HOW TO TEST HI-FI WITH SQUARE WAVES

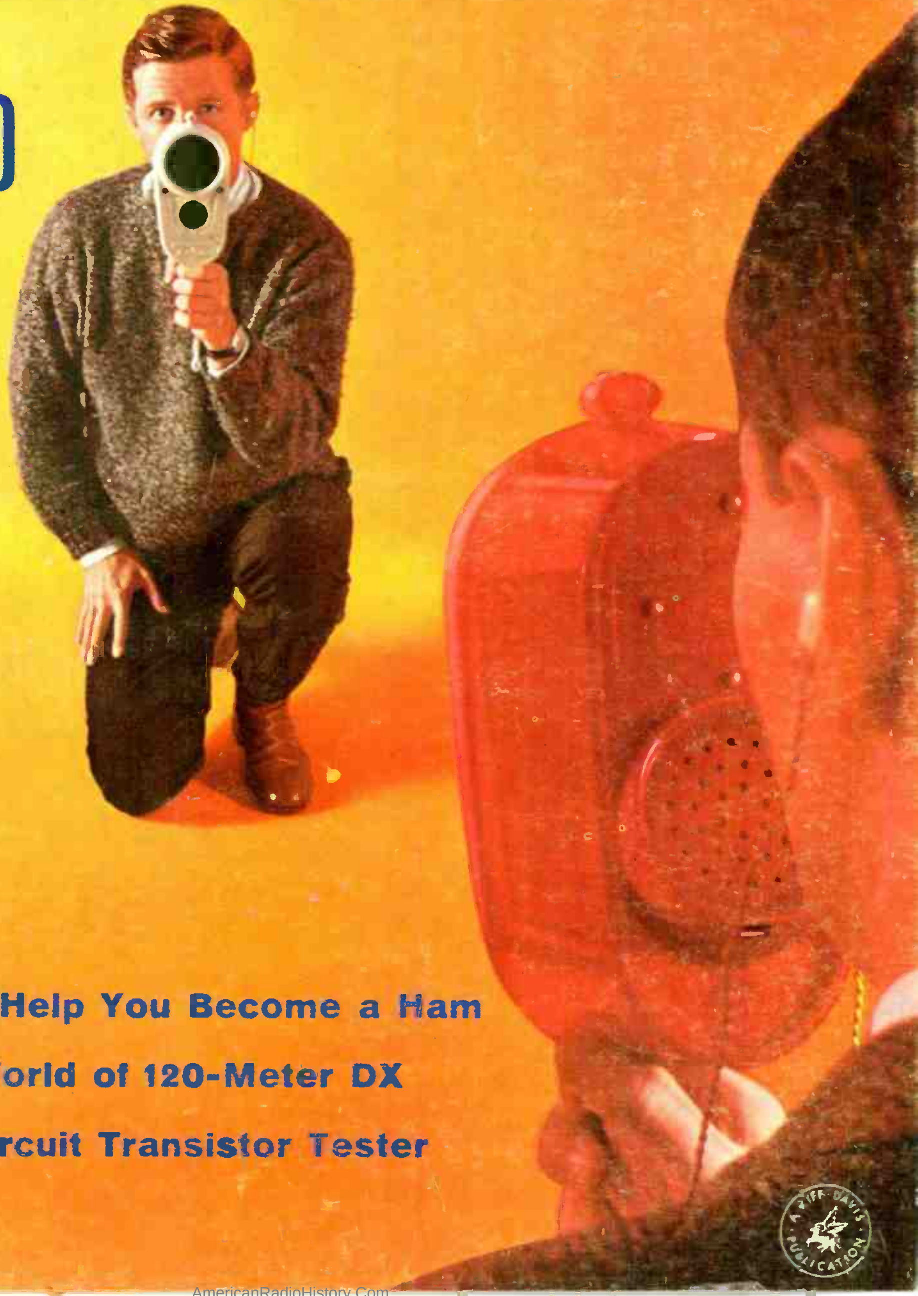
POPULAR ELECTRONICS

FEBRUARY 1961

35 CENTS

MAC 2

HI-FI · HAM & CITIZENS RADIO · SWL



INFRA-RED

Report on New IR Developments

(page 41)

Build $19 IR Burglar Alarm

(page 46)

IR Light Beam Communications

(cover & page 96)

- **100 Clubs Will Help You Become a Ham**
- **Little Known World of 120-Meter DX**
- **Build Our In-Circuit Transistor Tester**

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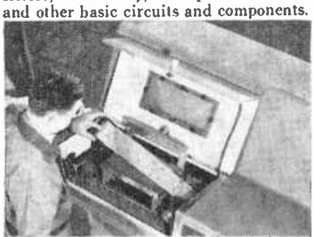

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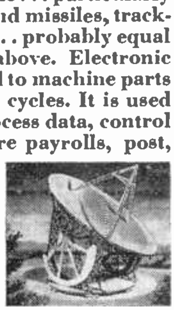

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FEBRUARY 1961

VOLUME 14 NUMBER 2

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Amateur, CB, and SWL

Electronic Features and New Developments

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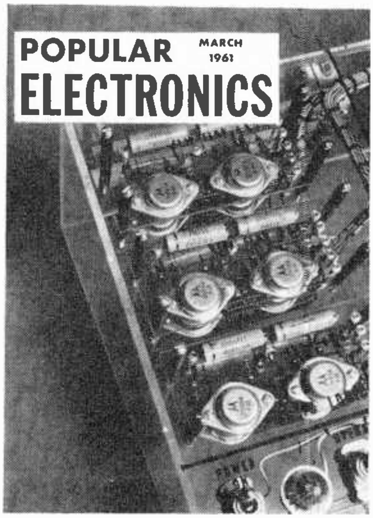

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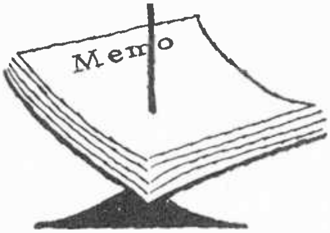


Notes from the Editor

BIGGER AND BIGGER. Looking into the future is sometimes more exciting than pondering the past, but a few days ago I found myself doing both. As you might guess, I was musing about electronics. But I wasn't thinking how tubes have grown smaller and smaller or transistors better and better. Instead, my thoughts were on a rather arbitrary graph of frequencies scientists call the spectrum.

Now I am not about to suggest that the spectrum has undergone a process of miniaturization, as have tubes, or that it has somehow "improved," as have transistors. Since it is governed by natural laws, the spectrum today is in every way the same spectrum of yesterday. But in a practical sense, today's spectrum differs from yesterday's in the same degree that today's button-base, multi-element tube differs from yesterday's inefficient, lamp-bulb-like giant. For just as hi-fi has pushed the range of sound reproduction to the limits of audibility, new developments in electronics promise to harness more and more of the spectrum's potential.

Two articles in this issue illustrate just how far we've come in exploiting the full range of frequencies at our disposal. One device covered, the laser, will enable us to control light waves in much the same way we currently tune radio waves. In itself, the laser represents man's first successful production of "coherent" --tuned--light. As you'll learn from reading the article, an actual light amplifier such as the laser has tremendous possibilities in communication and control. Even more important, the laser promises to open up vast new areas of hitherto unused frequencies.

The second article, or rather series of articles, since both theory and construction are covered, deals with another relatively new band of frequencies--infrared. Invisible to the eye, infrared radiation opens a whole new world to the scientist, particularly in such fields as chemical analysis and radar. More interesting, perhaps, is the fact that today's infrared radiation--like the ultraviolet within the laser's bandwidth--makes use of a host of frequencies that were all but useless yesterday. Anything wrong with calling that an "expanding" spectrum?

CANADIANS ON CB--PROBABLY! Rumors are flying thick and fast as I close this page. The allocation of the 11-meter band to Citizens Radio in Canada seems a foregone conclusion. Channel assignments, power limitation, and call letter designations will be similar to those here in the United States. CB'ers are also looking forward to a reciprocal agreement permitting operation of Canadian mobiles south of the border and our mobiles over on their side. Such a reciprocal agreement has worked successfully for radio amateurs for six or seven years.

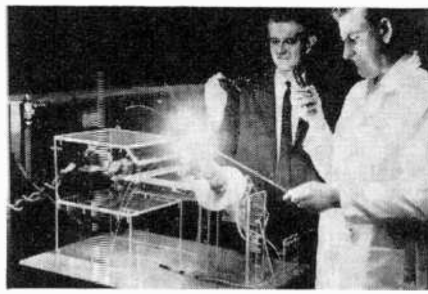
Oliver P. Ferrell

POP'tronics

NEWS SCOPE

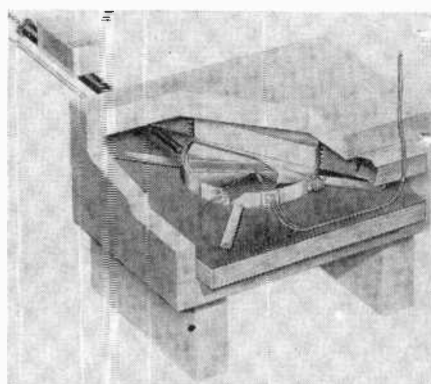
PEEPING FROM BEHIND a "stubby beard," the new Raytheon electrostatic printer tube prints as many as three 8½" x 11" photographs per second. This speed is over 1000% faster than that of news wire-service machines now being used by your local newspaper. The "stubby beard" is a row of .001-inch wires spaced 250 to the inch in a row on the front of a flattened cathode-ray tube. The electron beam sweeps across the wire ends inside the tube—electrons pass through the face of the tube via the metallic beard—depositing an electrostatic charge on paper as it passes the tube face. Present computer read-out printing techniques "develop" the picture in nothing flat. Quality: as good as the photos in POP'tronics.

A MOON TV STATION, manned by neither monkeys nor astronauts, is now in the developmental stage at the Kin Tel Division of Cohu Electronics, Inc. A compact camera, transmitter and telemetering system will be transported to the moon by rocket and "soft-landed" there. Telemetering from earth will direct the camera to pan the moon and earth or segments of the starry universe. U.h.f. will transmit the video back to earthbound scientists.



TEMPERATURES IN EXCESS of 3000° C are being achieved by a "Plasma Torch" developed by Amperex. The torch is a simple device that uses an r.f. field to generate heat—without consuming either fuel or electrodes. The heat results from the recombination of gas molecules that have been dissociated in a strong r.f. field. Available in models operating at 27 or 2450 mc., the torch prototypes are being sold for about $1000. Heat without oxidation has many important and diverse applications.

LANGUAGE COMPUTERS, considered a must for the scientific and literary fields, will soon make possible phone communications between people who do not speak the same language. Dr. Edwin G. Schneider of Sylvania predicts that intelligible bilingual telephone service will result from advances in communications and data processing. United Nations interpreters need not worry—computers cannot interpret the bang of a shoe . . . . yet!



BUDDING SCIENTISTS will be interested in a compact cyclotron, no larger than a desk, built by the Hughes Aircraft Company. Donated to Pomona College, the unit is the first designed for undergraduate instructional purposes in the U.S.A. Every physics major will eventually have a chance to do individual work on this 3' x 5' two-million-volt atom smasher. It's practically foolproof, and you don't need a Ph.D. to operate it.

FCC Report

By ROBERT E. TALL
Washington Correspondent

Answering Services

THE Federal Communications Commission seems pretty well satisfied with the operation of the Class D Citizens Radio Service (CB) at the present time. No new problems concerning regulation of the Class D Service have arisen and many of the Commission's older problems with CB'ers are being resolved. This situation is due in large measure to the success of the CB clubs around the country in putting the squeeze on known rule violators. The FCC appreciates the efforts of these organizations.

One problem that persists, however, is the unscrupulous modifying of CB transmitters to step up their r.f. power output. Complaints are being received by the Commission from some manufacturers of equipment contending that other manufacturers encourage home adjustment of the CB sets past the power input limits set by the FCC. The Commission is advising the complainants in such cases to present their story to the Federal Trade Commission.

There is a current surge of interest in the use of CB equipment with telephone answering services, and the FCC has clarified just how the Citizens Radio Service can be used in conjunction with the answering services, and has restated what kind of traffic *cannot* be handled.

Telephone answering services can use CB for communications incidental to the *internal* operation of the business. But extension of the answering services to permit CB contacts with customers for the purpose of relaying messages or reporting telephone calls is not permitted.

The FCC states that, "Inasmuch as the messages taken by the telephone answering services for their subscribers re-

late to the activities of the subscribers and not the answering service, such messages may not at any time be transmitted over a citizens radio station operated by the telephone answering service as licensee." Nor may any compensation or remuneration be accepted by the licensee from any person for the use of his CB radio station, and the transmission of communications for hire in the Citizens Radio Service is definitely prohibited. The Commission says that "these limitations apply even though there is no direct charge to the subscriber for the radio service."

The FCC pointed out that a CB'er who is a client of a telephone answering service can install a transmitter operated under a license held by him on the premises of the telephone answering service. This transmitter can be used to notify the CB'er of telephone calls received for him by the answering service. However, the CB unit at the answering service cannot be used to handle communications for any person other than the specific CB'er to which it is licensed, and the same unit cannot be licensed to more than one person. Also, it is emphasized, "the transmitter may not be connected to the public telephone system."

As evidence of control, the FCC explained, an agreement should be drawn up between the licensee and the answering service to provide that (1) the licensee of the citizens radio station will have control over the operation of the radio system at all times, even though it will be, in part, operated by answering service personnel; (2) the licensee will have full and unrestricted access to and jurisdiction over the transmitter to enable him to carry out his responsibilities under the license; and (3) it is understood that the licensee is fully responsible for the proper operation and control of the radio system and is subject to penalty for violations of any provisions of the Communications Act or of the Commission's rules.

One FCC representative called attention to the fact that the "not for hire" philosophy of CB communications may warrant a special drive on the part of the Commission some time in the future to eliminate abuses. -30-

Letters from our readers

"Satellite" Price Change

■ Those of your readers who want to build the "Satellite Flasher" project presented in your December 1960 issue will find that the price of the satellite "package" has increased somewhat. Although the 3-inch plastic ball and 2-inch beveled disc still sell for 20 cents and 5 cents, respectively, the cement used to glue them together is no longer available in 25-cent bottles. A larger size bottle, costing 75 cents, is available, however, and your

readers will probably be able to use the surplus cement for future projects. In addition, mailing and handling costs for the three items come to 35 cents, making a total cost of $1.35.

INDUSTRIAL PLASTICS SUPPLY CO.
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"The Radar Man"

■ In your October 1960 issue, you published a poem called "The Radar Man," submitted by "Educated G.I." I wrote "The Radar Man" in 1942. It was used to illustrate a safety poster in 1943, and has since appeared in a number of magazines. In my original version, the poem read as follows:

If you should see upon the street
A man equipped with dipole feet
With a family of curves trailing behind
He's a radar man with a micro-mind.

With micro-seconds and micro-waves
And micro-volts he fills his days
Thereby in the course of time
He developed a micro-mind.

His eyes take on a neon gleam
His ears extend to a yagi beam
His mouth becomes another pulse gate
His heart pumps blood at a video rate.

This radar man with the passing years
Attained infinite impedance between his ears

Letters

(Continued from page 16)

And finally succumbed to a heavy jolt
When he got what he thought was a micro-volt

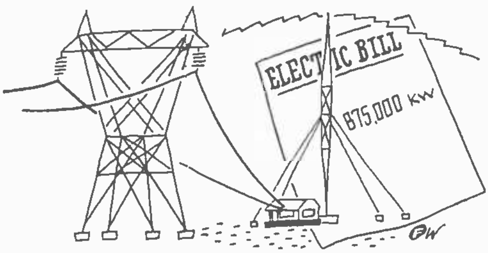
The Doc looked up from his microscope
Turned to his colleague and softly spoke
There's no trace of a brain that I can find
He's a radar man with a micro-mind.

Roy E. Curd
Sacramento, Calif.

Although we knew "The Radar Man" dated from World War II, Mr. Curd, we didn't know you wrote it. We're sure our readers will appreciate having this information, as well as the opportunity to read the original version.

A Lot of Power

■ I enjoyed the article on electric power in the November 1960 issue, but I think that the author's figure for power consumption in the United States in 1958 (160 million kilowatts) was much too low. Just consider the power consumed by a single 50-kilowatt AM broadcast station operating around the clock for a year. At average modulation, the transmitter consumes 100 kw., or 2400 kw. per day. For a year, that figure comes to about 875,000 kilowatts. Since there are about fifty 50-kw. stations on



the air day and night, their power consumption would come to approximately 44 million killowatts a year, not including studio equipment. What do you say?

Roy J. Humphrey
Station KQV
Pittsburgh, Pa.

The author's figure indicated average hourly potential *consumption, not actual total consumption for the year. Americans used 724,013,312,000 kilowatt hours in 1958, but their total demand in* any one hour *could have been as high as 160 million kilowatts, as stated.*

Radio Paging Services

■ I found your article on personal paging services ("Your Shirt Pocket Goes Beep Beep") very interesting, but I would like to point out that one of the author's statements is misleading.

Actually, the subscriber to the Bell Telephone System service doesn't go to the telephone and call the Mobile Service Operator. This was done in a few areas at first, but since the procedure was obviously in direct competition with local paging

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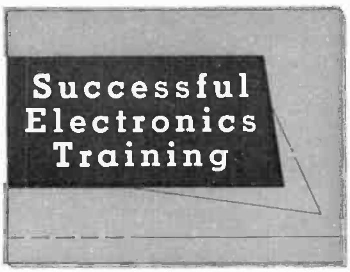

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Letters

(*Continued from page* 18)

and answering services, the Bell people arranged to have their subscribers call only a prearranged number.

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RICHARD S. HUTNER, President
Radio Page of America, Inc.
Fort Wayne, Ind.

Equations Evidently Erroneous

■ It's probably a typographical error, but it seems to me that the equation on page 96 of "The Load Line Story" (November 1960) contains an incorrect symbol. It is shown as:

$$E_P = E_b - I_P R_P$$

where R_P would probably be interpreted to mean plate resistance of the tube. I believe the equation should read:

$$E_P = E_b - I_P R_L$$

where R_L is the load resistance. This means that the plate voltage is equal to the supply voltage less the drop in the load resistor.

JAMES E. MARTZ
Milan, Ohio

■ I believe I have spotted an error in your October 1960 article on Wheatstone bridges. In discussing the capacitance bridge illustrated in Fig. 2 (page 84), the author arrives at the equation:

$$C_x = (C_s \times R_1)/R_2$$

This should be:

$$C_x = (C_s \times R_2)/R_1$$

EDSON R. DETJEN
Wilmington, Del.

Right you are, sirs. We're glad to hear that our readers know how to derive equations—as you both have done.

"T-R" Mix-Up

■ In the October 1960 issue, there is a block diagram of an EICO Citizens Band Transceiver (page 87). Can it be that the switch at the output of the audio stage is labeled incorrectly? It looks as if the "T" for transmit and the "R" for receive should be reversed.

JACK C. LEWIS
Hodgenville, Ky.

The answer to your question, Jack, is "yes." The switch is improperly marked. Thanks for calling it to our attention. -30-

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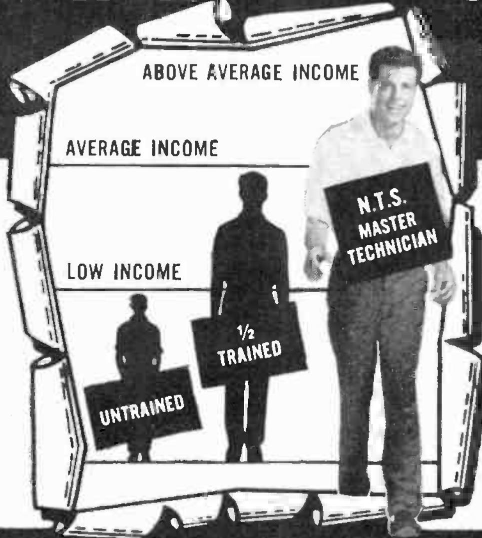

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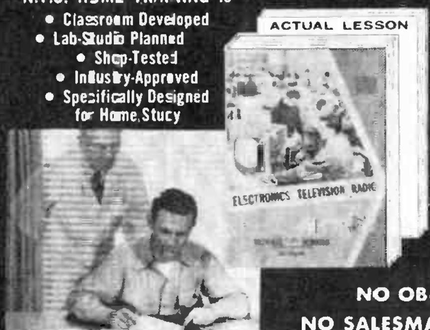

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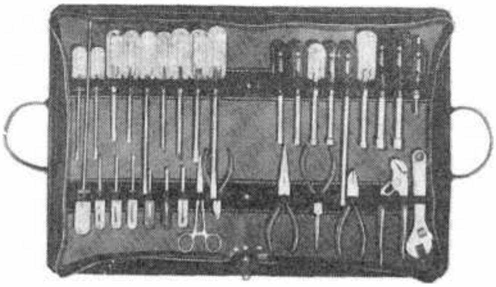
NEW products

LEATHER TOOL CASE

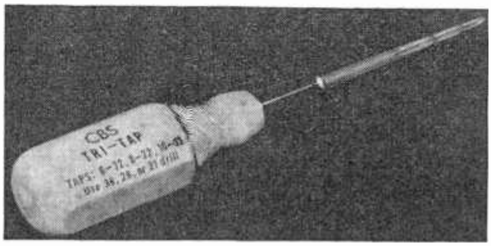
If you dig through a jumbled mess every time you need something from your tool box, here's an item that should interest you. It's an Xcelite leather case that



holds up to 40 tools individually (by leather thongs). A felt-type lining protects tool finishes and handles. For more information, request Bulletin 1060 from *Xcelite, Inc.,* Orchard Park, N. Y.

"TRI-TAP" TOOL

When threads wear and the screws that hold that favorite gadget of yours together won't stay in place, this handy



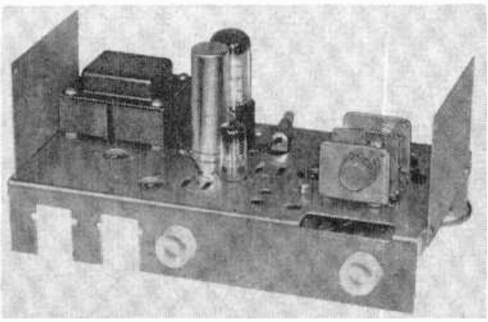
little tool will take care of them. Made of heat-treated high-carbon steel, the CBS "Tri-Tap" will tap new threads or renew old ones. It combines the three most popular tap sizes—*6-32, 8-32,* and *10-32. (CBS Electronics,* Danvers, Mass.)

P-C BOARD CAPACITOR

The ESS-7515 capacitor is an exact replacement for any one of eight dual 150-volt electrolytics commonly used on radio and TV printed-circuit boards. It will replace a 50/30-μf., 70/30-μf., 75/30-μf., 60/40-μf., 80/40-μf., 50/50-μf., 70/50-μf., or 80/50-μf. electrolytic. Price, $2.00. (*Cornell-Dubilier Electronics Div., Federal Pacific Electric Co.,* 333 Hamilton Ave., South Plainfield, N. J.)

BASIC RADIO KIT

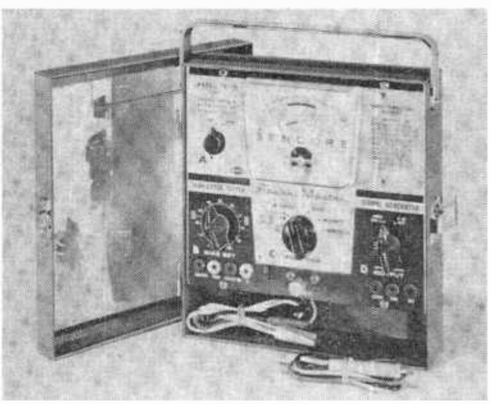
The Heathkit EK-2A educational kit is designed to give both youngsters and grown-ups an introduction to basic radio theory. In the course of learning, you build a crystal radio, improve it, and



finally wind up with a sensitive regenerative receiver. Price, $19.95. (*Heath Company,* Benton Harbor, Mich.)

