have a horizontal oscillator (multivibrator) that tends to take off; drops out of sync at the slightest provocation or wiggles, jiggles or otherwise cuts up. Better check to see that the oscillator circuit is adjusted properly. How? Connect a jumper across the ringing coil. Connect another from the sync input grid to ground. Now adjust the horizontal hold control until the picture floats by slowly. Remove the jumper from the ringing coil. Adjust the ringing coil until the picture again floats by. Remove the jumper from the sync input grid. Unless you have troubles in the circuit, the oscillator should now work perfectly. If the oscillator quits working with a jumper across the ringing coil, increase the size of R in Fig. 2 to 10,000 ohms and leave it in the circuit.

Horiz oscillator squegging

Let's say you have a gunboating (squegging) Synchroguide horizontal oscillator. You're in the home with no scope. You can make a fairly satisfactory adjustment with the help of a couple of jumpers.

Remove the sync signal by grounding it out with a jumper. (The grid of the sync clipper tube is usually a good place.) Connect another jumper across the phase coil (L2 in Fig. 3).

Adjust the horizontal frequency slug (L1) until the picture floats by (center the resistance control if there is one). Now remove the jumper from across the phase coil and adjust the phase coil until the picture again floats by. Unground the sync circuit. If the oscillator and control have no defective parts, the picture should lock in with virtually no instability. If it doesn't lock in you can start looking for defective components.

Got a sync problem?

The sync clipper is one of those combination sync clipper and noise-cancelling circuits using a 6BU8, 6CS6, etc. You realize that the trouble could be something in the noise-cancelling cir-

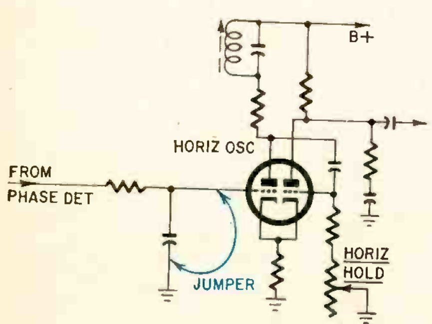


Fig. 1—Jumper divides the circuit. Determines whether phase detector is causing oscillator malfunction.

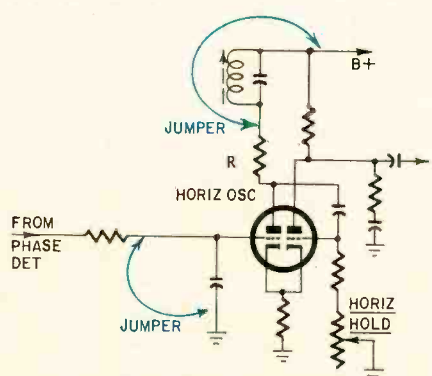


Fig. 2—Horizontal multivibrator adjustment is simplified with two jumpers.

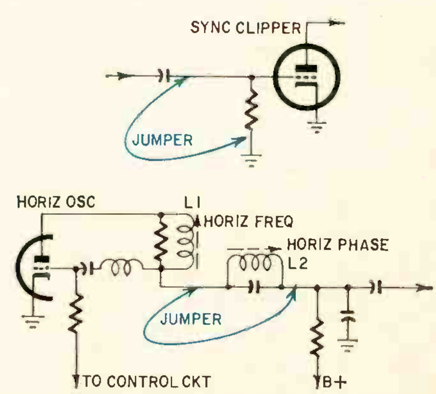


Fig. 3—Emergency adjustment of Synchroguide without a scope.

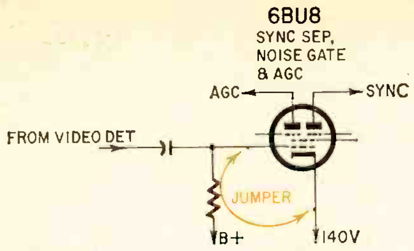


Fig. 4—Disabling the noise clipper.

cuit. How will you find out? You guessed it, a jumper! Connect it from the noise grid to cathode as shown in Fig. 4. This disables the noise canceller. If the sync still acts up, then you can concentrate on the sync-clipping portion of the circuit.

No agc voltage

It's a keyed agc circuit. Use a jumper here? Sure! Connect it from the grid

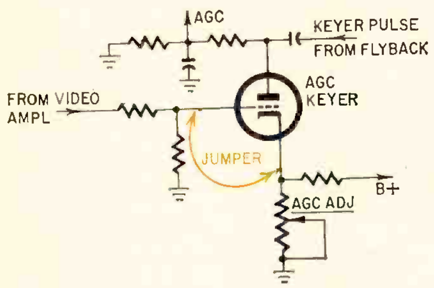


Fig. 5—Artificially keying an agc tube.

of the keyer to the cathode, as shown in Fig. 5. This zero-biases the keyer and you should have several volts negative on the plate of the keyer. If you don't, you have trouble in the keyer tube circuits, or else the keyer pulse isn't reaching the plate. On the other hand, if you *do* have negative voltage now, it's a sure sign that you have trouble in the biasing circuit and you know which way to look.

Sound bars

When you turn up the volume, do sound bars appear in the picture? Connect a jumper across the speaker voice coil (Fig. 6). Why? This will kill the speaker output. If you still have sound bars, you know it is probably improper bias or filtering in the audio circuits.

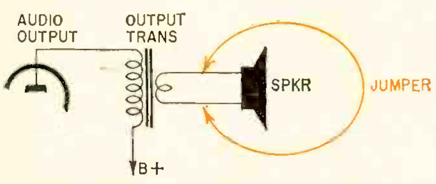


Fig. 6—Isolating the cause of sound bars.

If the sound bars are diminished, then something is loose or a tube is microphonic and the sound from the speaker is disturbing it.

Snowy picture

This is often caused by excessive (negative) agc voltage to the tuner because of an open delay resistor, R in Fig. 7. Check for this by connecting a jumper from the tuner agc terminal to ground. Clear the trouble? Then you

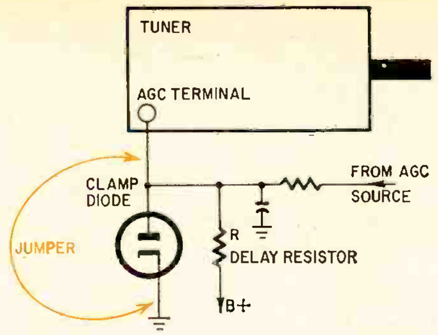


Fig. 7—Grounding agc to check delay resistor.

have excessive agc. Still snowy? Then the trouble is in the rf amplifier circuit or antenna.

No vertical deflection

Is it in the output stage or the oscillator? A jumper from the heater winding (hot side) to the output grid will produce deflection (distorted though it

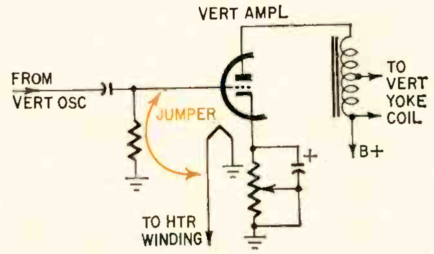


Fig. 8—Checking vertical output stage.

is) if the output stage is operative (Fig. 8).

(In circuits where the bias would be upset drastically by a direct jumper, use a 0.25-μf capacitor in series with the jumper or, better still, make up a capacitor jumper.)

Bright vertical bars

They're in the raster. Is it sweep trouble or are they being introduced into the video? A jumper tells you which. Simply short out the video input (Fig. 9). If the raster clears, you know you have either trouble in the video circuit or radiation from an unshielded flyback circuit. If the lines don't go

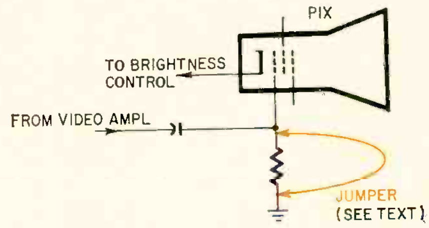


Fig. 9—Checking video troubles.

away, you have a horizontal sweep problem. Maybe a ringing yoke.

Fixed brightness

The brightness control has no effect. The picture tube checks OK. A jumper

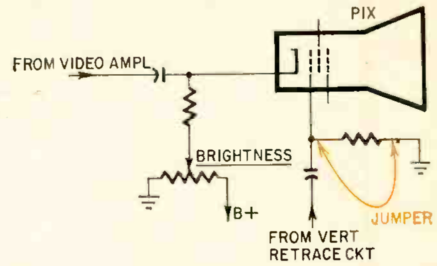


Fig. 10—Checking to see if retrace circuit is causing brightness control malfunction.

from grid to ground in the circuit of Fig. 10 will eliminate the vertical retrace circuit as a source of trouble. (It's often caused by a shorted capacitor in that circuit.)

Distorted sound

You suspect a leaky coupling capacitor—C in Fig. 11. You'd like to check it without disconnecting it first. Place a meter across the cathode resistor. Now ground the control grid with a jumper wire. Voltage go down? The capacitor

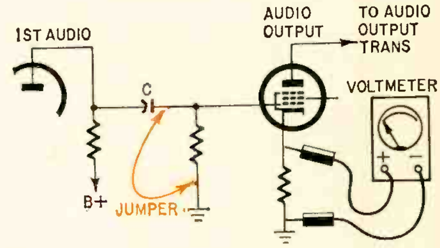


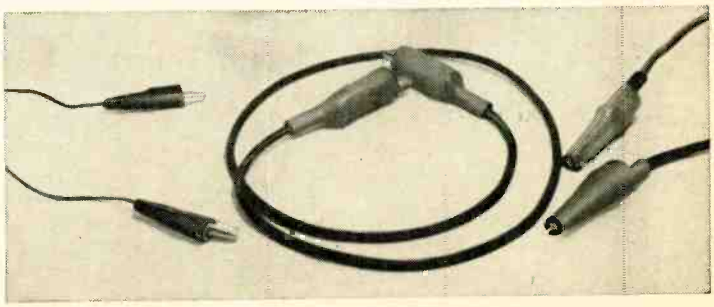
Fig. 11—Checking for leaky coupling capacitor.

is defective (leaky) since it is obviously causing the tube to draw more current.

High-voltage shock

Dislike getting shocked when you disconnect the picture-tube anode lead? This often happens even though you have shorted it out once or twice with a screwdriver. Connect a jumper, first to ground and then to the anode lead—you can't get shocked and even the most timid soul shouldn't be squeamish about removing the lead.

Of course this short article doesn't cover everything a jumper can be called upon to do (even a big book probably wouldn't hold all that could be written about the remarkable jumper), but it's a start—you take it from there. END



These simple jumper wires can save the technician a lot of time.

TV Camera You Can Build

Part II—How it works and how to wind the deflection coils

By W. E. PARKER

LAST MONTH WE PRESENTED COMPLETE construction details of a closed-circuit TV camera you can make for yourself. Complete alignment and setup instructions were also included. This month we will describe how the camera operates and, as promised, give construction details for the yoke and focus coil. If you make these units yourself, you can cut up to $75 off the total cost of the camera.

Circuit description

Before going into the circuit, let's examine the diagram (Fig. 1.) The camera has four main sections—video amplifier, deflection stages, modulator–oscillator, and the power supply.

The four-stage video amplifier (V2-a, b; V3-a, b) amplifies the weak signal from the signal electrode of the camera tube. The vertical (V5-a and b) and horizontal (V6, V7-a and b) deflection stages provide the necessary waveshape and currents to drive the deflection yoke that causes the electron beam to scan the photosensitive screen in the camera tube. The modulator–oscillator (V4) provides the rf carrier that is amplitude-modulated by the output of the video amplifier. A transformer-operated power supply with silicon rectifiers provides the three operating voltages used in the camera.

Note that blanking and sync pulses come from the deflection section of the camera.

Video amplifier

The video amplifier section V2 and V3 (Fig. 1.) is not to be confused with a video if strip. The bandpass of the video amplifier is from approximately 10 cycles to 3.7 mc. A video if amplifier must be aligned because of the tuned transformers and usually operates at much higher frequencies (26 mc, 45 mc, etc.). Peaking coils help extend the upper frequency limit of the TV camera video amplifiers. L1, L2 and L3 help reduce the effect of stray and shunt capacitances that attenuate the higher video frequencies. Fine picture detail depends on the response of the video amplifier to higher frequencies.

To help compensate for high-frequency attenuation, a very low-resistance plate load resistor, R16, is used in the plate circuit of V3-a. Peaking coil L2 gives this amplifier stage a rising output characteristic with rising frequency. Additional high-frequency signal amplification is provided by C14. Two dual-section 6BR8-A tubes are used in the four-stage video amplifier section.

The output level of the vidicon for picture highlights is 1 to 5 mv. With a gain of about 300 in the video amplifier stages, this produces about 1 volt of signal for the grid of the modulator-oscillator section.

Modulator–oscillator

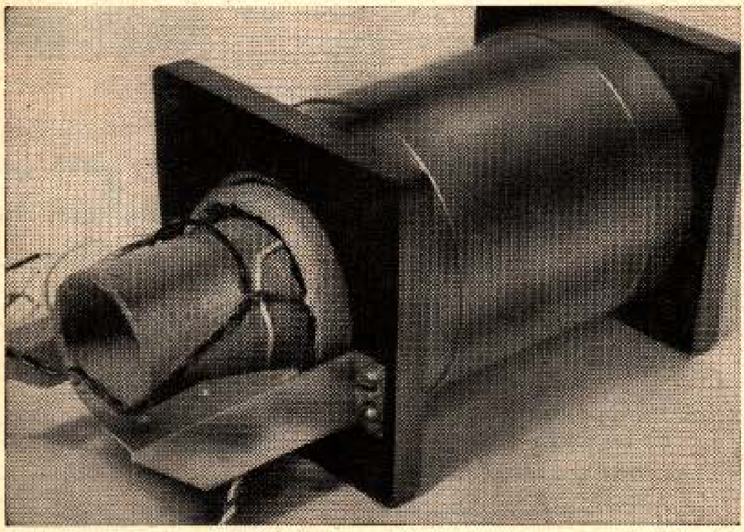
One half of a 12AT7 is used in a Hartley oscillator tunable from 54 to 88 mc. Slug-tuning L4 varies the oscillator frequency.

Rf from the oscillator is fed through C18 to the cathode of V4-a. The amplitude of the video signal on the grid of V4-a determines the amplitude of the rf on the modulator plate. The video signal is also on the plate of this tube. It may be connected to a TV monitor not requiring the rf section of a normal TV set or to a video modulator to modulate a ham TV transmitter.

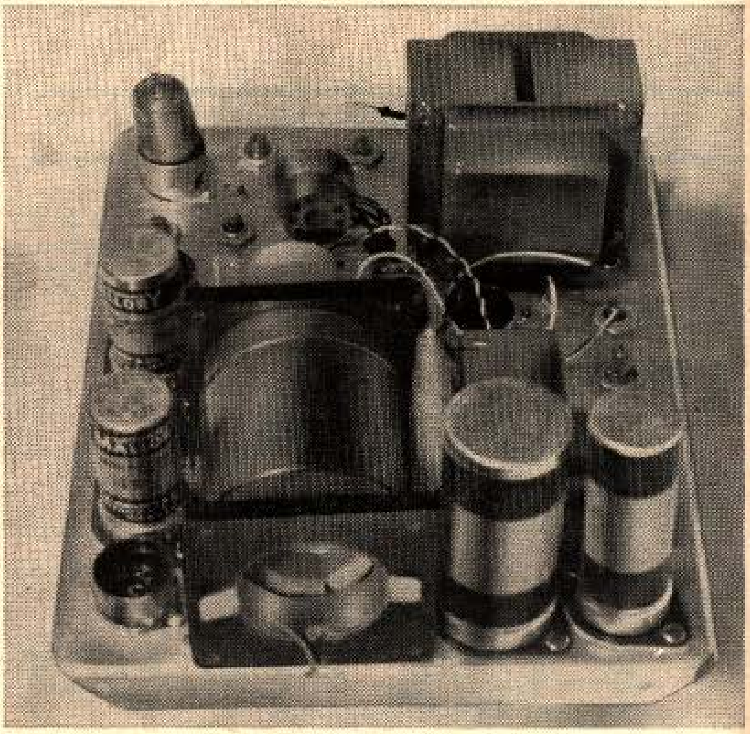
Vertical scanning

A nearly sinusoidal 60-cycle voltage from the power transformer is shaped by a shunt clipper and a short-time-constant R-C network consisting of C25 and R29. The vertical discharge section (V5-a) is similar to that in

The completed focus coil-yoke assembly ready to be slipped over the vidicon. Two aluminum brackets are for clamping vidicon and yoke assembly in position.



How the focus coil-yoke is positioned on the camera chassis.



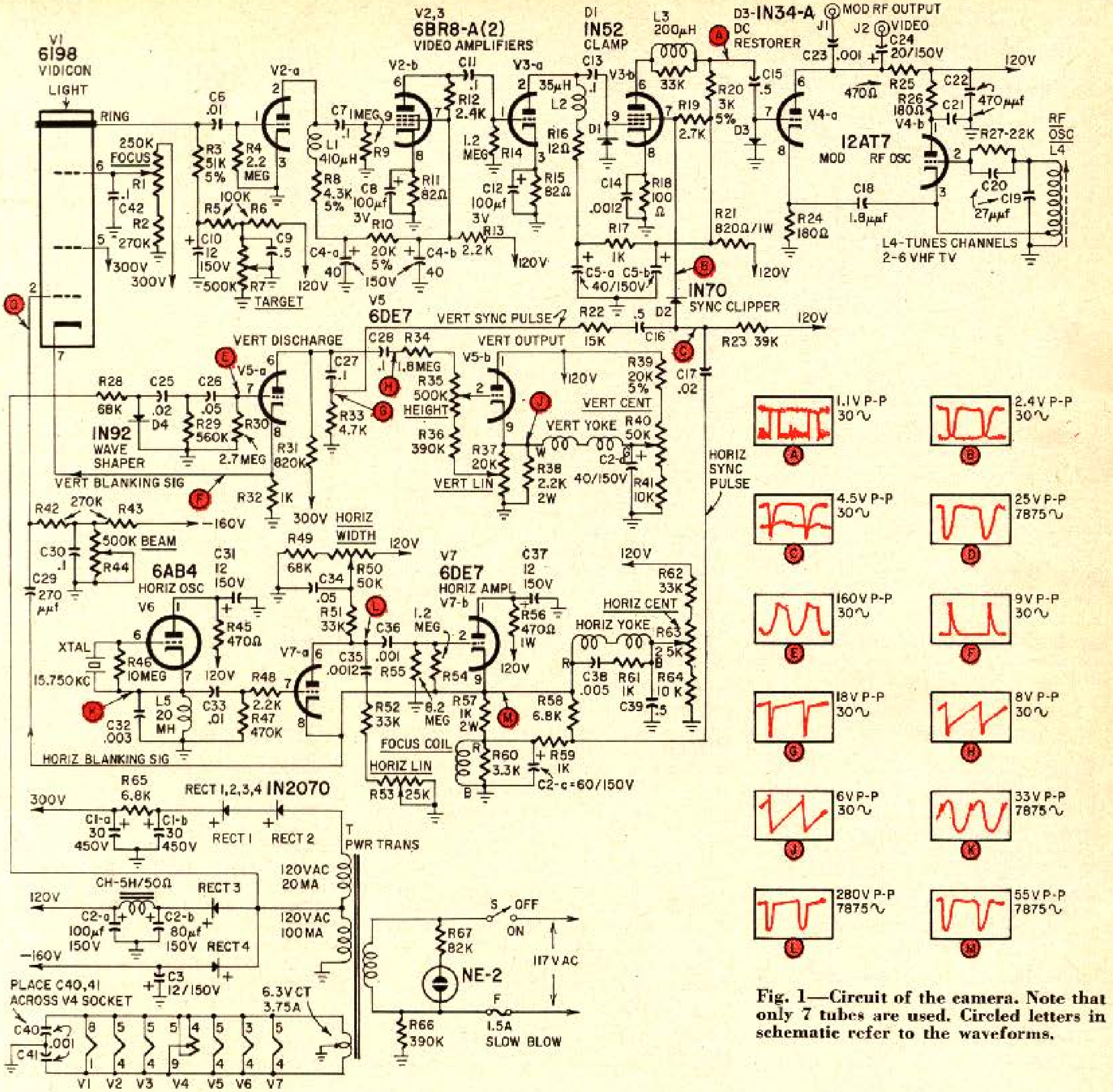


Fig. 1—Circuit of the camera. Note that only 7 tubes are used. Circled letters in schematic refer to the waveforms.

TV receivers, except that it is *not* in a self-oscillating circuit (a blocking oscillator or a multivibrator).

The proper sawtooth waveform is generated across C27 and R33. The other section of V5 is a cathode follower that supplies scanning current for the vertical deflection coils in the vidicon deflection yoke. R35 controls the amount of scanning current that flows to the yoke. R37 is the vertical linearity control. R40, the vertical centering control, sets the amount of direct current that flows in the yoke and thus positions the electron beam vertical on the target of the vidicon.

A positive-voltage pulse taken across R32 is applied to the cathode of the vidicon for vertical blanking. It cuts off the scanning beam during vertical retrace.

A negative pulse taken across R33 is fed to the sync clipper to provide the vertical sync pulse.

Horizontal scanning

The two sections of the 6DE7 are connected as a cathode-coupled multivibrator. The deflection coils are in the cathode circuit of the output section. Scanning width is controlled by R50, horizontal linearity by R53. The horizontal scan is centered with R63. There is some interaction between the horizontal linearity and the horizontal width controls.

A crystal-controlled oscillator locks the horizontal multivibrator to 15,750 cycles. An alternate circuit is shown in Fig. 2. It reduces the number of tubes from seven to six, including the vidicon pickup tube.

A negative pulse taken across R57 is connected through C29 to the vidicon grid for horizontal blanking. A negative pulse across R59 is fed to the sync clipper to provide the horizontal sync pulse.

Power supply

The power supply is very conven-

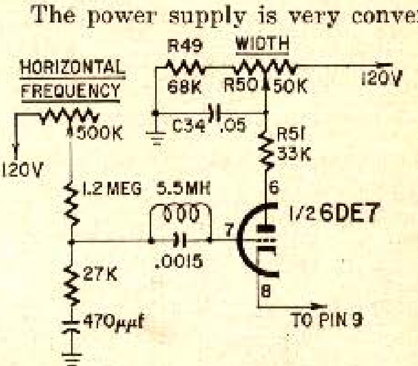
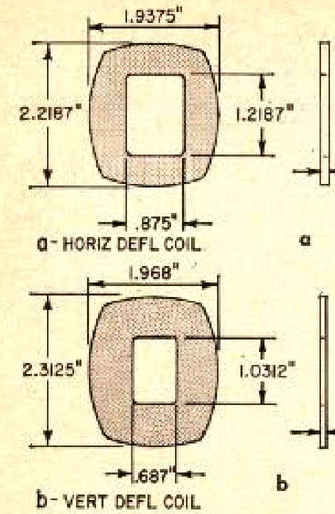


Fig. 2—Alternate to horizontal oscillator circuit eliminates one more tube.



Coil	Wire Size	Turns Per Coil	No. of Coils	Ohms Per Coil	Total Resistance	Turns Between Tie	Inductance 1,000 Cycles
Horizontal	#30	240 −0 +25	2	10	20	50	4.0 mh
Vertical	#36	600 −0 +50	2	102	205	120	51 mh
Focus	#32	6,500 −0 +500	1	325	325	...	...

Fig. 3—Outlines of the deflection coils and winding data for deflection and focus coils.

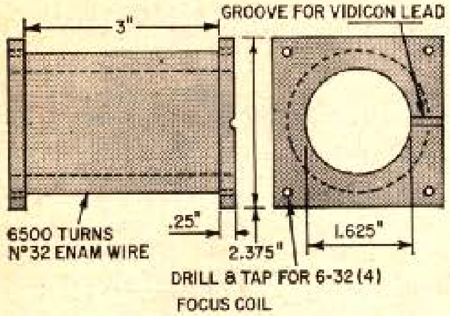


Fig. 4—Details of the focus coil form.

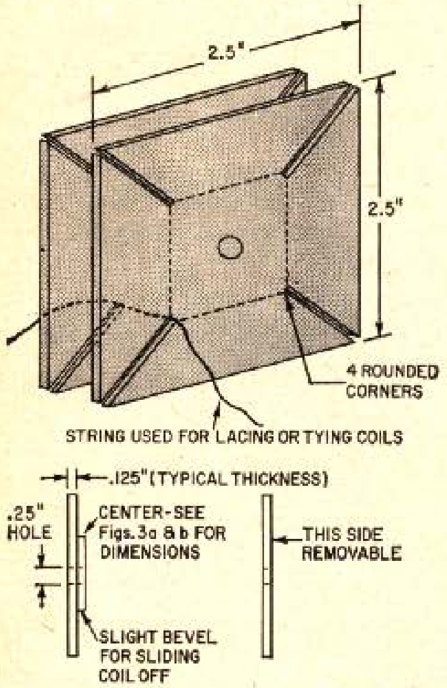


Fig. 5—Details of the form for the deflection coils.

tional. The voltages are not extremely critical and may be within 10% of those in Fig. 1. Filter capacitor C2 has four sections. Solder C40 and C41 across V4's socket for proper rf bypassing.

The electrostatic focus of the scanning beam is controlled by R1. The target or contrast of the picture is controlled by R7. The beam or brightness is controlled by R44.

A current surge through either the vertical or horizontal deflection coils (such as a momentary short circuit in the deflection circuitry) will deflect or position the scanning beam. Often this "shock deflection" exceeds the correction range of the vertical and horizontal positioning controls. Applying a reverse current surge will cancel the induced magnetism produced by the original unwanted current surge. This can be done by discharging a charged 0.1- to 0.5-μf capacitor across the deflection coils.

Underscanning the vidicon target area is not recommended as this leaves permanent raster edge marks on the vidicon target. Also, picture quality is degraded when smaller areas are scanned. When the camera scanning amplitudes are reduced, the size of picture on the monitor increases. This is a reversal of what happens when sweep or scanning adjustments are made on a TV receiver. Therefore, increasing camera scanning amplitudes produces a smaller image on the TV monitor. Move the camera closer to the subject if a larger image of the subject being televised is desired. Do not be tempted to reduce scanning amplitudes.

The camera is capable of 250 to 325 lines of resolution. It weighs less than 12 pounds. The rf output is approximately 100,000 microvolts. The camera consumes less power than a 60-watt light bulb. Convenient tripod mounting has been provided.

Making your own coils

As we explained last month, you can cut the cost of your camera sharply if you wind your own deflection and focus coils. Fig. 3-a shows the outline of the finished horizontal deflection coil. Fig. 3-b is the outline of the vertical deflection coil. The table in Fig. 3 gives winding data for the horizontal and vertical deflection coils. It also includes winding data for the focus coil.

The simplest coil is the focus coil. So we will cover its construction first. You'll need a coil form like the one in Fig. 4. You can use a cardboard tube (from a roll of Reynolds Aluminum Wrap, for example) as the core and make the end pieces of fiber, wood or Plexiglas. Now wind the coil. Some form of coil winder is recommended. You'll need 6,500 turns of No. 32 wire.

Once you've finished this comparatively easy part of the coil winding, put the focus coil on the side. Now make the coil forms for the deflection coils. Note that the forms are made of three pieces, two sides and a center (Fig. 5). Note also that each of the side pieces has four slots or slits cut into it. Before you start winding, place

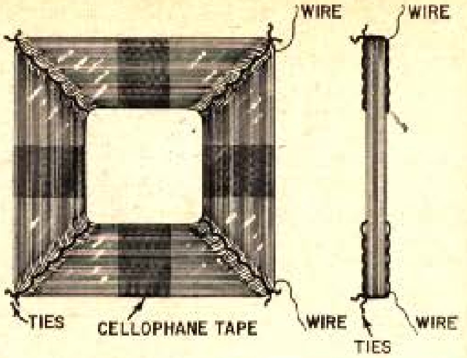


Fig. 6—Completed deflection coil after being removed from the winding form.

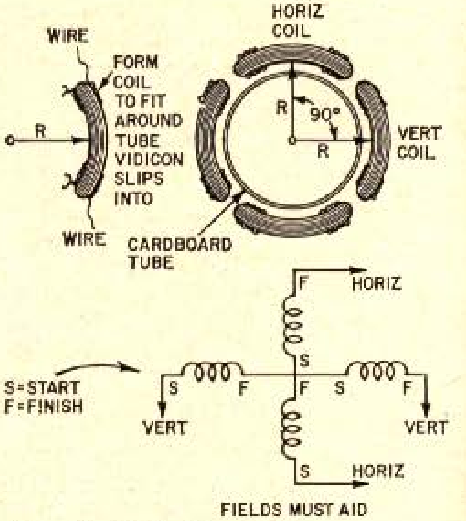


Fig. 7—Deflection coil arrangement.

a piece of string about 10 inches long in each of the slots. Then start winding. When you have wound 50 turns (for the horizontal coil), stop and tie the four strings, one at a time, around the winding completed so far. Then wind another 50 turns and tie again. Continue doing this until you have wound the necessary number of turns. Now take off the removable side of the form and slip off the coil. The ties will hold it in a thin flat disc, ready to be curved by hand around the cardboard tube the vidicon slips into. To simplify handling, wrap the sides of the coils with cellophane tape (Fig. 6).

Wind the vertical coils in the same way, only leave 120 turns between ties. You'll need two coils for the vertical section of the yoke and two coils for the horizontal section.

To assemble the coil assemblies you start with a 4 inch long cardboard tube large enough to fit over the vidicon, but not the glass exhaust tip.

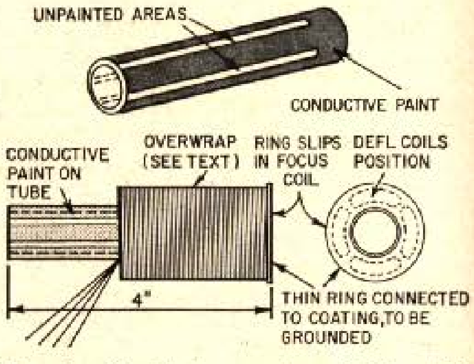


Fig. 8—Conductive paint shields vidicon. Overwrap shields deflection coils.

Paint the tube with silver or copper conductive paint, leaving four unpainted slots. The slots permit the paint to serve as an electrostatic shield but not as a shorted turn. The deflection coils are positioned over this tube (Fig. 7.) Then wind a soft-iron wire overwrap over the coils, and place a thin copper, aluminum or brass ring against the end of the coils. Connect the ring to the soft-iron overwrap, and the conductive coating. This forms an electrostatic shield and is grounded (Fig. 8).

Fig. 9 shows the final assembly. The tube carrying the deflection coils is slipped over the vidicon. Then the focus coil assembly is slipped into place over the deflection coils. At this stage inset the signal ring shield which is made of thin brass, copper tinfoil or aluminum. It contacts the electrostatic

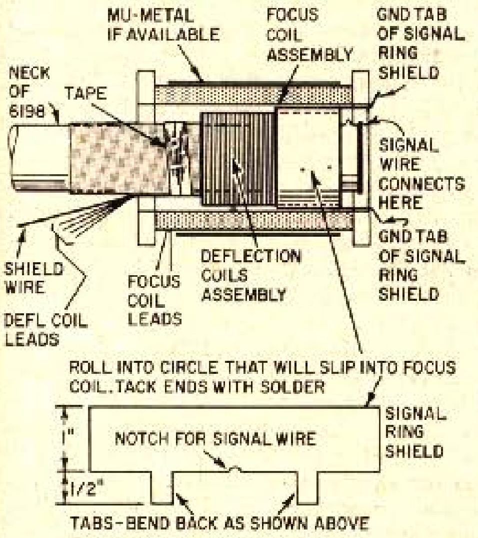


Fig. 9—Final deflection and focus coil assembly positioned around vidicon.

shield around the deflections coils. The tabs on the signal ring shield are grounded. If available, a mu-metal shield may be wrapped around the assembly, as shown in Fig. 9 and the photos. It is not absolutely necessary. You have now completed the coil assembly. END

References

1. J. R. Popkin-Clurman, "Simplified Ham TV Station," *Radio & TV News*, Parts I, II, and III, May, June and July 1950.
2. John W. Keller, "An Amateur Television Camera," *QST*, Vol. 38, No. 11, November 1953.
3. Donald L. Stoner, "Ham TV," *CQ*, Vol. 13, No. 5, May 1957.
4. R. G. Neuhauser, "Experimental Closed-Circuit Television," *Electronic Equipment*, December 1954.
5. Derek Swaine, "Low-Cost Closed-Circuit TV Camera," *Radio-Electronics*, Vol. 30, No. 11, November 1959.
6. D. G. Fink, *Television Engineering*, Second Edition, McGraw-Hill.
7. Scott Helt, *Practical Television Engineering*, Rinehart.

Aid to Educational TV

Congress has voted to furnish $25 million in Federal aid to accredited colleges and universities of the various states, on a dollar-for-dollar basis, to construct educational TV stations for broadcasting instructions to students in public schools and elsewhere. Under the terms of the bill, no state is to receive more than $1 million in aid.

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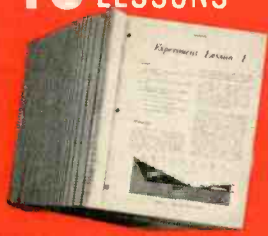

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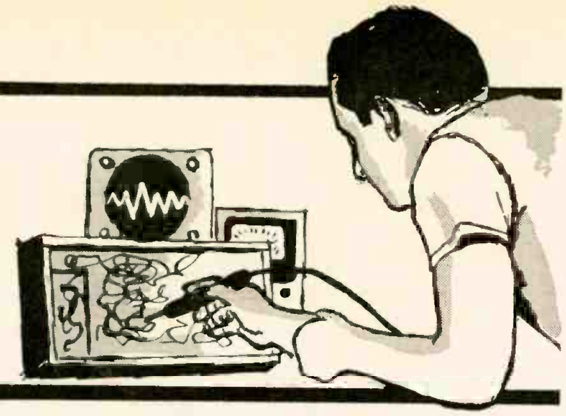
SERVICE CLINIC

Conducted by
JACK DARR
SERVICE EDITOR



This column is for your service questions. We answer them free of charge and your name and address will be kept confidential if you wish. The main purpose is to help those working in electronics with their problems.

We've changed our target a little and are no longer restricted to TV. Radio, audio and industrial electronics problems are also grist for the mill. All letters get a prompt individual answer and the more interesting ones will be printed here. So if you have a service problem, send it here. We'll do our very best to help you solve it.

IF THE VERTICAL LINES AT THE TOP OF a TV picture pull to the right, you can bet that a service technician is going to see that set pretty soon. It is a minor complaint, but very annoying to viewers.

Fig. 1 is a drawing of a TV screen with a cross-hatch pattern and pulling to the right. Eight squares across the top of the picture, with a 53-μsec scanning time per line, means about ⅛ of 53, or approximately 6-μsec, to scan each square. The top line in Fig. 1 is late by about ¾ of a square. If the trouble shows up as drawn, the next line is not quite as late, the next still closer to proper timing and, finally, after about 60 lines are scanned, the rest of the lines are on time.

If we connect a scope to the grid of the horizontal output tube through a low-capacitance probe and use the scope's internal sync, we'll see the familiar sawtooth or trapezoidal waveform of Fig. 2. Since the signal on the screen is the one which triggers the sweep inside the scope, a 6-μsec delay won't show too much. The sweep will obligingly pull over to match it, and we'll still see a nice clean waveform, showing no signs of trouble.

If we could make the sweep absolutely constant with no variation, then we could detect the slowing down of the top lines of the raster. So, we use the scope's external sync input. For a reference sync signal, we can connect to some point in the circuit where the station-signal horizontal sync is available; for instance, at the horizontal sync separator.

Now, with a stationary reference signal, the pattern will show up looking like Fig. 3. The 6-μsec delay of the top lines will cause a displacement of the vertical lines of the pattern, and the typical thickening will show up.

This must be caused by some 60-cycle ac, since the trouble shows up at the top of the picture, every 1/60 second. If the signal causing the trouble is coming from the local 60-cycle power supply, pulling will appear in other parts of the picture at times. It is impossible to synchronize power-line frequency everywhere in the country. If the 60-cycle signal is coming from the station signal, in other words from the vertical sync pulses, then it usually appears at the top of the picture.

There are two possibilities: One, the vertical oscillator–output stage is loading the power supply, often the boost-voltage supply, so heavily that we get a momentary drop in voltage on every sync pluse—sort of an inverted surge. The drop in voltage supply to the horizontal oscillator causes a drop in frequency, and the top lines arrive late.

Two, some portion of the vertical sync pulse is getting into the horizontal oscillator, phase comparator, etc.

To test for this, turn the set's brightness down, and disable the vertical oscillator. With the scope still connected to the horizontal output tube grid, switch in external sync. You can tell if the pulling disappears, because the thickening of the lines will go away.

Try checking the B-plus supply lines with a low-capacitance probe for any sign of vertical spikes or even sine-wave ac at 60 cycles. One rather unusual cause is cross-coupling in the yoke. However, most of these troubles are caused by bad electrolytic capacitors. Bridge each one, and, if they are parts of a multiple-section unit, disconnect each one and bridge one at a time. Leakage between units of multiple electrolytics is one very puzzling defect, so don't overlook it.

Convert to 27-inch screen

My customer wants to convert a Zenith 22L20 from its present 24CP4A CRT to a 27EP4. Can we do it?—G. P., —West Chester, Pa.

You should be able to. The 27EP4 actually calls for 2 kv *less* than the 24-inch tube. Same deflection angle, and the 27EP4 bulb diameter is really only 2-13/16 inches larger than the 24-incher. You'll probably have to add a 50-μμf 20-kv high-voltage filter capacitor, since the 27EP4 does not have an external conductive coating. With the reserve capacity in your sweep system, you should be able to sweep the extra inches without too much trouble. Set your horizontal linearity up for best linearity and minimum plate current and check the width setting. Also be sure you warn your customer of the cost of replacement CRT's.

Transformer puzzle

I have a vertical output transformer with the number 79B43-4. My distributor says that the number on this transformer has been changed to 79B391. When I tried it in the TV set, I get less sweep with the new transformer. The original transformer was a 79B29-1, and has three leads. I'm lost!—A. G.,—Union City, N.J.

You forgot to give me the make of TV set but those numbers are unmistakable—it's an Admiral. Somebody

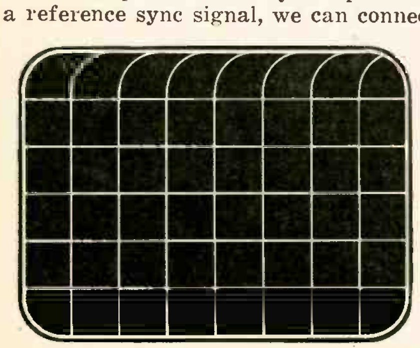


Fig. 1 — Crosshatch pattern on TV screen reveals vertical pulling at the top of the picture.

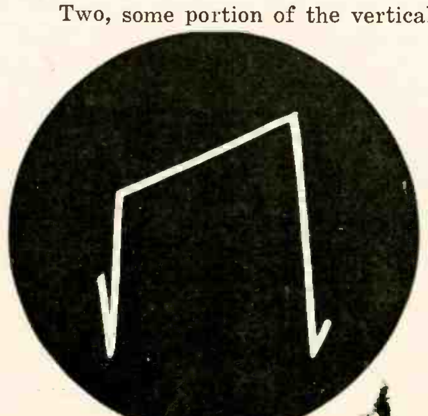


Fig. 2—Correct waveform on the grid of the horizontal output tube.

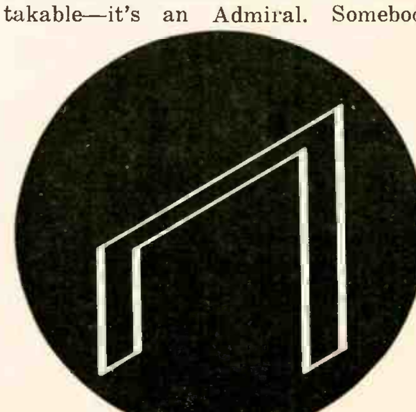


Fig. 3—Displacement of pattern caused by delay results in thickened vertical lines.

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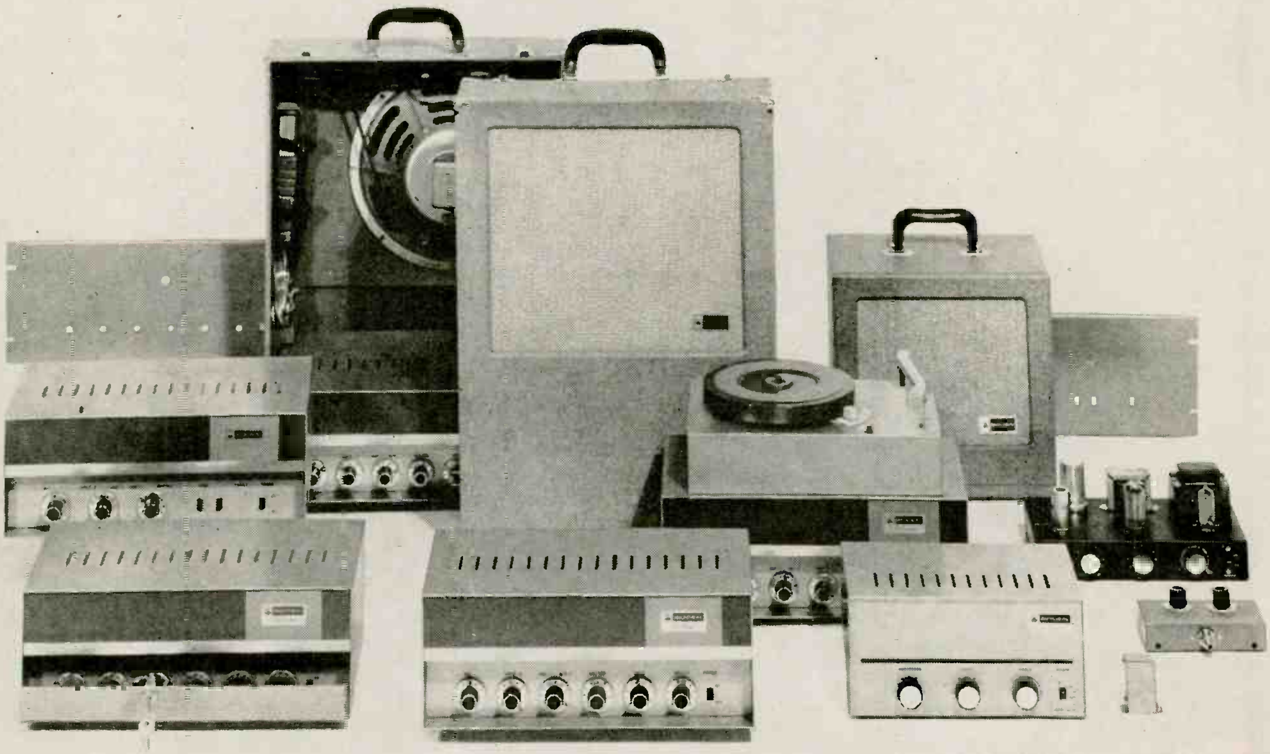

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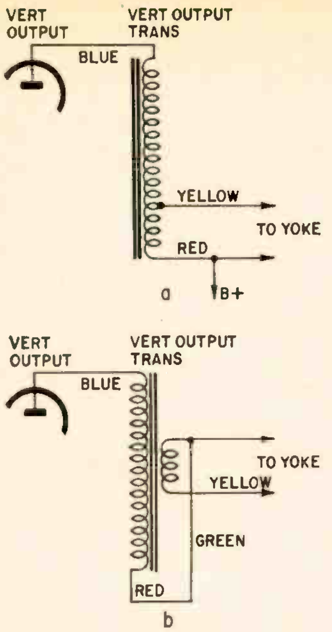

Fig. 4-a—Color coding of Admiral vertical output autotransformers. b—Standard transformer hooked up as autotransformer must have secondary winding in right phase. If picture is very small, reverse secondary connections.

else is mixed up, too. The 79B43-4 is a 15-to-1 autotransformer. The 79B39-1 is an 11-to-1 autotransformer, so you probably wouldn't get enough sweep, because of the impedance mismatch.