TRANSISTOR TESTER

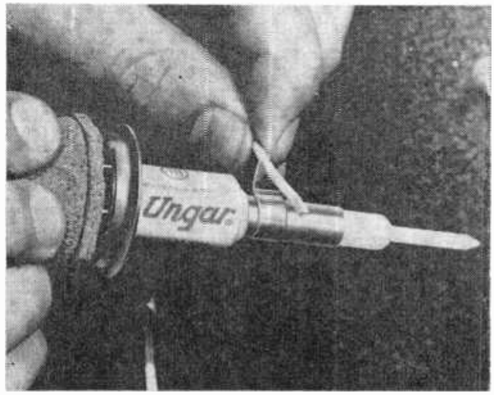
Designed for transistor-radio servicing, the Sencore "Transi Master" TR110 will check transistors both in and out of circuit. In-circuit units are given an a.c. test for gain; out-of-circuit units receive a d.c. gain and leakage check. Built into



the tester is an r.f.-a.f. signal generator and voltmeter-milliammeter for trouble-shooting purposes. The Transi Master is supplied with a test probe that connects to all three leads of a transistor at one time, and a mirrored-top case for ease in checking printed-circuit boards. Price, $49.50. (*Sencore—Service Instruments Corp.,* Addison, Ill.)

THERMO WIRE STRIPPER

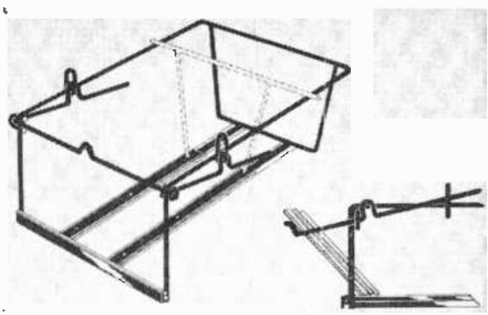
With the aid of a wire stripper announced by *Ungar Electric Tools,* 4101 Redwood



Ave., Los Angeles 66, Calif., you can strip insulation from wire while soldering. The stripping clip fits onto the barrel of a soldering tip, and will melt all rubber or plastic insulation from 8- to 24-gauge wire without nicking or scoring the strands. Clips are available in three different shapes at 75 cents each.

RECORD AND TAPE STORAGE FILE

Slide-out "Quick-See" album files for storing tapes and LP and 45-rpm records



are being offered by *Kersting Mfg. Co.,* 504 S. Date Ave., Alhambra, Calif. Designed for installation in cabinets, closets, or shelves, the units are available in models holding from 70 to 125 12" LP's. Prices range from $10.95 to $15.95 for a black finish, and from $11.70 to $16.70 for brass or copper; adjustable back rests cost from 60 to 75 cents. —30—

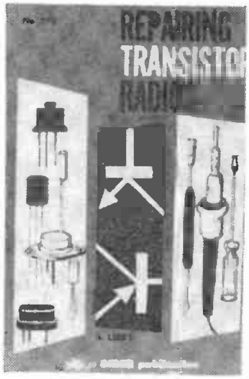
POP'tronics Bookshelf

"MOST-OFTEN-NEEDED 1961 TELEVISION SERVICING INFORMATION," Volume TV-18, compiled by M. N. Beitman. Published by Supreme Publications, 1760 Balsam Rd., Highland Pk., Ill. Soft cover. 192 pages. $3.00.

Like other Supreme manuals, this volume—the TV-18—is loaded with service information and is a "must" for every serviceman. Dozens of schematics, parts layouts, printed-circuit board layouts, alignment notes, etc., cover the bulk of 1961 TV sets, from Admiral to Zenith.

"REPAIRING TRANSISTOR RADIOS," by S. Libes. Published by John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. Soft cover. 168 pages. $3.50.

Many competent technicians are confused when it comes to servicing transistor radios—they understand the action of vacuum-tube circuits, but transistors "throw them." This book covers the operating theory of transistors and transistor circuits, especially those found in superheterodyne receivers. The various superhet elements (oscillators, audio amplifiers, power amplifiers, etc.) are discussed, and the chapters are sprinkled with schematics and test-procedure charts. Also included is a transistor-interchangeability chart.



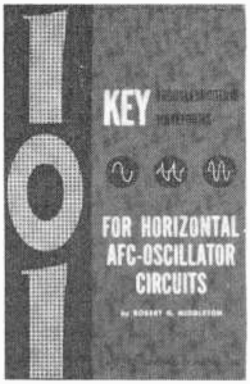
"101 KEY TROUBLESHOOTING WAVEFORMS FOR HORIZONTAL AFC-OSCILLATOR CIRCUITS," by Robert G. Middle-

Bookshelf

(*Continued from page* 24)

ton. Published by Howard W. Sams & Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. 128 pages. Soft cover. $2.00.

Trouble-shooting horizontal a.f.c.-oscillator circuits successfully can only be done by correctly analyzing oscilloscope waveforms. In the latest of Mr. Middleton's "101" series, 101 waveform diagrams are presented and explained in detail. Backed up with many typical schematic diagrams, the text discusses the normal operation of horizontal a.f.c.-oscillator circuits and how to detect and isolate the various causes of failure. Recommended for the TV serviceman.



Free Literature

A 24-page catalog prepared by the Jensen Manufacturing Company describes its line of loudspeakers, cabinets, and kits—and also gives helpful hints on planning a complete speaker system. Write to the Jensen people at 6601 S. Laramie Ave., Chicago 38, Ill., for your free copy.

Model builders and radio-control experimenters will be interested in a new catalog chock full of bargains. Just send a letter and a four-cent stamp (to cover the cost of mailing) to America's Hobby Center, Inc., 146 W. 22nd St., New York 11, N. Y.

A four-page brochure describing industrial sound systems can be obtained from North American Philips Co., High Fidelity Div., Commercial Sound Dept., 230 Duffy Ave., Hicksville, L. I., N. Y. Among the individual Norelco products covered are amplifiers, preamplifiers, delayed-sound equipment, intercom systems, loudspeaker columns, and microphones. —30—

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Hi-Fi Showcase

AS THE NEW YEAR gathers steam, more and more stereo/hi-fi products are making their way to your local dealer's shelves. We don't have room to talk about every one of them, but you'll find many of the more interesting items discussed below. Write directly to the manufacturers for additional information—names and addresses are given at the end of this column, on page 32.

If you're a tape fan, you'll want to investigate the "Quik-Cue" contact tabs made by ***W. H. Brady***. Applied to any standard recording tape, the tabs can be used to actuate a relay either to shut off the tape recorder or reverse and repeat the program. . . . Precise FM tuning is a semi-automatic operation with the ***Fisher*** FM-200 tuner. Touch the tuning knob and the a.f.c. automatically clicks off, permitting precise tuning for maximum signal. Remove your hand from the knob, and the a.f.c. clicks back on, holding the tuner spot on frequency. The FM-200 incorporates the ultra-low-noise "Golden Cascade" r.f. stage and makes use of five limiters to achieve an almost unbelievable 1.5-db capture ratio. Price of the FM-200, $229.50.

The old changer-vs.-player argument has been all but ended with the ***Garrard*** Type A player. A dynamically balanced tone arm, a professional turntable, and an automatic record-changing mechanism are successfully combined in a unit that is both a manual player and a fully automatic record changer. Distributed by British Industries, the Type A reduces wow and flutter to miniscule proportions with a 6-lb. cast and polished turntable and Garrard's newly developed "laboratory series" motor. Price, $69.50, less cartridge. . . . Designed as a companion unit for the AJ-30 stereo tuner, ***Heath***'s AA-100 stereo amplifier is basically a redesign of the company's popular AA-50. Specifications—25 watts per channel from five separate stereo inputs—are the same for both the AA-50 and the AA-100, but there are big differ-

new! *outstanding value*

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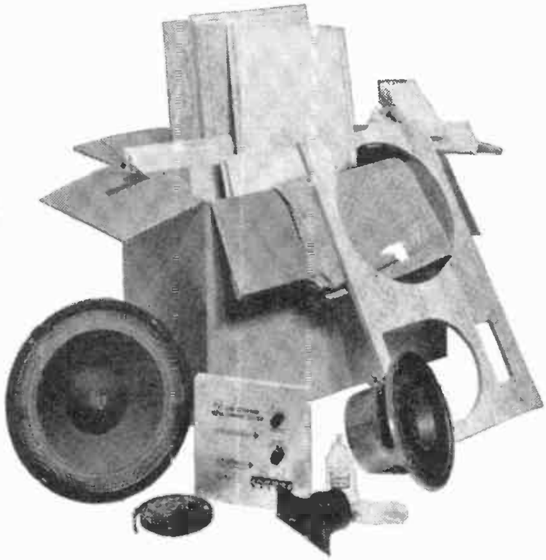
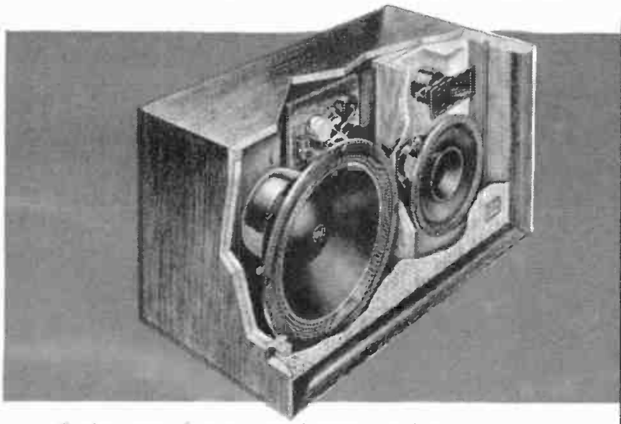
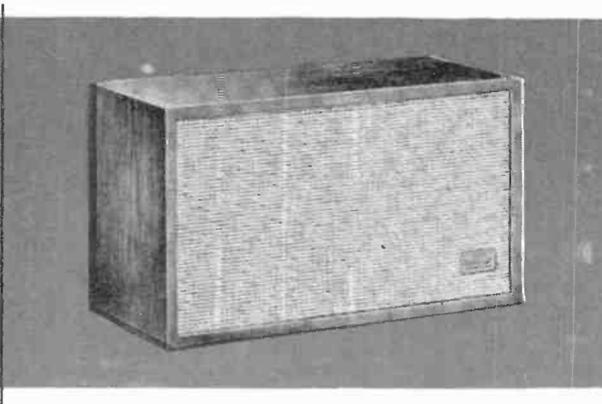
ULTRA-COMPACT SPEAKER SYSTEMS

in kit form



Now Electro-Voice takes the mystery out of ultra-compact speaker systems. No longer are the components a "sealed" secret. You see what you get, know what you get, and enjoy the fun and economy of building your own speaker system. All the materials and instructions you need are included in the package. These new kits are exactly the same as the carefully-designed, assembled systems currently sold by Electro-Voice. Systems that produce a clarity of sound that enable you to feel the deepest bass, marvel at the effortless clarity in the midrange, and delight in the brilliant definition of the upper harmonics.





Performance Depends on Component Quality

Within each Electro-Voice system, every component is engineered to complement perfectly the others with which it is used. Some of the outstanding features you'll be receiving are illustrated in the cutaway view of the Esquire 200 featured above: (1) Substantial magnetic circuits for maximum sensitivity, power handling capacity, and uniformity of response. (2) High compliance viscous damped cloth suspension for smooth response and low resonant frequency. (3) Edgewise-wound voice coil for most effective use of available magnetic energy. (4) Die-cast frames for greatest reliability of performance. (5) True electrical cross-over, at exceptionally low frequency of 200 cycles, to minimize all forms of distortion associated with the use of woofers covering the midrange. (6) Midrange speaker in a totally isolated cavity for outstandingly uniform response throughout the range over which it is employed. (7) Sonophase® throat structure and integral diffraction horn to give virtually unequalled high frequency response range, with excellent coverage of the whole listening area. (8) Two level controls which permit exact adjustment of response characteristics to personal taste and individual acoustic environments.

A Variety of Prices and Performance

The Esquire 200—Now the value-packed Esquire is available in three different forms . . . the handsome Esquire 200, the economical unfinished Esquire 200 Utility and the new Esquire 200 Kit. Each is a full three-way system with a 12" woofer, 8" cone-type mid-range speaker and E-V Super Sonax very-high-frequency driver. Esquire 200—14" high x 25" wide x 13½" deep. Hand-rubbed Walnut, Mahogany or Limed Oak. . . . .$133.00. Esquire 200 Unfinished Fir Utility—14" high x 23½" wide x 12" deep. . . . .$107.50. Esquire 200 in easy-to-assemble Kit form—14" high x 23½" wide x 12" deep. . . . .$93.00.

The Regal 300—A premium-quality, three-way system utilizing the finest quality components to assure the best sound possible in a small-sized system. Deluxe 12" woofer, a Deluxe 8" cone-type midrange speaker, and a compression-type, diffraction horn-loaded very-high-frequency driver. 14" high x 25" wide x 13½" deep. Walnut, mahogany, or limed oak. . . . .$179.00. Unfinished fir. . . . .$149.00. In Easy-to-assemble Kit Form. . . . .$125.00.

Consumer Products Division **Electro-Voice**

Dept. 2P, Electro-Voice, Inc., Buchanan, Michigan

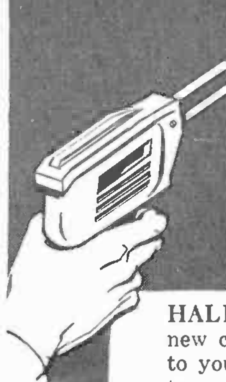
Showcase

(*Continued from page* 28)

ences in appearance. Housed in a rugged steel case covered with a luxurious luggage-tan vinyl, the AA-100 employs unique refracted lighting to softly illuminate its entire plastic-faced control panel. Kit price is $79.95; a fully wired model (the WAA-100) sells for $139.95. . . . Ever hear of a complete stereo record booth that occupied only a few feet of counter space? ***Sargent-Rayment*** thinks it has one in its new "Binaphone"—a demonstration unit combining stereo amplifier, stereo headphones, and a manual turntable with a stereo cartridge.

Powerful enough to drive any speaker system, yet simple enough for the amateur kit-builder, ***H. H. Scott***'s LK-72 amplifier kit is a perfect match for its LT-10 tuner. Four 7951 output tubes deliver 36 watts per channel through oversized (12-lb.) output transformers. To make assembly even more of a breeze, the LK-72 is supplied with pre-cut and pre-stripped hookup wire. Price, $149.95.

. . . Amplifiers, phonographs, and tuners slide smoothly out of the way when mounted on easy-to-install "Fonoslides" offered by ***Selby***. Permanently lubricated, the slides are precision-engineered for vibrationless performance even under loads as great as 60 pounds. Prices vary with track and channel lengths. . . . With an output of 36 watts per channel, ***Sherwood***'s S-5000 II stereo power amplifier provides up to five modes of operation (stereo, reverse stereo, mono 1, mono 2, and mono 1 and 2). New 12-db per octave scratch and rumble filters are effective on all channels, and the unit has provisions for the popular third-channel output. Price, $199.50. . . . Greater compliance and cleaner high-frequency response are features of two ***Shure*** cartridges, the M7-N21D and M3-N21D. Essentially improved versions of the M7D and M3D models, they are intended for use in tone arms tracking at 2 grams or less—such as the M232 (12") and M236 (16") arms. (The older M7D and M3D cartridges are still manufactured for arms requiring heavier tracking pressures.) Unmounted, the cartridges



Very Hot News . . . from hallicrafters

Two great new kits...a complete, high-performance AM/CW station, from the world's most experienced designers of short wave equipment

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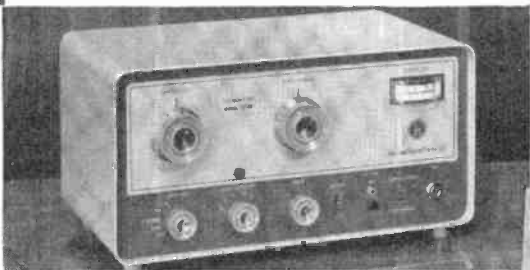
First, the unparalleled design experience of Hallicrafters' communications laboratories; and *second*, production-line proof of "Constructability" *before you buy*.

Have a wonderful time! Save a bundle of money! End up with a station the most experienced amateur would be proud to call his own.



HT-40 TRANSMITTER, $79.95

A perfect match for the handsome SX-140, both in quality and appearance. Hallicrafters' transmitter leadership is evident in every precision-engineered feature of this crystal-controlled 75-watt beauty—features as important to old-timers as they are to novices.

- **FEATURES**: You get excellent CW performance as well as AM. Full band switching, 80 through 6 meters. Enjoy easy tune-up and crisp, clean styling that has efficient operation as well as appearance in mind. Unit is fully metered, TVI filtered.
- **SPECIFICATIONS**: Maximum D.C. power input: 75 watts. Power output in excess of 35 watts CW, 30 watts peak AM phone. (Slightly less on 6 meters.) Frequency bands: 80, 40, 20, 15, 10 and 6 meters.
- **TUBES AND FUNCTIONS**: 6DQ5 power output; 6CX8 crystal oscillator and driver; 12AX7 speech amplifier; 6DE7 modulator; silicon high voltage rectifiers.
- **FRONT PANEL**: Function (AC off, tune, standby, AM, CW); Band Selector (80, 40, 20, 15, 10, 6); Drive control; Plate tuning, plate loading, Crystal-V.F.O.; Grid Current; Meter; AC indicator light; RF output.
- **REAR CHASSIS**: Microphone gain; antenna co-ax connector; remote control terminals; AC power cord.

SX-140 RECEIVER, $94.95

Doesn't it make sense to team up your skill with the experience of a company who has designed and built more high-performance receivers than any other in the world? Especially when the result is the *lowest-priced amateur band receiver available?*

- **FEATURES**: You get complete coverage of all amateur bands 80 through 6 meters, with extremely high sensitivity and sharp selectivity. Unit has RF stage; S-meter; antenna trimmer; and XTAL calibrator. Tuning ratio is 25 to 1.
- **CONTROLS**: Tuning; Antenna Trimmer; Cal. Reset; Function (AC off, standby, AM, CW-SSB); Band Selector; Cal. on/off; RF Gain; Auto. Noise Limiter on/off; Selectivity /BFO; Audio Gain; phone jack; S-meter Adj.
- **TUBES AND FUNCTIONS**: 6AZ8 tuned RF amplifier and crystal calibrator; 6U8 oscillator and mixer; 6BA6 1650 kc. IF amplifier and BFO; 6T8A 2nd detector, A.V.C., ANL and 1st audio; 6AW8A audio power amplifier and S-meter amplifier; (2) silicon high voltage rectifiers.

P.S. *Both units are available fully wired, and tested. SX-140, $109.95. HT-40, $99.95.*

halli-kits from hallicrafters

Chicago 24, Illinois

... where the new ideas in communications are born!

Export Sales: *International Div., Raytheon Co., Waltham, Mass. Canada: Gould Sales Co., Montreal, P.Q.*

Showcase

(*Continued from page* 30)

sell for $36.75 and $47.25, respectively; either of the cartridges is also available installed in the M232 or the M236 tone arms. And if that record changer of yours is at all suited to stereo, you'll be interested in another Shure product—the M8D stereo cartridge. Tracking at pressures from 5 to 8 grams and completely compatible, the M8D sells for $16.50, complete with a 7-mil diamond stylus.

Stereo furniture in a choice of select walnut, teak, mahogany, or birch should be welcome news to any hi-fi enthusiast, particularly if the Mrs. is concerned about all those tubes and wires. When such furniture is available in easy-to-assemble kit form at substantial do-it-yourself savings, it is just that much more impressive. ***Sieler*** produces stereo cabinet kits in a variety of styles, with prices beginning at $29.95. . . . Although opinions vary, most audiophiles admit that the cartridge, if not the heart of a hi-fi system, is one of its keystones. This being the case, ***Smith Labs*** has delved into its bag of research tricks and come up with the "photoSonic 120." A non-magnetic, non-capacitive, non-piezo-electric cartridge, the 120 depends on a fourth method of sound pickup—photo-electricity. Tracking at pressures from 0.5 to 0.9 gram, the 120 actually relies on the modulation of a light beam for its sound. Fully compatible, the unit sells for $47.50. . . . A budget-priced, all-plastic manual tone arm complete with a crystal cartridge is just the thing for recreation room listening. Produced by ***Sonotone***, the T1 Series arm is available in either brown or gray and with either high or low output cartridges. It sells for $7.45. —30—

W. H. Brady Co., 727 West Glendale Ave., Milwaukee 9, Wis.
Fisher Radio Corp., 21-21 44th Dr., Long Island City 1, N. Y.
Garrard Div., British Industries Corp., Port Washington, N. Y.
Heath Co., Benton Harbor, Mich.
Sargent-Rayment Co., 4926 East 12th St., Oakland 1, Calif.
H. H. Scott, Inc., 111 Powdermill Rd., Maynard, Mass.
Selby Furniture Hardware Co., 11 West 17th St., New York 11, N. Y.
Sherwood Electronic Laboratories, Inc., 4300 N. California Ave., Chicago 18, Ill.
Shure Bros. Inc., 222 Hartrey Ave., Evanston, Ill.
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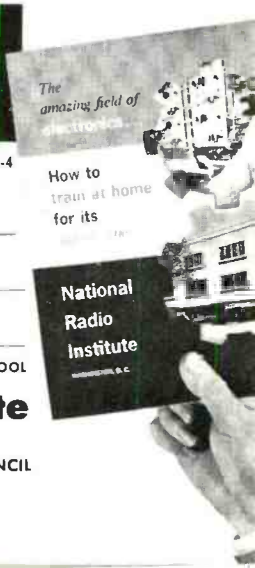

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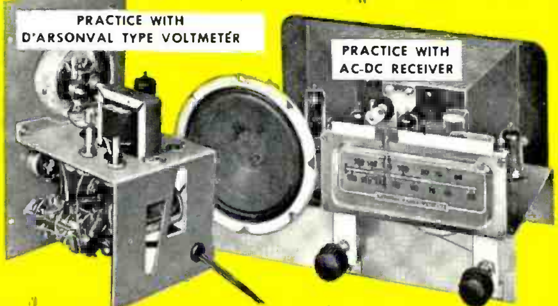

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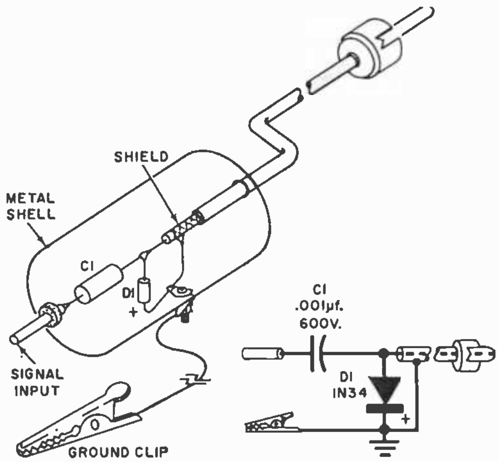
Tips and Techniques

INEXPENSIVE SIGNAL TRACER

The simple r.f.-a.f. probe shown in the diagrams will plug into any utility amplifier or even a hi-fi system. It can be built in any small metal container; insulate the signal input pin from the metal shell but ground the positive diode terminal and the output cable's shield to the shell. The shielded cable can be up to six feet



long or more; the ground lead connected to the alligator clip should be about a foot long. To use the probe, fasten the clip to the set being tested, connect the output cable to the input of any amplifier, and touch the signal input pin to the grid and plate of each stage until the inoperative stage is found. The quality of the signal may also be judged from the sound reproduced as the probe is moved from stage to stage.

—*Steven C. Hall*

VTVM TEST LEAD ADAPTER

If you want to use standard test leads with a VTVM or signal generator equipped with a microphone-type chassis connector, try this adapter. Solder about ½" of bare hookup wire to the terminal of an insulated pin jack. Then push the only for those who really need them...

CADRE

Only a short time ago, the FCC opened 22 channels for Citizens Band operation. Licensing was radically simplified. Where formerly two-way radio licenses were granted only to public safety agencies and certain other special groups, SUDDENLY, EVERYBODY COULD HAVE 2-WAY RADIO!

. . . providing, of course, he could afford the bulk and cost of the equipment that was then available.

Yet in spite of the bulk and the cost, nearly two million Citizens Band transceivers have been purchased to date! A tremendous demand has developed!

You can imagine what will happen now that compact, professional-quality instruments like the CADRE '500' and the CADRE '100' are available!

These CADRE units are built to the highest standards of the electronics industry, by a company that has been long established as a prime manufacturer of precision electronic research equipment and computer assemblies. CADRE transceivers are 100% transistorized – compact, lightweight . . . engineered for unparalleled performance and reliability.

The CADRE 5-Watt Transceiver, at $199.95, for example, for offices, homes, cars, trucks, boats, aircraft, etc., measures a mere 11 x 5 x 3", weighs less than 6 pounds! Nevertheless, it offers 5 crystal-controlled transmit/receive channels (may be used on all 22), and a range of 10 miles on land, 20 over water!