Standard color code on these transformers is blue for plate, red for B-plus and yellow for the yoke lead. The other yoke lead connects to B-plus (Fig. 4). In many cases, you can also use a dual-winding or standard transformer to replace an autotransformer by connecting the windings in the right phase. If you get the secondary reversed, you'll have a picture about 2 to 3 inches high.

Intermittent headache

An RC 21T208 will run for about 2 hours, then pull in at the sides of the raster, start rolling vertically and black out. Turn it off for 5 minutes, and it'll go for another 2 hours. This is while the chassis is in the cabinet. Take it out and it'll run indefinitely!—C. S. C., Cannel City, Kentucky.

This is obviously a thermal intermittent. The only difference between operation inside the cabinet and outside is the operating temperature. Therefore, take it out of the cabinet, and apply heat selectively. A standard heat lamp in a gooseneck desk lamp is a good source for the first test. Use a mask to confine the heat to a circle about an inch in diameter. Direct this on the vertical oscillator or output transformer first. From your description, I suspect some trouble there, such as intermittently shorted turns in the vertical output transformer. This stage is fed from the boost voltage, and any overload here would load down the boost, causing the shrinkage and probably the vertical rolling.

There are other suspects too. Check the width and linearity coils by heating them up. Look to see if they are darkened or charred. They may have an intermittent short to the cores. The flyback is another good suspect. A drop in the boost voltage caused by flyback or high-voltage supply troubles could cause the rolling by changing the plate voltage on the vertical oscillator and output stages.

For a pinpoint check, apply heat with the tip of a soldering iron to all suspected parts in all these circuits. Also, check the damper-tube socket for an intermittent leakage.

Slow warmup

The complaint is that a Dumont RA-165 is becoming progressively slower about producing a raster. Can you give me some advice about this?—W. R. J., Toronto, Ont., Canada

The most frequent cause is a slow-heating picture tube. However, if the tube produces a good picture after it finally does get hot, it isn't too serious. The best thing to do is check the picture tube with a good tester; this will tell you whether the tube is weak. If it is, many times a "rejuvenation" will help in making it heat faster.

The tester will tell you whether using a brightener will help. We don't recommend installing brighteners until the tube's output has fallen so low that it is necessary to overheat the cathode to get enough beam current. Using brighteners on a normal tube will shorten its life of course.

Another possibility, of course, is a slow-heating horizontal output or (more likely) damper tube. You can check this by measuring the high voltage during warmup. If it comes up to its normal value quite a while before the screen shows a raster, then the CRT is slow. If the voltage comes up slowly, check the horizontal output and high-voltage sections.

Incidentally, time the actual warmup with a watch—never estimate. If the tube shows light within 1.5 minutes, it's nearly OK. Most people grossly overestimate the time!

Tuner trouble

I have a Philco 22D4330 in the shop. Channel 10 comes in on channel 9. What is my trouble and how can I remedy it?—F. B. Newark, Ohio.

This is caused by a misalignment or, more correctly, miscalibration of the tuner oscillator. This set uses an incremental inductance tuner. This means that there are basically only *two* oscillator coils used—one for the high channels and one for the lows. The switch in the tuner shorts out sections of the inductor until it is resonant on the desired channel.

Proper tuning procedure on these tuners is always to begin at the highest frequency channel, and tune the small brass screw visible through a hole in the front for best picture and sound. There will be one screw for each channel, usually numbered. Then tune the next lowest, and so on. If your channel 10 is the highest channel available locally, tune it first, then check the rest, tuning if required. If it is way off, move the channel 13 slug a quarter-turn, then go back to channel 10. You will find a marked change. A quarter-turn on channel 13 may have as much effect as five full turns on channel 10.

Horizontal instability

This chassis has been pushing me around quite a bit. It will start in sync, run for about 5 minutes, then fall out. Tickle the horizontal oscillator transformer, and it runs from then on. I took all the old tubes out, put them in a bucket and started with a fresh batch off the shelf. This didn't do it, so I took those out, and put in another batch.

All voltages, waveforms and everything else are absolutely normal. Resistors and capacitors all check OK.—R. C. S. Troy, N. Y.

I'm sorry to say that it looks as if you are blessed with a good thermal intermittent! From the time constant of the defect, I don't think it will be a tube; this sounds more like a heat-sensitive capacitor or possibly a resistor. When the trouble appears, try heating each capacitor and resistor in the frequency-controlling circuits: the shapers, coupling capacitors, capacitors across the ringing coil, etc. It will undoubtedly take you some time, but that is where it will be found.

A can of the "cooling compound" recently marketed is a great help in cases like this. It is a standard spray can like those used for cleaners, but it contains only the propellant. When sprayed on a suspected part, it cools it very rapidly, and the resultant temperature change will often dig out a stubborn intermittent. If any part seems to be heat-sensitive, try touching each part with the tip of a soldering iron, just long enough to raise its temperature above normal.

Replacement transformer

I need a power transformer for a Tech-Master C-30 TV, but am unable to locate the parts here. Can you help me find a suitable replacement?—G. S. H., Ontario, Canada.

A Triad R-61-BC will replace the power transformer in this set. This transformer has three 6.3-volt filament windings, two at 6 amperes, and a separate winding for the damper heater. To use this unit in the Tech-Master set, connect the two 6-amp windings in series, phasing them properly to give you the 12 volts needed (Fig. 5). END

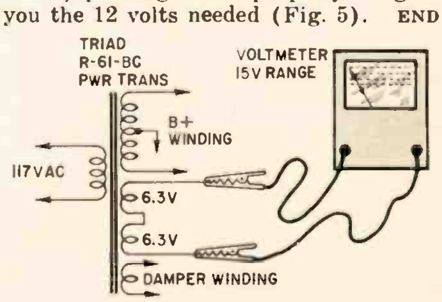

Fig. 5—Connect the two 6.3-volt windings in series adding to get the 12-volt winding needed in a Tech-Master C-30. The voltmeter shows when they are connected properly.

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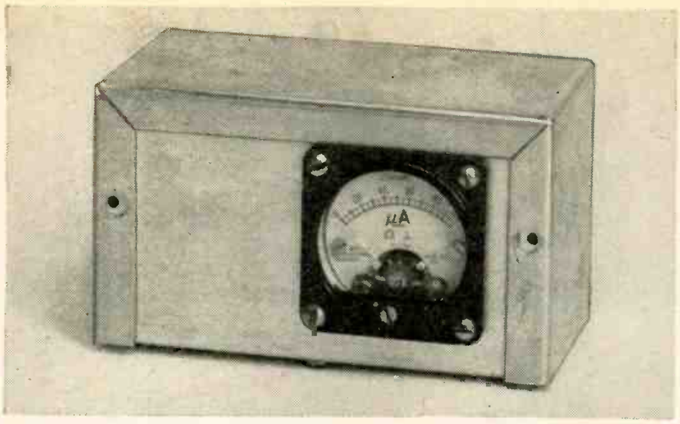


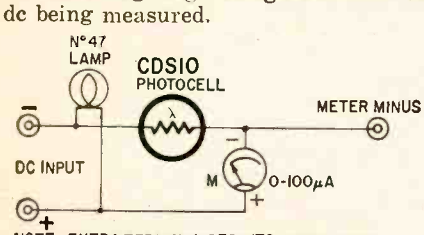
expanded-scale voltmeter

0.4 volt makes the difference between zero and a full-scale reading

By I. QUEEN
EDITORIAL ASSOCIATE

THIS METER CAN MEASURE SMALL DIFferences in voltage. It ranges from about 0.9 to 1.2 volts dc. The tables with the circuit show typical calibrations.

The applied voltage lights a 6.3-volt pilot lamp. At the low voltage the light is very dim, but is enough to affect a cadmium sulphide photocell. This cell acts like a variable resistor, its output depending upon the light received and on the energizing voltage which is the dc being measured.



NOTE- EXTRA TERMINAL PERMITS CONNECTION DIRECTLY ACROSS METER FOR μA MEASUREMENTS

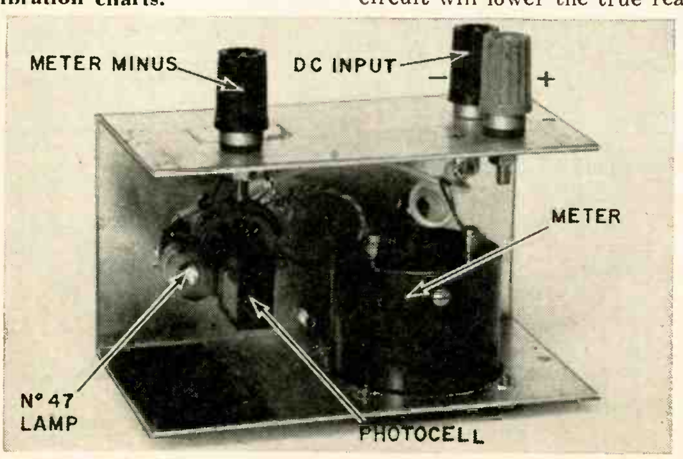
μa READING	INPUT VOLTS (dc)	μa READING	INPUT MA (dc)
10	.9	10	55
20	1.0	20	60
35	1.1	60	65
62	1.2	100	68
100	1.3		

Circuit of the simple unit along with typical calibration charts.

The cell must be shielded from external illumination during measurement. All parts are housed inside a 4 x 2¼ x 2¼-inch metal box. The meter is 1½ inches square.

Parts placement is not critical, except that the lamp must be quite close to the cell—about ½ inch away. For convenient mounting, clip the long leads of the cadmium sulphide cell and plug them into a nine-pin miniature socket. Also, with the aid of heavy wires, solder the lamp to convenient pins on the same socket. Thus the lamp–cell combination becomes a single, fixed unit that can be mounted inside the box. I found results improved when a metal-foil hood was placed over the assembly. It reflects more light from the lamp onto the cell.

This meter is useful for checking the condition of a rechargeable nickel-cadmium cell. These vary only a few tenths of a volt from full charge to discharge, making a conventional meter useless. With the expanded meter, the deflection is about *one-third full scale* for a difference of only 0.1 volt. Note, also, that the source being measured is loaded to some extent by the lamp, a desirable condition. For this reason, use reasonably heavy leads to measure the battery. A high resistance in the circuit will lower the true reading. END

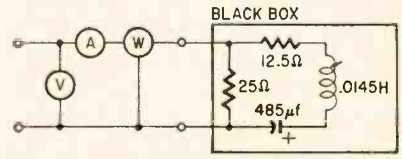


Interior of the expanded-scale meter.

What's Your EQ? May Solutions

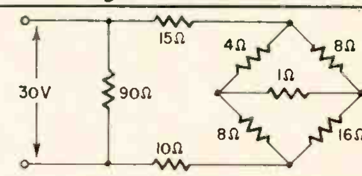
Variable-Current Black Box

The circuit is as shown. To solve, first calculate the dc, which must be passing through a resistor of 25 ohms. Since the voltage–current product at



60 cycles equals the power, a series-resonant circuit is suggested. The current at 400 cycles permits the reactance to be calculated. Then the inductance, capacitance and resistance in the ac circuit can be found.

An Easy One



If we lay out the resistors in the pattern shown in the sketch, it becomes an obvious balanced bridge. So the drop across the 1-ohm resistor is zero.

Iterative Network

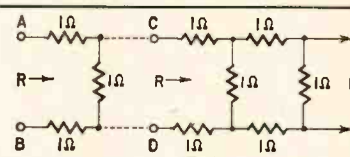


Fig.1

We can make this circuit (Fig. 1) more easily understandable by breaking it just after the first section and labeling the new inputs C and D. Since the lattice extends to infinity, we also see resistance R at points C and D. Now we can draw an equivalent circuit as in Fig. 2. This is a simple series-parallel combination which we can solve.

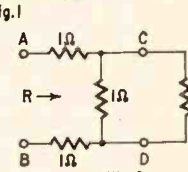


Fig.2

$$R = 1 + 1 + \frac{R}{R + 1}$$

The last term is the parallel combination of R and 1 ohm. Multiplying both sides of the equation (by R + 1 to get rid of the fraction, we get:

$$R \times (R + 1) = 2R + R + 2,$$

which is equivalent to:

$$R^2 - 2R - 2 = 0.$$

This works out to:

$R = 1 \pm (3)^{1/2} = 2.735$ ohms. The negative solution is an entirely different story, and not applicable to our present problem.

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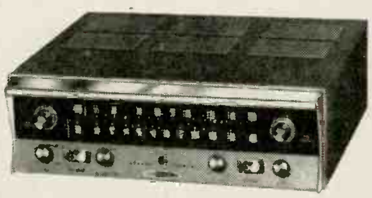

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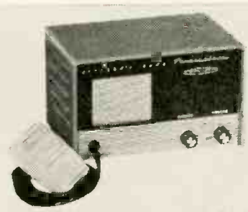

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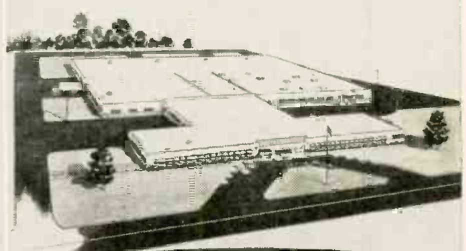

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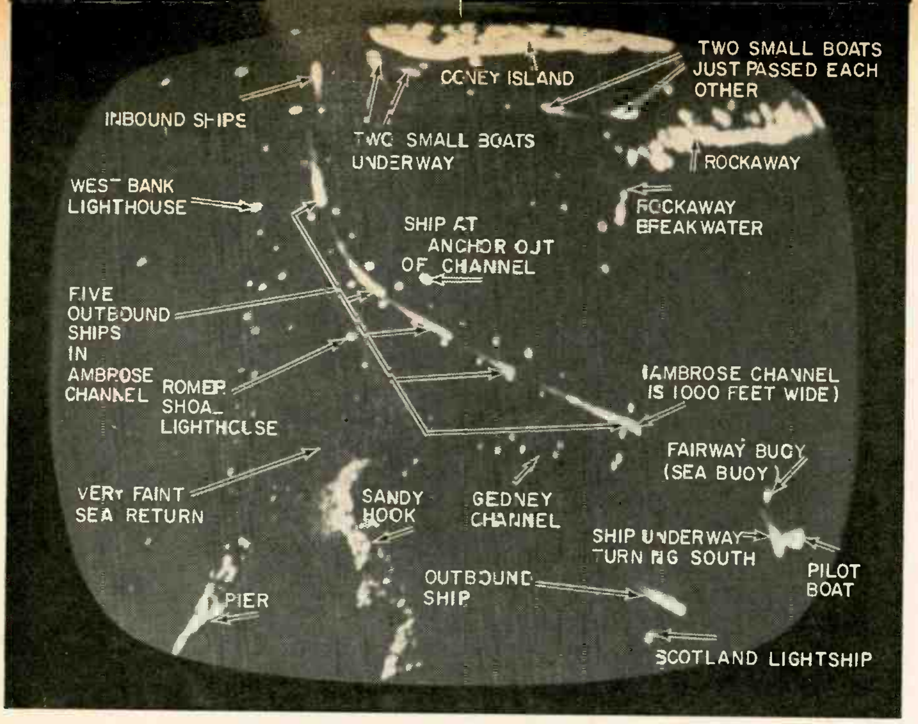


Area just outside New York Harbor, as seen on RATAN screen.

RATAN-Harbor TV-Radar

Any uhf TV set becomes a radar indicator with this new system

A NEW TYPE OF RADAR PRESENTATION may give the small boatman all the benefits of marine radar for the price of a portable TV receiver. Demonstrated recently by the Coast Guard to the technical press, the new system is called RATAN (*R*adar *a*nd *T*elevision *A*id to *N*avigation). The pressmen saw a scene on the TV screens like the one shown in the photo here. Their own ship, the US Coast Guard Cutter Spencer, could be followed on the TV screen throughout the voyage from New York Harbor to Sandy Hook, off the coast of New Jersey.

The new system differs in several respects from conventional PPI (*P*lan *P*osition *I*ndicator) radar. Most important—to small boatmen, at least—is that the radar scope is any uhf TV receiver. The second point is that RATAN shows each ship in position on a map of the area, unlike the PPI scope, which shows your own ship standing still in the center of the universe, with everything else moving in relation to it. The third feature is that moving vessels show a "wake", due to the persistence of the scope trace. This persistence is controllable by the transmitter operator. Because of the "wake", moving objects can be distinguished from stationary ones. The direction in which a vessel is moving is easily noted and, within limits, its speed can be determined. The long-persistence screen produces another effect. Buoys not easily seen on a PPI scope, continue to come up in brightness until they are easily recognizable on the longer-persistence RATAN.

How it's done

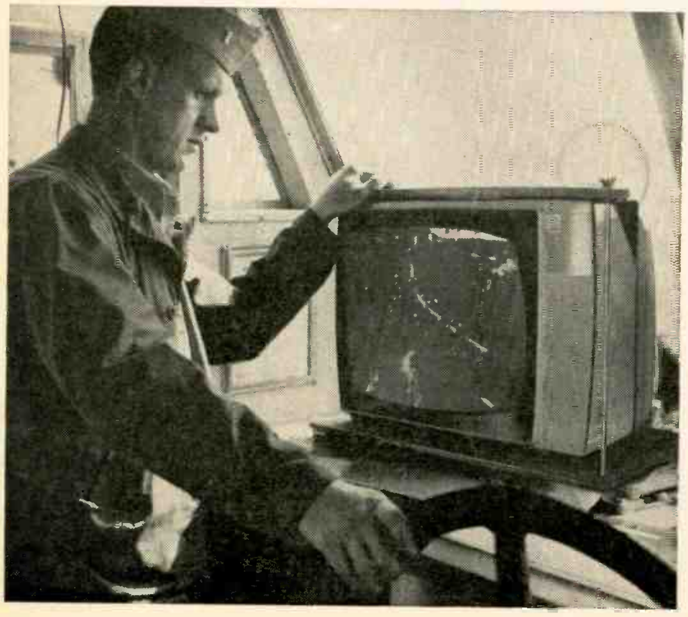
The secret of the new radar is an instrument that Raytheon calls a "scan-conversion unit." Part of this is a specially developed scan-conversion tube, a double-ended device. One end is a picture storage tube, on which the radar presentation (or any other TV picture) can be held any desired time. The other end is a flying-spot camera tube, which scans the picture on the storage face and presents the signals to a uhf TV transmitter.

The scene shown at the Coast Guard demonstration was picked up with an ordinary radar—a Raytheon 1605—at the Coast Guard station at Sandy Hook. The conversion unit picked these signals up as a conventional PPI presentation, and fed them out as a TV raster to a uhf TV transmitter, working on channel 47 (671 mc).

RATAN has one limitation. It is what in Europe is called a "harbor radar," covering a fixed area around a permanent radar station. Larger ships would, in addition to RATAN, carry their own radar.

To the small boatman, the advantages are overwhelming. It gives him radar where he needs it most, and at a price he can afford—that of a portable TV. Further, he can understand the RATAN display much more easily than he could a PPI scope. He might have trouble identifying his own craft, but this can be solved in a number of ways. Possibly the easiest is by making what aviators call a procedural turn, and watching for the trace on the screen.

In crowded harbors or heavy fog, such maneuvers would have their disadvantages. A "position locator", a rotating, highly directional beam, so gated on and off that it would be visible to a viewer only when the antenna pointed in his direction, has been proposed. The boatman would see a white line from the transmitter crossing his own craft. This solution was proposed in a paper read to the IRE Convention by A. Roberts of General Precision, and it—or some similar device—may eventually be incorporated into the system. END



How display looks to boatman. Small circle of wire behind set is antenna.

Scan - conversion tube that changes PPI display into TV image.

EQUIPMENT REPORT

2 New Tools for Transistor Servicing

Heathkit IM-30 transistor checker and B & K model 960 transistor radio analyst

By WAYNE LEMONS

A new self-powered transistor tester with features usually found only in more expensive testers, has been recently introduced by Heathkit. The model IM-30 checks dc beta and dc alpha, using a special bridge circuit. Bridge null is indicated on a zero-center, 10–0–10 microammeter. Lever switches set the different functions. The instrument checks for I_{CEO} and I_{CBO} leakage, collector-to-emitter shorts, dc gain and by calculation, ac current gain and ac and dc transconductance, base resistance and collector resistance. Diodes can be checked for forward and reverse current.

Other switches select collector voltage, leak voltage, leak current ranges, collector current ranges and the correct polarity for p-n-p or n-p-n transistors.

A bias control across an internal 1.5-volt battery adjusts collector current to any desired value between 0 and 15 amps. The dc beta (gain in common-emitter circuit) control is calibrated in two ranges: 0–150 and 150–300. The dc alpha is also calibrated on this control in two ranges from 0–0.9966. High- and low-gain ranges are selected by a front-panel switch.