The CADRE 100-MW Transceiver, $124.95, fits into a shirt pocket! Weighs 20 ounces, yet receives and transmits on any of the 22 channels . . . efficiently, clearly . . . without annoying noise. A perfect "pocket telephone"

For the time being, it is unlikely that there will be enough CADRE transceivers to meet *all* the demand. Obviously, our dealers cannot restrict their sale to the fields of medicine, agriculture, transportation, municipal services, etc. However, since these CADRE units were engineered for professional and serious commercial applications – and cost more than ordinary CB transceivers – we believe that as "water finds its own level," CADRE transceivers will, for the most part, find their way into the hands of those who really need them.

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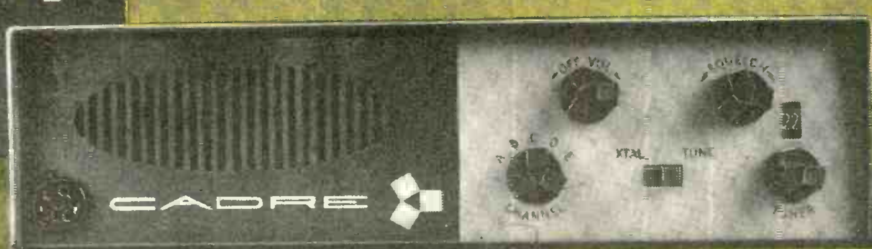
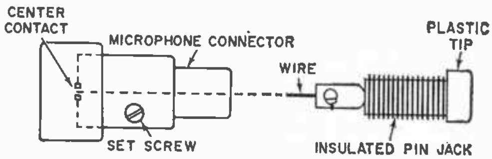


CADRE INDUSTRIES CORP., Endicott, N.Y.

Prices appearing in this advertisement are suggested retail prices.

(Continued from page 36)

wire through the center terminal hole of a microphone plug connector as shown, and solder it in place. If the pin jack lug is of the long, thin variety, the lug itself can be pushed through the micro-

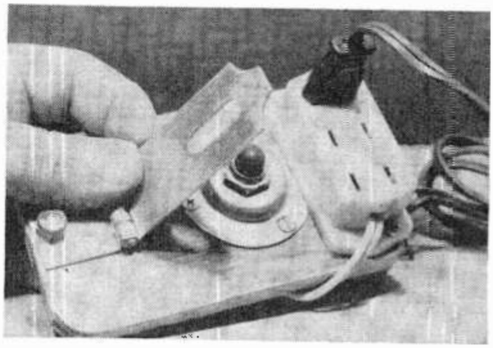


phone connector terminal hole. In any case, clip off the excess lead protruding through the hole and tighten the connector's setscrew on the pin jack's plastic body.

—*Robert L. Noland*

SAFETY POWER SWITCH

If you use a power tool, connecting a footswitch to it will give you an added safety factor. You can make a footswitch with any normally-open s.p.s.t. push-button switch designed to carry the power tool's load. Mount the switch on a 5" x 8" x 1" piece of wood, as shown, under a lock hasp which is used as the footswitch's treadle. A double or triple power receptacle mounted next to the



switch will serve as the power outlet. Connect the switch in series with the receptacle and a heavy-duty power cord and plug. To operate the footswitch, plug the power tool into the receptacle and step down on the treadle. The power

(*Continued on page* 107)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New FM-AM Stereo Tuner ST96
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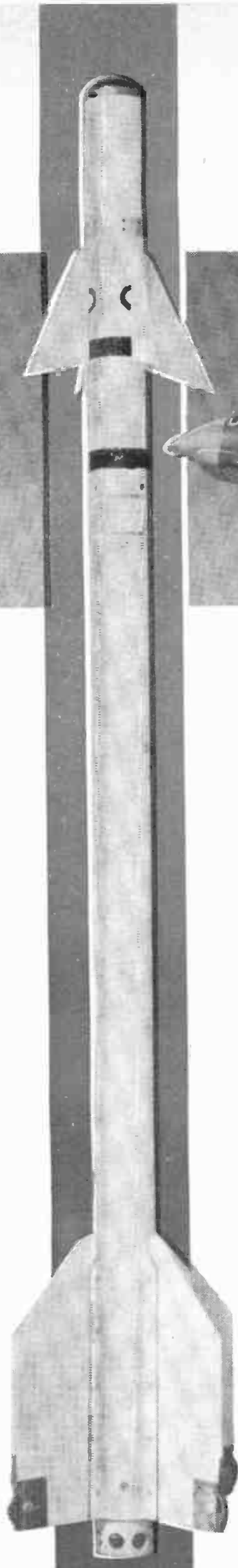
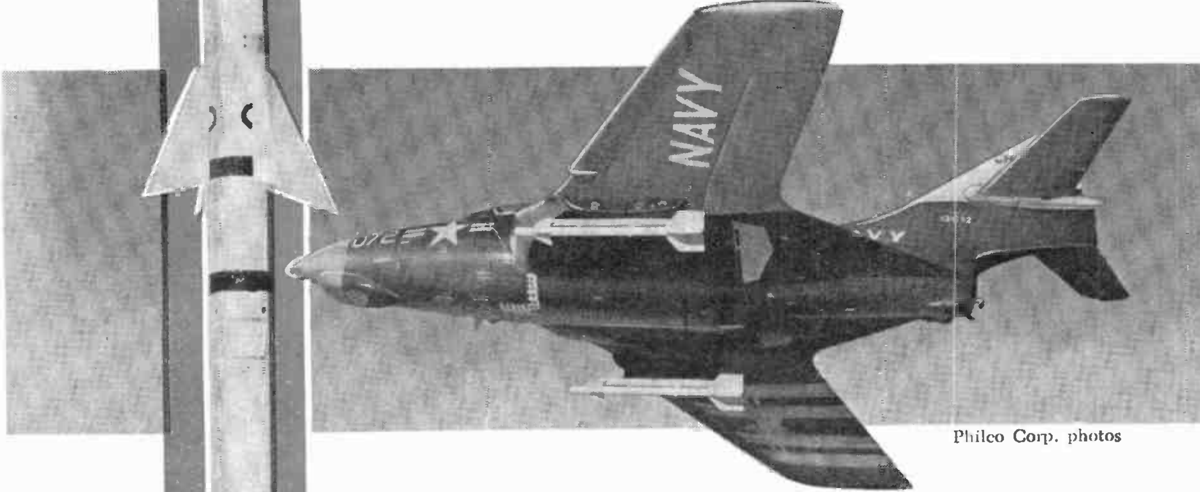




Philco Corp. photos

INFRARED

Yesterday's discovery . . .

. . . tomorrow's promise

DURING the Quemoy crisis two years ago, a new weapon made the headlines. Known as the "Sidewinder," the instrument was the first guided missile to destroy enemy aircraft in actual combat. The Chinese Nationalists exploded scores of Red MIG-17 jets in mid-air with the aid of this lethal device.

Interestingly enough, the Sidewinder missile is named after the desert rattlesnake—both strike by homing in on the *infrared radiations* which their targets emit. The hot exhaust of an enemy jet becomes the target for this heat-seeking missile, which zooms into the tailpipe and destroys the aircraft in a fiery explosion.

What Is Infrared? Actually an electromagnetic radiation much like radio or light waves, infrared is produced to some extent by every object above absolute zero (−237° C). And the hotter an object becomes, the more infrared is emitted —the sun, for example, is an excellent infrared radiator.

The discovery of infrared took place over 160 years ago. In the year 1800, William Herschel placed a number of thermometers along the full length of a rainbow-like spec-

By **CHARLES CARINGELLA,** W6NJV

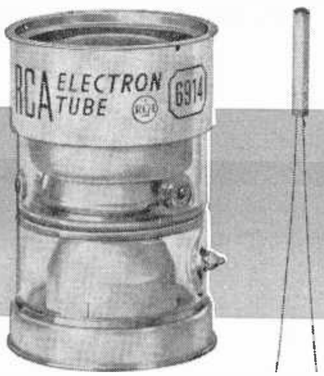


Image tube (far left) converts invisible infrared into visible light; the World War II "snooperscope," which enabled troops to see in the dark, employed such a detector. Modern single-crystal infrared detector (left) is a byproduct of transistor development; unit produces output voltage in proportion to amount of infrared radiation falling upon it. Both devices are products of Radio Corporation of America.

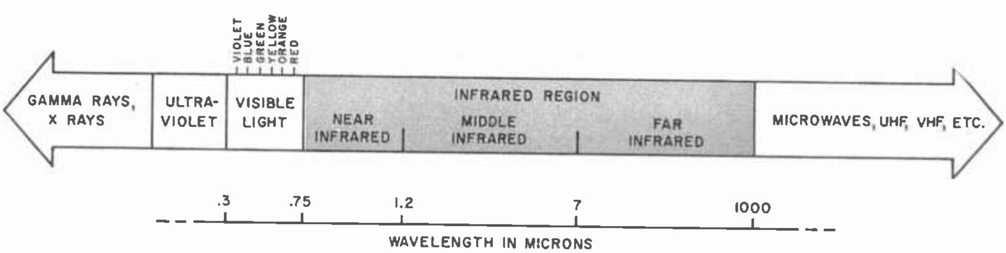
trum of the sun's light which had been dispersed by a glass prism. As he expected, the thermometers were heated by this visible light—from the violet at one end of the spectrum to the red at the other. But there was one thing Herschel didn't expect. The thermometers were also heated at the end of the spectrum beyond the visible red region, indicating that some form of energy was also present there! Since this radiation was below the visible red region, he dubbed it "infra-red."

For over a century, Hershel's discovery remained nothing more than a scientific curiosity. Then, in the 1920's and 1930's, several laboratory instruments were developed which used infrared to identify unknown materials and analyze chemical compounds. And World War II brought the amazing "snooperscope" which enabled our troops to literally see in the dark.

Types of Systems. Infrared systems are classified into two groups. In the "active" system, the target is illuminated by an infrared spotlight; the snooperscope is an example of a device which uses this system. The second or "passive" system detects the infrared energy emitted by the target itself, as does the Sidewinder missile. As might be expected, the passive system requires a very sensitive detector, since the amount of infrared which objects emit is often extremely small.

The basic instrument used for measuring infrared radiation is the radiometer. Acting somewhat like the more common photocell, the radiometer collects radiation from a narrow field and converts it into electrical energy which can then be read on a meter or recorded on a chart. Radiometers are used to monitor temperatures remotely with a very high degree of accuracy.

Applications. Infrared has been applied to a wide variety of guided missiles, with air-to-air types—such as the Sidewinder—the most successful. Another military application is in aircraft gunfire control. Fire-control systems using visual sights are naturally limited to daytime operation, but infrared equipment extends the operation of such systems into total darkness.



Infrared band, sandwiched between visible light and microwave regions, comprises wavelengths from 0.75 to approximately 1000 microns.

Still other military applications include airborne early-warning systems, ballistic-missile detection systems, "passive" viewing systems for watching troop movements at night, and infrared communications systems. The "Midas" satellites, for example, will have infrared "eyes" to detect the white-hot exhaust of missiles as they are launched from enemy territory.

Many *commercial* applications of infrared stem from one fact: as infrared light is passed through a chemical compound, certain wavelengths are absorbed and do not pass through. These wavelengths or groups of wavelengths are known as absorption bands. And because the molecules of every substance have a different infrared absorption band, these bands provide a means of identifying molecules in much the same way that a set of fingerprints can identify a particular human being.

The infrared spectrophotometer, for example, is an instrument which analyzes compounds and gases. It automatically measures the changes in wavelength of the infrared light passing through a sample and records the resultant absorption bands on a chart.

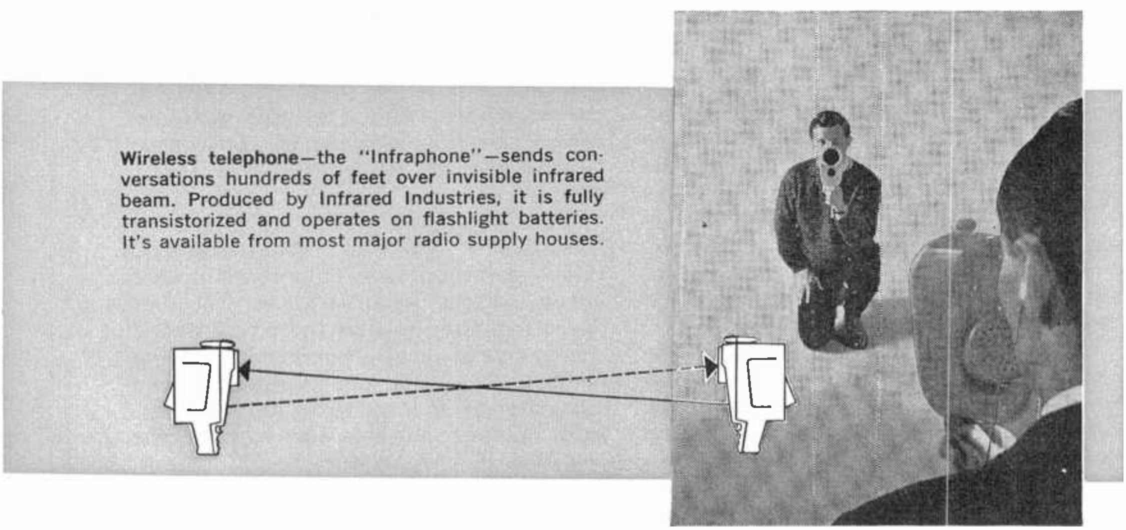
Infrared finds dozens of uses in industry. Among them: analyzing fertilizers, insecticides, and soils in agriculture; complex propellant mixtures and exhaust gases in aircraft and missiles; molecular structure of enzymes and amino acids in biochemistry; essential oils and mixtures in cosmetics; compounds in pharmaceutics.

Fire *detection* is also becoming an important application for infrared. Airlines are now using infrared fire-detection devices aboard their planes, and railroads call on infrared to detect "hot" boxes from fixed positions—even though the trains are moving by at high speeds! Some day, a greater degree of protection from forest fires may be provided through the use of small, battery-operated infrared devices.

Place in the Spectrum. All of the advanced military systems now in use, as well as many of the commercial applications, were made possible by new developments in detectors and optics since World War II. Before taking a closer look at infrared detectors, let's see just how infrared fits into the whole of the electromagnetic spectrum.

The infrared frequency band, which is located between visible light and radar, ranges from approximately 1 million to 500 million megacycles; the corresponding wavelengths are 1000 to 0.75 microns. (The micron—actually one millionth of a meter—is the unit commonly used for measuring wavelengths in infrared work).

In some of its characteristics, infrared resembles visible light—for example, lenses and parabolic mirrors are used to collect and focus infrared energy on a



Wireless telephone—the "Infraphone"—sends conversations hundreds of feet over invisible infrared beam. Produced by Infrared Industries, it is fully transistorized and operates on flashlight batteries. It's available from most major radio supply houses.

detector. However, it also behaves somewhat like radio or radar waves: it will go right through materials such as germanium and silicon, both of which are impervious to visible light!

Infrared Detectors. One type of infrared detector, the *image tube,* operates only in the near-infrared region. The object to be viewed is irradiated with an infrared spotlight, a device much like an ordinary spotlight, except that it makes use of a filter which lets only the infrared pass. The infrared is reflected from the object and strikes a sensitive film in the image tube.

Since this film is photoemissive, it emits electrons when excited by the infrared light. The electrons are emitted from the back side of the film into the vacuum within the image tube and electrostatically focused on a phosphor viewing screen. Thus, the image tube effectively converts the invisible infrared to visible light and enables the viewer to "see" in total darkness.

Infrared detectors, other than the photoemissive type, fall into one of three groups—thermal radiation detectors, film-type infrared photoconductors, and single-crystal infrared detectors. Since they are detectors, all convert infrared radiations into electrical signals. But each works differently and therefore has special characteristics all its own.

The *thermal radiation* detectors make use of the heating effects of infrared. There are two types: one is the thermoelectric detector which operates on the thermocouple principle. It consists of two dissimilar metals which generate voltage at the junction as the temperature of the junction changes. Naturally, the junction temperature is proportional to the amount of radiation hitting it.

The second type of thermal detector is the bolometer. It consists of a thin metal or semiconductor strip. As the temperature of the strip changes, so does the resistance. And if voltage is applied across the bolometric strip, the current flowing through it will vary as its resistance changes.

Traffic detector—the "Traffitrol"—uses infrared beam to detect and count vehicles traveling at speeds up to 80 miles per hour. Highly accurate and virtually foolproof, the device is among the first to apply infrared principles to traffic problems. The "Traffitrol" is manufactured by the Heiland Division of Minneapolis-Honeywell.

Photoconductive detectors are comprised of a thin film (about 1 micron thick) deposited on a thin sheet of insulating material such as glass. For their operation, they rely on the photoconductive effects of certain semiconductor compounds. The radiation changes the conductivity of the material in much the same manner that base bias controls current flow in a transistor.

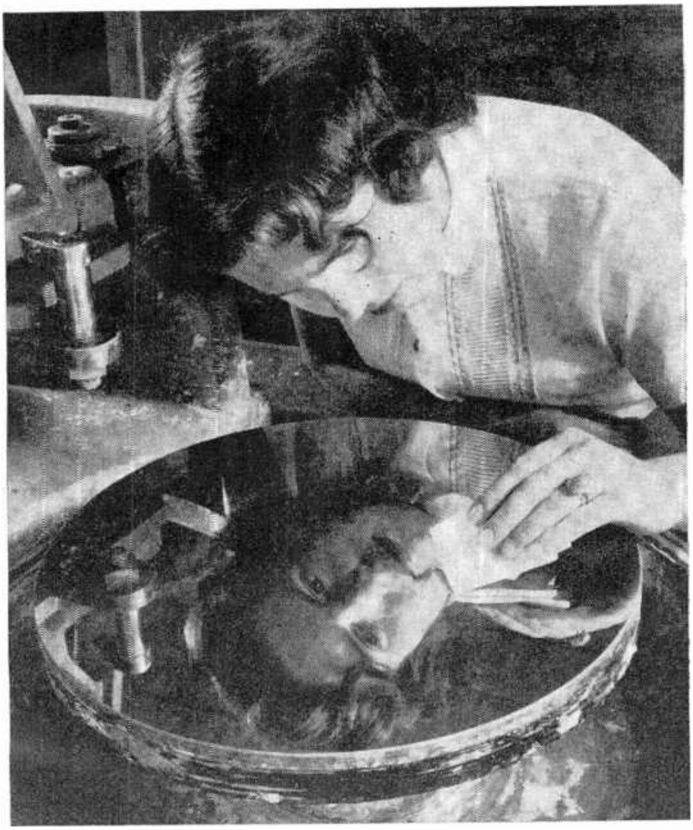
This effect can be demonstrated by connecting a bias battery and a sensitive current meter in series with the detector. As radiation falls upon the detector, current will flow. And by replacing the meter with a load resistor, a signal will be developed across it in proportion to the amount of radiation.

Single-crystal infrared detectors were made possible largely by the invention and development of the transistor. In this type of detector, a semiconductor crystal is used, generally comprised of either germanium or silicon. The material is processed in such a way as to make it photovoltaic, which means that it generates a small d.c. voltage proportional to the amount of radiation falling on it.

In all of these detectors, the signal voltages produced are very small. As a result, special low-noise amplifiers are required to bring the signal up to more usable levels.

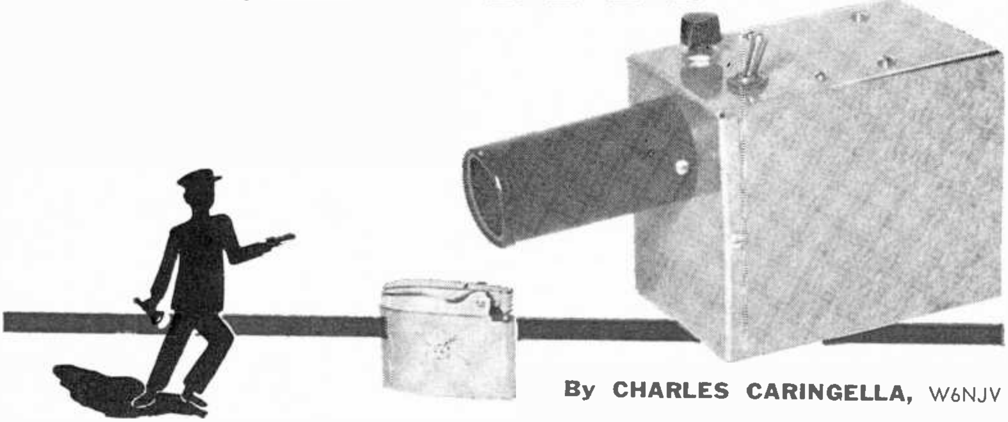
Tomorrow's Promise. As knowledge of infrared and its amazing properties increases, so, too, will its uses. A new traffic-control detector, for example, can detect and count cars traveling at speeds up to 80 miles an hour. Another recent development—a solid casting of germanium, 15 inches in diameter—expands the viewing range of infrared missile detection systems enormously (scientists have termed it comparable to "replacing a porthole with a picture window!") Even infrared detectors have reached all but unbelievable levels of sensitivity. One recent model, already on the market, is so sensitive that it can detect a cigarette burning 500 miles away!

Fantastic? To be sure, but this is the fantastic, invisible world of infrared. What still more wonderful developments in this invisible world will tomorrow bring? -30-



Infrared "picture window" produced by scientists at Hughes Aircraft is solid germanium casting 15" in diameter and 1/2" thick. Optically ground and polished, it is opaque to ordinary light but refracts infrared rays much as a glass lens collects and focuses rays from visible part of spectrum. Used in missile detection systems, the casting is made from 9 1/2 pounds of germanium, and is valued at approximately six thousand dollars.

BUILD AN INFRARED BURGLAR ALARM



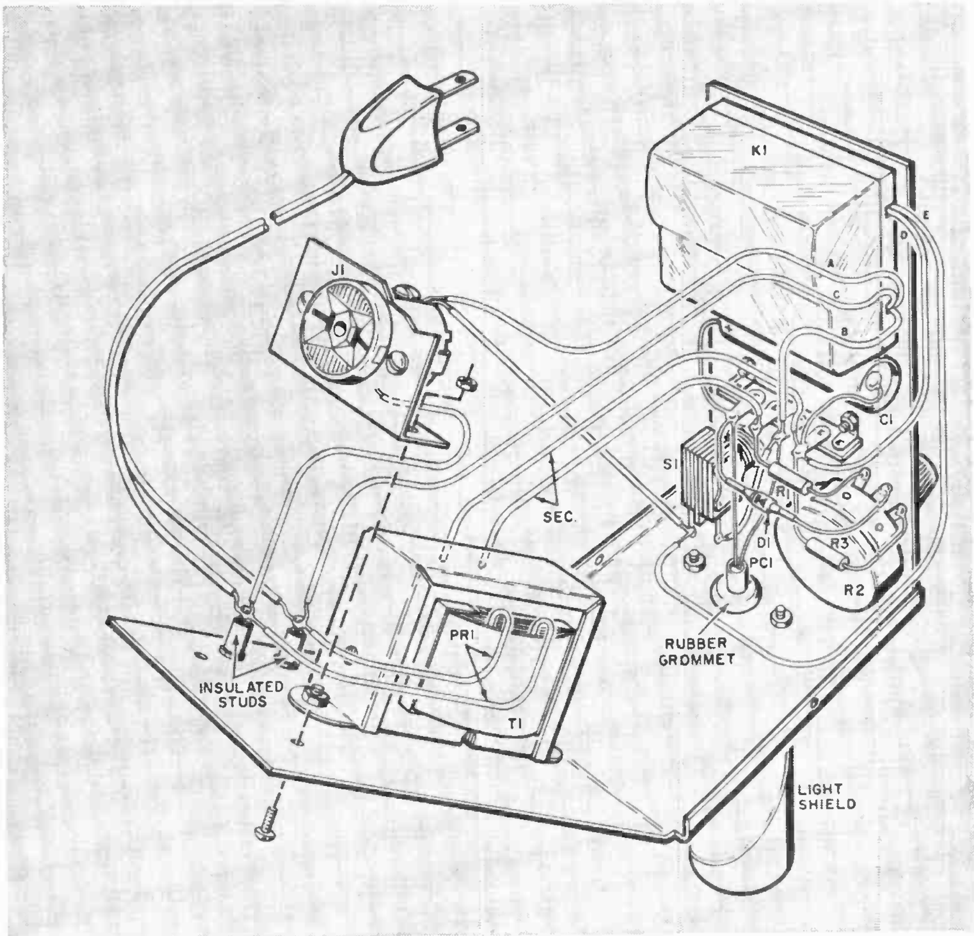
By CHARLES CARINGELLA, W6NJV

IF YOU'VE EVER SEEN a photoelectric eye in operation, you've probably noticed its telltale light beam. But the alarm system described here has no visible beam and can thus function undetected—even in total darkness. Its secret: it relies on invisible infrared radiation instead of light.

Although at first glance the infrared alarm system would appear to be quite expensive, you'll find that it can be built for less than $25.00. If you already have some of the parts in your junk box, the cost will be reduced accordingly. In any case, the infrared detector and infrared spotlight are easy to build and their circuitry is quite simple and non-critical.

Construction. The infrared detector is housed in a 5" x 4" x 3" aluminum box. Parts placement is not critical but the pictorial diagram can be used as a guide. The photocell (*PC1*) is pushed through a rubber grommet which is mounted on the box's 3" x 4" cover panel and soldered directly into the circuit. Use a heat sink when soldering *PC1* and mount a piece of cardboard tubing around it to keep out extraneous light (see photo); the cardboard should be painted black to minimize reflections. Mount sensitivity-control *R2* and reset-switch *S1* on top of the unit or wherever convenient.

The infrared spotlight is housed in a 6" x 6" x 6" aluminum cabinet (see page 49). Cement the infrared filter across a 5"-diameter opening cut at one end of the box; the filter specified in the parts list is 5⅜" in diameter and ⅛" thick.



Infrared detector wiring is simple and straightforward, although photocell PC1 requires special consideration. See text for details.

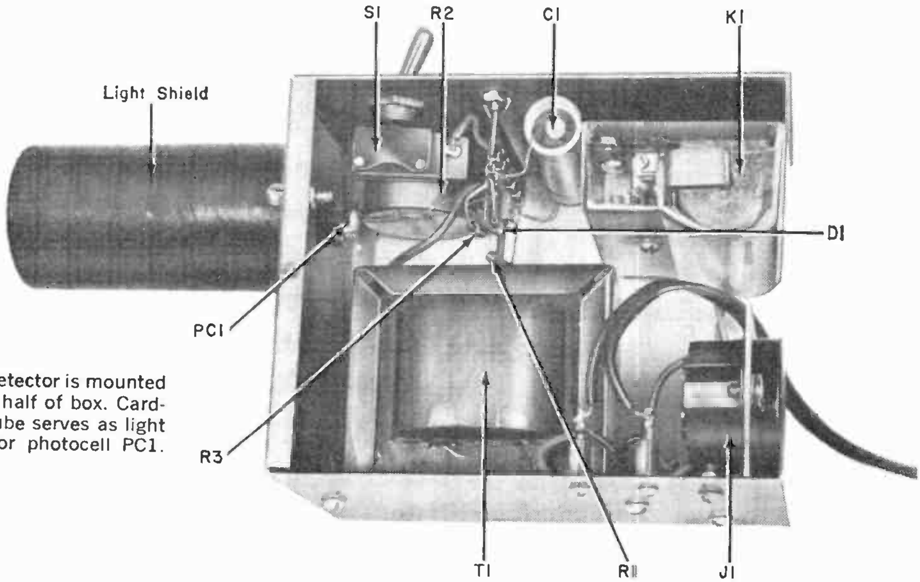
The lamp can be any 117-volt light bulb —its actual wattage will depend on the distance between the infrared spotlight and the detector.

Use a 5"-diameter parabolic reflector to concentrate the lamp's output in a single beam. The aluminum reflector from a work lamp or spotlight will do nicely. Mount the lamp and reflector directly behind the filter with the lamp's filament at the focus of the parabola.

The focal point of the parabola may be determined by pointing the reflector toward a light source and focusing the light bounced off the reflector onto a piece of translucent white paper. Use a long, narrow piece of paper so as not to obstruct the reflector's pick-up field with your hand. At the focal point, the reflected light should form an intense bright spot.

Operation. You can use the infrared alarm system to guard a single door or window or to cover a large area. To protect a room or store against burglary, mirrors can be used to reflect the infrared beam across all doors and windows. If the beam is broken anywhere in its circuit around the room, the alarm will sound; this "round-the-room" setup is shown on page 49.

If the system is used to keep tabs on people entering and leaving a store, for example, place the infrared spotlight and detector in the store in such a way that the beam passes across the entranceway. Either the door opening or someone entering the store will break the beam be-



Entire detector is mounted in front half of box. Cardboard tube serves as light shield for photocell PC1.

tween the spotlight and detector's photocell and set off chimes or a buzzer.

Once the spotlight, receiver, and mirrors are installed, both the reset-switch (*S1*) and the sensitivity control (*R2*) should be set and adjusted for operation as either a burglar alarm or a store "announcer."

First, open switch *S1* and temporarily cover photocell *PC1*. Then power the detector and plug a test alarm—a lamp or buzzer draining less than 100 watts—into 117-volt receptacle *J1*. The test alarm should be on.

Now, uncover *PC1* and turn on the infrared beam, close reset-switch *S1*, and advance *R2* until the test alarm goes off. If the test alarm does not go off anywhere in *R2*'s range, be sure that the in-

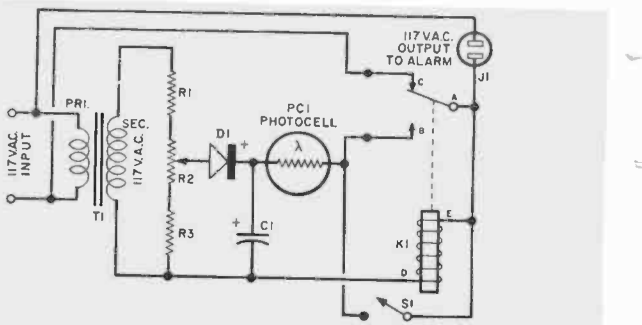
PARTS LIST

Infrared Detector

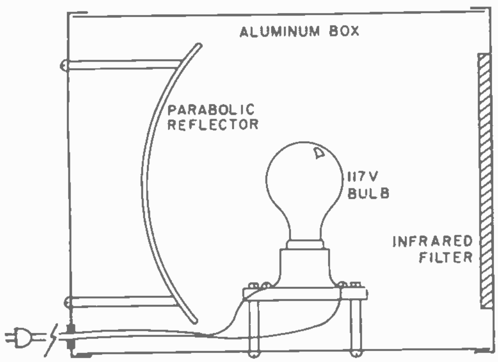
C1—10-µf., 150-volt electrolytic capacitor
D1—Silicon diode (Sarkes-Tarzian 2F-4 or equivalent)
J1—A.c. power receptacle (Amphenol 61-F1 or equivalent)
K1—Relay, s.p.d.t. contacts, 5500-ohm coil (Advance SV/1C/5500D or equivalent)
PC1—Cadmium selenide photocell (Clairex CL-3 or CL-603)
R1, R3—2200-ohm, 1-watt resistor
R2—5000-ohm, 2-watt, linear taper potentiometer (Ohmite CU5021)
S1—S.p.s.t. toggle switch
T1—117-volt isolation transformer, one-to-one ratio (Lafayette TR-91 or equivalent)
1—5" x 4" x 3" aluminum box (Bud CU-2105A or equivalent)
Misc.—Hardware, terminal strip, etc.

Infrared Spotlight

1—6" x 6" x 6" aluminum utility cabinet (Bud AU-1039 or equivalent)
1—5" parabolic reflector (see text)
1—5⅜"-diameter x ⅛"-thick infrared filter (Edmund Scientific Co., Barrington, N. J., Catalog No. 60,033, $2 postpaid—or equivalent)
1—117-volt lamp (see text)
Misc.—Socket, hardware, etc.

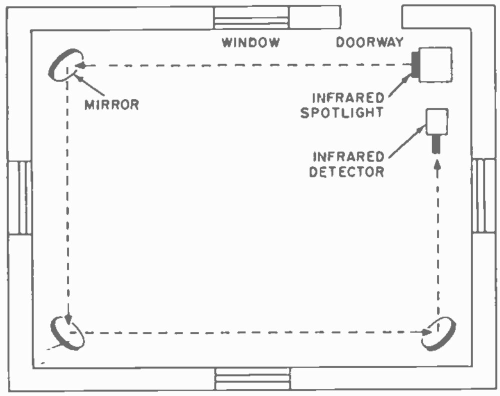


Schematic diagram of the infrared detector.



Infrared spotlight's box should have lightproof air vents. Use high-wattage lamp for long beam lengths.

Round-the-room setup protects doors and windows. Metal or front-surface mirrors give best results.



HOW IT WORKS

The infrared alarm system consists of two units: the infrared spotlight and the detector. The spotlight contains a lamp, a reflector, and an infrared filter. The lamp is an ordinary 117-volt light bulb. All of the light from the bulb is focused into a single beam by the reflector. The infrared filter removes most of the visible light and allows only the infrared radiation to pass through relatively unimpeded.

The heart of the detector is the cadmium selenide photocell (*PC1*) which is sensitive to visible light and to near-infrared radiation. The photocell has a very high ratio of dark resistance to light resistance: it measures well over one megohm with no light falling on it, and only a few thousand ohms in daylight. The photocell behaves very much like a switch, which is its function in the detector.

Transformer *T1* is a one-to-one isolation transformer operating from the 117-volt a.c. line. Resistors *R1* and *R3* and sensitivity control *R2* form a voltage divider to reduce the a.c. voltage on *T1*'s secondary to the operating range of *PC1* and relay *K1*; potentiometer *R2* allows this voltage to be varied from approximately 20 to 80 volts. Diode *D1* rectifies the a.c. and capacitor *C1* filters *D1*'s output.

Photocell *PC1* is connected in series with reset-switch *S1* and the coil of relay *K1*. When no light falls on *PC1*, its resistance remains very high and no current flows through *K1*'s coil, keeping the relay de-energized. When *PC1* is illuminated, its resistance drops, allowing energizing current to flow. With *S1* closed and *R2* properly adjusted, relay *K1* locks up on its own contacts (*a* and *b*) and remains locked until the light or infrared source is removed.

When the infrared beam is broken, *K1* is de-energized and the contacts (*a* and *c*) of *K1* close and apply 117 volts a.c. to alarm output receptacle *J1*. When the infrared beam is restored, *K1* is energized again and the alarm goes off.

With reset-switch *S1* open, relay *K1* remains in its de-energized condition even if the infrared beam is restored. In this case, the alarm can not be silenced until *S1* is closed.

frared beam is focused on photocell *PC1*; you may have to put a larger lamp in the spotlight for long beam lengths or when mirrors are used.

When the test alarm is turned off by *R2*, open *S2*. The unit is now armed and ready to operate as a burglar alarm. Break the infrared beam and the test alarm will be turned on; the alarm will stay on even though the beam is restored.

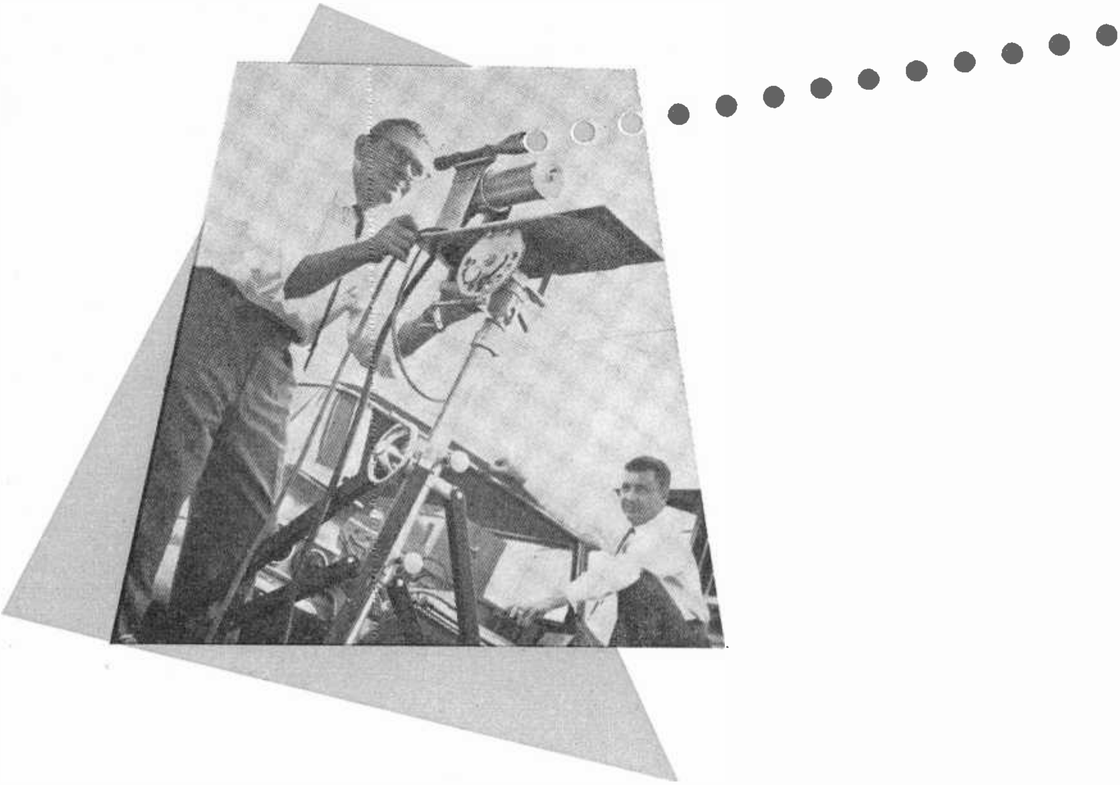
To operate the system as a store announcer, go through the adjustment procedure described for the burglar alarm but open reset-switch *S1* after sensitivity control *R2* has been adjusted to turn off the alarm. With this setting of *S1*, the alarm is on only while the beam is broken. When the beam is restored, the alarm is silenced.

If you use the system as a burglar alarm, a large gong or other electric noisemaker will be appropriate as the alarm signal. For a store announcer, as mentioned before, chimes or a buzzer will be better. In either case, be sure that the alarm or announcer plugged into *J1* drains no more than 100 watts in order to protect the contacts of relay *K1*. –30–

Introducing the LASER

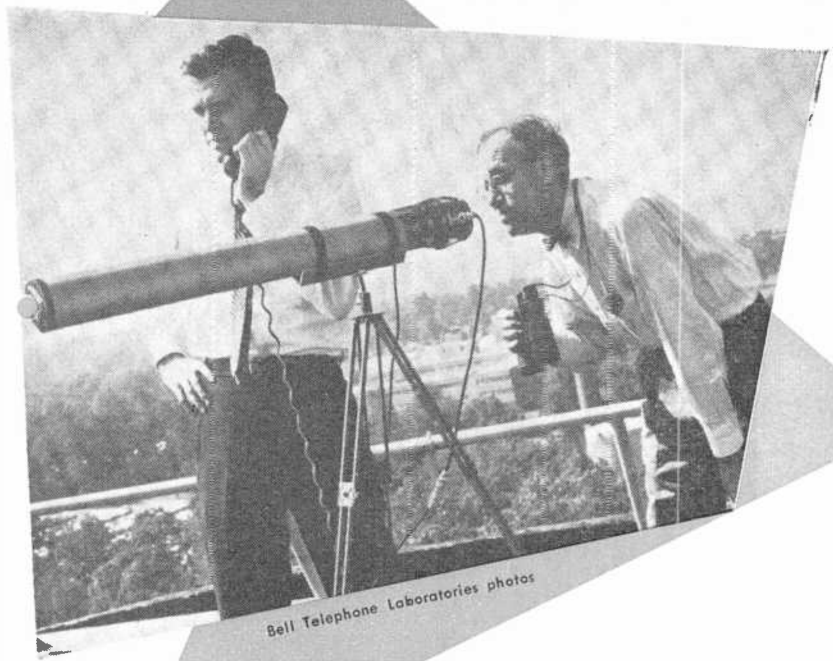
BRIGHTEST LIGHT in ELECTRONICS' FUTURE

By KEN GILMORE



One day last September, two Bell Telephone scientists, R. J. Collins and W. S. Boyle, stood on a hill at the company's laboratory in Holmdel, New Jersey. Beside them, mounted on a tripod, was a brass cylinder a little bigger than a flashlight. At a precise moment, one of them touched a button on some nearby electronic equipment. Instantly, a brilliant red flash shot from one end of the cylinder. Two other Bell scientists, D. F. Nelson and W. L. Bond, standing on a rooftop 25 miles away, were able to see the flash with their naked eyes.

This accomplishment—transmission and detection of a light flash over a 25-mile distance—seems unremarkable enough. Yet Dr. George Dacey, Bell's Director of Solid State Electronics Research, thought otherwise. Hearing of the experiment's success, he made a simple but solemn pronouncement: "A new era of communications has begun!"



A NEW KIND OF LIGHT never before seen on earth is the product of the *laser*—a device which taps the power of the electron's spin to generate a light beam of unparalleled intensity and purity. What does the laser offer science? Just this:

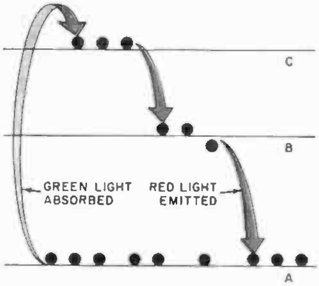
- true amplification of light for the first time in history
- the first truly coherent (single-frequency) beam of light ever produced by man

The weird light of the laser has a number of properties that may well make it the most promising development in communications—and in a few other fields as well—since De Forest put the grid in the vacuum tube. Soon-to-be-available devices making use of the laser's unique abilities include such wonders as:

- super-precise radar with a beam hundreds of times narrower than anything now available
- an atomic clock 1000 times more accurate than the best current models which do not stray more than one second in one hundred years
- a super heater that can pour out thousands of watts of energy into an area the size of a pinhead
- a radio transmission system of such tremendous capablities that it could carry more than 10,000 simultaneous television signals using only a single channel

What the Laser Is. The laser, for all its revolutionary properties, actually stems from another development several years old. As you may have noticed, there's a similarity between the words "laser" and "maser," and the similarity is more than coincidence. A laser is simply a maser capable of operating at frequencies within the visible light range.

Dr. Charles Townes of Columbia University—the inventor of the maser—suggested some time ago that there seemed to be no reason why his device could not operate in the visible light range. Now years of theoretical work by both Hughes Research Laboratories and Bell Telephone Laboratories in solid-



HOW THE LASER WORKS

A laser is a small rod of synthetic ruby which absorbs light energy at one frequency and emits light at another frequency or color. Its operation depends on the fact that the ruby contains chromium atoms which can be at any one of at least three different energy levels, as illustrated at left.

The lowest level—*A*—represents the area where the atoms will normally be. If, however, a photon of light from outside the system hits one of the chromium atoms, that atom absorbs light energy and is lifted to a more excited state, represented by level *C*. Almost immediately, it falls back to level *B*, giving up a little of the energy absorbed from the photon. It remains at level *B* for a relatively long period, as measured in atomic time—perhaps as much as ten microseconds. Eventually, it falls back to level *A*, and in the process gives up the rest of the energy absorbed from the photon. This emitted energy is in the form of red light.

The process described so far is normal fluorescence—just like that which takes place in fluorescent lighting. In the fluorescent bulb, ultraviolet light is used to excite the atoms of fluorescent material, which then give off a white light. But the separate quantities of light given off by the electrons are not in phase. Instead, they are random, or—to use the scientists' word—*incoherent*; in a way, they are similar to radio noise. The laser, on the other hand, generates a *coherent* signal—a signal of one frequency, with all electromagnetic light radiation in phase.

An intense green light is beamed at the ruby. This light "pumps" huge quantities of chromium atoms into energy level *C*. These atoms quickly fall to level *B* where they remain for a while. Occasionally, one atom spontaneously falls back to energy level *A*, emitting red light. But there are so many atoms now at energy level *B* that the spontaneously emitted light from the atom that falls will almost certainly bump into another chromium atom at level *B*. This collision will cause the second atom to give off its energy in phase with the first atom. The energy from the second atom bumps into another atom, and so on.

The chain reaction builds rapidly. Because the ends of the rod are silvered, the emitted light bounces back and forth, stimulating still more atoms to give up their energy. Soon, tremendous quantities of red light are rushing back and forth in the rod like water sloshing back and forth in a bathtub. Finally, it reaches such a level of intensity that it bursts through one end of the rod (one end has less silver than the other) and shines forth in a brilliant, coherent ray.

state electronics have proven him right! (For details on the maser, see April 1960 issue of POPULAR ELECTRONICS.)

In spite of its tremendous promise, the laser is an extremely simple-looking device. It is nothing more than a cylinder of synthetic ruby about ¼" in diameter and 1½" long, mounted in the center of a spiral coil of glass. The coil is a xenon-filled flash tube, very much like the ones used by photographers for taking flash pictures.

To operate the gadget, scientists send a jolt of current through the gas-filled tube, setting off a brilliant flash of greenish light. The electrons in the ruby absorb this light, and generate energy at another frequency. To put it another way, the ruby absorbs greenish light, only to give off a pure red ray. And the beam produced by this atomic flashlight is capable of performing the feats mentioned earlier—as well as a number of others—because it is unique in several important ways. Let's see just what makes the laser's light so different.

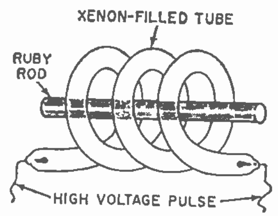
"Coherent" Light. The light generated by the laser is *coherent*. This means that *all* its rays are at one frequency. Natural light, in contrast, whether produced by the sun, a light bulb, or a match, is made up of rays of many different colors, or frequencies. Even light sent through a colored filter contains many frequencies, although far fewer than "white" light.

Light containing many frequencies is roughly comparable to a completely untuned radio signal or a raucous noise. Such a hodgepodge signal is impossible to control effectively. About the only thing you can do to transmit information with such an undisciplined mixture—whether light, radio frequencies or just plain noise—is to turn it on and off to form a simple code. Ships, of course, have been using blinker lights for years.

With the laser, we have a coherent *light* source for the first time. We can control it in the same sophisticated ways we take for granted in radio. In addition, because of the extremely high frequencies at which light is transmitted, we can perform a number of tricks impossible with radio.

For example, fantastic amounts of information can be packed into one light beam. With such a system, we may some day transmit thousands of television signals and hundreds of thousands of telephone, teletype, and telegraph signals on a single laser beam!

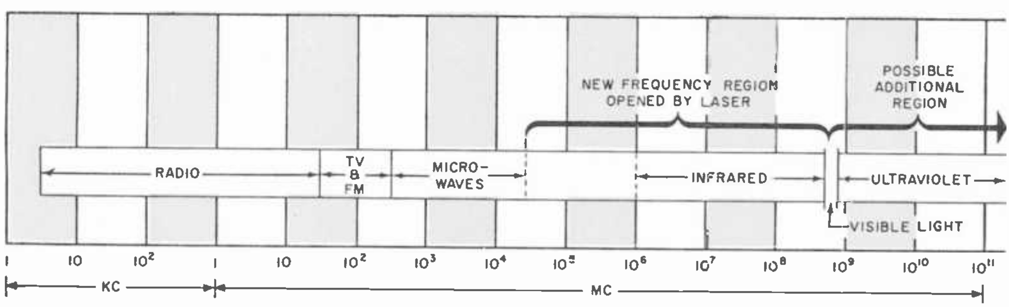
In addition, the laser, by operating in the visible light spectrum, vastly increases the number of useful frequencies we can put to work. Heretofore, we have been able to use frequencies up to about 50,000 mc. (See chart above.) But even though this upper limit has been gradually pushed back, the need for additional space to accommodate the ever-growing load of world-wide communications has grown much faster. Now the laser, in one jump, has extended the range of useful frequencies tremendously. As Dr. Theodore H. Maiman of Hughes Aircraft put it recently, "The laser jumps the gap from 50,000 million cycles to 500,000 billion cycles, opening the way for a host of important applications."



Heart of maser is silver-ended ruby rod, placed in coiled, xenon-filled tube.

Narrow Beam. The coherence of laser light is responsible for another useful property; it makes the laser beam far narrower than any previously available. For example, a high-quality military searchlight—the kind used to spot raiding aircraft during World War II—produces a beam approximately one degree in width. One mile from the light, the beam is about 85 feet wide. This may sound impressive, but only until we compare it with the laser beam—which will ultimately be able to illuminate a spot approximately 5 *inches* in diameter a mile away!

Another comparison: the beam from the military searchlight, if directed at the moon, would spread to cover an area 3600 miles in diameter, bigger than the moon itself. But the laser beam would illuminate a spot on the moon's surface less than 10 miles in diameter, without any optical help at all. And one scientist predicts that with a proper setup of lenses, the diameter of the spot could be reduced to two miles!



Frequency spectrum, showing new frequency region opened by laser. Note laser's wide operating range.