The IM-30 has external binding posts for using external batteries or power supplies for making gains and leakage tests at higher voltages than the internal 9-volt battery supply. Meter scales and ranges are included in the instrument to measure these external sources up to 50 volts. External

The Heathkit IM-30 transistor checker on the job.

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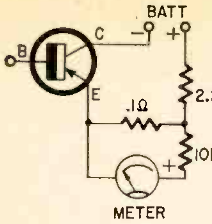


Fig. 1—IM-30 short test.

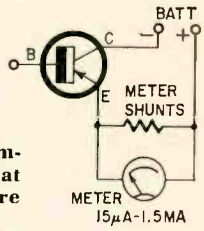


Fig. 2—I_{CEO} leakage test, similar to short test except that meter ranges are much more sensitive.

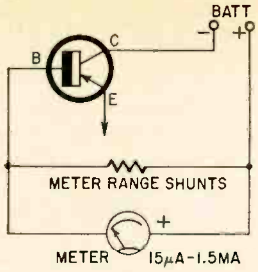


Fig. 3—I_{CBO} leakage test. Collector-to-base with emitter open.

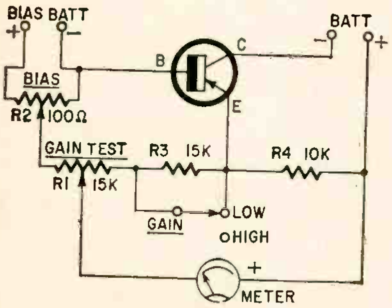


Fig. 4—Bridge gain test circuit. R3 extends beta range to 300 when switch is in the *high* position.

bias voltage terminals are also provided.

For transistor radios, the supply in the IM-30 is adequate. For video output and sometimes other transistors in transistor TV's, and for special-purpose and industrial transistors, a higher test voltage may be desirable. Occasionally, a transistor will check OK on a low-voltage test, but have excessive leakage at its rated or operating voltage. This is true even in transistor radios. The IM-30 lets you select the leakage voltage you want to use (which should always be approximately the operating voltage of the transistor in the set) in 1.5-volt steps up to 9 volts. Collector voltages for gain tests can also be selected in the same manner.

Breakdown of tester circuits

Fig. 1 is a simplified circuit of the IM-30 SHORT test. This is made between collector and emitter with the base open. A low-resistance shunt across the meter, and a 10,000-ohm resistor in series with it, protect the meter from damage if the transistor is shorted.

Fig. 2 shows the I_{CEO} LEAKAGE test and is identical to the short test except that the meter shunt is selected by a front-panel switch to give a much more sensitive meter indication (15 μa to 1.5 ma). An I_{CBO} LEAKAGE test measures leakage current from collector to base with the emitter open (Fig. 3).

Fig. 4 shows the GAIN measuring bridge circuit. In this test, the meter shows the difference between the voltage drop across R4 (10,000 ohms) and GAIN TEST control R1 (15,000 ohms). The gain control is adjusted until the voltage drops are the same—this is indicated by a zero (center) reading on the meter. The farther the control must be turned toward the base, the greater the gain of the transistor. For gains above 150, resistor R3 (15,000 ohms) is switched in to extend the range from 150 to 300. The gain control is also calibrated in dc alpha. Alpha is beta divided by beta plus 1.

When beginning a transistor check, set the dc bias control until the collector current reads the desired value, usually about 5 ma for small-signal transistors. (Bias may be set so the collector current is most any reasonable value. It will have no effect on the gain reading.) Fig. 5 shows this collector-current test circuit. Fig. 6 is the simplified base-current circuit. Base currents can be read in ranges of times 10 from 15 μa to 1.5 ma.

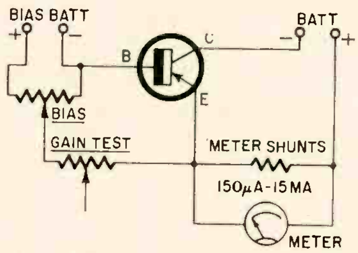


Fig. 5—Collector current is adjusted by bias control. Meter current ranges in multiples of 10 from 150 μa to 15 ma.

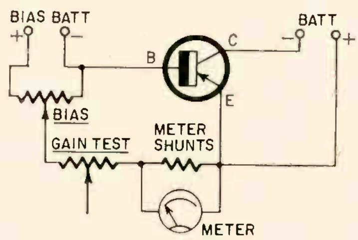


Fig. 6—Base current from 15 μa to 1.5 ma can be read by this circuit.

Using the IM-30

The IM-30 can be used in service shops to check all transistors including small signal, power, and special types (both p-n-p and n-p-n) for shorts, leakage, gain and other special tests if desired, as well as for checking diodes. Transistors are checked under actual dc operating conditions with voltages similar to those found in the transistorized equipment. The IM-30 is ideal for matching transistors. It is especially good for go–no–go production-line testing. You can set the unit for specified test conditions, check each transistor for shorts, and to see if leakage is within allowable limits.

To check gain, set up the desired bias conditions and set the gain test control for the minimum allowable gain. Pull the gain *lever*. The transistor under test will deflect the meter one way if the gain is low, the other way if the gain is higher. (Direction of meter indication is determined by whether the transistor is a p-n-p or n-p-n type.)

This looks like a good tester for service technicians, production-line testing, design engineers or just about anyone working with transistors. Fairly easy to assemble, it should take the casual kit builder no more than 8 hours. Just be careful to keep solder from running into the switch rotors. Solder with the terminals *down* so any stray solder will run out of rather than into the switch mechanism.

B&K model 960

A new instrument that goes a long way toward solving the extra equipment problem for transistor radio service is the new B & K. They call it a Transistor Radio Analyst. It features a 0–12-volt power supply, tapped in 1.5-volt steps, and a single probe "in-circuit" transistor and stage tester. In addition, the model 960 provides a 2-band signal generator (250 to 2,200 kc), a 2,000-cycle audio generator, a vacuum-tube volt-ohmmeter; and an out-of-circuit transistor tester.

Fig. 7 is a simplified circuit of the rf–af signal generator. Half of a 12AU7 uses separately switched-in oscillator coils to cover 250 to 800 kc (band A) and 800 to 2,200 kc (band B). An RF OFF switch disables this circuit when it is not needed.

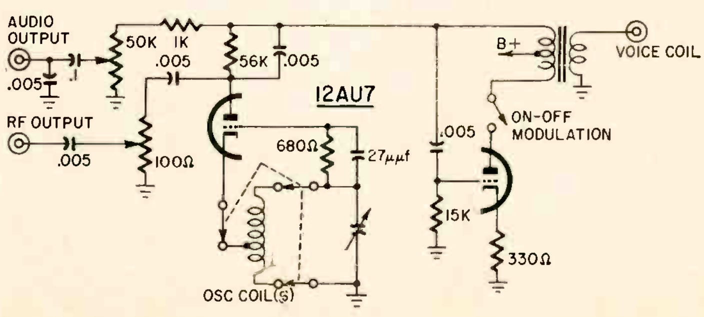
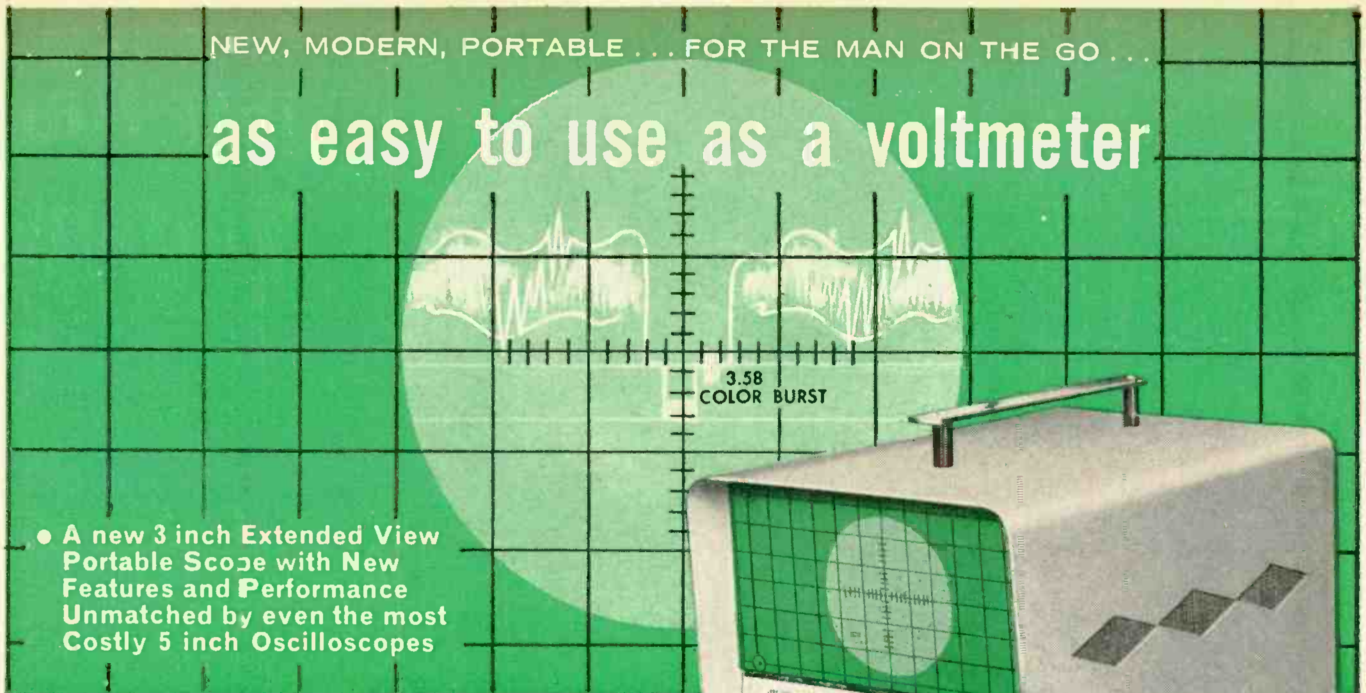


Fig. 7—Simplified circuit of rf–af generator in the B & K 960.



NEW

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Here it is, the scope that technicians, engineers and servicemen from coast to coast have been demanding. A portable wide band scope that can be used on the job anywhere, yet has the highest laboratory specifications for shop or lab. Cumbersome color TV sets, remote audio and organ installations and computers are just a few of the jobs that make owning a scope of this type so essential. Why consider a narrow band scope, when for only a few dollars more, this professional wide band sensitive scope equips you for any job.

• The PS120 provides features never before offered. Only two major controls make the PS120 as easy to use as a voltmeter. Even its smart good looks were designed for functional efficiency. New forward thrust design, creating its own shadow mask, and full width calibrated graph increase sharpness of wave form patterns. A permanent chromed steel carrying handle instead of untidy leather strap and a concealed compartment under panel for leads, jacks and AC line cord make the PS120 the first truly portable scope combining neatness with top efficiency.

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

S P E C I F I C A T I O N S

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

HIGH DEFLECTION SENSITIVITY:

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

HIGH INPUT RESISTANCE AND LOW CAPACITY:

Vert. input cable	2.7 Meg. shunted by approx. 99 MMF
Aux. vert. input jack	2.7 Meg. shunted by approx. 25 MMF
Through low cap. probe	27 Meg. shunted by 9 MMF
Horiz. input jack	330 K to 4 Meg.

HORIZONTAL SWEEP OSCILLATOR:

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

MAXIMUM AC INPUT VOLTAGE:

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

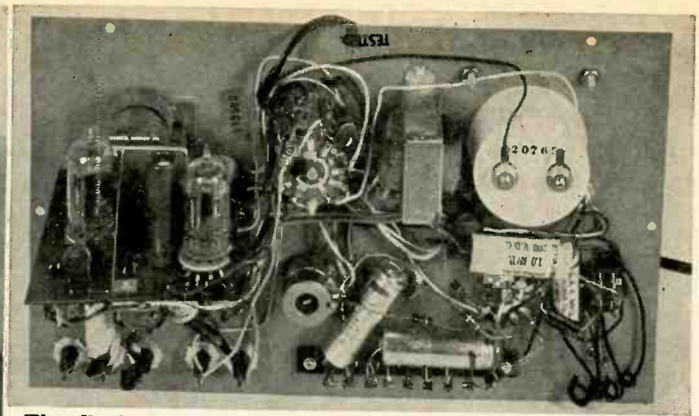
POWER REQUIREMENTS:

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

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

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

S E N C O R E
ADDISON 2, ILLINOIS



The B & K 960 transistor radio analyst tracks down a circuit fault (left). Back panel view above.

The af generator uses the other half of the 12AU7. The circuit constants are such that it oscillates at about 2,000 cycles. The audio can be taken off at the AUDIO OUTPUT jack for signal-tracing audio stages. A winding on the oscillator coil provides a low-impedance signal for testing speakers at the VOICE COIL jack. The audio also modulates the rf signal when desired.

The tapped, metered power supply is unusually versatile. Taps are provided in 1.5-volt steps along a low-resistance bleeder network (Fig. 8). These taps make it possible to test any radio, even those using a tapped battery power supply, and, since the supply is well filtered and low-impedance, motorboating should be virtually eliminated. (Higher-impedance test power supplies sometimes cause radios that rely on the battery as part of the filter system to motorboat.)

The power supply current meter has two ranges: 0–15 ma and 0–150 ma. They are selected by a front-panel switch. These are ideal ranges for checking almost any transistor radio.

Since nearly all transistor radios use 9 volts or less, the 12-volt maximum of this supply is adequate for just about any radio that will hit your shop.

The vtvm has two ranges: 0–1.5 and 0–15 volts. This will take care of all voltages you're likely to encounter in transistor service. The 1.5-volt range is ideal for checking bias.

The ohmmeter has only one scale. It reads 1,000 ohms at center scale and has a full-scale reading of 1 megohm.

The in-circuit test

The unique feature of the model 960 is the "in-circuit" transistor and stage tester that utilizes only a single-wire test probe. Here's how to work it. Switch on the Analyzer and set the function switch to IN CIRCUIT. This switches the meter into a bridge circuit as shown in Fig. 9. Connect the radio to be tested to the power supply, observing correct polarity. Adjust the control marked IN-CIRCUIT METER SET until the meter reads in the green calibrate area. Switch the PNP–NPN switch to the type of transistor stage to be tested. Touch the IN-CIRCUIT TEST probe to the *base* of the transistor. This should increase transistor current. (The probe supplies a negative voltage for p-n-p transistors and a positive voltage for n-p-n's.) Since the meter is in a balanced circuit, even a slight increase in overall current will deflect it up scale —if the transistor and its dc circuit are operative. If the meter *doesn't* deflect up scale, either the transistor or its dc circuit is defective.

Although this in-circuit test does not tell absolutely whether a stage is good, it certainly indicates if the stage is bad. For example, if the meter deflects up scale in an i.f. stage, you know that the dc circuit of the stage is good and that the transistor responds to bias. It does not tell you whether the gain of the transistor or stage is adequate. On the other hand, if there were no up-scale deflection, you would be certain that either the transistor or the dc circuit was defective. Then it would simply be a matter of pinpointing the specific bad part in that stage.

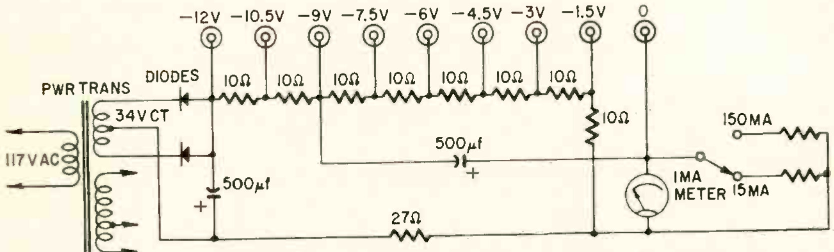


Fig. 8—Metered power supply circuit in the 960.

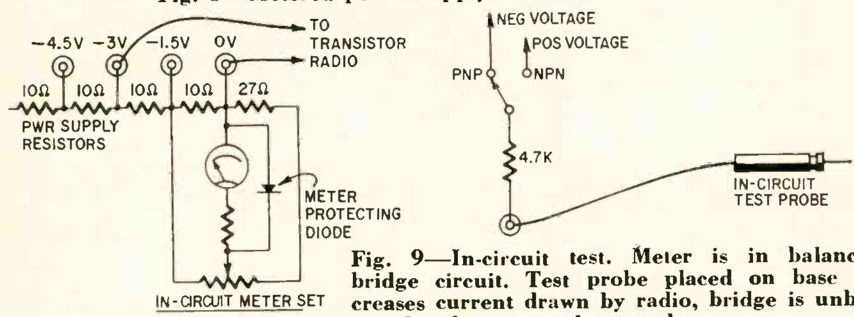


Fig. 9—In-circuit test. Meter is in balanced bridge circuit. Test probe placed on base increases current drawn by radio, bridge is unbalanced and meter reads up scale.

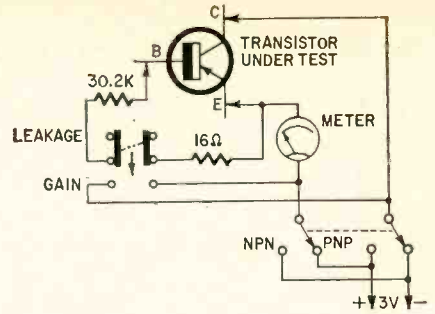


Fig. 10—Out-of-circuit transistor leakage-gain test.

Out-of-circuit test

The model 960 also has an out-of-circuit test on the front panel. A simplified circuit is shown in Fig. 10. With the switch in the LEAKAGE position, an I_{CEO} (current from collector to emitter with base open) test is made. With the switch in the GAIN position, the transistor is forward-biased through the 30,200-ohm resistor, and a meter shunt is switched in. The meter reads emitter current and is calibrated in dc beta (gain).

The B & K unit looks like a good instrument for anyone servicing transistor radios. We checked out several radios with it as our sole test instrument. In every case tried, we were able to find the trouble without resorting to any other equipment. END

MIDGET 4-channel CB R/C receiver

A packaged amplifier unit makes this tiny receiver practical

By E. L. SAFFORD, JR.

THE Centralab TA-12-B, a tiny packaged amplifier, makes possible a very small four-channel radio-control receiver for 27 mc. Requiring only 1.5 to 1.75 volts to operate (a penlight, mercury or wet cell) and only a hair larger than a standard reed decoder, the receiver can be used in model airplanes, model trains or very small model boats.

The relative size of the TA-12-B can be seen in the photos. It consists of four transistors in a high-gain, very stable circuit, with provisions for a volume control. Its circuit and frequency response curve are shown in Fig. 1. Six wire leads provide the connections. A metal cover shields the circuitry. It can be mounted in any position. The output, 0.5 mw, is large enough to drive any power stage. Its price is high, but the unit *is* small!

Receiver operation

Although the receiver to be described here can be used as either a single- or multichannel type, tones are required. In the single-channel application, any tone from 300 to 1,000 cycles will give good performance. The relay is a Jaico 100-ohm type requiring about 12 ma to close and opening at 8 ma. Without signal, the 2N109 (Fig. 2) draws about 15 ma; with signal, about 5 ma.

For multichannel operation, the relay is converted into a reed decoder. Small pieces of a wristwatch spring are so positioned over the pole piece that when tones of 200, 225, 250 and 280 cycles per second are received, each reed vibrates, the shortest with the highest frequency and the longest with the lowest frequency. As each reed vibrates, it touches a fixed contact positioned above it, making an intermittent connection that can make a second relay or transistor operate. The second relay or transistor causes motors, escapements or other power devices to furnish physical motion. Reed tones must be exact and are governed by the length of the pieces of watch spring.

Circuit details

The superregenerative detector stage is a simple, straightforward, standard circuit using a Philco AO-1 transistor (Fig. 3). The coil is wound on a ¼-inch slug-tuned CTC form. The audio voltage output is developed across the 1,000-ohm resistor in the lead to the negative 1.5-volt line. Since the amount of superregeneration is small, I used an oscilloscope to test the operation of this part of the circuit. Connect scope leads across the 1,000-ohm resistor.

When the power is off, the scope line should be thin and narrow. With power connected to the receiver and the stage working, the line on the scope will broaden, indicating the presence of rf. The widened line may be from ⅛ to ¼ inch higher than the one without power. If a transmitter is turned on and a tone transmitted, you can see the modulation on the wider picture when the receiver is properly tuned.

The two 47,000-ohm resistors and .001-μf disc capacitors form a quench filter for the input. A second quench filter, a 5.6-μf 6-volt capacitor, is placed across a 27,000-ohm resistor at the TA-12. (The 5.6-μf capacitors are not available everywhere. In most cases, 5-μf or 6-μf units should do the job satisfactorily. — *Editor*). This gives a good, pure sine wave for tones up to about 600 cycles. Use a smaller capacitor if higher-frequency tones are to be received.

The 2N109 stage is straightforward. Base bias resistor (R8) may be any value from 5,000 to 10,000 ohms. The lower value gives a higher static current and is better for single-channel operation. Be sure to connect the 5.6-μf coupling and filter capacitors with the polarity shown. Also, do not

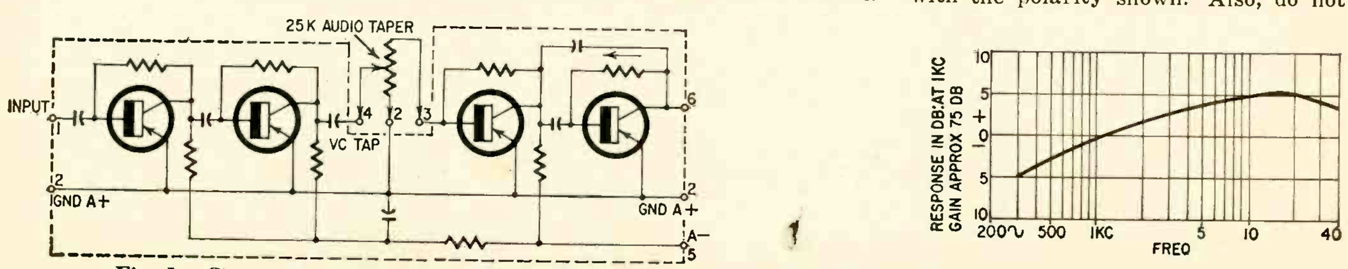


Fig. 1—Circuit of the TA-12-B, a packaged 4-transistor amplifier and its frequency response chart.