Piping it Through. Of course, like every device, the laser has its limitations. Even the higher microwave frequencies now in use are partially blocked by clouds, dust, fog, and atmospheric moisture. Laser beams, at still higher frequencies, are affected even more. As a result, a point-to-point laser communications link

(*Continued on page* 112)

EASY DOES IT when you're MOUNTING Hi-Fi SPEAKERS

THE audiophile who can set up his own hi-fi system usually knows just what to do with each component. But equally important is knowing what *not* to do.

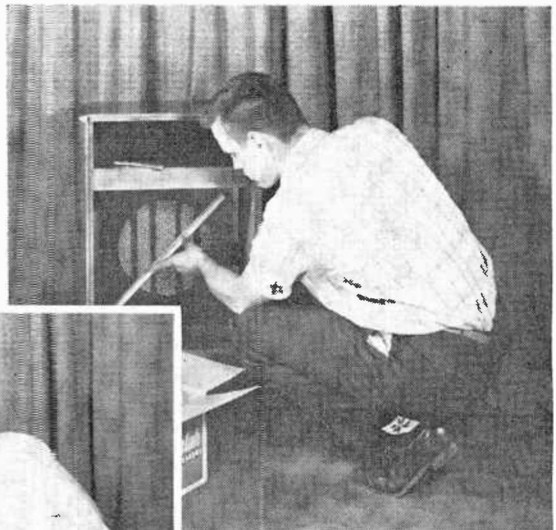
Take the matter of mounting a speaker in a baffle for instance. To the uninitiated, it looks like little more than tightening a few nuts with a wrench. But to those in the know, proper installation of a speaker in its baffle is as important to good sound as a cleanly shaped point on a diamond stylus.

According to Al Altenhof of Utah Radio & Electronic Corp., the thing to remember is that a speaker is a precision item held to dimensions of several thousandths of an inch. Screwing a speaker to a warped mounting board or tightening the nuts too tight can easily throw most speaker cones out of alignment. Mr. Altenhof recommends following these three easy steps when mounting a speaker:

1. Check the mounting board to be sure it isn't warped.
2. Slowly place speaker on the screws, carefully aligning its holes with the screws to avoid damaging the cone.
3. Tighten the mounting nuts by hand, then use a wrench to give each nut one additional turn.

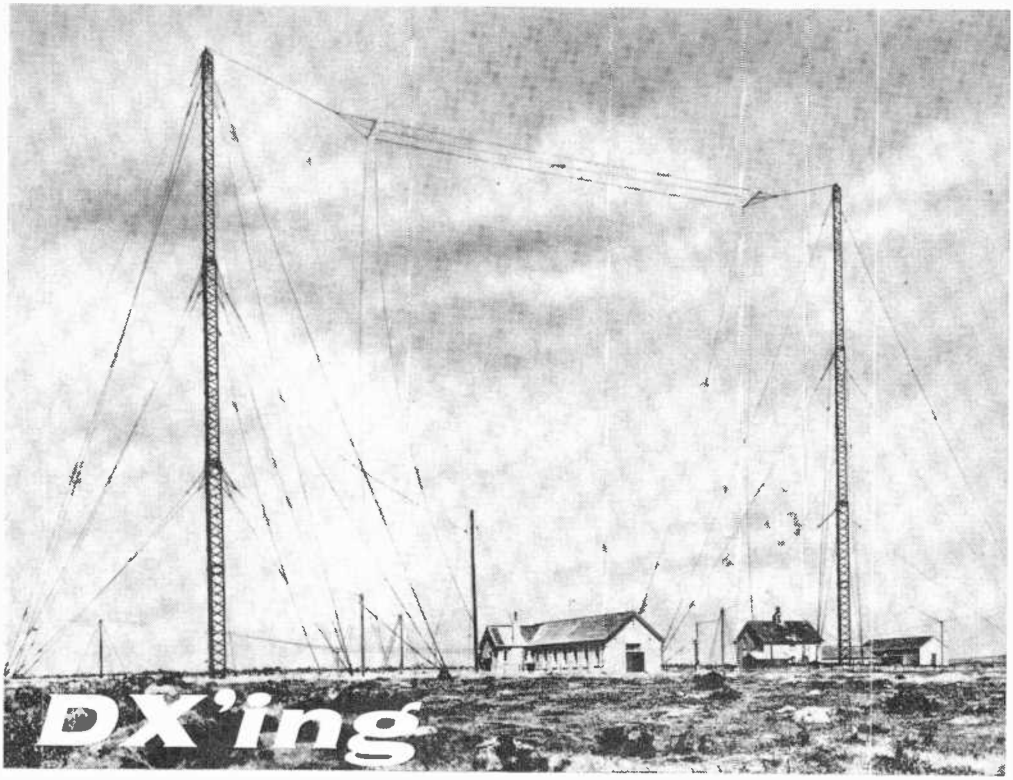
-30-

Utah Radio & Electronic Corp. photos



Check mounting surface before putting the speaker in place to be sure that the surface is not warped.

Be careful to avoid overtightening the nuts. Too much muscle may result in damage or distortion.



DX'ing on the BONUS BAND

Countless hours of winter-evening listening await the newcomer and seasoned pro alike on 120 meters

By **TOM KNEITEL,** WPE2AB

DID YOU EVER notice that the "bonus" short-wave band on "table-model" broadcast radios is usually the 2.5-mc. (120-meter) marine band? The reasoning behind this fact is simple: 120 meters is probably the most interesting band for the DX'er to monitor.

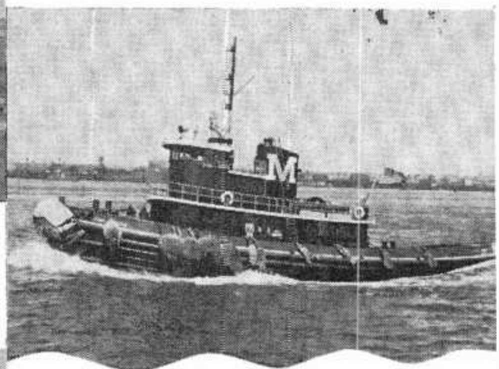
Although there are all sorts of DX goodies to be heard on 120 meters, the big feature of the band is the batch of coastal radiotelephone stations, popularly known as "ship-to-shore" stations or "marine operator" stations, which dot our coastlines, the Great Lakes, and our larger rivers. There are a great many of these stations, and the table on the following page lists many of those most often heard.

In only a few hours' listening on the "bonus band," you may be able to pick up the New York Marine Operator working the atomic sub U.S.S. "Nautilus," the Miami Marine Operator talking to the luxury cruise ship S.S. "Yarmouth," and the Boston Marine Operator QSO'ing one of the U.S.A.F. Texas Tower radar platforms in the Atlantic. Or you might tune in the coastal stations on the Pacific coast passing calls to and from the vast fishing fleets which operate from Canada to Mexico. You can also hear tugs, yachts, dredges, ferry boats, Mississippi

Coastal Radiotelephone Stations Operating on 120 Meters

Location	Call	Owner	Frequency (kc.)
Baltimore, Md.	WLF	Chesapeake & Potomac Tel. Co.	2558
Barbados, B.W.I.	—	Cable & Wireless, Ltd.	2582
Belle Isle, Nfld.	VCM	Dept. of Transport	2582
Boston, Mass.	WOU	New England Tel. & Tel. Co.	2450 2506
Buffalo, N.Y.	WBL	Radio Corp. of America	2514 2550 2582
Burin, Que.	VCP	Dept. of Transport	2514
Burlington Canal, Ont.	XLI46	Dept. of Public Works	2514 2550 2582
Camperdown, N.S.	VCS	Dept. of Transport	2582
Cape Race, Nfld.	VCE	Dept. of Transport	2582
Cartwright, Nfld.	VOK	Dept. of Transport	2538
Cat Cay, Bahamas	ZFO2		2582
Charleston, S.C.	WJO	Southern Bell Tel. Co.	2566
Chicago, Ill.	WAY	Illinois Bell Tel. Co.	2514 2550 2782
Churchill, Man.	VAP	Dept. of Transport	2582
Corner Brook, Nfld.	VOJ	Dept. of Transport	2558
Cornwall, Ont.	CZ6G	Cornwall Canal Admin.	2514 2550 2582
Detroit, Mich.	WFR	Mich. Bell Tel. Co.	2514 2550 2582
Duluth, Minn.	WAS	Lorain County Radio Corp.	2514 2550 2582
Galveston, Tex.	KQP	Southwestern Bell Tel. Co.	2450 2530
Goose, Nfld.	VAZ	Dept. of Transport	2582
Halifax, N.S.	VBQ	Dept. of Transport	2530 2582
Havana, Cuba	CM2K	Government	2506
Hilo, Hawaii	KSV	Hilo Fisheries	2582
Honolulu, Hawaii	KQM	Hawaii Telephone Co.	2530
Hopedale, Nfld.	VOQ	Dept. of Transport	2538
Inagua, Bahamas	VSG2		2522
Jacksonville, Fla.	WNJ	Southern Bell Tel. Co.	2566
Kingston, Jamaica	—	Cable & Wireless Ltd. (W.I.)	2590
Kingston, Ont.	VBH	Dept. of Transport	2514 2550 2582
Lorain, Ohio	WMI	Lorain County Radio Corp.	2514 2550 2582
Los Angeles, Calif.	KOU	Southern Calif. Tel. Co.	2522 2566 2598
Louisville, Ky.	WFN	Warner & Tamble Radio Service	2782
Memphis, Tenn.	WJG	Warner & Tamble Radio Service	2782
Miami, Fla.	WDR	Southern Bell Tel. Co.	2490 2514
Midland, Ont.	VBC	Dept. of Transport	2514 2550 2582
Mobile, Ala.	WLO	Mobileradio, WLO	2572
Montreal, Que.	VCA	Dept. of Transport	2514 2582
Nassau, Bahamas	VPN2		2558
New Orleans, La.	WAK	Southern Bell Tel. Co.	2482 2558 2598
New York, N.Y.	WOX	New York Tel. Co.	2482 2522 2590
Norfolk, Va.	WAE/WGB	Chesapeake & Potomac Tel. Co.	2538
North Sydney, N.S.	VCO	Dept. of Transport	2582
Pittsburgh, Pa.	WCM	Radio Corp. of America	2782
Pointe Noire, Que.	VDP	Dept. of Transport	2582
Port Arthur, Ont.	VBA	Dept. of Transport	2514 2550 2582
Port Burwell, Ont.	VBF	Dept. of Transport	2514 2550 2582
Port Harrison, Ont.	VAL	Dept. of Transport	2582
Port Huron, Mich.	WFV	Mich. Bell Tel. Co.	2514 2550 2582
Portland, Ore.	KQX	Pacific Tel. & Tel. Co.	2598
Port Washington, Wis.	WAD	Lorain Co. Radio Corp.	2514 2550 2582
Prince Rupert, B.C.	CFW4	North-West Tel. Co., Ltd.	2590
Quantico, Va.	WHF	Chesapeake & Potomac Tel. Co.	2538
Quebec, Que.	VCC	Dept. of Transport	2514 2582
Resolution, N.W.T.	VAW	Dept. of Transport	2582
Rogers City, Mich.	WLC	Central Radio Telegraph Co.	2514 2550 2582
San Francisco, Calif.	KLH	Pacific Tel. & Tel. Co.	2450 2506 2566
San Juan, P.R.	WCT	Radio Corp. of P.R.	2530
Sarnia, Ont.	VBE	Dept. of Transport	2514 2550 2582
Sault Ste. Marie, Ont.	VBB	Dept. of Transport	2514 2550 2582
Sault Ste. Marie, Ont.	VDX	Sault Ste. Marie Canal Admin.	2514 2550 2582
Seattle, Wash.	KOW	Pacific Tel. & Tel. Co.	2482 2522
Seven Islands, Que.	VCK	Dept. of Transport	2514 2550 2582
St. John, N.B.	VAR	Dept. of Transport	2582
St. Louis, Mo.	WGK	Radio Corp. of America	2782
Tampa, Fla.	WFA	Southern Bell Tel. Co.	2466 2550
Three Rivers, Que.	VBK	Dept. of Transport	2514 2550 2582
Toronto, Ont.	VBG	Dept. of Transport	2514 2550 2582
Twillingate, Nfld.	VOTW	Dept. of Transport	2538 2582
Vancouver, B.C.	CFW	North-West Telephone Co., Ltd.	2538 2558
Wilmington, Del.	WAQ	American Tel. & Tel.	2558
Wilmington, Del.	WEH	Diamond State Tel. Co.	2558
Yarmouth, N.S.	VAU	Dept. of Transport	2530 2582

U. S. Coast Guard



One evening's monitoring will enable you to hear shore-based marine operators call almost every type of vessel afloat.

River steamers, Great Lakes ore carriers, tankers, freighters—and sometimes an aeroplane or two—being worked by the marine operators.

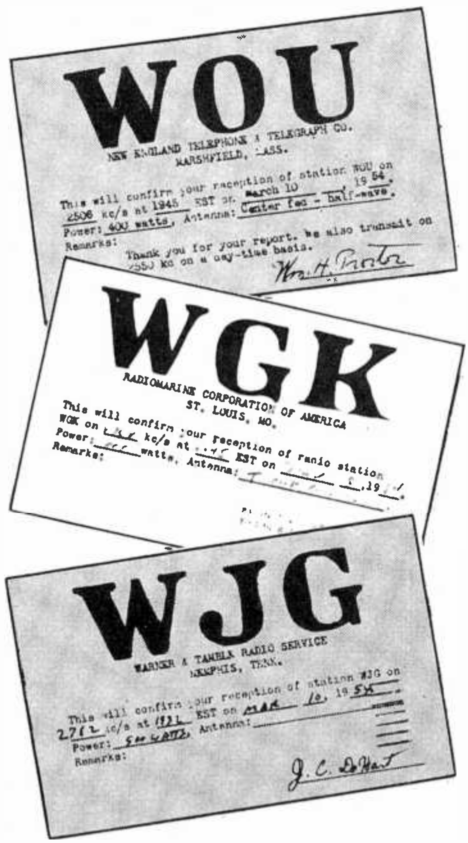
Listening "Tricks." From coast to coast, the DX really pours in. Its always a feast —never a famine. However, although 120 meters is probably the easiest "utility" band to DX, there are a few "tricks of the trade" which can add to your enjoyment of the band: knowing where to listen for what station, when to listen, and how to send a "QSL-able" reception report.

The best time to try your DX'ing on 120 meters is during the winter, late at night. (During the summer you not only have to put up with teeth-gnashing static, but with tens of thousands of pleasure boats. The latter force some stations to remain on a channel continuously for several hours, jamming it for any kind of DX work.) If, like many DX'ers, you are bothered by image signals from local broadcasting stations, you will find that this interference clears up after midnight—when many local broadcasters call it a day.

Coastal stations, which generally use YL operators, more often than not identify themselves only by the name of the city in which they are located ("New Orleans Marine Operator," for example). Sometimes the Great Lakes, Mississippi, and Canadian stations will announce their call letters.

When a ship-to-shore call is in progress, you can only hear one side of the call since the ship and shore stations transmit on different frequencies. If you hear both sides of the conversation, this doesn't mean that you are receiving signals from both the ship and the station on shore. The coastal station is supposed to run a busy signal whenever the ship is transmitting, so that you can't hear both sides of a phone call; but sometimes the operator goofs and—instead of running the busy signal—rebroadcasts the ship's signal through the coastal station's transmitter.

QSL'ing Coastal Stations. The need for the busy signal has a direct relationship to the reason why the novice DX'er usually has no luck whatsoever in QSL'ing coastal stations. It's all tied into something the FCC calls "secrecy of communications" laws, which forbid divulging information about ship-to-shore (and other) non-broadcast traffic. An unin-


WOU
NEW ENGLAND TELEPHONE & TELEGRAPH CO.
MARSHFIELD, MASS.
This will confirm your reception of station WOU on 2506 kc/s at 1945 EST on March 10 1954.
Power: 400 watts, Antenna: Center fed - half-wave.
Remarks: Thank you for your report. We also transmit on 2550 kc on a day-time basis.

WGK
RADIOMARINE CORPORATION OF AMERICA
ST. LOUIS, MO.
This will confirm your reception of radio station WGK on kc/s at EST on , 19 .
Power: watts, Antenna:
Remarks:

WJG
WARNER & TAMBLE RADIO SERVICE
MEMPHIS, TENN.
This will confirm your reception of station WJG on 2712 kc/s at 1931 EST on MAR 10, 1955.
Power: 50 watts, Antenna:
Remarks:

A homemade QSL card should be prepared for each station you hear, since marine stations do not supply their own cards. Use the back of a self-addressed postcard, as shown at left, and mail it to the station with your listening report. At the station, the frequency, time, date, power, and antenna-type blanks will be filled in, the card signed and mailed back.

formed DX'er will send off a reception report and go into all sorts of details as to what was said during the conversation he monitored. This kind of thing may be great for reporting to BC stations, but it's strictly thumbs down on 120 meters. A station receiving such a report will either file it in the wastebasket or answer it with a semi-nasty form letter telling you about secrecy of communications laws, and asking you to listen elsewhere.

The "old pro" approach is to send a report (in letter form, never on a "SWL card") giving the date, time and quality of your reception and only the call letters of the ship the station contacted during the time you were monitoring it. Do not tell them what you heard. If you can't get a ship's call letters, use the name of the ship. *Give nothing more than the call letters or the name of the ship.* Then mention the type of equipment you use, including your antenna. And it never hurts to say that you are aware of secrecy of communications laws, and that your reception report (and the verification) will not cause any violation of the laws.

You might also wish to mention briefly some details of your achievements in DX'ing—such as the number of countries you have QSL'd, how long you have been DX'ing, etc. It adds a personal touch to the report which could help you to get an answer. Finally, always include with your report a prepared reply card that the station can fill in and return to you.

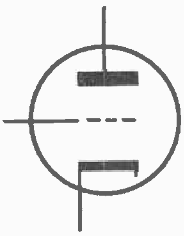
The only time you should give any details of a transmission from a coastal station is when you come across the station sending a regularly scheduled weather report. Since weather reports are "broadcasts," and not addressed to a specific station, secrecy of communications does not apply.

Address your reception reports to: Station Manager, Coastal Radiotelephone Station (call letters), (name of owner), (city and state). It's a challenge to find out how many of these stations you can hear and QSL. —30—

Vacuum Tube Quiz

Glancing at a tube's symbol or one of its constructional features should remind you of the graph of its characteristic curves or its outward appearance or application. Try to identify the numbered items at left, below, with the corresponding lettered items at right. Answers are on page 116.

By ROBERT P. BALIN



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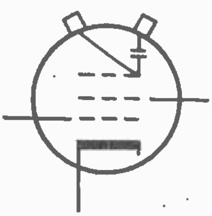

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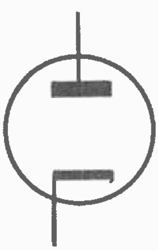

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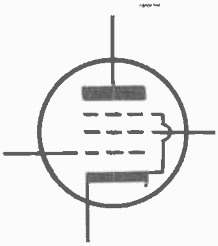

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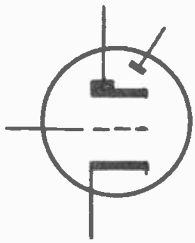

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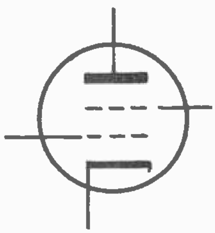

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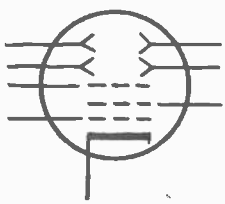

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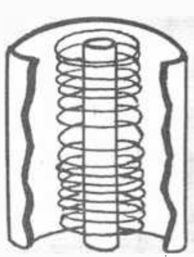

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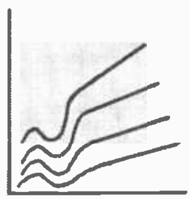

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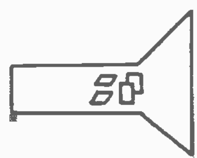

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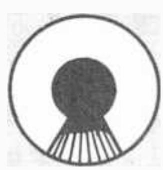

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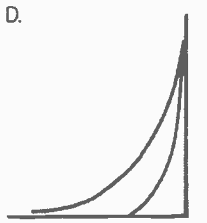

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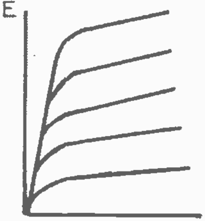

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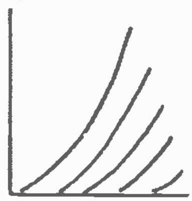

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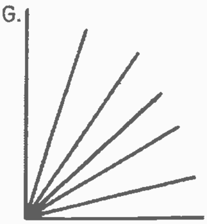

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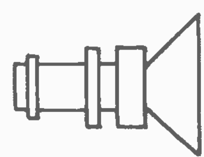


Tilting Tiros II

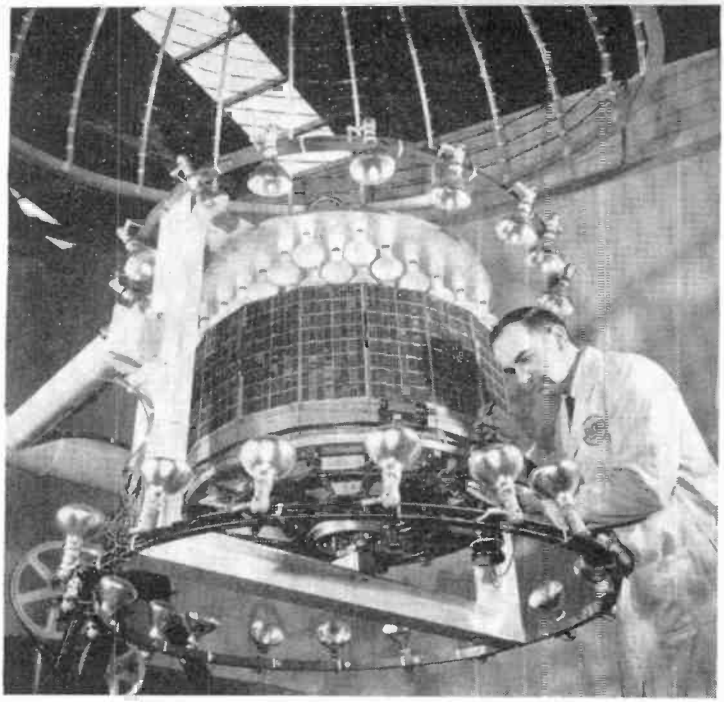
Magnetic "hand" tilts space satellite

THE NATION'S latest "weather-eye" satellite, "Tiros II," has achieved a major "first" in space. By means of a remote-control system, ground observers can tilt the satellite in space for improved TV coverage of clouds above the earth.

Developed by the Radio Corporation of America, the new orientation technique uses the effect of the earth's magnetic field to alter the "attitude" of the satellite upon command—without the need for special propulsion devices. This technique was the outcome of studies by RCA and government scientists of an unexpected gradual shift in the attitude of the first Tiros satellite under the influence of the magnetic field surrounding the earth.

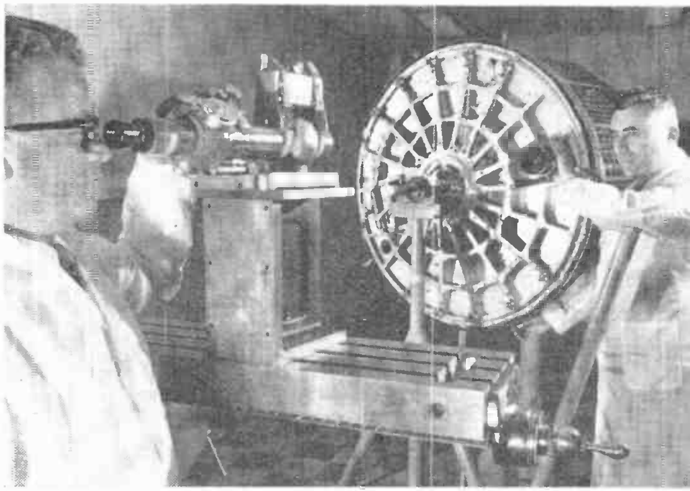
In the first Tiros, which returned nearly 23,000 useful TV cloud pictures to earth following its launching last April, these magnetic forces caused the satellite to tilt gradually away from the predicted position of its axis in space. In Tiros II, the forces are being harnessed by a controllable magnetic field generated around the satellite itself by wire coils on the lower sides of the vehicle. Interacting with the earth's magnetic field, this controllable field gives ground observers an invisible "hand" to tilt the satellite on command, in order to obtain a more advantageous angle.

Spherical "cage" designed to produce magnetic fields resembling those of the earth was used in pre-launching tests of Tiros II. Here, Warren P. Manger, of the RCA Astro-Electronics Division, takes reading of magnetic effect within the wired "cage," preparatory to rotating the satellite on its mount for study of the orientation system.



Magnetic orientation system being tested at RCA's Space Center in Princeton, N. J. Lights above and around the satellite are used to check operation of solar cells which surround satellite.

Wide-angled television camera on Tiros II is checked by Sidney Sternberg, at far right, and Ralph Jordan at the RCA Space Center. Tiros II, mounted on its side in this photo, is identical in external appearance to Tiros I.



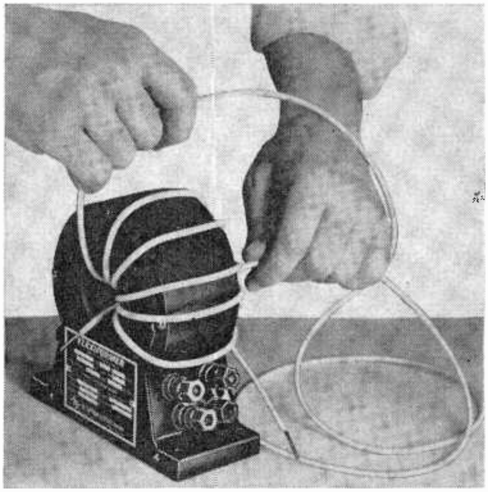
Equipped with the orientation-control system and with newly developed infrared instruments to measure the emission and reflection of solar heat by the earth and its atmosphere, Tiros II represents the second step in the experimental weather satellite program being conducted by the National Aeronautics and Space Administration to study the feasibility of regular satellite weather operations.

Among the major features common to both the Tiros I and II satellites are electronic clocks that control the timing of cameras, tape recorders, and infrared systems during each orbit; more than 9000 solar cells on the top and sides of the satellite to convert electrical energy for operation of the electronic systems; "yo-yo" weights which slow the satellite's spin from 120 rpm to 12 rpm as it enters orbit; and five pairs of solid-fuel spin-up rockets to restore spin momentum. —30—

THE FLEXIFORMER

"Wind-it-yourself" transformer provides 1001 output voltages

By CLIFFORD G. SCHMITT



HAVE YOU EVER WISHED that you had a shelf full of transformers? No matter what voltage or current a particular filament or transistor might require, you could just rummage through the pile and come up with the right one. A new device called a "Flexiformer" goes a long way toward providing that "pile" of transformers, and without taking up all that storage space!

NOMINAL OUTPUT (Volts)	SECONDARY TURNS		MAXIMUM LOAD CURRENT (Amperes)	MINIMUM WIRE SIZE NO. FOR MAX. CURRENT
	AT NO LOAD	AT FULL LOAD		
1	4	5	150	3
2	7	9	75	8
2.5	9	11	60	8
5	17	21	30	10
6.3	21	27	24	12
10	34	42	15	14
12.6	42	53	12	14
24	80	100	7	18

Table 1.

The Flexiformer, available from the Superior Electric Company, of Bristol, Conn., for $25.00, could be called a "do-it-yourself" transformer. Actually, it's a self-contained toroidal primary coil enclosed in a doughnut-shaped iron frame which doubles as the magnetic core. You can design and assemble a transformer by winding a secondary coil around the frame. Connections are made to the five-way binding post on the base.

With the Flexiformer and a standard-type a.c. milliammeter or ammeter, you can also measure a.c. currents up to 400 times the meter's maximum reading.

Winding Low-Voltage Transformer. The number of turns and wire size for a particular voltage and current are easily found using the information in Table 1 or by a simple computing method which is engraved on the rear nameplate of the Flexiformer.

Say, for example, that you need a filament transformer to check out a high-power transmitting tube having a 5-volt, 30-ampere filament. Using Table 1, just look down the *Nominal Output Volts* column for 5 volts. The horizontal listing tells you that the number of turns needed will be 21, the maximum load is 30 amperes, and at least a #10 wire should be used in winding the secondary—a slightly heavier wire will decrease losses. After a few minutes' work, your 5-volt, 30-ampere transformer is completed.

If Table 1 does not list the voltage you want, you can calculate the necessary

(*Continued on page* 119)

BC-BAND DX BOOSTER

High-gain r.f. stage brings pepped-up performance to almost any receiver

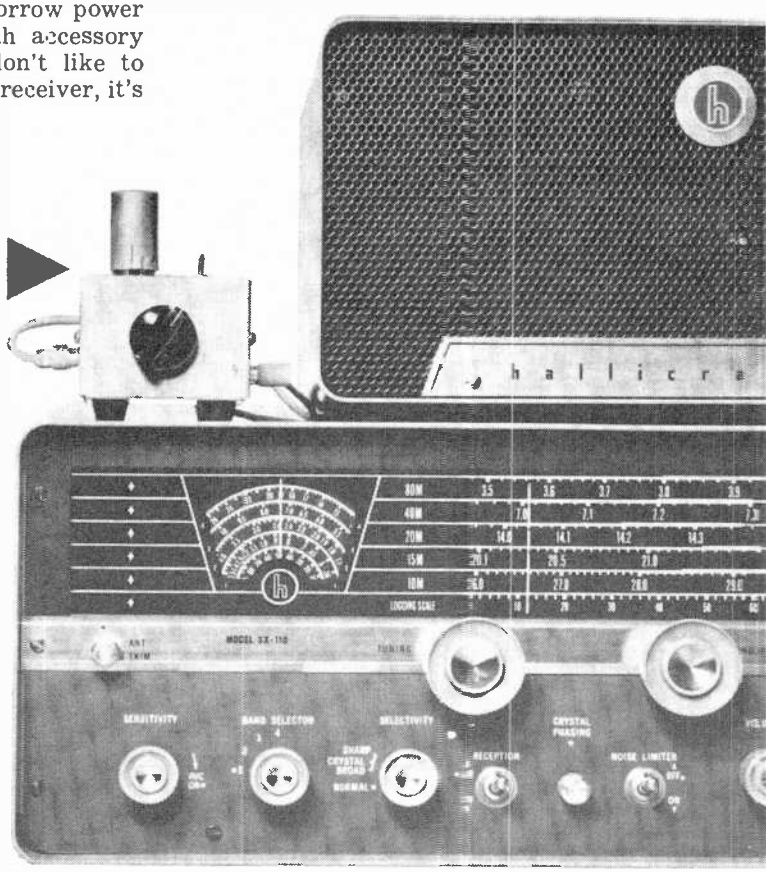
By
MIKE SWINK
KØVVR

Did you ever wish that your receiver was sensitive enough to pull in DX stations from other states or countries on the broadcast band? Well, here's a one-tube r.f. booster designed to pep up those weak BC-band DX signals. It will give your signal a boost of about seven "S" units if you use a communications receiver. With entertainment-type broadcast receivers, which are normally poor performers, it will have even more spectacular results.

The booster can be powered by stealing plate and heater current from your receiver. If you have a communications set with an accessory socket, you can easily tap the power off there. It will be a little more trouble to borrow power from sets not equipped with accessory sockets. However, if you don't like to delve into the wiring of your receiver, it's a simple and inexpensive job to make the small companion power supply designed for the booster.

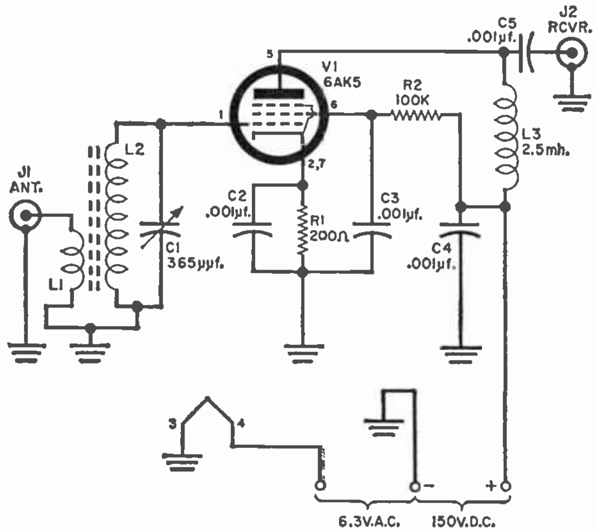
Parts needed for the booster alone will cost only about \$5 or so. The power supply, if you decide you want to build it, will cost slightly under \$10.00. Construction time depends on your skill with tools, but even a rank beginner should have little difficulty with the booster's simple circuit.

Construction. The booster shown here was built in a 4" x 2¼" x 2¼" aluminum chassis box. A larger box can be used if you wish. In any case, follow the layout



BOOSTER PARTS LIST

C1—365-μμf. midget variable capacitor (Lafayette MS-445 or equivalent)
C2, C3, C4, C5—0.001-μf., 600-volt disc capacitor
L1—30 turns of enameled wire—see text
L2—Ferrite broadcast-band loopstick (Lafayette MS-11 or equivalent)
L3—2.5-mh. r.f. choke
R1—200-ohm, ½-watt resistor
R2—100,000-ohm, ½-watt resistor
V1—6AK5 tube
1—7-pin miniature tube socket, shield base (Amphenol 147-913 or equivalent)
1—1⅜" 7-pin miniature tube shield (Amphenol 5-401 or equivalent)
1—4" x 2¼" x 2¼" aluminum box (Bud CU-2103A or equiv.—see text)
Misc.—Hardware, grommet, rubber feet, knob, etc.

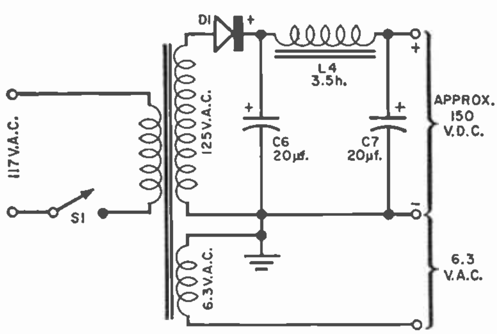


The DX booster uses a ferrite loopstick, tuned by capacitor C1, as its antenna coil. Capacitor C5 couples output to receiver.

POWER SUPPLY PARTS

C6, C7—20-μf., 250-volt electrolytic capacitor
D1—50-ma., 200-volt P.I.V. silicon rectifier
L4—3.5-henry, 50-ma. choke (Stancor C1080 or equivalent—see text)
S1—S.p.s.t. switch
T1—Power transformer; primary 117 volts a.c.; secondaries 125 volts at 15 ma., 6.3 volts at 0.6 amp. (Stancor PS-8415 or equivalent)
1—2" x 6" x 4" chassis (Bud AC-431 or equivalent)
Misc.—Hardware, binding posts, etc.

Small power supply can be built for the booster if no other power source is readily available. Parts list is shown at left.



in the pictorial. Be sure to mount jacks *J1* and *J2* on opposite sides of the box; both jacks are grounded to the box through their ground strips.

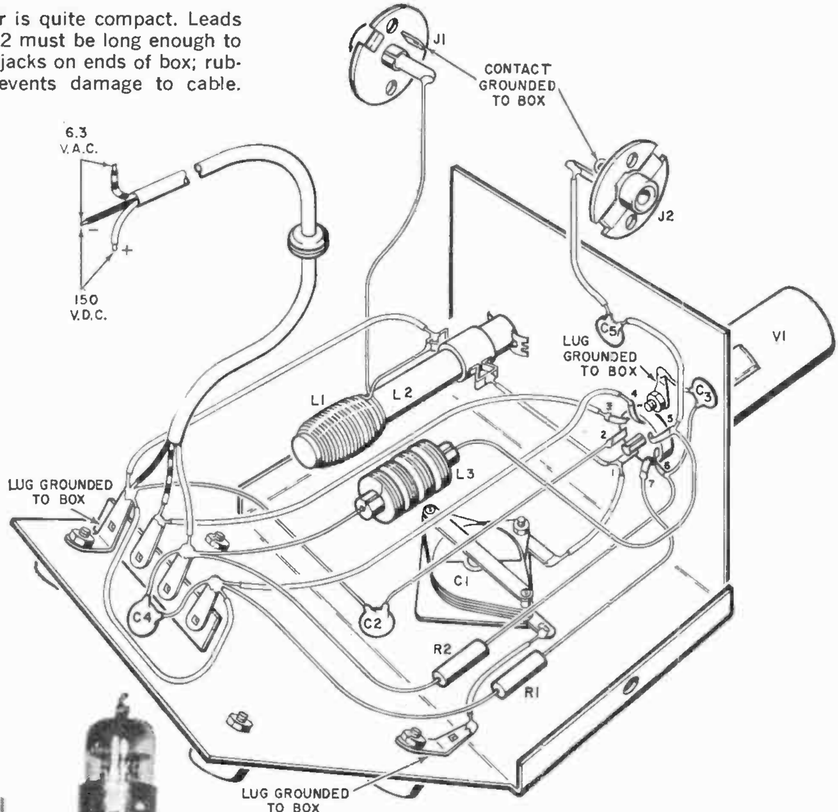
Coil *L2* is a standard ferrite antenna loopstick; any readily available unit will do, but make certain it fits inside the box you choose. Coil *L1* is made up of about 30 turns of insulated wire wound over *L2*. The exact diameter of wire used for *L1* is not important; anything from No. 28 to No. 32 is fine, and the wire can have either enamel or cotton insulation.

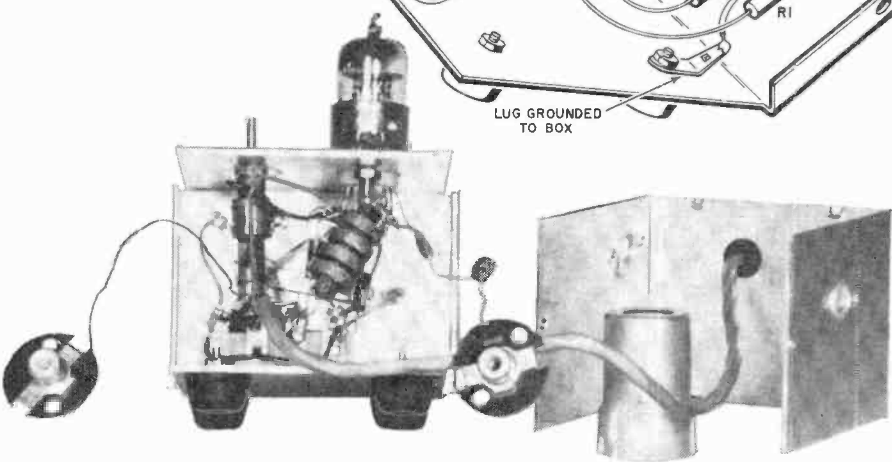
Mount the polyethylene insulated variable capacitor *(C1)* near coil *L2;* be sure to mount coils *L2* and *L3* at right angles to each other and well spaced. Location of the other components is not as critical.

The power supply is built on a separate chassis following the schematic diagram. Parts placement here is not at all critical. For economy's sake, a 1000-ohm, ½-watt resistor could be used instead of filter choke *L4*. Note that a single binding post is used as a common ground for B- and one of the 6.3-volt a.c. output terminals.

Operation. Do not use the booster with an a.c.-d.c. set unless you use the power supply. If you are powering the booster from an a.c. (only) communications receiver, connect the booster's three-wire power cable to a plug that matches the set's accessory socket, if it has one. The exact "B" supply voltage for the booster should be about 150 volts d.c., but *no more than* 170 volts d.c. If your receiver has a 12-volt a.c. heater supply, connect a 36-ohm, 2-watt, 5% composition resistor in series with the booster's

Layout of booster is quite compact. Leads to jacks J1 and J2 must be long enough to permit mounting jacks on ends of box; rubber grommet prevents damage to cable.





ungrounded 6.3-volt a.c. heater lead.

With power applied, the booster is ready for operation. Connect a dipole antenna to jack *J1* and connect the receiver's antenna terminals to jack *J2*. For operation with a long-wire antenna, connect only the center (hot) terminal of *J1* to the antenna with a good ground connected to *J1*'s ground.

Tune in stations on your receiver in the usual manner. Then adjust the booster's tuning capacitor *(C1)* for best reception. The slug on coil *L2* can also be adjusted to give operation over the entire broadcast band. Since the bandwidth of tuned circuit *C1-L2* is quite sharp, *C1* will need resetting whenever the receiver's frequency is changed more than 100 kc. If your receiver sports an antenna trimmer, don't forget to use it whenever you tune in a new station; repeak it each time along with *C1*.

Using the booster with a National NC-173 receiver in Kansas, the author has picked up a station on 900 kc. in Mexico City (XEW) 1600 miles away with good results on many nights. Other intermediate-range stations have also been heard with only a 30-foot antenna connected to the booster. –30–

On the Grid

By SINCLAIR

"NO! NO! NO! That is *not* realism. Haven't you ever heard a concert hall performance? Don't you know what real music sounds like?"

Well, anyhow, Mike knew this much: the Professor was mad; mad at Mike, mad at the equipment, and mad at the world.

"Look," said Mike, "maybe I've got a tin ear, but this hi-fi system sounds good to me. We built the rig with the best components. Why, from the hand-polished diamond stylus to the polyurethane cone in the 30-inch woofer, there just aren't any better components."

"Perhaps, Michael, that's precisely the trouble," the Professor said icily. "The components are too good, and you're not good enough. When I hired you to design and install the ultimate in hi-fi equipment, I counted on your ingenuity as an electronics entrepreneur. I thought that with your electronics know-how and your own native intelligence, you would be able to handle the job."

Mike knew he was in trouble. When the Professor contracted him to set up a super stereo hi-fi system, he hadn't realized that any man could be such a stickler for realism. The system really sounded good, better than any other Mike had heard, possibly better than any other system in existence. Now he had to think fast to protect his promised rewards.

"Prof," said Mike, "I think I know where the trouble is, if we assume that the speaker is the weakest link in the system."

"Well, at least you've read what's been published on the subject!"

Brushing aside this nasty remark, Mike continued. "I have some ideas for improving that weak link."

"How?" asked the Professor.

"First of all, we'll do away with the conventional electrical-to-mechanical-to-acoustical transfer of energy inherent in all cone-type speaker systems. The actual conversion of electrical to acoustical signals would be best."

"Interesting," mused the Professor. "Go on."

"It seems to me that since sound is essentially generated by alternate compressions and rarefactions of air, we should be able to accomplish this by working with ionized air."

"Ionized air? Without a vacuum system? Never."

"Now, hold on. If we can keep the distance between our high-voltage elements small enough, we should be able to produce enough ionization to result in a usable effect."

"Well," said the Profesor, "it might be worth a try, but hasn't this principle been used already in a commercial unit?"

"Yes, but that was the Ionovac, a

small tweeter assembly. I plan to have our system cover the complete audio spectrum."

Mike began scribbling on a pad. "Now, here are some of the things I figure we're going to need. I'll start on the ionizing grid if you'll go down to my shop and pick up the high-voltage power supply I pulled out of some junked diathermy equipment the other day."

WHEN the Professor returned, pushing a large cart holding two heavy chassis, Mike had completed most of the gridwork. At one end of the room he had strung fine copper wire from the ceiling to the floor in rows, so that the entire wall was covered by a curtain of wire. Tiny insulators strategically placed along each wire kept adjacent wires from touching.

"What we have to do now," Mike said, as he started soldering every other wire to a bus bar, "is to apply the high voltage to alternate wires in the gridwork so a high potential is set up across each air gap."

The Professor quickly joined Mike and, with soldering gun in hand, began connecting the remaining rows of wires to a ground lead.

After wiring in the power supplies, Mike turned to the Professor with a hopeful smile, "All that's left to do now is to couple the signal voltage from the amplifiers to each side of the gridwork and sit back and listen to a system that's really a system."

The final step of coupling the amplifiers to the ionizing grid was made through a special impedance-matching circuit, and the system was ready.

"Well, let's try a record," Mike said, as he carefully preset amplifier level controls.

"Ah, yes!" said the Professor, selecting a record from a large stack and reverently handing it to Mike. "Here's one of my favorites."

"Good grief! Haven't you anything better than this? We want something that isn't so worn that all the transients are lost."

"That happens to be one of the best I have," sniffed the Professor. "Besides, it features a Pablo Casals solo on the cello."

"Okay," Mike sighed. "Pablo Casals it is. Stand back, Prof, while I fire up."

As Mike applied power to the system, a faint blue-violet glow became visible between each wire in the ionizing grid. The glow grew in intensity and size until the entire network was a wall of soft fluorescence, throbbing gently.

"Line-voltage variations," muttered Mike as he gently lowered the tone arm onto the revolving record.

Immediately the rich, full tones of the cello filled the room and the soft glow of the grid broke into rapidly changing patterns of light and shadow. Waves of fluorescence rolled and undulated across the grid in a rhythmic motion.

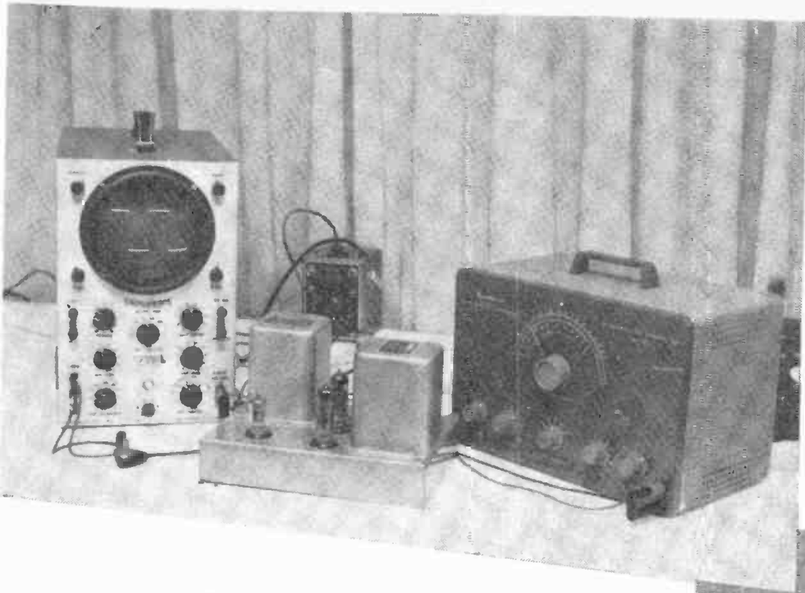
"Hey, sort of sound pictures," Mike said. Turning to the Professor, Mike was surprised to see him staring at the luminous wall.

"Look, Michael, look! Just right of center. Don't you see it? There's someone sitting there!"

As Mike looked into the glowing gridwork, he *could* see the faint outlines of a person playing a musical instrument. A cello!

"Prof, that's Casals. We've reproduced the image as well as the sound. Professor, that's realism. This visual information must be unknowingly impressed on the fine structure of the microgroove modulation. This is terrific! We'll make millions!"

(*Continued on page* 115)



hi-fi testing

part 3

The Square-Wave Generator

After covering the harmonic and intermodulation distortion analyzers in parts 1 and 2, we conclude our hi-fi testing series this month with a discussion of a third test instrument—the square-wave generator

By G. H. HARRISON

THE SQUARE-WAVE GENERATOR enjoys the dubious honor of being perhaps the least used, least understood, and least appreciated of all hi-fi test instruments. Yet it is undoubtedly one of the most useful. With a square-wave generator and an oscilloscope, you can check an amplifier's frequency response by making three quick measurements. To get the same information in the usual way—plotting a standard frequency response curve with an audio generator and an output meter—would require at least a dozen different measurements over a wide range of frequencies.

Even more important, the audio generator would tell you nothing about the amplifier's performance *except* its frequency response. The three quick square-wave tests, on the other hand, would show not only frequency response, but transient response, phase shift, and any tendency toward oscillation or "ringing" as well.

We'll look into these tests in detail a little later. First, let's examine the device responsible for the square wave: the square-wave generator itself.

The "Clipper Circuit." There are two basic types of square-wave generators in wide use today. The simplest kind is the sine-wave "clipper," such as the one used in the EICO 377 sine- and square-wave generator. Figure 1 shows the simplified diagram of the square-wave section of this instrument. (For a complete discussion of the 377's oscillator, see "Test Instruments—the Audio Generator," POPULAR ELECTRONICS, January, February, and March, 1960.)

With the waveform selector switch on the front panel in its "square" position, the output of the 377's oscillator is fed to the grid of the 6SN7. Here an interesting thing happens—the signal is too much for the tube to handle. In other words, the grid draws current on positive peaks, and on negative peaks the tube is driven to cutoff. Thus, both positive and negative peaks of the signal are "clipped" or flattened, as shown by the small waveform insets in Fig. 1.