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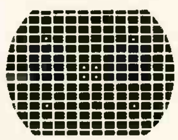

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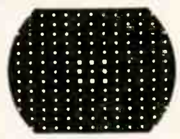
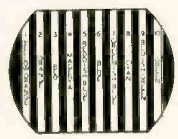


Generates white dot, crosshatch and color bar patterns on the TV screen for color TV convergence adjustments.



Generates full color rainbow display and color bar pattern to test color sync circuits, check range of hue control, align color demodulators. Demonstrates to customers correct color values.

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Model 960 Transistor Radio Analyst

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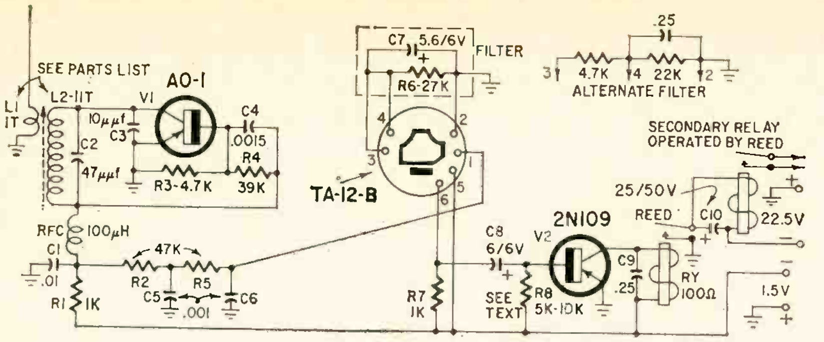


Fig. 2—Circuit of the complete 4-channel receiver.

Miniature transistor amplifier (Centralab TA-12-B)
R1, R7—1,000 ohms
R2, R5—47,000 ohms
R3—4,700 ohms
R4—39,000 ohms
R6—27,000 ohms
R8—5,000 to 10,000 ohms (see text)
All resistors ¼-watt 10%
C1—.01 μf, ceramic
C2—47 μμf, ceramic
C3—10 μμf, ceramic
C4—.0015 μf, ceramic
C5, C6—.001 μf, ceramic
C7, C8—5.6 μf, 6 volts, miniature electrolytics (Solid Tantalum Texas Instruments capacitor available from Lafayette Radio and Allied Radio)
C9—0.25 μf, ceramic
C10—25μf, 50 volts, electrolytic
All capacitors 6 volts or higher
L1—1 turn No. 28 enameled wire around L2
L2—11 turns No. 28 enameled wire spaced 1/16 inch on CTC (Cambridge Thermionic Corp.) LSM ¼ inch red dot coil form with core. Winding length ½ inch.
RFC—100μh
RY—100 ohms (Jaico relay coil or relay, Jaidinger Mfg. Co., 1921 W. Hubbard St., Chicago 22, Ill.)
V1—A0-1 (Philco)
V2—2N109
Batteries 1.5 and 22.5 volts
Miscellaneous hardware

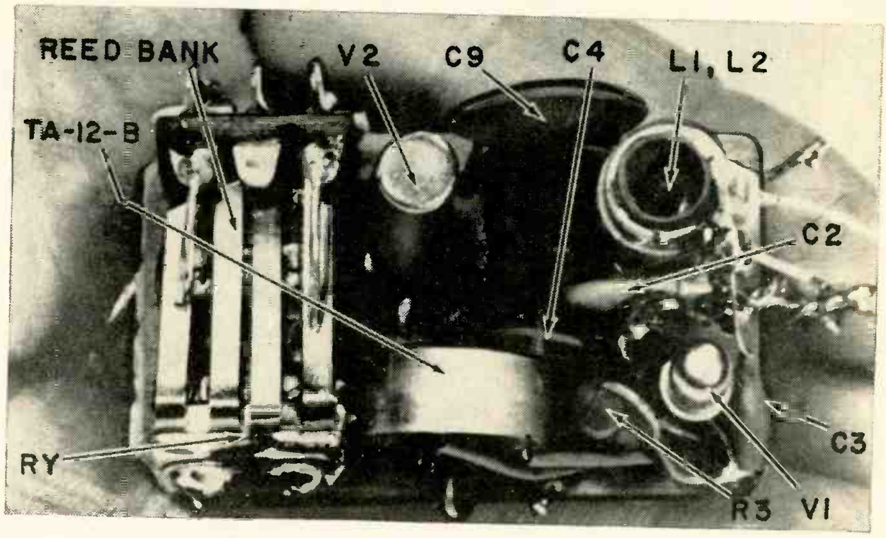
omit the 0.25-μf relay or reed bypass or reduce its value as this will cause trouble.

Reed-unit construction

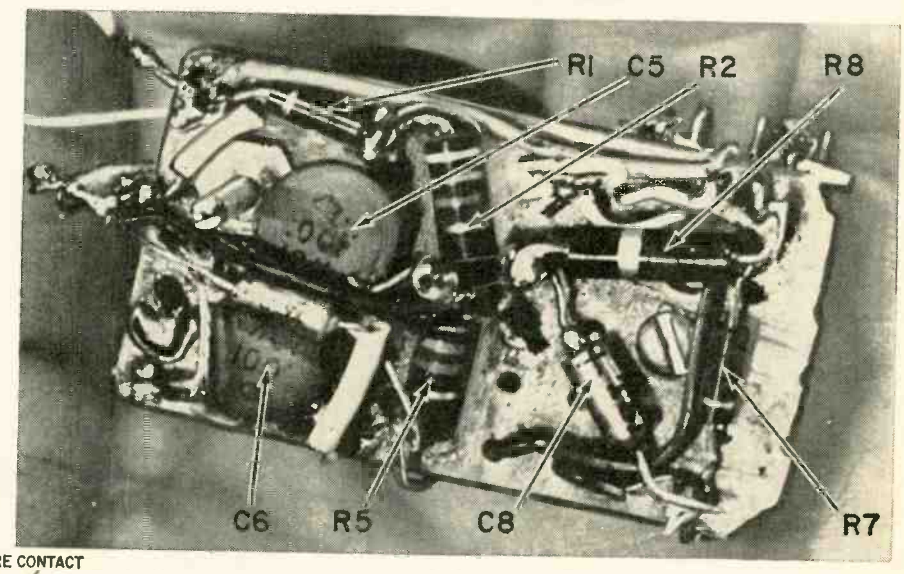
To convert the Jaico 100-ohm relay into a four-channel reed decoder, the following steps are necessary. First, carefully remove the relay armature and the bradded solder lug on the back of the relay frame. Next file down the top of the frame where the armature was pivoted until it is smooth and level and even with the top of the coil. Carefully remove the normally closed fixed contact from the front of the relay frame.

Cut a small piece of metal from a coffee can, about ⅜ inch long and ¼ inch wide. Sand it bright. Bend it tightly together so it is ⅜ by ⅛ inch in size. Position it on top of the pole piece as shown in Fig. 4-a. Hold it tight against the pole top and solder just the front edge. **Be very careful to keep solder from running under the metal strip.** Solder between the pole top and the strip will seriously impair the reed unit's performance. The metal strip *must* touch the pole top tightly.

Now get a wristwatch spring. We used one from an old Timex watch. Straighten it out and sand both sides



Top chassis view of the midget receiver.



Other side of the receiver's chassis.

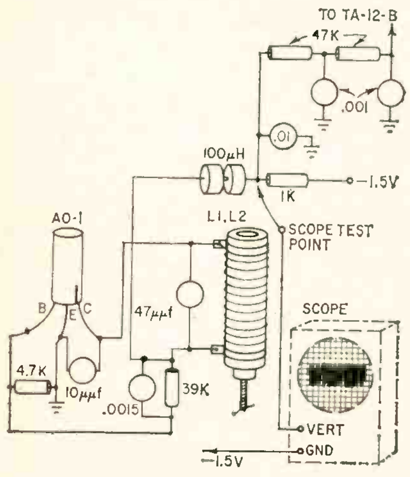


Fig. 3—Pictorial diagram of the receiver detector set up for oscilloscope test for superregeneration.

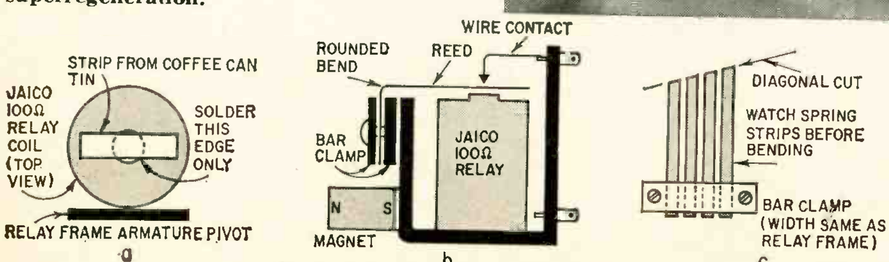
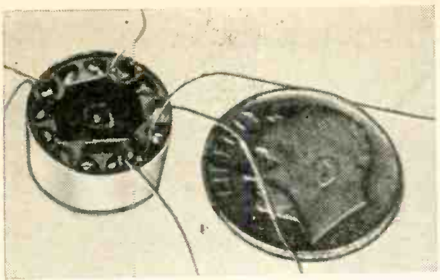


Fig. 4—Details of reed unit construction.



One thin dime is larger than a TA-12-B amplifier.

bright. Cut four 1⅛-inch pieces. Bend these ¼ inch from one end, rounding the bend as in Fig. 4-b. The longer part should now be at least ¾ inch long. Clamp the short ends between two small soft iron bars and file the inside of the bar smooth so it will fit tightly and firmly against the relay frame (Fig. 4-b).

Cut the long ends of the watch-spring strips diagonally as in Fig. 4-c. The sharper the diagonal, the wider the reed frequencies separate. The flatter the cut, the closer the reed frequencies. Then position the long part of the reeds 1/16 inch above the metal strip you soldered to the relay's pole piece.

Pressing the reed clamp bars tight against the relay frame, solder the edges to hold the bar in place. **Do not let solder run between the bar clamp and the frame.**

I found that positioning a small magnet like those in a dime store pot holder, as shown in Fig. 4-a, increases the reed vibration amplitude significantly. Try both ends of the magnet against the frame as one end will work better than the other.

When the proper tones are transmitted, and yours will be right around my values if you use the length reeds specified, the reeds will vibrate a full 1/16 inch up and 1/16 inch down. Now you can position fixed contacts over the reeds, above the pole piece, to complete the intermittent contact.

Reed-decoder improvement

The reed decoder can be improved if the magnet can be cut and positioned between the spring clamp bars and the

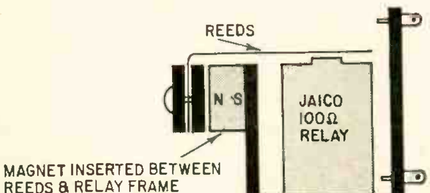


Fig. 5—Modification to improve the reed unit.

frame as shown in Fig. 5. For those who would like to build the receiver but not the reed unit, use the Min-X reed decoder, with a 200-ohm coil, obtainable through hobby shops. You can get 8 to 10 channels with this commercial item.

Any commercial radio control tone-type transmitter can be used with the receiver, provided its tones can be adjusted to the reed frequencies. END

soldering shortcuts

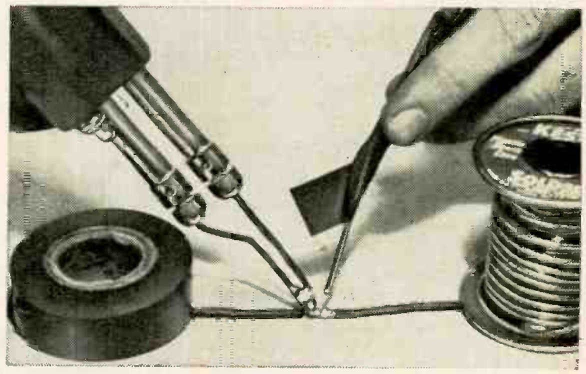
BY JOHN A. COMSTOCK

Many electronic technicians spend about half of their servicing time soldering and unsoldering circuit components. Because of this, much valuable time is wasted solving problems which crop up during various soldering jobs.

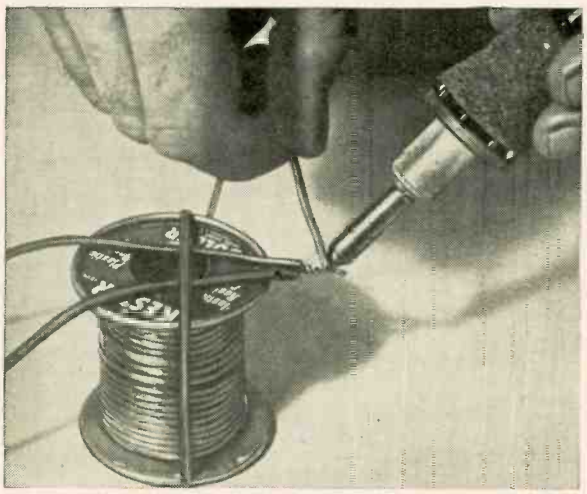
Here are several selected soldering shortcuts that will prove helpful. They will save time, trouble, and effort.

When replacing a defective part, how do you mark the location so you solder the replacement to the right lugs? Try color-coding the lugs with food coloring. A brush dipped in water removes the coloring quickly.

How do you shunt iron heat to avoid overheating delicate components? You could use various gadgets such as test clips, metal paper clamps, etc. Generally, a small pair of long-nose pliers with a rubber band around the handle works best.



If a live circuit can't be disrupted while you solder, avoid shocks by wrapping solder with plastic electrician's tape. This also keeps finger grease, which sometimes hampers adhesion, off the solder.



The technician's No. 1 problem is the need for a third hand to hold parts and wires. When they can be pinned down outside the circuit, a rubber band around the spool of solder will do the trick.

When small-gage wire solder is not available for work on transistors or printed circuits, hammer solder flat. This reduces solder's melting temperature and allows use of smaller iron and less part-damaging heat.

If you pick up your soldering gun, squeeze the trigger and discover the tip doesn't heat in the normal time, tighten tip-holding nuts or screws. If spotlights don't light, check for a blown or loose bulb. END

Technotes

PANEL MOUNTED METER ACCURACY

A meter intended for mounting on an iron panel will not give the same reading when it is removed from the panel. If the series or shunt resistors for the meter must be adjusted, do so with the meter mounted on the panel.

This also holds true for meters used on small portable meter cases. The meter should be a unit intended for such duty. Do not use such a meter too close to a massive iron structure or readings will not be accurate.—*Warren Roy*

RCA CTC4, CTC5, CTC7 COLOR CHASSIS

Whenever the focus control goes on one of these chassis, install a 56,000-ohm 1-watt resistor in series with the arm of the replacement pot. If you use an RCA replacement part, you'll find that it is slightly different from the original and a variation on the mounting is needed.

Clip off the locating tab on the replacement pot. It won't line up with the locating hole in the chassis. This means you must be sure that the mounting nut is securely tightened. You will also find that the control terminals cannot be inserted through the mounting board. Instead, solder a short piece of bus wire to each terminal. These wires can then be inserted into the proper mounting board holes. (Fig. 2).

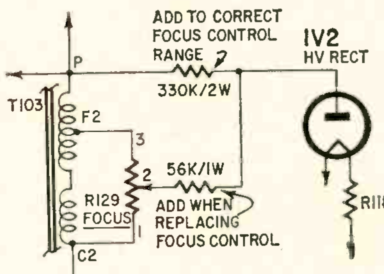


Fig. 1

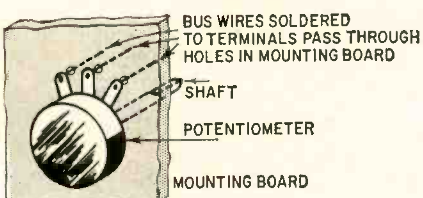


Fig. 2

After installation, if you find that the ranges of the focus control allows proper focus near the maximum clockwise position, add a 330,000-ohm 2-watt resistor as shown in Fig. 1—*RCA TV Service Tips*

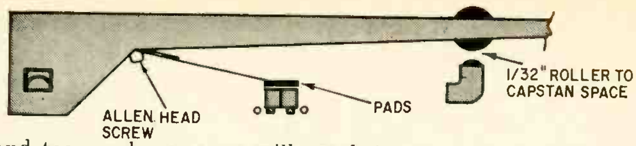
STEELMAN TRANSITAPE MODELS 7111-A, -B

Symptom: Short battery life, slow tape speed.

With a tape in place and running, the motor should draw about 100 ma. Greater current drain indicates improper flywheel pressure, a sticky pressure roller, too much pressure on the pressure pads or, once in a great while, an unsatisfactory motor.

The flywheel is the large brass wheel. Use your fingers and the holes in the casting to check for smooth rotation and end play. The wheel should have an endwise movement of .005 inch. This distance is barely but definitely discernible to the fingers. If necessary, loosen the rear-bearing lock nut, and back the bearing off. Try again. Too much end play will cause slippage (speed loss), and too little play will increase motor load needlessly.

Bring the bearing up very gently. It is made of sapphire



and too much pressure will crack it.

To check the pressure applied to the tape by the pressure arm, run the tape through and check motor current. Now lift the arm by hand, and observe the change in motor current. Stop the machine and test for roller freedom by turning the black rubber roller with your fingers. If it sticks or does not turn freely, replace with Steelman part No. 700047 and shaft No. 700067.

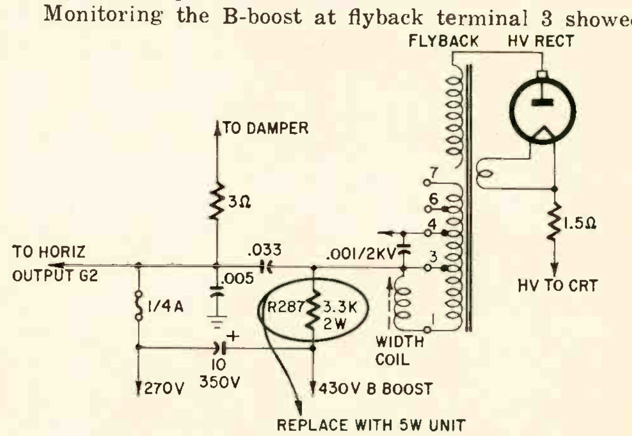
If the roller is satisfactory, check the pressure pads by watching them as you raise the pressure roller 1/16 inch from the capstan. After this distance the pads should leave the tape. If necessary, adjust by loosening the Allen-head screw found under the other end of the pressure arm (see diagram).

Note that, while too much pressure on the tape will reduce motor battery life considerably, too little pressure will cause erratic record and playback. Normal motor battery life is about 50 hours with intermittent Transitape operation.—*Max Alth*

DuMONT RA-306

The set developed an intermittent loss of height. Monitoring the B-boost line showed it was affected whenever the height would shrink. The B-plus to the vertical oscillator is fed by bootstrap B.

Monitoring the B-boost at flyback terminal 3 showed



no appreciable change in B-boost with the height change. R287, the 3,300-ohm resistor in the B-boost line, was checked and its value was found to be off. Replacing the resistor put an end to this intermittent. We used a 5-watt replacement to prevent any recurrence.—*Warren Roy*

FOCUS PRECAUTIONS

Both the focusing and ion-trap magnets affect the electron beam. Any appreciable adjustment of the focus magnet should be followed up by a readjustment of the ion-trap magnet.

Some TV sets have a funnel to help guide the screwdriver to the focus adjustment screw. If the screwdriver slips, it may move the ion-trap magnet slightly. If only a slight change is made, it may not be noticed immediately. As a general precaution, make it a rule always to check the adjustment of the ion trap after any focus adjustment.—*Joe Shane*

END

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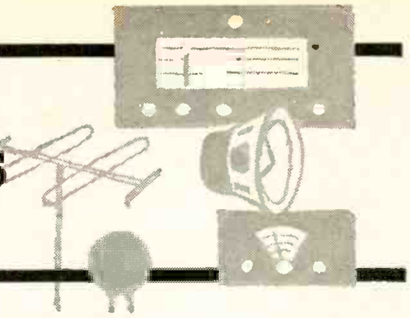
RADIO-ELECTRONICS wants Industrial Technotes. These should cover equipment (including closed-circuit television) actually used in industrial work, or technotes on counters, controls and other apparatus whose users are largely industrial. Unillustrated Technotes pay $5; circuit diagrams raise the price to $9 and acceptable photos are worth $7 each. Send your technotes from industry to Technotes Editor, RADIO-ELECTRONICS, 154 W. 14th St., New York 11, N. Y.

NEW PRODUCTS



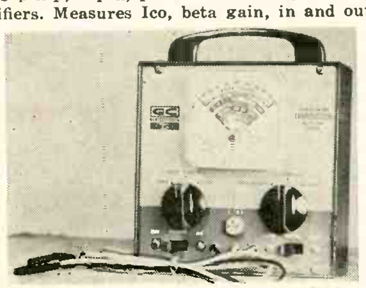
TRANSISTOR AUDIOMETER, *model ZA-100-T.* Portable, single-channel diagnostic hearing testing device, powered by eight Z-9 mercury batteries, one ZM-401. Automatic mercury shutoff switch; test meter indicates battery condition. Temperature-compensated circuitry includes transistor thermistor-stabilized Wienbridge oscillator, tone interrupter switch with rise and decay time of 0.005–0.150 second, tone interrupter reverse switch. Masking control calibrated in levels of total sound intensity above .0002 dyne/sq cm. Continuously rotating frequency-selector dial, frequency accuracy within ±3%. Measures frequencies 125–8,000 cycles air

conduction, 250–4,000 cycles bone conduction. 10⅝ in. wide x 7 in. high 6⅜ in. deep. 8½ lbs. 2 TDH-39 headphones with MX41/AR cushions, headband, yokes, cord, bone-conduction receiver.—**Zenith Radio Corp.**, 6001 W. Dickens Ave., Chicago 39, Ill.