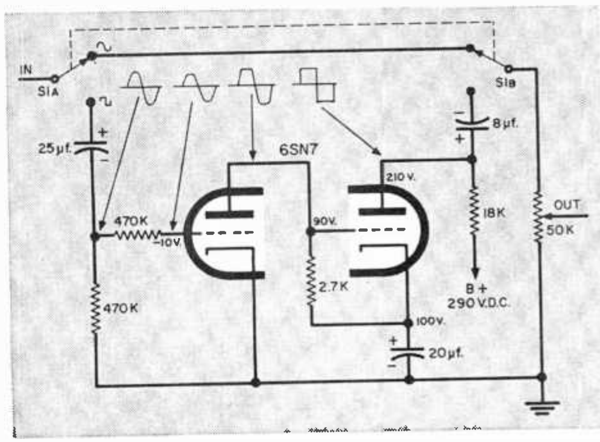


Fig. 1. Simplified clipper circuit in EICO 377 sine- and square-wave generator. Switch is shown in sine-wave position.

The clipped waveform is applied to the second triode of the 6SN7, and the final result is an almost perfect square wave. Of course, it isn't absolutely square. In a theoretically perfect square wave, the voltage would go from maximum negative to maximum positive—and vice versa—instantaneously. In practice, a less-than-perfect square wave, such as the one generated by the 377, always takes a few microseconds to rise to its maximum levels (see Fig. 2). Nonetheless, such a waveform is satisfactory for most general test purposes.

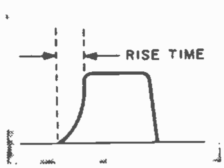


Fig. 2. Square-wave "rise time" is length of time required for wave to reach its maximum positive or negative peak. Diagram purposely shows exaggerated rise time.

The Schmitt "Trigger." Although many instruments use some variation of the clipper circuit just described, a basically different type of circuit is coming into wide use. Known as the Schmitt Trigger (shown in Fig. 3), it is essentially a variation of a cathode-coupled "one-kick" multivibrator, a type of oscillator which doesn't have quite enough feedback to sustain oscillation. But each time a signal is applied, it goes through one cycle of operation, then sits back and waits for another "kick" to come along and stir it into action again.

Unlike a regular multivibrator, the Schmitt Trigger has no built-in time constants, and thus doesn't oscillate at any specific frequency of its own. Instead, sending a series of "trigger" pulses into the circuit produces square waves at the frequency of the pulses. Let's see how it works.

Assume that there is a B+ voltage of about 190 volts and no input signal to the *V1* grid. With *V1* conducting, the voltage drop across cathode resistor *R1* is about 65 volts. Likewise, plate resistor *R2* will drop approximately 30 volts, leaving some 160 volts on the plate. This 160 volts, of course, also appears across the voltage divider, *R3-R4*.

The ratio of *R3* to *R4* is such that the voltage at the *V2* grid is about 55 volts. Since *V1* and *V2* have a common cathode resistor, the 65 volts appearing on the *V1* cathode also appears on the *V2* cathode. With *V1* conducting, *V2* is cut off, and the circuit is in a state of equilibrium. The voltage at the plate of *V2* approaches the supply voltage.

Now assume that a negative signal is applied to the grid of *V1*. As this grid goes negative, the current flowing through *V1* decreases, causing its plate voltage to rise. The grid of *V2*, connected to the *V1* plate through voltage divider *R3-R4,* begins to go positive. As a result, *V2* comes out of its cutoff condition and starts to conduct. Its plate current flows through common cathode resistor *R1,* increasing the voltage drop across it, and, in effect, increasing the bias on *V1*—the grid voltage of which is still dropping. This in turn further decreases the *V1* plate current, raising the *V1* plate voltage still more, and driving the *V2* grid even more positive. As a result, the plate current of *V2* increases still more, which further raises the bias on *V1,* and so on.

This process continues until *V2* is saturated and *V1* is cut off—a condition exactly opposite to the one we had a moment ago before the negative trigger pulse came along. Incidentally, while it may sound complicated, this entire operation takes only about one-tenth of a microsecond. When the process is complete, the circuit is once again in equilibrium, although the tubes have of course reversed their relative positions.

When the next trigger pulse comes along—positive, this time—the entire sequence takes place again, but in reverse. The trigger pulse begins to drive the *V1* grid positive. The tube again starts to conduct, which simultaneously increases its cathode bias voltage and decreases its plate voltage. The grid of *V2* starts to go negative and the entire sequence snowballs. The result: one ten-millionth of a second later, *V1* is conducting again and *V2* is cut off. Thus, the output from the plate of *V2* is a square wave, the frequency of which is determined by the frequency of the input pulses.

In practice, the shape of the trigger pulse is unimportant. The action of the circuit, as we have seen, is so fast that the entire reversal in either direction will have taken place and completed itself in the first one-ten-millionth of a second that the pulse is applied. Consequently, since the shape isn't important, the trigger pulse is usually a simple sine wave—the easiest kind to generate.

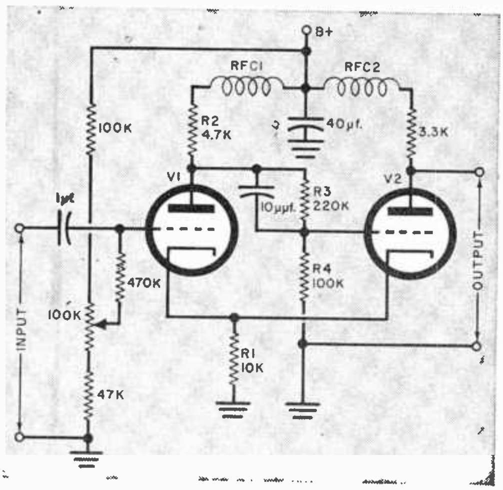
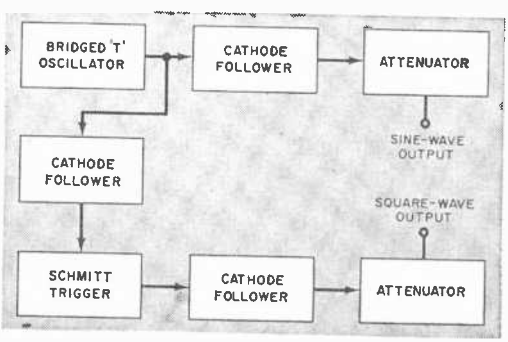


Fig. 3. Schmitt Trigger circuit employed in Heath AG-10 sine-/square-wave generator.

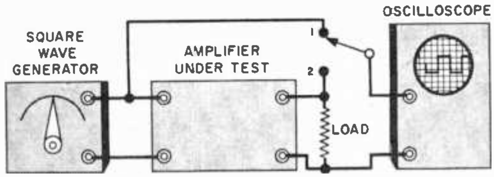
Fig. 4. Block diagram of Heath AG-10 generator. Note wide use of cathode followers.



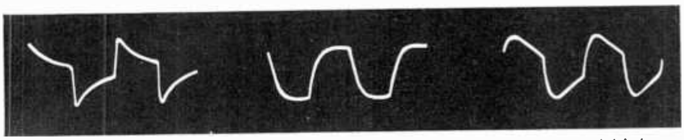
Sine and Square. One instrument using the Schmitt Trigger circuit is the Heath AG-10 sine-/square-wave generator. Figure 4 shows the Heath circuit in a full block diagram. The basic frequency-determining circuit is the Sulzer bridge (for details, see the "Audio Generator" series mentioned earlier). For a sine-wave output signal, the output from the Sulzer circuit is fed into a cathode follower, then to an attenuating network.

A sine-wave signal is also tapped off the Sulzer bridge and applied to the Schmitt circuit as a triggering pulse. Thus, both sine- and square-wave output frequencies are determined by the Sulzer bridge.

Incidentally, since the two circuits do not interfere with each other, both the sine- and square-wave outputs can be used simultaneously. The sine output, for example, can be used as an external sync signal for the scope during square-wave tests. The cathode follower between the bridge oscillator and the Schmitt Trigger effectively isolates the square-wave circuit from the oscillator,



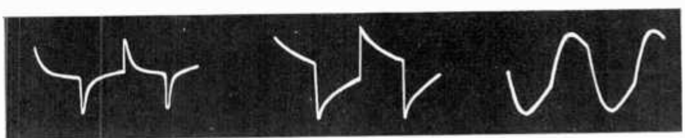
Basic circuit for square-wave testing is shown above. With the switch in position 1, check both generator and oscilloscope for good square-wave response. Then flip to position 2 to check the amplifier under test. The waveforms below cover most common amplifier troubles.



Poor low-frequency response, fair highs

Poor high-frequency response, good lows

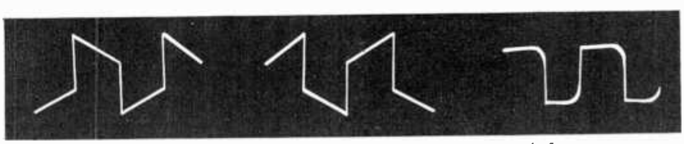
Poor low- and high-frequency response



Very bad low-frequency response

Fair low-, very good high-frequency response

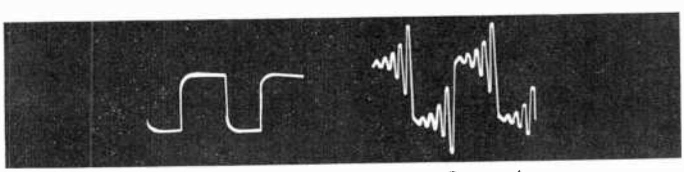
Very poor high- and low-frequency response



Low-frequency phase shift (leading)

Low-frequency phase shift (lagging)

High-frequency phase shift (leading)



High-frequency phase shift (lagging)

Damped wave oscillation (ringing)

so that no harmonics can be fed back into the oscillator to contaminate the sine-wave output.

Many Frequencies. Now let's see how we can put the square wave to work testing a hi-fi amplifier. A little closer look at the square waveform itself will show why it is so useful. The square wave's usefulness springs from the fact that it is made up of many frequencies. In content, this odd-looking waveform is actually a combination of a fundamental and all its odd-order harmonics; for this reason, sending one square wave through an amplifier is the equivalent of using a large number of test frequencies simultaneously.

If a square wave of any given frequency goes through an amplifier and comes out looking just like it did when it went in, we know the amplifier is essentially flat over a wide band of frequencies. As a rule of thumb, this band extends from one-tenth the fundamental frequency of the square wave to 10 times its frequency. For example, if an amplifier passes a 200-cycle square wave without distortion, the amplifier can be assumed flat from 20 to 2000 cycles. Consequently, with two or three test frequencies, we can check the frequency response of an amplifier over the entire audio spectrum.

With settings of 100, 1000, and 3000 cycles, for example, you can check an amplifier from 10 to 30,000 cycles with a good bit of overlap between bands. And if the wave form fails to come out square, you can tell what is happening inside the amplifier simply by studying the waveform shape (see page 71 for hints on diagnosing waveforms).

Transients and Phase. As we mentioned earlier, you can check an amplifier's transient response by noting its square-wave pattern. In general, if the square wave's leading edge is clean and sharp with the highest used test frequency, the amplifier's transient response is good.

Phase shift—overlooked by some designers—can also cause distortion. Since music is made up of tones containing many harmonics and since phase shift varies with frequency, the different harmonics of any given note—each harmonic at its own frequency—will be shifted out of place by varying amounts. Thus, the complex phase relationships which help to give each musical sound its own tonal characteristics are upset. Square waves are an excellent means of measuring phase shift, since the shape of the output waveform always indicates whether phase shift is present. In addition, the waveform indicates whether the phase is leading or lagging, and thus paves the way for the insertion of phase-correcting networks.

Ringing—damped oscillations set up somewhere in an amplifier's circuits—is so called because it is actually reproduced by the speaker as a "ringing" sound. It can be caused by unintentional tuned circuits anywhere in an amplifier—in a tone control network, for example, or a capacitor-transformer combination which resonates at some particular frequency. When a note comes through at this frequency, it sets up oscillations in the tuned circuit. These oscillations die away quickly, but not before the ringing sound is heard. The square-wave test spots this trouble quickly and makes locating the offending circuit easy.

Practical Tips. As with other instruments, there are a few tricks which will help you get better results with a square-wave generator. In most circuits, as in the Heath AG-10, the output voltage is taken directly from the cathode of a cathode follower. Since the cathode follower is cut off for half of each cycle, the negative half of each square wave is at ground potential, while the positive portion is above ground. If the application you have in mind requires a complete absence of d.c. voltage, you will have to couple the output through a capacitor.

Keep in mind that the square wave is a relatively tender beast and that its feelings or—more accurately—its shape can be easily mutilated. Consequently, a few precautions are in order. At high frequencies and high output voltages, the capacitance of the coaxial test leads usually furnished by the manufacturer may round off the leading edge of the square wave rather badly. In this situation, ordinary "open" test leads are much better.

At very low output voltages, on the other hand, it's best to use the coax lead supplied, since stray hum pickup can severely wrinkle the top and bottom portions of the square wave. Under certain conditions, you can also get better results by matching the characteristic output impedance of the cable with a properly calculated network. The instruction book will probably give details on this procedure.

The square-wave generator is not, of course, intended to replace all other test instruments. While it can tell you quickly if an amplifier's response is reasonably flat, it cannot, for example, plot a family of tone control curves; you'll have to go back to the audio oscillator and output meter for that. And it can't measure harmonic or intermodulation distortion, check output power, or do any of a half-dozen other jobs.

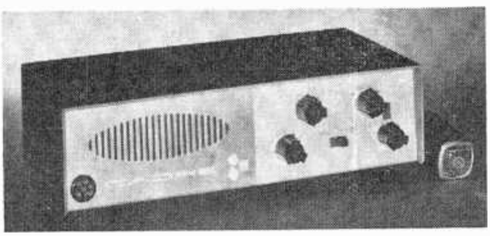
But it can be extremely helpful, as we have seen, because of its versatility and the uniqueness of the tests it offers. All in all, the square-wave generator should occupy an important place on the test bench of anyone seriously concerned with hi-fi equipment. —30—

On the Citizens Band

By TOM KNEITEL, 2W1965

HAVE YOU SEEN the Cadre transistorized 5-watt transceivers in use in your area? The Cadre "500" is pretty new but should be in wide distribution by the time you read this column. Make it a point to watch one in action.

The "500" has 14 transistors and 6 diodes, which means that you can forget about blown tubes or heat dissipation problems. The transmitter is a five-channel job, with the receiver crystal-tuned to five transmitting channels. One of the especially nice features of the "500" is



its weight, or rather the *lack* of same—it weighs in at less than six pounds, about half the weight of most "tube" rigs.

Some CB'ers who watch too much TV, or who are just plain "gung-ho," begin shouting "MAYDAY"—the radiotelephone international distress signal—into their microphones when they get a flat or run out of gas. Although this kind of trouble may, in fact, actually cause a CB'er much personal distress, it is hardly reason enough to send an "SOS." As a matter of fact, it's considered a Federal offense to do so.

While several radio services have suitable distress signals outlined in their FCC Rules, CB does not. Moreover, paragraph 19.83 of the CB Rules states that "no person shall transmit false or deceptive signals or communications . . . ," thus giving the FCC ample ammunition to act against CB'ers who push the panic button too quickly.

"MAYDAY" should be used *only* in a grave and severe emergency, involving mortal danger. Use the "CB-11" code, or even yell "Help!" or "Yipe!" if you must yell something, but go easy on that "MAYDAY" stuff.

Many letters and cards have been coming in from CB clubs saying that POP'tronics has been adopted as their official CB magazine. This is very flattering news. As you may know, amateur and commercial radio services have their own publications, but thus far CB has been left standing in the cold. POP'tronics was the first national publication to recognize CB, and the first to devote and maintain a regular column dedicated to the service. As CB has grown, so has our coverage. We look forward to continued growth for both.

Ever notice how hot a CB mike can get? Yours doesn't get hot? Mine doesn't, either, but a lot of guys I hear on the air seem to have this trouble. They throw on their carrier and blow into the mike (to cool it off?) for a few minutes. No call, no talking, no nothing. I guess

maybe the guys with the hot mikes are the ones that give out with all the hot air when they finally decide to talk.

Remember Hurricane "Donna" last September? Roland Wendt, 7W1913, of Sarasota, Fla., and 26 other Florida CB'ers do. They were part of it. The story of this small band of resourceful CB'ers provided a much needed tribute for CB, and it's also pretty interesting. Here's what happened.

When "Donna" was on the way to Florida, "Shorty" Gilbert, 7WØ98Ø, and a group of other CB'ers stuck a ground plane on the roof of the Sarasota County Court House. Roland Wendt set up a CB rig in the basement of the building. By 10:00 p.m. Friday (Sept. 9), the station was ready for emergency operation, and 25 mobile units were standing by awaiting instructions. "Donna" finally blew into town at 6:00 a.m. Saturday, and the CB network went into action.

The population of Sarasota County was hustled into shelters and a CB mobile unit was stationed at each shelter. A CB mobile unit was also stationed at the power company to keep the emergency-repair truck dispatcher informed of dangerous conditions caused by the winds. Land-line telephone service began to fail about 8:00 p.m. and CB radio was the only organized service in contact with the "outside world."

When all the power lines went down, the base station kept operating from an emergency power supply. One local broadcasting station was abandoned and another lost communications with its news-gathering mobile units. CB mobile units filled in with reports to the station, and then took over the power company's communications when its commercial rigs failed. The CB network was handling 50 messages per hour.

In the midst of all this action, the band "opened up," and skip interference began pouring in from 12W's out west. But the 12W's, hearing the emergency operations on Channel 9, *all* announced that they were clearing the channel so as not to interfere.

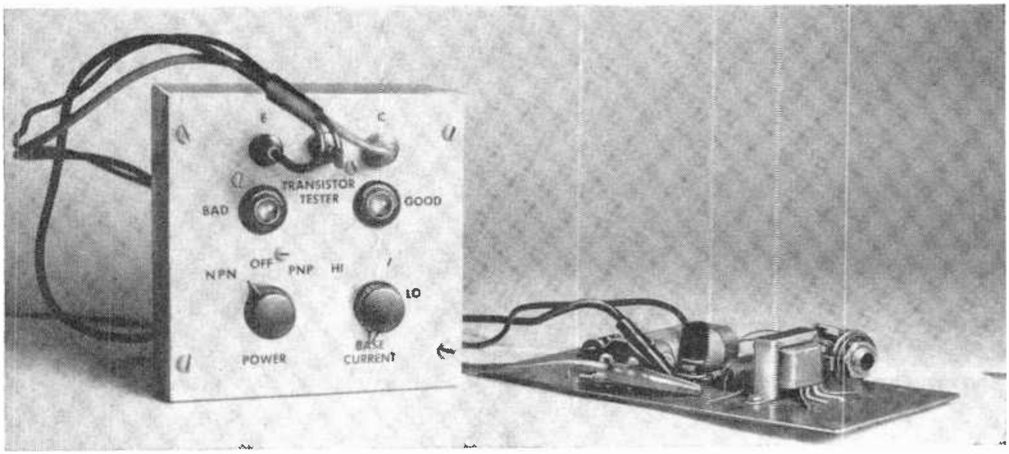
The CB network was in operation, without any interruption, until 3:00 p.m. Sunday. The CB volunteers risked their lives during "Donna." They tangled with falling trees, downed electrical lines, broken gas and water mains, high water, and a frightened public.

In recognition of the contribution of the CB'ers, Mr. William J. Riley, Director of the Sarasota County Civil Defense Council, wrote an official commendation to the Secretary of the FCC. His letter said, in part, "I hope this letter will serve to make you aware of the tremendous potential this body of men presents toward safeguarding life and limb. I fervently pray that other areas of our state and great country are blessed with men such as these; ready, willing and available to help in time of need." A list of all the participating CB'ers was included.

After such a glowing report, we hate to pour cold water on the fire with some scuttlebutt picked up from an FCC source—who wishes to remain nameless—but we'd better. It seems that the boys in Washington are somewhat riled about the many complaints that they have been receiving on the improper use of CB. The squawks have come mostly from "commercials" who feel that the "rag-chewers" have ruined their investment in CB equipment.

So the FCC had its field offices make a spot check as to the amount of nonsense going on in each call area. One of the areas reported that 82% of the transmissions were unnecessary. After 7:00 p.m. the figure went up to *almost 100%*.

These FCC "surveys" more often than not herald a rule change. In other words, there's a good possibility that the old FCC rule-changing bandwagon may soon be rolling down our alley again. I hope that the legitimate users of CB don't get run over by it. -30-



In-Circuit Transistor Tester

Home-brew test instrument checks home-brew projects

By C. L. HENRY

IF you're tired of unsoldering transistors just to test them, and want a dependable transistor tester, this project is for you. With this tester, you'll be able to check most transistors without removing them from the circuit. In one simple operation, it will tell you the quality of the transistor and show up leaky or shorted units.

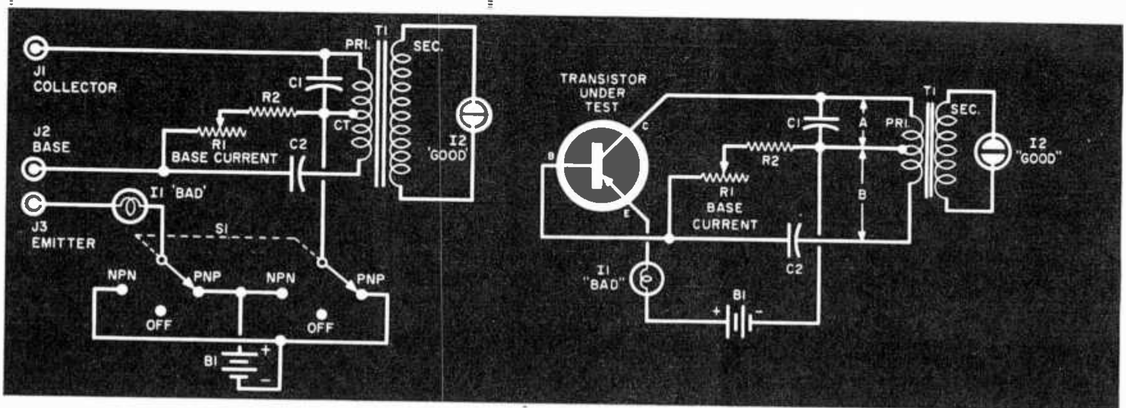
You don't have to worry about elaborate circuitry, critical wiring, or expensive components. Construction costs are kept down since no meters are used in the tester; a pair of lamps serve as indicators. You should be able to build the unit in an evening—for less than ten dollars.

Construction. The transistor tester is housed in a 4" x 4" x 2" aluminum box which has removable front and back covers. All controls and indicator lamps go on the front cover; mount base-current potentiometer *R1* and power switch *S1* on the lower half, and the indicator lamps (*I1* and *I2*) in the center. The lamps are held in place by rubber grommets and are soldered directly into the circuit.

The collector, base, and emitter jacks (*J1*, *J2*, and *J3*) connect to the transistor under test; these jacks are also mounted on the front cover, near the top. Pin jacks serve as test jacks on the author's model, but universal binding posts might be handier. In addition to the jacks or binding posts, you can also mount an audio and a power transistor socket on one side of the box for

PARTS LIST

B1—3-volt battery (two type "C" cells in series)
C1—0.1-µf., 200-volt capacitor
C2—0.068-µf., 400-volt disc capacitor
I1—2-volt, 60-ma. flashlight lamp (GE 49 or equivalent)
I2—NE-51 neon lamp
J1, J2, J3—Pin jack (Lafayette PJ-23 or equivalent)
R1—10,000-ohm potentiometer (IRC Q11-116 or equivalent)
R2—220-ohm, ½-watt resistor
S1—Two-pole, three-position rotary switch (Mallory 3223J or equivalent)
T1—Miniature audio transformer, 1500-ohm center-tapped primary, 500,000-ohm secondary (Argonne AR-141 or equivalent)
1—4" x 4" x 2" aluminum utility box (Bud AU-1083 or equivalent)
1—Dual "C" cell battery holder (Lafayette MS-174 or equivalent)
Misc.—Hardware, knobs, grommets, etc.



Actual schematic of the tester (above) and simplified schematic (right). See How It Works.

rapid testing of transistors which are not wired in circuits.

For testing in-circuit transistors, make three test leads from 2′ lengths of flexible wire. Solder an alligator clip to one end of each lead and a phone tip lug to the other end; the phone tips mate with the tester's pin jacks.