6-METER VFO, *model HE-61.* Shielded tuning components, high-Q Clapp oscillator circuit. Operates in 4–4.5 mc range, output frequency 8 mc. Ferrite tuned coil output approximately 10 v. Use with any tranceiver having standard 8-mc crystal. Cable with 5-prong power plug for units with correct input, instructions

for units without; cable and standard crystal plug for vfo input. Illuminated dial calibrated 50–54 mc. Single-knob planetary drive mechanism. Tube complement: 12BA6 oscillator, 0A2 voltage regulator.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

TRANSISTOR TESTER, *model No. 36,560.* Tests p-n-p, n-p-n, power transistors, diodes and rectifiers. Measures Ico, beta gain, in and out of



circuit. Short, leakage, gain tests. Wide-angle meter, transistor socket for out-of-circuit tests, zero adjustments on meter.—**GC Electronics**, 400 S. Wyman St., Rockford, Ill.

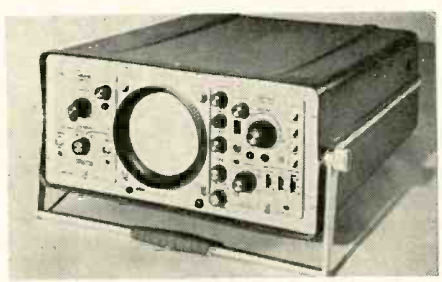
VFO, *model HG-10.* Covers 80–2 meters with each band separately calibrated on rotating drum type slide-rule dial. 28-1 gear-drive

vernier tuning. Epoxy-coated coils on ceramic forms for high stability. Double-bearing tuning capacitor. Heavy steel chassis, cathode-follower output. Spot switch for off-the-air tuning. Circuit designed for grid-block keying with manufacturer's DX-60, or cathode keying with other transmitters.—**Heath Co.**, Benton Harbor, Mich.

SELF-SERVICE TUBE TESTER, *model 201-L.* Tests more than 1,200 types including nuvistors, compactrons, Novars, 10-pin, series-string, OZ4, 1-volt, electron-ray, hi-fi and foreign and 6 and 12-volt auto radio vibrators. Will

accommodate new types introduced in the future. Storage compartment holds over 600 tubes.—**Mercury Electronics Corp.**, 111 Roosevelt Ave., Mineola, N. L.

PORTABLE SOLID-STATE SCOPE, *type 765, PortaScope.* Sensitivity 5 mv/cm, bandwidth 25 mc. Interchangeable dual plug-in range dc–25 mc, 3 db down; additional plug-ins available



later. 27 lb (5 lb each plug-in). *Model 766*, bench type; *model 767*, rack-mounted.—**Allen B. Du-Mont Labs.**, 750 Bloomfield Ave., Clifton, N. J.

DC POWER SUPPLIES. *Model EC-1*, for

warmup, demonstration and checkout operations. Adjustable power source for mobile and marine AM and FM radio, 12-volt dc supply for lab research. Ripple 0.5% at 5 amps. Ampere output 0–5 adc. 3-position voltage adjustment switch, pilot light and wingnut output terminals. *model EC-2*, for auto radio and transistor portable servicing. Ripple 0.5% at 5 amps. Dc output 0–16 volts and 0–5 amps continuous. Variable voltage adjustment, voltmeter/ammeter, meter function switch, pilot light and insulated output binding posts.—**Electro Products Labs**, 4500 Ravenswood Ave., Chicago 40, Ill.

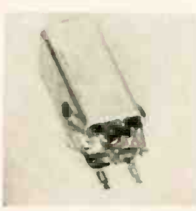
TUBE CHECKER, *Kit IT-21*. Checks all common tube types including compactron, Novar, nuvistor, 10-pin miniatures. Tests for quality on basis of total emission, and for shorts, leakage, open elements and filament continuity. Quality read on multi-colored meter scale. Multiple

filament voltages, adjustable cathode current, variable meter sensitivity and individual tube-element switching. Thirteen 3-position lever switches allow checking each tube element individually for open or short conditions. Roll chart, line adjust control.—**Heath Co.**, Benton Harbor, Mich.

IN-CIRCUIT CAPACITOR TESTER, *Realistic model TK-112*. Tests papers, mylars, ceramics, micas and tubulars for shorts or open. Direct measurement of electrolytic capacitor values, 4 to 400 μf. All indications on EM84 eye tube. Coaxial cable with insulated alligator clips. Single

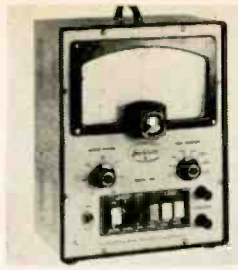
sequential test connects leads once for open or short reading. Short test reveals shorted capacitors with current shunting resistance as low as 10 ohms.—**Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17, Mass.

MINIATURE IF TRANSFORMERS. *Part Nos. RTC-9284 to RTC-9295:* hollow hexagonal-hole cores for double or single-ended tuning. Mounted with snap fasteners attached to shields



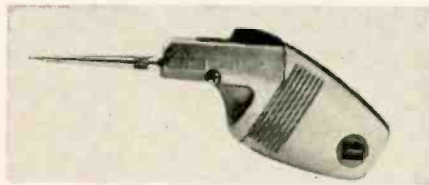
for positive ground connection without extra soldering. 262- and 455-kc input and output units, 4.5-mc input and interstage, plus 4.5-mc ratio detector. *Part Nos. RTC-9266 to RTC-9307:* With ground lugs for printed-circuit boards.—**Stancor Electronics Inc.** 3501 W. Addison St., Chicago 18, Ill.

CAPACITANCE CHECKER, *model 691*. 4 ranges for testing capacitors from 10 μμf to 1,000 μf. Leakage tests for polarized and unpolarized units. Power factor test for electrolytics from 0–60%. Low-voltage bridge for checking electrolytics in transistor circuits.—**Jackson**



Electrical Instruments Co., 124 McDonough St., Dayton, Ohio.

SOLDER DISPENSER, *Weller Kormat*. Speeds soldering by delivering solder to connection, even in tight corners. Keeps solder clean.



Protects heat-sensitive components from thermoshock, as aluminum probe absorbs part of soldering heat. Takes solder 15 to 22 gauge. Holds solder in handle, or can be connected to external spool of solder.—**Weller Electric Corp.**, 601 Stone's Crossing Rd., Easton, Pa.

SUPER CONTACT CLEANER, *no 8680*. Heavy-duty contact cleaner with silicone addi-

tive, in 6-oz spray can.—**GC Electronics**, 400 So. Wyman St., Rockford, Ill.

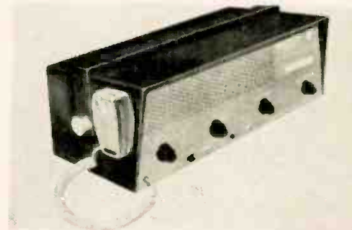
FM MULTIPLEX TUNER, *model LT-81*. Sensitivity 2 μv, 20-db quieting. Grounded-grid low-noise front end, triode mixer, 8-gang tuning

capacitor, tuned dual limiters, Foster-Seeley discriminator. Afc and afc defeat, precision tuning meter. Response 20–20,000 cycles ±½ db. Stereo separation 30 db, less than 1% harmonic distortion. Antenna input 300 ohms.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

FM MULTIPLEX ADAPTER KIT, *model KT-220*, for manufacturer's recent tuners or any quality wide-band FM or FM/AM tuner with

or without multiplex jacks. Prealigned coils. Self-powered, may be remotely connected to a tuner. Separation 30 db, 400 cycles. Distortion below 1%. Noise-limiter slide switch, on-off power slide switch with pilot light, separation control. Tubes: 12AU7, 6BN8, 12AX7, plus silicon rectifier. Shielded cable. All necessary components.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

CB TRANSCEIVER, *model TRC-5*. 117 vac, for base station, mobile or industrial operation. Voice signal 2 watts rf, frequency stability ±.005%. 5 transmitting channels, front-panel switch. Superhet receiver tunable over entire band from 26.9 to 27.3 mc, plus single crystal-controlled receiver channel. High-impedance, ceramic push-to-talk mike with coiled cord.



Transmitting and receiving crystals available for all CB channels, plus converters from 6 and 12 vdc.—**Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17, Mass.

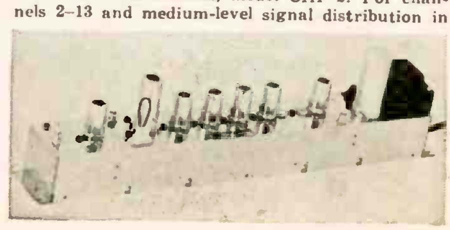
CB TRANSCEIVER, *model DN-348*. Receiver section: 5-tube superhet circuit with rf stage, squelch, noise limiter. Front-panel variable tuning dial selects any CB channel. I.f. 455 kc, sensitivity ½ μv for 6-db signal-to-noise ratio. Selectivity 5 kc at 6 db down from peak response. Audio response 300–2,500 cycles, ±3 db. Input impedance 50 to 70 ohms. Transmitter

section: 5-watt nominal power input to final rf amplifier, nominal power output 3 watts. Operating frequency within .005% of crystal frequency over ambient temperature range of −20 to +130°F. AM plate modulation automatically limited to less than 100%. Output impedance 50–70 ohms.—**Daystrom Products Corp.**, Box 167, St. Joseph, Mich.

VHF RADIO RECEIVER, *model CRX-2 (illus)*. FM reception 151–174 mc, for public service, land transportation, industrial communications, marine use. *Model CRX-1*, narrow-band, triple-conversion FM receiver, range 30–50 mc. *Model CRX-3*, dual-conversion AM receiver, range 108–135 mc, may be used for satellite communications. All units have built-in speaker, terminal strip for external speaker and internal-external speaker switch, adjustable squelch con-

trol, tuning control, channel-selector switch, antenna connector, ground legs, transformer power supply for 105/120 volts, 50/60 cycles ac. 13½ in. x 5⅞ in. x 8¾ in.—**Hallicrafters Co.**, 4401 W. 5th Ave., Chicago 24, Ill.

TV AMPLIFIER, *model CAP-2*. For channels 2–13 and medium-level signal distribution in



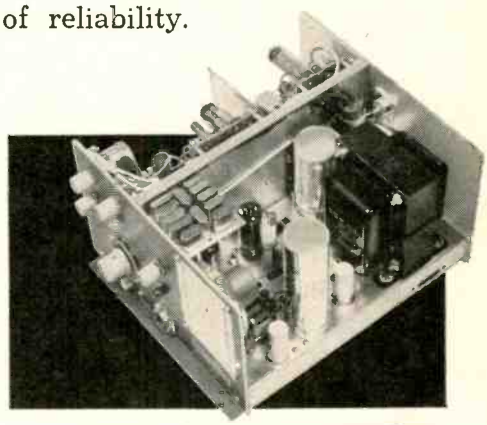
Superior Performance

These two words . . . perhaps more than all others, describe the

INTERNATIONAL MODEL 100 EXECUTIVE CITIZENS BAND TRANSCEIVER

Superior performance is the product of efficient design, precision engineering, top quality components and construction. From interior to the clean attractive lines of its exterior, the Model 100 gives you that extra measure of reliability.

Check these outstanding features . . .



Crystal filter for minimizing adjacent channel interference. Built-in calibration circuit ● 12-position crystal controlled transmit channel selector ● Front panel microphone jack ● Provision for connecting external speaker and S/meter ● Tunable dual conversion superheterodyne receiver covering all 23 channels. ● Two crystal controlled receive positions ● Push-to-talk operation ● Three way power supply for 6/12 vdc and 115 vac ● Five watts plate input ● Certified tolerance ± .005% ● Brown cabinet with brown and silver panel ● Dimensions: 5½″ H. x 8½″ W. x 9″ D.

Complete with 1 transmit crystal, 1 receive crystal, new style ceramic microphone and coil cord $199.50

External S/Meter and Speaker

This external S/meter and speaker is the perfect companion for the Model 100. Constructed with the same clean lines and fine craftsmanship. Utilizes a high impedance vacuum tube volt meter circuit. Connects to socket on rear of transceiver. S/meter reads in three ranges.

Complete with interconnecting cable $49.50

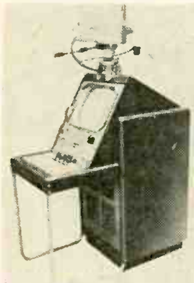
INTERNATIONAL CRYSTAL MFG. CO., INC.

18 NORTH LEE • OKLAHOMA CITY, OKLAHOMA

The next time you visit your International dealer ask him for a demonstration of the Model 100 Executive and the system-engineered accessories. A complete catalog of International equipment and crystals may be obtained by writing International Crystal Mfg. Co.

community TV systems, educational and industrial installations. Gain 65 db with agc disabled. Recommended output: Picture carrier 3 volts, sound carrier 1 volt. Input and output impedance 75 ohms; supply voltage 117 volt, 60 cycle, 40 watts.—**Benco Television Associates, Ltd.**, 27 Taber Rd., Rexdale, Ontario, Canada.

PORTABLE TV CONSOLE, *model ST-1, Porta-Studio* for schools and industry. Transistorized camera and mike for audio and video reception. Combined with modulator into complete

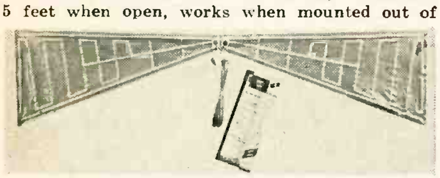


CCTV system, originating any channel from 2 to 13. Lighting equipment and 17-inch monitor. *Model ST-2:* two camera inputs, lights for two cameras and two 8-inch monitors.—**Blonder-Tongue Labs.**, 9 Alling St., Newark, N. J.

REPLACEMENT FLYBACKS for Motorola TV sets. Stancor *part No. HO-342* replaces 24C740969 and 24C742676 in 50 Motorola models and chassis. *HO-343* replaces 24C744042 in 119

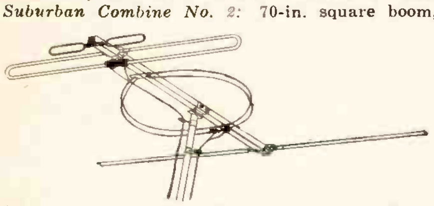
models and chassis. *HO-344* replaces Motorola 24K748397 and 24K754273-Z in 279 models and chassis.—**Stancor Electronics Inc.**, 3501 Addison St., Chicago 18, Ill.

FM–TV INDOOR ANTENNA, *Brite-Site.* 5 feet when open, works when mounted out of



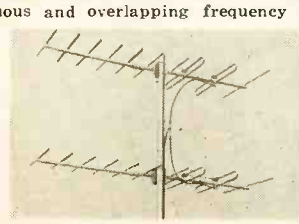
sight. Vinyl plastic, silver printed circuit.—**RCA, Parts & Accessories**, PO Box 654, Camden 2, N. J.

FM-TV ANTENNAS, *Combine series. Metropolitan Combine No. 1:* 40-in. square boom, 2 elements low-band TV, 3 elements collinear high-band TV, all-directional halo element on FM. *Suburban Combine No. 2:* 70-in. square boom,



4 elements low-band TV, 10 elements collinear high-band TV, 3-element directional on FM. *Fringe Combine No. 3:* 100-in. square boom, 5 elements low-band TV, 15 elements collinear high-band TV, 4 elements directional on FM. All units require 2 separate transmission lines, no couplers, pre-assembled snapout construction.—**Finney Co.**, 34 W. Interstate, Bedford, Ohio.

10-ELEMENT YAGIS. High-band units give continuous and overlapping frequency coverage



in 112- and 305-mc ranges, high gain, low vswr. Aluminum alloy tubing, heli-arc welded construction. *Model Y-102* for vhf communication frequencies, *Y-103* for vhf plus high-band TV channels.—**Taco**, Box 38, Sherburne, N. Y.

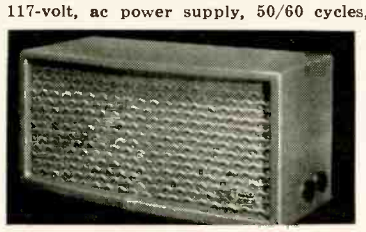
STEREO PREAMP–CONTROL CENTER, *model PR2.* 15 inputs, 14 separate controls. Phonomix switch, loudness and volume controls,

phasing switch, equalized tape head inputs, separate recorder inputs, switched high–low cutoff filters and pure rectified dc on all filaments.—**Bogen-Presto Co.**, PO Box 500, Paramus, N. J.

STEREO RECEIVER KIT, *model KU-45 Audio Center.* Combines AM/FM multiplex stereo tuner and 32-watt stereo amplifier. Dynamic sideband regulation reduces over-modulation and fringe-area distortion; afc locks in FM broad-

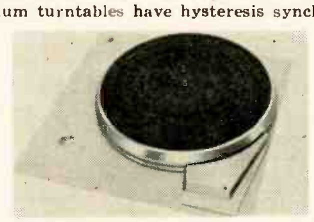
cast signal, prevents drift. Point-to-point wiring, prewired and prealigned FM front-end assembly. Push-button on-off switch, regular or reversed stereo switch, dual-concentric clutch type bass and treble controls. Amplifier Section: 32 watts continuous sine-wave power output; response ±1 db, 30–16,000 cycles at rated power; harmonic distortion 1.0% at rated power; hum and noise better than —75 db; output impedances 4, 8, 16 ohms each channel, 8 and 16 ohms center channel. Tuner Section: FM sensitivity 2½ μv usable IHFM sensitivity, 30-db quieting; i.f. bandwidth 200 kc, 3 db down; AM sensitivity 3 μv, 10-db signal-to-noise ratio. 4¾ x 16⅞ x 13 in. Supplied with parts, tubes, wire, solder, built-in AM loopstick and FM folded-dipole antennas.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

AMPLIFIER/SPEAKER, *model S-2300.* 8-watt push-pull amplifier, 8-in. woofer, 3½-in. tweeter, built-in crossover network. Operates on any 117-volt, ac power supply, 50/60 cycles, 60



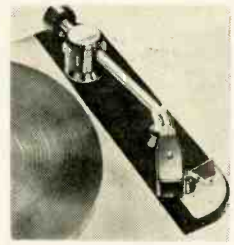
watts. Separate bass and treble controls, multipurpose jack, for audio connection with sound source. Response 20–15,000 cycles; harmonic distortion less than 1%; hum and noise 55 db below rated output.—**H. Herbert Orr Enterprises Inc.**, 714 Wesley St., Opelika, Ala.

HI-FI TURNTABLE, *Rondine 2. model R,* 33⅓ rpm only (illus.). *Model R 320,* turntable with S-320 pickup arm. *Model R 320A,* turntable with AP-320 automatic pickup arm. Solid cast-aluminum turntables have hysteresis synchronous



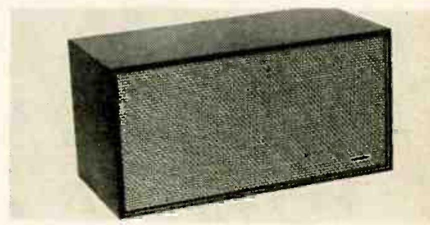
motor, noise level 57 db below average recording level, wow and flutter 0.15%. Minimum size for cabinet installation with stereo pickup arm 15⅛ x 14¾ in. Height above deck 3 in., depth below deck 4¼ in.—**Rek-O-Kut Co.**, 38-19 108th St. Corona 68, N. Y.

PICKUP ARM, *model BTD-12S,* for 12-in. hi-fi turntables. Independent turntable leveling, resonant frequency below 16 cycles with ordinary pickup cartridges, lower with high-compliance cartridges. Precision cueing device, integral with arm, for lowering and lifting arm without touching it. Adjustments: static balancing with damped counterweight for overall cartridge weights of 5–19 grams; spring-applied stylus force with knob calibrated from zero to 8 grams; vertical height (range 1⅝ in.). Stylus overhang (range 7/16 in.) individually set for each cartridge. Vertical pivot design keeps stylus in vertical plane for each height adjustment. Bearing



friction below 1/10 gram in any direction at stylus. Arm 12½ in. overall, with mounting board for manufacturer's TD-124 and TD-121 turntables.—**ELPA Marketing Industries**, Thorens Div., New Hyde Park, N. Y.

HI-FI SPEAKER SYSTEM, *series AS-51.* 2 Jensen speakers, 8-in. woofer, compression type tweeter with flared horn. Range ±5 db, 50–12,000 cycles. Built-in 1,600-cycle crossover network. Control adjusts power level of tweeter.

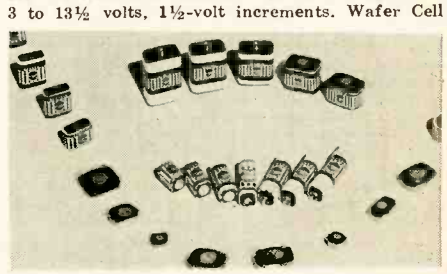


Speaker impedance 16 ohms, power rating 25 watts. Used with hi-fi amplifiers with as low as 3 watts output. Vertical or horizontal mounting. —**Heath Co.**, Benton Harbor, Mich.

COLUMN SPEAKER, *Uniline CS-3.* 6 elliptical speakers, 2 tweeters. Response 150–10,000 cycles; vertical dispersion 22°, horizontal dis-

persion 120°. Power capacity 25 watts, impedance 16 ohms. 48 x 7½ x 8¾ in.—**University Loudspeakers, Inc.**, 80 S. Kensico Ave., White Plains, N. Y.

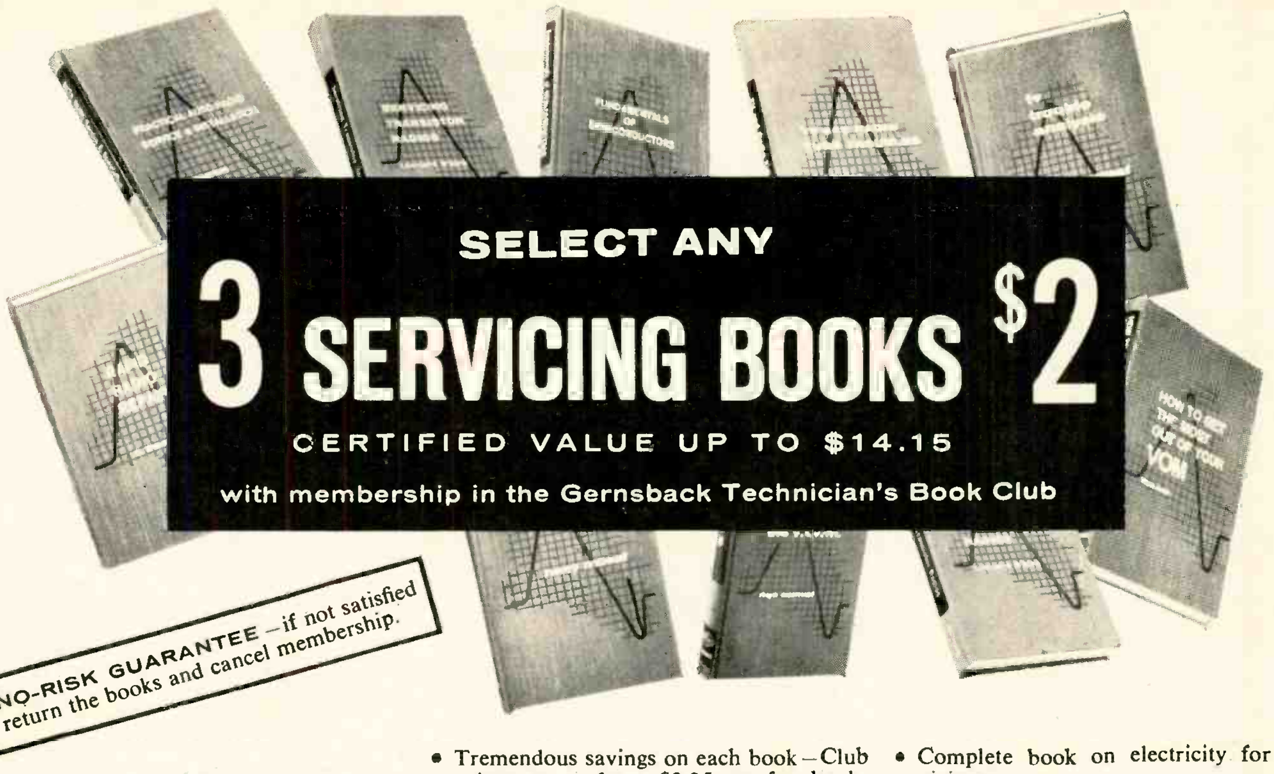
MINIATURE DRY BATTERIES, 44 types, for transistorized circuits. 8 power ratings from 3 to 13½ volts, 1½-volt increments. Wafer Cell



construction, sandwich of artificial manganese dioxide mix between disc-electrodes of zinc and carbon, heat-sealed in airtight pliofilm envelope. —**Burgess Battery Co.**, Freeport, Ill.

WEATHERPROOF SPEAKER. *Mini-*

SPECIAL INTRODUCTORY OFFER



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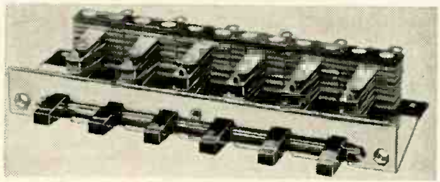
Speaker. Compact, weatherproof, dustproof. Self-contained steel enclosure. For use as extension, test, PA, intercom, or paging unit. Withstands extremes of humidity, temperature or shock. provision for installing volume control and on-ff switch.—**Minneapolis Speaker Co.**, 3806 Grand Ave. So., Minneapolis 9, Minn.

"LITTEL" KEY SWITCH, *model MLK*, 6 or 12 stations. Key switches supported by common pivot rod of nickel-plated brass wire. Requires 2-3/32 in. depth behind mounting panel. 3-position lever type switch, or 2-position switch with



momentary or locking action. Choice of contacts: silver rated at 3 amps, 120-volt ac noninductive load. Palladium contacts on special order.—**Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago 30, Ill.

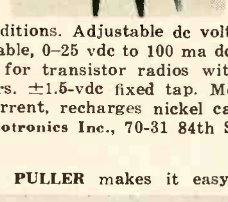
SCREWDRIVERS on rack display card. 3/16 x 4-in. and ¼ x 4-in. round blade, No. 2 Phillips screwdriver, bonus driver with overall

length 2¾ in. Fluted, plastic handles, Vanadium steel blades.—**Vaco Products Co.**, 317 E. Ontario St., Chicago 11, Ill.

SURGISTOR, *1000 series*. Protects all tubes, silicon rectifiers, fuses, pilot bulbs and electrolytic capacitors from in-rush currents, by connection in series with power lead. Line

voltage initially reduced to one-third normal for about 10 seconds; full line voltage automatically restored by self-contained thermal switch.—**Wuerth Products Corp.**, 1931 Moffett St., Hollywood, Fla.

BATTERY ELIMINATOR/CHARGER, *model P-25*. Eliminates need for batteries in transistor equipment during test and repair, simulates weak

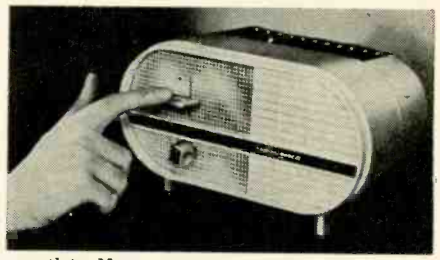


battery conditions. Adjustable dc voltage, continuously variable, 0–25 vdc to 100 ma dc. Automatic center tap for transistor radios without output transformers. ±1.5-vdc fixed tap. Monitors voltage and current, recharges nickel cadmium batteries.—**Pacotronics Inc.**, 70-31 84th St., Glendale 27, N. Y.

FUSE PULLER makes it easy to replace

fuses in hard to get at locations. One end takes long fuses, the other end short ones. Nylon molding resists grease, oil and other chemicals.—**Bussman Mfg. Div., McGraw-Edison Co.**, St. Louis 7, Mo.

WIRELESS INTERCOM, model FW-40 is an all-transistor 2-station system. Plug units into



ac outlets. No warmup, no connecting leads. Additional single-station units can be added.—**Fanon Electronic Industries Inc.**, 439 Frelinghuysen Ave., Newark 14, N. J.

All specifications are from manufacturer's data

NEW LITERATURE

CATALOGS • BOOKLETS • CHARTS

INDUSTRIAL CATALOG. 20-page, 2-color booklet offers printed circuitry, connectors, hardware, semiconductor products, industrial components, test instruments, communications equipment and technical books. Many illustrations. Request on company letterhead.—**Allied Electronics**, 100 N. Western Ave., Chicago 80, Ill.

TECHNICAL BOOKLIST. 32-page 2-color catalog contains data on 147 books on electronics, TV, radio, audio, computers, electricity, etc., with subject index.—**Howard W. Sams & Co. Inc.**, Technical Book Div., 2201 E. 46 St., Indianapolis 6, Ind.

PLANNING MASTER TV SYSTEMS. 28-page manual gives detailed design information on various systems. Includes data charts and many illustrations.—**Blonder Tongue**, 9 Alling St., Newark, N.J.

ULTRASONIC MACHINING explained in 16-page illustrated *Bulletin 2-300*. Describes applications in drilling, slicing, engraving, trepanning and shaping hard and brittle materials. Full specs for manufacturer's impact grinders, plus tables of cutting rates for materials cut by ultrasonic techniques.—**Raytheon Co.**, Commercial Apparatus & Systems Div., c/o Donald W. Hawes, 225 Crescent St., Waltham 54, Mass.

STEREO HI-FI BROCHURE, *AL-1302-3*. 3-color foldup booklet features mikes, tuners, amplifiers, speakers and speaker systems. Illustrated section covers recommended component arrangements.—**Altec Lansing Corp.**, 1515 S. Manchester Ave., Anaheim, Calif.

ELECTROMAGNETIC RELAYS shown in 16-page *Catalog 62*. Illustrated sections feature high-performance, power, special-purpose, general-purpose, and telephone types, with full engineering data.—**Potter & Brumfield**, Technical Information Section, Princeton, Ind.

TEST LEADS AND COAX CABLES pictured in 4-page ordering guide. Shows shielded, unshielded and twisted pair, plus clips, ends, plugs, lugs and leads. Contains prices, testing specs and modifications.—**Angler Industries Inc.**, 75 Winthrop St., Newark 4, N.J.

STEREO HI-FI KITS, 8 models, pictured in 4-page leaflet, with full specs. Also available leaflet on kit or assembled marine radio equipment, 6 units, with photos and specs.—**Daystrom Products Corp.**, Box 167, St. Joseph, Mich.

PHOTOCONDUCTOR DEVICES. 4-page, 2-color leaflet describes special features, applications of manufacturer's photoconductor line. Gives technical data on one sample type.—**Sylvania Electric Products Inc.**, 1100 Main St., Buffalo 9, N.Y.

RUGGEDIZED YAGIS, over 100 types in ranges 30–500 mc, detailed in 16-page *Catalog 600*. Data include specific frequency, weight, nominal half-power beam width (degrees) for E and H planes, number of driven elements, maximum VSWR, maximum power input, nominal gain above isotropic source. Contains data on stacking systems, coaxial stacking lines, mounting kits for Yagis, skewing information for increased E-plane beam width, power-handling capability and wind-load specifications. Specs given on high-gain uhf screen antennas and special-purpose Yagis.—**Technical Appliance Corp.**, Sherburne, N. Y.

KIT BUILDER'S GUIDE. Full-color 6-page leaflet shows complete line of amplifier and tuner kits, with specs for each. Includes full-page color photo of kit as supplied. Finished products pictured on cover.—**H. H. Scott, Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.

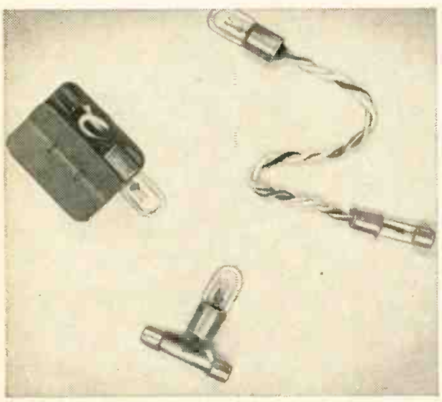
GENERAL CATALOG. 264 pages of electron components and systems. Capacitors, resistors, test instruments, amateur gear, etc.—**Dixie Radio Supply Co. Inc.**, 1900 Barnwell St., Columbia, S. C.

THERMISTORS. 13-page glossy catalog gives definition, manufacturing process, characteristics and application data on 13 types. Many illustrations and diagrams.—**Nucleonic Products Co. Inc.**, 1601 Grande Vista Ave., Los Angeles 23, Calif.

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

BARGAIN CURRENT INDICATOR

A 150 to 250-ma pilot lamp can be used to effectively adjust horizontal amplifier drive and similar circuits for minimum current. A fuse substitute is made from a piece of dowel and the ends of a blown fuse. The newer twistlock fuses are a bit more difficult to substitute but it is still possible. Drill a hole through the end caps of the fuse for the inner contact wire. The dimmer the lamp, the lower the value of current passing through it.



a. The photo shows: dowel replaces glass fuse body.

b. The pilot lamp is held in one end of the snap-on fuse holder. Jumper makes the connection to the center contact.

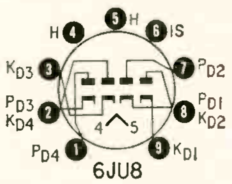
c. Top wire is soldered first so heat will not affect insulation of wire through hole that makes contact with bottom contact.—*Elmer Carlson*

NEW TUBES and SEMI-CONDUCTORS

EVER SEE A QUADRUPLE DIODE IN A 9-PIN envelope? You will in just a few moments. It will be followed by a 10.7-mc FM if transistor, a compactron mobile communications tube, a couple of i.f. pentodes and a forced-air cooled metal-ceramic communications tube.

6JU8

A quadruple diode in a 9-pin miniature envelope. It is intended for use



in phase-detector and noise-immune color-killer circuits of color TV receivers, and in FM stereo multiplex equipment.

Maximum ratings of the RCA 6JU8 are:

PIV_P	300
I_p (peak ma)	54
I_{out} (dc ma)	9
$V_{htr-cath}$ (peak)	
(htr neg with respect to cath)	300
(htr pos with respect to cath)	300

2N1747

A p-n-p germanium MADT unit designed for 10.7-mc FM i.f. and limiter applications and for AM/FM i.f. stages

which are only used for FM i.f. signals. It is intended for use in 6-volt auto and 6 to 9-volt portable radios.

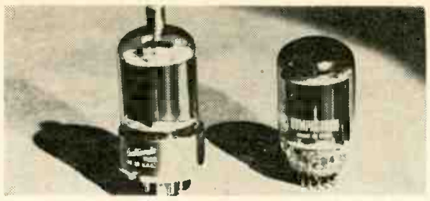
Absolute maximum ratings of the Philco 2N1747 are:

V_{CB}	20
V_{CES}	20
V_{EB}	0.5
I_C (ma)	50
P_{total} (mw)	60

7984

This a compactron version of the

popular 6146. In its new shape the tube



delivers 46 watts at 175 mc, 11 more than the earlier version.

The G-E 7984 has a 13.5-volt 580-ma heater. Maximum ratings in intermittent mobile rf service, class-C telegraphy and FM telephony are:

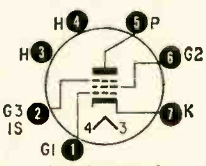
V_P	750
V_{G2}	250
V_{G1}	−150
I_P (ma)	180
I_{G1} (ma)	4
P_P (watts)	35

Typical operation as a 175-mc amplifier:

V_P	450
V_{G2}	125
V_{G1}	−60
R_{G1} (kohms)	25
I_P (ma)	180
I_{G2} (ma)	12
I_{G1} (ma)	2.5
Driving power (watts)	2
Power output (watts)	46

6HR6, 19HR6

These two 7-pin miniature pentodes are designed for use as i.f. amplifiers in FM, AM and FM/AM receivers. They are identical except for their heater ratings. The 6HR6 has a 6.3-



6HR6, 19HR6

volt 450-ma heater while the 19HR6 has an 18.9-volt 150-ma heater.

Maximum ratings of the RCA HR6 in class-A1 amplifier service are:

V_P (supply)	200
G3 connected to cathode at socket	
V_{G2} (supply)	115
V_{G1} (supply)	0
R_K (ohms)	68
R_P (approx kohms)	500
gm (μmhos)	8,500
I_P (ma)	13.2
I_{G2} (ma)	4.3

8177

This uhf tetrode is a metal-ceramic, coaxial, forced-air-cooled unit for frequencies up to 1,000 mc. The tube is especially designed for use as a power amplifier and frequency multiplier in TV transmitters, vhf-uhf communications, and tropospheric scatter equipment.

With a plate current capability of 0.95 ampere, the Amperex 8177 can provide a power output of 2,070 watts at 600 mc and 1,500 watts at 900 mc in class C telephony operation. The tube has a helical thoriated tungsten filamentary cathode for extra long life in critical applications. END

new PATENTS

POWER SUPPLY FOR DIRECT-COUPLED AMPLIFIER

Patent No. 2,970,278

John H. Reaves, McLean, Va. (Assigned to USA as represented by Secretary of Commerce)

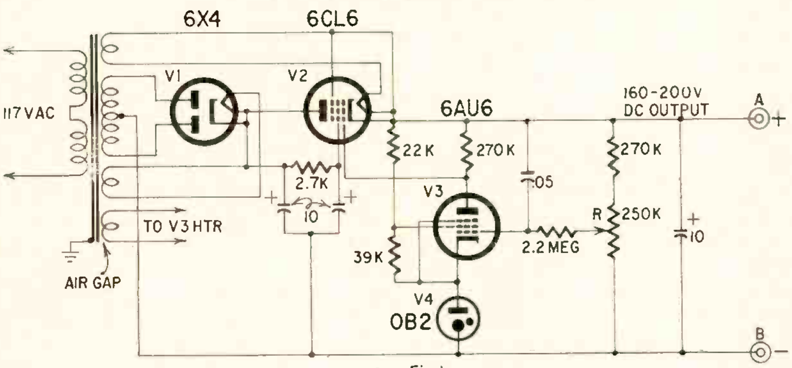


Fig. 1

In this type of amplifier, the plate of one stage is connected to the grid of the next. Since a plate requires a high positive voltage, while a grid must be negative, a suitable power supply must not couple the stages. However, the capacitance (to ground) of a conventional supply may be as high as 700 $\mu\mu f$.

This power supply is specially designed for low capacitance, near 18 $\mu\mu f$, to minimize coupling. It is voltage-regulated to eliminate filter chokes, which introduce high capacitance (Fig. 1). It delivers 200 volts without load, 199 volts at 20-ma drain.

The secondary of the transformer is kept well away from the primary by winding it on another leg of the core, to reduce capacitance (Fig. 2). Chassis and panel are made of insulating Plexiglass.

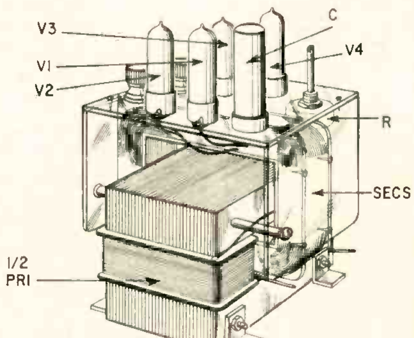


Fig. 2

PRECISE TIMER

Patent No. 2,976,487

Ezra Cohen, Brooklyn, N.Y. (Assigned to Bell Telephone Labs, Inc.)

In R-C timers, a capacitor charges to a critical voltage, at which instant a relay is energized. If the supply voltage is unregulated, the timing interval cannot be controlled precisely. This inventor discloses an ingenious solution to the problem.

Two power supplies are used, one positive, the other negative, relative to ground. By Ohms law, the voltage at point G is

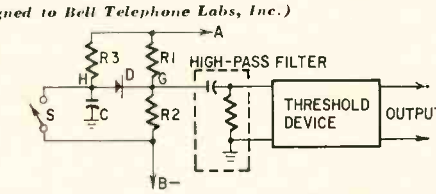
$$A - (A + B)\left(\frac{R_1}{R_1 + R_2}\right)$$

When S is closed, the voltage on capacitor C is −B volts. When S is opened, the capacitor begins to charge to A volts. From the usual formula for a charging capacitor, the voltage at point H is found to be

$$A - (A + B)e^{-T/RC}$$

Choosing T=RC, it is evident that the above equations are identical when

$$\frac{1}{e} = \frac{1}{2.7} = \frac{R_1}{R_1 + R_2}$$



When R1 and R2 are chosen in accordance with the previous equation, the voltages at points G and H will be *equal* (and D will conduct after a timing interval of T = RC seconds). There will be an abrupt voltage change from whatever value G had to the value present at H, and this pulse will be passed through a filter. It will excite a threshold device, which may be a multivibrator. Thus the exact instant of conduction by D can control some output device.

Note that the timing instant does not depend upon either A or −B, the supply voltages.

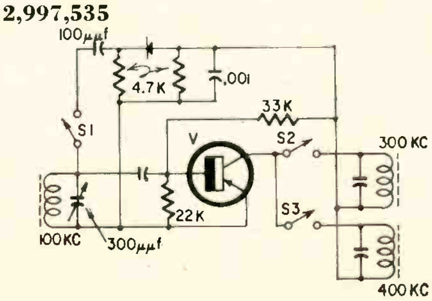
TV REMOTE CONTROL

Patent No. 2,997,535

Sheldon T. Brady, N. Hollywood, and Brian E. Hooper, Sherman Oaks, Calif. (Assigned to Packard-Bell Electronics Corp., Los Angeles, Calif.)

This control is very compact since it contains no power source of its own. Instead it receives a 100-kc signal from the nearby TV receiver. When S1 is closed (see schematic) the signal is rectified and used to bias V, a harmonic generator. Output is 300 kc if S2 is closed, 400 kc if S3 is closed. Additional harmonics and switches may be added if desired.

The selected harmonic is radiated back to the TV set, which amplifies it and uses it to control a relay. Each harmonic controls a different function, such as switching on and off, setting volume, tuning, etc. END



TECHNICIANS' NEWS

PIONEER TECHNICIANS INCORPORATE

An association intended to unite old-time television-electronic technicians has been organized by a group of six former RCA-NBC television technicians who were actively connected with the first transmissions of modern television 25 years ago. The purpose of the new corporation, according to its charter, is to secure the respect of the public for television-electronic technicians, to increase confidence, and to provide for the development, activities, guidance and general welfare of electronic technicians.

Membership in four grades is planned: The senior group will consist of technicians who were active in the field before 1941; the second group of those who were technicians during the war years and before 1946, the year television effectively reached the public; a general group—those who have been technicians for ten years or more, and an associate member group for those younger TV and electronic technicians not falling in the other groups. Honorary membership may be an elected grade as determined by an awards committee.

An organization meeting has been held, and it is expected that a call for membership will be issued after another charter member meeting, scheduled for early summer, to adopt the constitution and bylaws now being written. Meanwhile, those interested in the new organization may communicate with Mr. W. Hollander Bohlke, Secretary, 39 Treaty Elm Lane, Haddonfield, N. J.

RTSA-MUNCIE JOINS IESA

Indianapolis, Ind.—The Radio-Television Service Association of Muncie has joined the Indiana Electronic Service Association. Leonard Hickey, president of the group, will be the IESA director from Muncie.

DOINGS IN INDIANA

Lapel—Installation of new officers was the business of a steak-dinner-meeting held at Passwater's Restaurant. IESA Chairman LaMar Zimmerman, Jr. installed the officers.

President of the group is Don Claus; vice president, James W. Baker; secretary, Gerald Whitesel; treasurer, Harold Scott; and sergeant-at-arms is Earl Jarrett.

Indianapolis—A "Beans and Steak" dinner concluded the membership drive of the Indianapolis Television Technicians Association Inc. Two teams were set up in the membership drive. The team that brought in the most new members got the steak, the losers got the beans.

SERVICE CHARGES A PROBLEM

Philadelphia, Pa.—How much to charge a customer seems to be one of the biggest problems the television service technician has to face, according to the February-March issue of Philco's *Servicemen's Bulletin*. The article states "Caught between the rising cost of doing business and squeeze of competition, shop owners today appear unsure of how valuable their services are."

To back up this statement Philco showed that rates vary over a very wide range—from a low of $2 to as much as $12 an hour. The average minimum charge turned out to be about $4.70.

To help clear up the confusion Philco offers this formula to determine what a service shop should charge:

1. Add up all costs for the entire year other than the technician's salary. Divide these costs by the number of full-time technicians, including yourself, who were employed at any one time during the year.

2. Add up all technicians salaries and divide by the number of men to get average salary.

3. Determine the average number of hours per technician per week normally spent on calls. Multiply by 52 weeks. Do not include time spent in picking up parts, making reports or performing administrative duties, but do include overtime and bench work time.

4. Divide the number of hours per year of productive work (step 3) into the sum of steps 1 and 2. The answer is your cost per hour per technician and the basis of your hourly service rate.

5. To arrive at your minimum rate, multiply the cost per hour (step 4) by eight to get your average cost per working day.

6. From your records find the average number of calls per day per technician by adding up all the calls completed in a period, divide by the number of working days in the period and divide again by the number of technicians making the calls.

7. Divide this figure (step 6) into the cost per working day (step 5) to get average cost per service call. This is the basis of minimum service call charges. Obviously, some figure must be added to this basic charge if you are to show a profit.

TRI-STATE NEWS

Wilmington, Del.—A series of articles are being run in the *News Journal* by the Television Service Dealers Association of Delaware to help promote better customer relations. Members of the group are preparing stories explaining the charges, problems, etc. of the service technician repairing his customer's set.

Camden, N. J.—What's new in the Motorola line was presented to members of the Allied Electronic Technicians Association Inc. of N. J. at a meeting co-sponsored by Philadelphia Distributors and Motorola. Schematics of the new line of receivers were handed out after the meeting.

Glenholden, Pa.—A committee was set up to look into the aspects of helping members who need assistance because of illness, death in the family, etc. The Television Service Dealers Association of Delaware County, Inc. appointed Jim Carver chairman of the committee to be assisted by John Matthey and Charlie Phillips.

ACTIVITY IN WISCONSIN

Green Bay—New officers were officially installed at the annual banquet of the local TESA at the Zuider Zee Supper Club. Norm Lubow gave a short talk on last year's activities and this year's state convention to be held here.

Sheboygan County — The new sales tax filled the air with questions at a meeting of TESA at the Grand Hotel. Other business included a brief discussion on licensing and the addition of new bad credit risks to the association's master list.

Milwaukee—Committee chairmen summarized last year's activities at TESA's regular meeting at Covics Amerwood Hall. Membership committee reported that their campaign netted several new members last year. Technical Standards reported that 67 technicians' certificates have been issued to date. Activities for the year saw a group medical insurance plan adopted by the association and a lot of work done toward licensing technicians in the state. END

50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Practical Electrics	1921
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In June, 1912, *Modern Electrics*

Transmitting Photographs by Wire.
Detector Crystal Tester.
Wireless Legislation: Senate Bill S-6412.
Loud Acoustical Reproduction of Wireless Signals, by Stanley E. Hyde.
Underwriters Rules for Wireless Installations.
Ideal Oscillation Transformer, by Moore Stuart.
A New Type of Variable Condenser, by P. Mertz.
Cat Whisker Detector, by Earl Zander.
Wireless Outfit For a Dollar, by Lance Boyd.
Balanced Detector Stand, by M. E. Armstrong.

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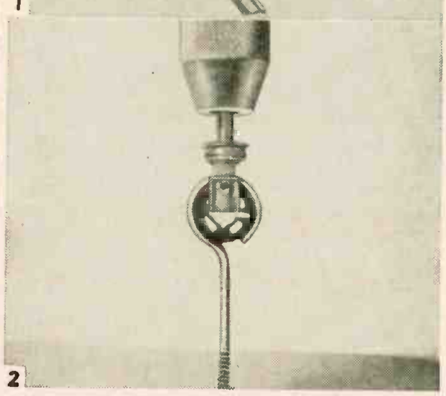
TURNING TV STANDOFFS

The often difficult task of screwing TV standoff insulators into house siding is simple if you do it with your drill. Remove the bakelite handle and terminal screws from a phone plug, then

1

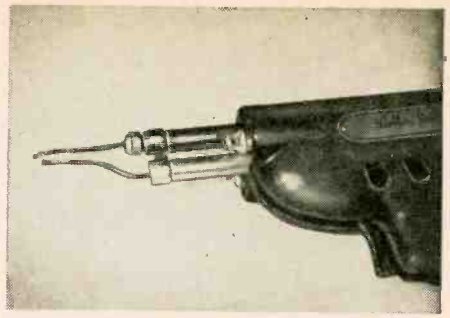


2

chuck the plug in your hand drill (Fig. 1). Now you can use this drill to simplify turning TV standoffs (Fig. 2).—*John A. Comstock*

SOLDERING-GUN REPAIR

An excellent substitute for one of the tip-holding nuts on a soldering gun is a self-tapping screw threaded into



one of the holes into which the tip prongs are normally inserted. The screw will provide a good electrical contact. Any tendency of the tip to heat more slowly after a while can be remedied by loosening and retightening the screw, breaking the oxide film formed at the point of contact.—*Leonard I. Kindler*

MIRROR MAGNIFIES MARKINGS

A shaving mirror of the magnifying type (see photo) makes it quite a bit easier for you to read markings on

components in a circuit. Although the markings must be read in reverse, they are magnified several times by the mirror.—*Jerome A. Carlson*

TRY STRANDED SOLDER

Hammer or pinch wire solder flat, then cut it into narrow strands. This reduces the solder melting temperature,

allows better control of quantity applied (essential when soldering in transistorized gear) and permits the use of a smaller iron and less heat.—*James C. Conrad*

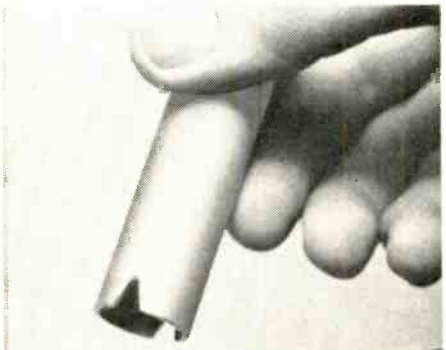
TVI TRAP

The trimmers from a discarded if transformer and a couple of scraps of 300-ohm ribbon line can be used as an effective interference trap. The shorted length of ribbon line (3½ inches for the high channels and 4½ inches for the low) is an inductance that is tuned by the trimmer capacitor. Slip the antenna lead connected to the TV set through the space between the trimmer terminals. Tape the short lengths of twin-lead to the receiver transmission line. The looser the coupling to the antenna, the more selective the trap will be.

If interference is exceptionally severe, it may be possible to find a point of maximum effectiveness by sliding a shorting bar (aluminum foil will do) along the lead-in. The point where the interference is least (it's usually within 10 feet of the antenna terminal board) is the place to tape the trap.—*E. C. Carlson*

PIPE TOOL DEBURRS CHASSIS

Hacksaw a "V" into one end of a short length of pipe for a deburring tool that makes chassis edge burr removal



quick and easy. Simply draw the tool toward you over the ragged chassis edge. Those who hacksaw a metal chassis while building or servicing electronics gear will find this tool very useful.—*Joe C. Allen* END

"This small sheet includes the description, operating instructions, schematic diagram, alignment procedure and trouble-shooting chart. The large sheet consists of all the information you need for restringing the dial cord."

ESSENTIAL CHARACTERISTICS (Receiving, Five-Star, Special-Purpose and Picture Tubes), by R. G. Kempton, J. H. Robb, P. E. Hatfield. *General Electric Co., Receiving Tube Dept., Owensboro, Ky. 5½ x 8½ in. 300 pp. $1.50.*

The ninth edition of this standard work runs 300 pages. Includes for the first time characteristics of G-E's new Universal capacitors, as well as cross-reference listings of the prototypes of Five-Star and other special purpose tubes.

AMPLIFIER CIRCUITS, by Thomas M. Adams. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 136 pp. $2.95.*

Diagrams (some in color) and simple language explain amplifier theory and current paths.

ESSENTIALS OF MATHEMATICS, by Russell V. Person. *John Wiley & Sons Inc., 440 Park Ave. South, New York 16, N.Y. 6 x 9 in. 646 pp. $7.*

Practical introduction to algebra, geometry, logs and trig for home-study or class.

INTRODUCTION TO ELECTRIC CIRCUIT ANALYSIS, by Ralph E. Armington and Carl Volz. *Prentice-Hall Inc., Englewood Cliffs, N.J. 6 x 9 in. 243 pp. $9.*

Basic engineering text; requires a knowledge of calculus.

ALLIED ELECTRONICS DATA HANDBOOK, (3rd Edition) (Formulas and Data Most Commonly Used In Electronics), Edited by Lieut. Comdr. Nelson M. Cooke, USN. *Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. 6 x 9 in. 80 pp. 35¢.*

The new edition contains all the old formulas and tables, together with a great deal of new material, including up-to-date information on transistors and American-foreign tube interchangeability.

ELECTRONIC ENGINEERING PRINCIPLES (3rd Edition), by John D. Ryder. *Prentice-Hall, Inc., Englewood Cliffs, N. J. 6 x 9 in. 428 pp. $12.65.*

A standard engineering text that integrates the study of tube and transistor circuits.

MINIATURIZATION, edited by H. D. Gilbert. *Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. 6 x 9 in. 306 pp. $10.*

Design, manufacture and maintenance of components and assemblies used in missiles, medicine, computers, etc., are described by 16 experts.

ELECTRONIC GAMES & TOYS YOU CAN BUILD, by Len Buckwalter. *Howard W. Sams & Co., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in., 128 pp. $2.50.*

You can make your own games and do mystifying tricks with the aid of simple tools and a few electronic components.

SILICON CONTROLLED RECTIFIER MANUAL, by F. W. Gutzeiller, D. R. Grafham, D. V. Jones, H. R. Lowry, J. E. Mungenast, R R. Rottier, G E. Snyder, T. P. Sylvan, E. E. Von Zastrow. *Application Engineering Ctr. General Electric, West Genesee St., Auburn, N. Y. 5½ x 8½ in. 352 pp. $1.50.*

This second edition of the *Silicon Controlled Rectifier Manual* has jumped from 255 to 352 pages. With the additional material and several new contributors, it remains more than ever the industry's manual on the subject.

ABC'S OF RADAR, by Alan Andrews. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 112 pp. $1.95.*

A simple but thorough text for use as a reference or as a study guide for the radar endorsement on your FCC license.

ELECTRONIC MUSIC AND MUSIQUE CONCRÈTE, by F. C. Judd. *Neville Spearman Ltd., 112 Whitfield St., London W 1, England. 5½ x 8⅛ in. 74 pp. 16 shillings.*

A complete explanation and description of this new type of music, including circuits to generate it (with constants of the various types of electronic tone sources). Appendices, bibliography and index.

MAGNETIC AMPLIFIER ANALYSIS, by David L. Lafuze. *John Wiley & Sons Inc., 440 Park Ave. So., New York 16, N.Y. 5¾ x 9 in., 252 pp. $9.75.*

How to design half-wave and full-wave amplifiers. Sample calculations are included. END

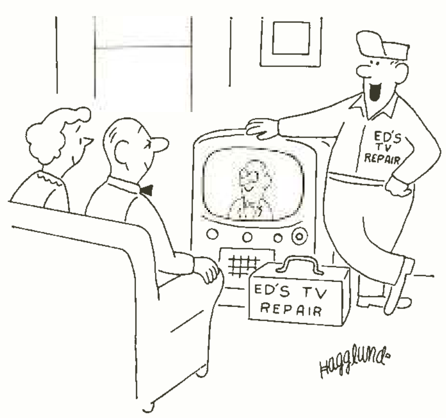
CORRECTIONS

There is an error in the caption for Fig. 1 of the article "PA Speakers—Why So Many Types?" on page 55 of the March issue. It should read "Typical horn characteristics. The upper diagrams are for horns of different tapers and equal mouth areas. The lower ones are for horns with equal tapers and different mouth areas."

We thank the author, Victor Brociner, for bringing this to our attention.

In Fig. 4 of the article "New Directions in Hi-Fi Amplifiers" (page 37 of the April issue) there should be a 68-ohm 1 watt resistor connecting the junction of the two driver transformer primaries and the 500-μf filter to the −23-volt bus.

Our thanks to Mr. Walter R. McCarty of Midland, Tex. for calling this to our attention.



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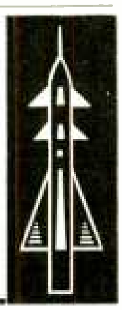

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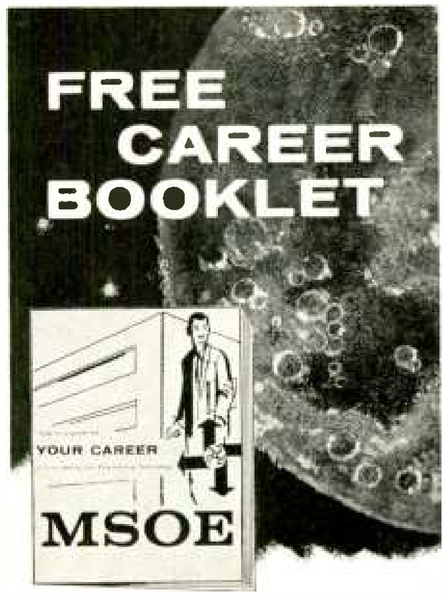

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TRANSISTORIZED products dealers catalog, $1. **INTERMARKET**, CPO 1717, Tokyo, Japan.

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NOTEWORTHY CIRCUITS

MODIFIED BAXANDALL CIRCUIT

The treble section of a Baxandall negative-feedback type tone control uses a center-tapped 500,000-ohm linear potentiometer. The center-tapped pot can be eliminated by using the modified

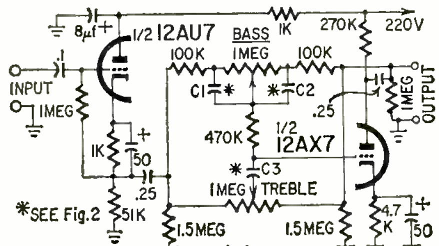
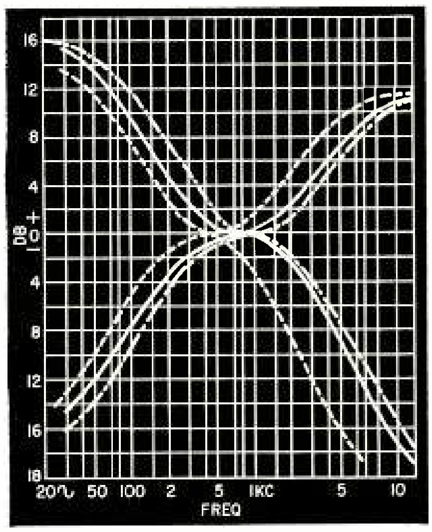


Fig.1

circuit (Fig. 1) taken from *Radio et TV* (Paris, France). Here, we have a 1-megohm untapped treble control with each end shunted to ground through a



	C1-C2	C3	FCROSSOVER
—·—·—	.003	100μμf	1KC
———	.005	100μμf	800∿
- - - - -	.005	330μμf	400∿

Fig.2

1.5-megohm resistor. The curves in Fig. 2 show the response and crossover points of the bass and treble controls for various values of C1, C2 and C3.

Remember, this circuit like many low-level tone control circuits is susceptible to hum. Keep all leads as short as possible to avoid trouble.

TUNING-FORK OSCILLATOR

A constant standard tone is often needed when tuning musical instruments. You can make one by adding an electronic drive to a standard tuning fork, as outlined in *Wireless World* (London, England). Fig. 1 shows the transistorized fork driver. Fig. 2 shows the parts layout. The transistor type is not critical. You can use almost any audio type with a current gain of 40 or more.

Driver and pickup coils L1, L2 may be salvaged from a high-resistance headphone. Each should have a resistance around 1,000 ohms. C1 tunes L1 approximately to the fork frequency for improved efficiency and waveform purity. It may be omitted if high harmonic output is desired.

Mount the bias magnet, taken from an old meter, headphone or speaker, below the coils and not necessarily in

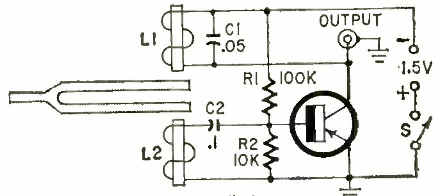


Fig.1

direct contact with the pole pieces. Adjust the spacing so the fork just vibrates. Excessive vibration mars accuracy and stability. Clamp the fork rigidly by its handle to prevent all lateral movement except the tine vibrations. Reverse the connections to L1 or L2 if the circuit does not oscillate.

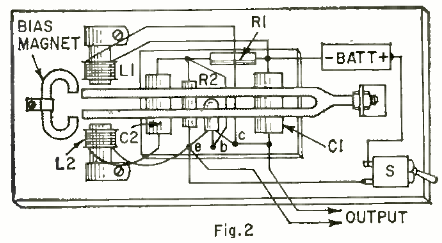


Fig.2

Tuning forks for B and C (494 and 522 cycles, respectively) are readily available and may be modified to provide a 500-cycle standard. A fork's frequency can be raised by carefully filing the tines and using a scope to compare its frequency with a known source. If the fork's frequency is too high, file the crotch.

For further information on electronically driven tuning forks as audio standards, see "Tuning-Fork Audio Frequency Standard," *CQ*, May 1956, and "Harmonic Generator with Tuning Fork Drive," *Electronic Engineering*, January 1956.

ULTRA-SIMPLE TRANSISTORIZED DC MICROAMMETER

Most transistorized microammeters described previously use a zero-set

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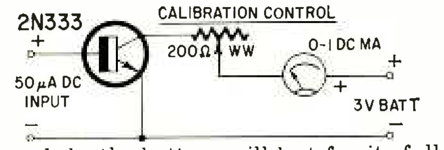
bridge requiring at least three fixed resistors and a zero-set potentiometer. Because these circuits employed a germanium transistor, temperature drift necessitated frequent resetting of zero. The diagram shows a minimum-component circuit which overcomes the old disadvantages.

A 2N333 silicon transistor is used. This unit costs $6.50 but offers enough advantages to justify the investment. For example, no zero drift can be seen on the 0–1 dc milliammeter, so no zero-set circuit is needed; no deflection drift can be seen on the meter and, since the no-signal collector current is so tiny (nominal value of .002 microampere), no ON-OFF switch is



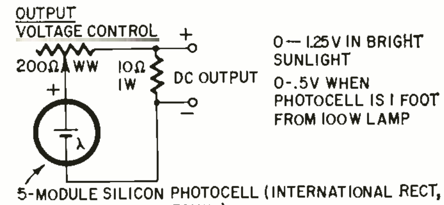
needed—the battery will last for its full shelf life.

A 50 μa dc input will deflect the 1-ma meter to full scale (10 μa will deflect a 100-μa 2,000-ohm meter to full scale). Response is linear. The 200-ohm CALIBRATION CONTROL adjusts for full-scale deflection with an accurately known dc input. This control may be enclosed inside the instrument case and provided with a slotted shaft for screwdriver adjustment, since it seldom needs adjustment and then only when the calibration is checked periodically.—*Ted Ladd*

SOLAR BATTERY POWERS TUNNEL DIODES

A silicon solar battery, operated from either sunlight or artificial illumination, will supply enough dc power to operate tunner-diode oscillators and short-distance transmitters. However, some experimenters have had trouble because of the internal resistance of the cell under varying operating conditions. The secret is to provide the cell with a constant, low-resistance output (lower than that of the tunnel diode).

Here is a practical solar battery circuit. The light-sensitive unit is a five-module silicon photocell (International Rectifier type SM5-1020E6BPL,



5-MODULE SILICON PHOTOCELL (INTERNATIONAL RECT, 5SM-1020E6BPL OR EQUIV)

or equivalent). (This sun battery may be considered expensive but it is well worth the cost in this application.) The 10-ohm resistor provides the dc source with the low-impedance output needed for proper operation of the tunnel diode. The 200-ohm pot permits smooth adjustment of the output voltage. The maximum dc voltage is 1.25 in bright sunlight, or 0.5 when a 100-watt incandescent lamp is placed 1 foot from the cell.—*Rufus P. Turner* END

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21AMP4A	21ACP4 21ACP4A 21AMP4	21AMP4A 21AQP4 21AQP4A	21BSP4 21CUP4
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