Operation. Connect each transistor electrode to the tester's jacks (*J1*, *J2*, and *J3*) and rotate base-current potentiometer *R1* to its maximum resistance position. Throw *S1* to either its *p-n-p* or *n-p-n* position, according to the type of transistor under test; if *S1* is in the correct position and the transistor is okay, the "good" lamp (*I2*) will light. (Setting the switch in the wrong position won't harm the transistor, so if you're not sure which type it is, try both positions.

The brilliance of the "good" lamp is an indication of the transistor's quality, since the transistor is now actually operating as an oscillator in the circuit. If you have another transistor of the same type on hand, you can compare the relative "goodness" of the two transistors by comparing the relative brilliance of the "good" lamp as you test each transistor.

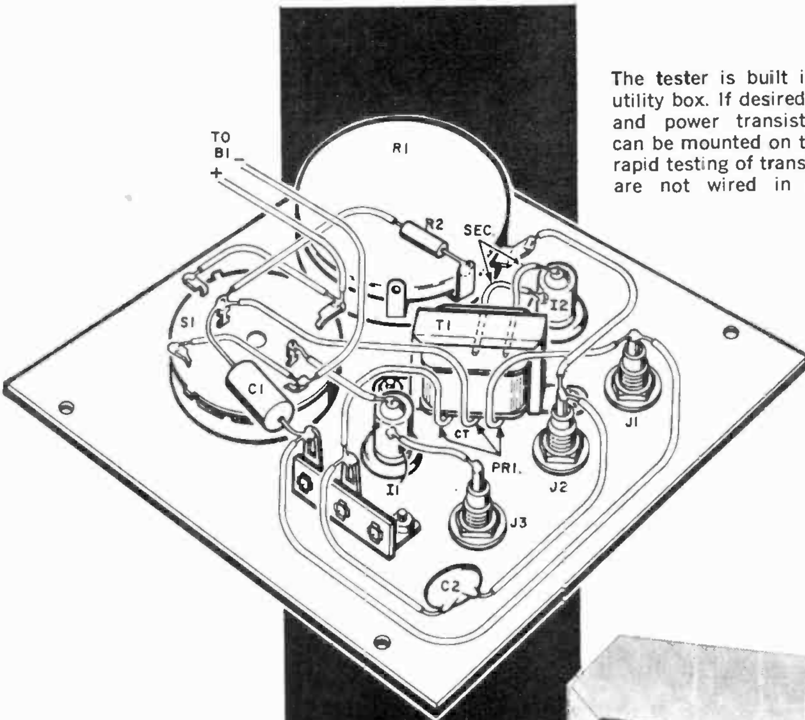
"Bad" lamp *I1* indicates the transistor's collector current. The brighter the lamp, the higher the current. When *R1* is in its minimum resistance position, the collector current should be high and the "bad" lamp should light for most transistors—good or bad. With *R1* in its

HOW IT WORKS

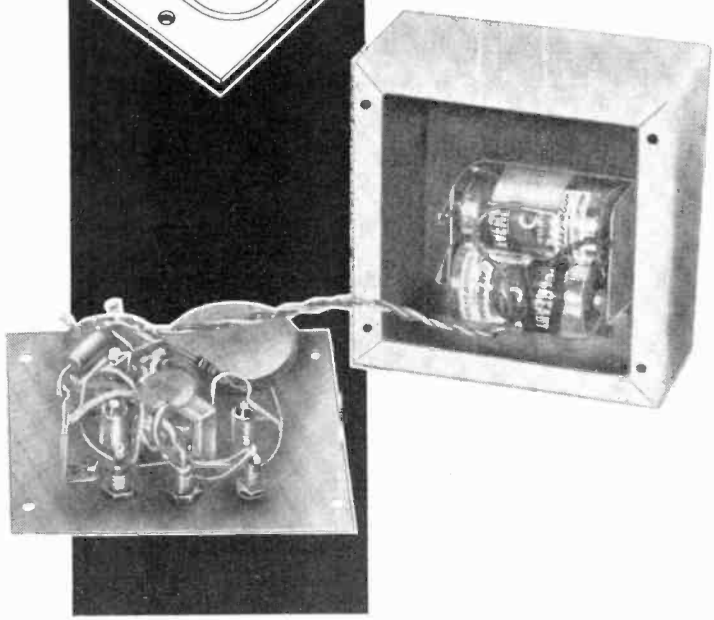
The transistor tester is basically an audio oscillator in which the transistor under test becomes an integral part of the circuit. The strength of oscillation provides a relative measure of the transistor's quality.

In the simplified schematic of the unit (above), power switch *S1* has been omitted and the battery is shown connected in the *p-n-p* position of *S1*. Transformer *T1* is used in a Hartley oscillator circuit and as a step-up transformer. One half of the primary of *T1* (A) serves as the transistor's collector load, the other half (B) for audio feedback. Capacitor *C1* tunes *T1*'s primary to raise the oscillator voltage on *T1*'s secondary to the point where neon lamp *I2* will fire. The brightness of *I2* depends on the quality and characteristics of the transistor under test.

Emitter current is measured by the brightness of lamp *I1*, which also serves to limit the transistor's current drain to less than 50 ma. Potentiometer *R1* sets the base current of the transistor; resistor *R2* maintains a minimum resistance in the base circuit. Feedback from the collector to the base passes through capacitor *C2*, which also blocks d.c. from the base.



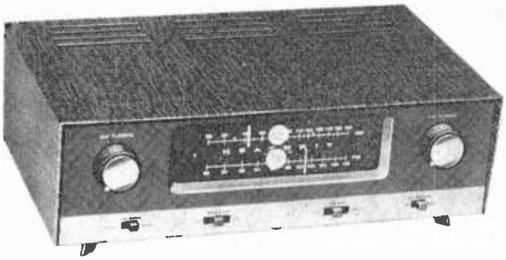
The tester is built in a small utility box. If desired, an audio and power transistor socket can be mounted on the box for rapid testing of transistors that are not wired in a circuit.



maximum resistance position. the "bad" lamp shouldn't light; if it does, the transistor has excessive leakage. If both lamps light when *R1* is at a maximum, it indicates that the transistor is operative but may not work in critical circuits.

If an in-circuit transistor tests "bad," don't condemn it; test it outside of the circuit—some other component may be at fault.

The most common trouble in power transistors is an emitter-to-collector short; if the transistor has this type of short, the "bad" lamp will light in all positions of *R1*. On the other hand, the most common trouble in audio transistors is an open collector or emitter; in this case neither lamp will light. In the last analysis, the "good" lamp must light for a transistor to be rated "good." -30-



FOR THE PRICE, we think you'll look far and long to beat Heath's AJ-10 combination AM/FM stereo tuner. After putting the AJ-10 through its paces here at POP'-tronics, we've concluded that this attractive tuner offers just about everything the stereo broadcast listener could want—low-distortion AM, full-fidelity FM, or—in the ever-growing number of areas served by stereo broadcasts—full AM/FM stereo. Priced at $59.95, the AJ-10 stereo tuner kit is available from the Heath Company, Benton Harbor, Mich.

In design, the AM section is relatively straightforward, with one tuned r.f. stage, a standard mixer-oscillator, and a single i.f. amplifier. But there are a number of "hidden" features which make the AJ-10 the true hi-fi tuner that it is. For example, a bandwidth switch offers greater selectivity in its "narrow" position, increased fidelity in its "broad" position. A low-distortion,

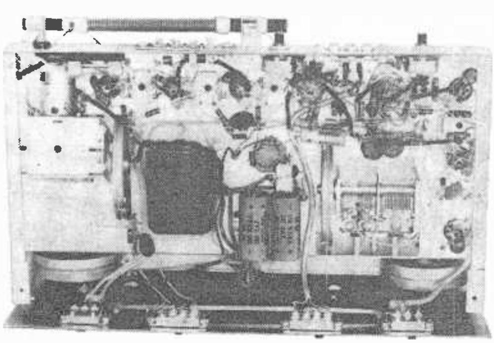
AM/FM Stereo Tuner

Heath's AJ-10 offers full-fidelity reception for less than $60

voltage-doubler-type detector provides maximum voltage to a cathode-follower output stage, and the detector is also coupled to a magic-eye indicator tube for precise tuning.

In the FM section, a completely wired front-end does much to simplify construction of the usually troublesome r.f. stages. A three-position a.f.c. in conjunction with a second magic-eye tube makes accurate FM tuning easy; a ratio detector in addition to a limiter stage results in noise-free reception. And, with an eye to the future, Heath has furnished a multiplex output for use with an external multiplex adapter.

We were particularly impressed with the individual flywheel tuning on both AM and FM as well as the individual magic-eye tuning indicators. The completed unit is attractive in its vinyl-covered steel case and—on AM—ready to operate on a built-in rod antenna. Naturally, you'll need a good FM antenna for the ultimate in FM reception. —30—



It's a ham's world

Amateur radio clubs throughout America are extending helping hands to CB'ers who wish to participate in this exciting hobby. With theory and code courses, they speed the CB'er on his way to Novice and General Class tickets

More than 105,000 United States Citizens 18 years of age or older have been licensed by the Federal Communications Commission to operate low-power, short-distance radio transmitters for business and personal communications in the Citizens Radio Service.

This astounding growth (there were less than 500 two years ago) suggests considerable latent interest in radio communications on the part of the general public, an interest stimulated to action when manufacturers began mass-producing equipment for the Class D Citizens Band at a price not too far removed from the average man's pocketbook. That this interest is heavily on the personal side, rather than business and utilitarian, is evident from the Commission's difficulties in keeping CB licensees from straying into the field of the Amateur Radio Service—calling CQ, attempting to work distant stations at random, etc.

In the belief that many readers, and CB'ers in particular, may have an interest in a personal communications service with privileges and opportunities much greater than those at 27 mc., the Editor of POPULAR ELECTRONICS *has asked us to prepare a brief outline of the amateur radio hobby. The following pages will tell you what amateur radio is, what it does, and what you have to do to become a ham.*

Headquarters Staff, ARRL

Over two-thirds of the students enrolled in Allied Radio's Novice Amateur Course will pass the FCC exam held during the last session and obtain their ham licenses.

CITIZENS RADIO is a specific service with a single purpose—necessary communications of a business or personal nature, transmitted in the minimum possible time. It is an accessory, an adjunct, a means to an end. And this is the major difference between CB and amateur radio. Ham radio is the end in itself. Hams get their licenses because they want to engage in radio communication and experimentation as an objective.

- A CB licensee is denied the right of experimentation with his equipment. This is logical and proper, for the CB'er has not been required to demonstrate any technical knowledge. The ham, on the other hand, has passed an FCC test in radio theory and practice (as well as code). This is not particularly difficult, at least for the Novice Class amateur license. But it entitles him to construct his own equipment, and to experiment with and alter it as the mood strikes him. It entitles him to try new antennas—which are not restricted as to height, to raise the power of his signal, and to try new circuits.
- A CB licensee is limited to a choice of a few specific channels in the 27-mc. band, and may communicate only locally. The ham, on the other hand, has a choice of numerous slices of the radio spectrum from 1.8 mc. to 30,000 mc. and higher. He can select the one he wishes to provide communication over a distance ranging from "next door" to any point on the globe. (Novices have a limited selection, but they do have a choice of segments of four bands at different points in the spectrum.) Further, the amateur is not confined to a spot (fixed-frequency) channel; he may transmit anywhere within his assigned bands. This often permits him to "get out from under" interference and conduct two-way communication impossible under the "party-line" system of spot channels.
- A CB licensee is limited to 5 watts of power. An amateur may use up to 1000 watts on most bands, although Novices are restricted to 75 watts.
- A CB licensee is limited to AM voice communication. A ham may choose that or c.w. telegraphy, single-sideband, FM telephony, radio teleprinter, facsimile, or even television.
- A CB licensee must be at least 18 years of age. There is no age limit in amateur radio—boys and girls of 7 have become hams, as have men and women of 70.

The greatest difference of all between the CB'er and ham is in the things an amateur may do. For example, you may be a "tinkerer"—you may like to build gadgets and make them work. In ham radio your gadgets don't stay on the bench—you put them into your amateur station and use them for daily communication, and it is a source of satisfaction that communication is made possible with gear you have built yourself.

You may have the competitive urge. Every day thousands of amateurs compete to see who can relay the most messages; elaborate "traffic" nets have been established by the Communications Department of the American Radio Relay League. Other amateurs compete with each other in working DX (distant) stations; some have "worked" 300 different countries or colonies around the world, and exchanged colorful QSL cards in confirmation. Beyond these daily activities, there are dozens of contests of various kinds held annually. The biggest is the Sweepstakes engaged in by amateurs all over the United States. Field Day brings thousands of amateurs into the countryside with portable self-powered equipment.

One of the finest aspects of amateur radio as a hobby is that it is not only a source of delightful fun and pleasant recreation but also an outstanding opportunity for voluntary public service. The communicating experience an amateur acquires, and the organized networks in which many hams participate become of untold value to the community and the nation in times of disaster. Let a hurricane or an earthquake destroy normal lines of communication, and hundreds of amateurs are ready to step in and provide emergency circuits for the Red Cross, civil defense, military and municipal agencies. So important, in fact, is the amateur's work in emergency communication that the FCC has set up special rules for a Radio Amateur Civil Emergency Service, in which public-spirited amateurs can enroll as a part of official civil defense efforts.

With the intense, personal interest a young amateur develops in his hobby, it is not surprising to find that many radio industry executives, and electronics engineers high in the profession today, were first drawn to radio as a career through a ham station of their own. Nearly one-half of all amateurs are employed in communications, electronics or allied fields. The rapid advances in the art of electronics and its daily expansion into new phases of American industry make it apparent that the field is a continually growing one which offers unparalleled opportunities to the young man who is faced with selecting his life's work. Also, a ham radio ticket is often useful in obtaining a communications assignment for those who are entering military service.

You can join more than 208,000 U.S. amateurs by the simple first step of obtaining a Novice Class license. This requires passing a code test at a speed of only 5 words per minute and a 20-question exam in basic FCC rules governing the amateur service and elementary radio practice. With this license, you can use radiotelegraphy anywhere in the 3700-3750 kc., 7150-7200 kc., and 21,100-21,150 kc. bands, and telegraphy or voice in the 145-147 mc. band.

Your transmitter must be crystal-controlled and limited to 75 watts plate power input. World-wide communication is possible with this type of transmitter (and a low-priced ham band receiver) which you can design and construct yourself, assemble from a kit, or purchase ready-made. Your financial outlay won't be much greater than for the cheapest CB transceiver.

The term of the Novice Class license is one year, by which time you will have adequate skill in code and radio theory to pass the General Class exam. A General Class license is good for five years, is renewable, and allows all amateur privileges on all bands.

To start in ham radio, you are not obliged to appear personally at an FCC office. Novice Class examinations are taken "by mail," under the supervision of a volunteer examiner who holds a General Class or higher ham license. The FCC district office will, on request, mail the examination in a sealed envelope, which can be opened only by the volunteer examiner. First, you demonstrate your ability to receive and send 5 wpm of code. Then, assuming you pass, you tackle the written quiz. All papers, together with the volunteer examiner's certification, go back to the district office. In a few weeks, you will have your ham ticket.

Amateur radio clubs around the country sponsor code and radio theory training classes for those interested in ham radio. At the end of the course they conduct the FCC examination. Booklets on learning code, theory, and FCC regulations are published by the American Radio Relay League and are available from its West Hartford, Connecticut, headquarters or at most radio distributors.

Musts for the beginning ham, these three ARRL publications are available at most radio parts dealers. Their total cost is $1.25.

Ham radio's appeal is universal. A cross section of amateur radio is a cross section of any community. When you get on the air as a ham, you may find yourself talking with the son of a former President of the United States, or a popular band leader, or a high-ranking military officer—or your newsboy or gas station owner. All are bonded together by an intense, personal interest in the art of radio communication and experimentation.

Turn the page for a comprehensive listing of amateur radio clubs that hold training classes

Listed below in alphabetical order by state and city are radio amateur clubs that are tentatively scheduled to hold training classes this winter. Each club's name is

Fayetteville High School Amateur Radio Club
Joe G. Roberts, W5TIC
Fayetteville High School
Fayetteville, Ark.

Lockheed (Aircraft) Amateur Radio Club
Dean Norvell
Dept. 72/25—Lockheed Aircraft
Burbank, Calif.

Dunsmuir Amateur Radio Club
Ray Rains, W6IOM
Box 692
Dunsmuir, Calif.

Fresno Amateur Radio Club (C)
Secretary
P. O. Box 783
Fresno, Calif.

Douglas El Segundo Amateur Radio Club
George Leber, W6MDQ
238 W. 137 St.
Hawthorne, Calif.

W6VPZ Radio Club (C)
Henry Lulli, W6OLZ
175 N. Hawthorne Blvd.
Hawthorne, Calif.

Antelope Valley Amateur Radio Club
Jack Kaufman, W6OLG
Box 1221
Lancaster, Calif.

San Fernando Valley Radio Club
William Cassillas, K6BAU
7657 Hinds Ave.
North Hollywood, Calif.

Orange County Amateur Radio Club, Inc.
Shelley Trotter, W6BAM
18811 E. Vanderlip
Santa Ana, Calif.

Denver Radio Club, Inc.
Sid Schomay, WØIJD
1328 Holly St.
Denver, Colo.

Montrose County Amateur Radio Club
Fred King, Jr., KØGEU
439 S. 6th St.
Montrose, Colo.

Stamford Amateur Radio Club
Norm Wilford
Creeping Hemlock Rd.
Norwalk, Conn.

Steel City Amateur Radio Club
Frank Beebe
2114 Sherwood Lane
Pueblo, Colo.

University of Conn. Amateur Radio Club
John Fisher
Rm. 206 Theta Chi
Storrs, Conn.

Stratford Amateur Radio Club
Richard Carlson, W1KZX
Booth Park
Stratford, Conn.

Daytona Beach Amateur Radio Assn., Inc.
Clyde P. Mashburn, W4SDR
25 S. Halifax Dr.
Daytona Beach, Fla.

St. Petersburg Amateur Radio Club
James N. Dillman
P. O. Box 4026
St. Petersburg, Fla.

Tampa Amateur Radio Club, Inc.
Herb Smith, K4LML
123 Besphorus Ave.
Tampa 6, Fla.

Amateur Radio Club of Augusta, Ga., Inc.
Al Allred, K4AUM
Bell Ave. & Saxon Dr.
Hephzibah, Ga.

Kennehoochee Amateur Radio Club
H. C. Mersereau, K4YRO
P. O. Box 160
Marietta, Ga.

Allied Novice Amateur Course
George Bercos, W9WOV
Allied Radio Corp.
100 N. Western Ave.
Chicago 80, Ill.

Hamfesters Radio Club, Inc.
Betty E. Sandberg, W9STR
5035 N. Kennison
Chicago 30, Ill.

Vermilion County Amateur Radio Assn.
Oliver Jones, W9IIE
29 S. Beard St.
Danville, Ill.

Montgomery County AREC
D. A. Hoover
401 E. Wood
Hillsboro, Ill.

Joliet Amateur Radio Society
J. R. House, K9HUY
1610 Avalon Ave.
Joliet, Ill.

Kankakee Area Radio Society
Robert C. Mehrer, K9CWF
RFD 3
Kankakee, Ill.

Y-RAD Club
E. Paul Johnson, K9BEF
604—9th Ave.
Rock Falls, Ill.

Sangamon Valley Radio Club
E. A. Metzger, W9PRN
1520 S. 4th St.
Springfield, Ill.

Tri State Amateur Radio Society
J. W. Russelburg
P. O. Box 5
Evansville, Ind.

Calumet Amateur Radio Club
Charles J. Hanusin, K9GSV
2021 Indianapolis Blvd.
Whiting, Ind.

Quinebaug Valley Radio Club
Roger M. Johnston, K1JNS
Brimfield, Mass.

Massachusetts Dept. of Education
Division of University Extension
William G. Welsh, W1SAD
24 Antrim St.
Cambridge 39, Mass.

Waltham Amateur Radio Assn.
Verne Robertson, W1EGE
84 Orange St.
Waltham, Mass.

Lake Region Amateur Radio Club
Arne Arneson, KØYDT
Fergus Falls, Minn.

St. Paul Radio Club, Inc.
Norman Johnson, WØTHY
998 McLean Ave.
St. Paul 6, Minn.

Winona Amateur Radio Club (C)
Scott Baudhuin, KØQPG
Winona, Minn.

Baldwyn Amateur Radio Klub
Lanny Outlaw
Baldwyn, Miss.

Mid-Mo Amateur Radio Club
Don L. Dulle
1825 W. Main
Jefferson City, Mo.

Butte Amateur Radio Club
Bob Corbett, W7FLB
2032 California
Butte, Mont.

Hi Line Radio Club
James E. Woodwick, K7BQN
1163 Grant Ave.
Havre, Mont.

Lincoln Amateur Radio Club
John Turner, KØJKH
5235 Walker Ave.
Lincoln 4, Nebr.

followed by the name of the person to contact for more information. The letters (C) or (TH), when used, mean that code classes only or theory classes only are given

Avenel Radio Club (C)
Adolph F. Elster, W2FSL
53 Commercial Ave.
Avenel, N. J.

Woodbridge Radio Club (TH)
Tom Malloy
87 Bedford St.
Iselin, N. J.

Pompton Valley Radio Club, Inc.
Lester Tansek, K2MDV
131 MacDonald Dr.
Wayne, N. J.

Auburn Amateur Radio Assn.
Robert Laxton, W2TCU
Bluefield Road
Auburn, N. Y.

Elmira Amateur Radio Assn., Inc.
Dransfield Hamilton
954 Farham St.
Elmira, N. Y.

Cornell Amateur Radio Club
David Bessel
Dryden Rd.
Ithaca, N. Y.

Communications Club of New Rochelle
Gray Berry, K2SJN
c/o C.D. Office
281 Washington Ave.
New Rochelle, N. Y.

Delehanty Institute
Mr. Ward, Registrar
117 E. 11th St.
New York 3, N. Y.
(nominal charge)

RCA Institute
350 W. 4th St.
New York 14, N. Y.
(nominal charge)

Ogdensburg Amateur Radio Club
Bob Gerecke, WA2FJN
16 Academy Place
Ogdensburg, N. Y.

Port Jervis C.D. Radio Club
Harold Aughton
3 Weversink Ave.
Port Jervis, N. Y.

Rochester Amateur Radio Assn., Inc.
Peter C. Trapolino, K2RIT
60 Yarker Ave.
Rochester 12, N. Y.

Eastern Suffolk Radio Club, Inc.
C. Walter Lindgren, W2AJR
Parish Memorial Hall
Lewis St.
Southampton, N. Y.

Mecklenburg Amateur Radio Society
Robert W. Reed
Box 3230 (T)
Charlotte, N. C.

Kinston Amateur Radio Society
E. E. Kupstas
1809 Queens Rd.
Kinston, N. C.

Greater Cincinnati Amateur Radio Assn.
Paul R. Wolf, W8IVE
1329 Coolidge Ave.
Cincinnati 30, Ohio

Parma Radio Club
Tom Hill, K8DHX
5310 W. Pleasant Valley Rd.
Parma 29, Ohio

Seneca Radio Club
Kenneth M. Hydeman
48 Short St.
Tiffin, Ohio

Northfork Amateur Radio Club
O. T. Keith
Box 43
Carter, Okla.

Chisholm Trail Amateur Radio Club
Bert Isbell
1310 S. 13 St.
Duncan, Okla.

Muskogee Amateur Radio Club
"Chief" Breshears, W5EJK
1112 E. Okmulgee
Muskogee, Okla.

Lehigh Valley Amateur Radio Club
James H. Fry, K3HCA
827 N. Leh St.
Allentown, Pa.

Delaware-Lehigh Amateur Radio Club
Robert R. Rothrock, K3MAZ
1719 Callone Ave.
Bethlehem, Pa.

Coke Center Radio Club
H. S. Dolde, K3BTF
818 Morrell Ave.
Connellsville, Pa.

Reading Radio Club, Inc.
Russell W. Frederick, W3CDS
Berks County Court House
Sixth and Court Sts.
Reading, Pa.

Lancaster Amateur Radio Club
W. Tom Myers, Jr.
Box 431
Lancaster, S. C.

Sioux Falls Amateur Radio Club, Inc.
J. W. Sikorski
Box 91
Sioux Falls, S. D.

Radio Amateurs Club of Knoxville (C)
F. E. Lamb, K4VZI
6007 Kaywood Dr.
Knoxville, Tenn.

Corpus Christi Amateur Radio Club
Gene Henderson, K5WQF
P. O. Box 2073
Corpus Christi, Texas

Dallas Amateur Radio Club, Inc.
W. F. Waters, W5PED
1519 Kings Highway
Dallas 8, Texas

Convair Amateur Radio Club
Max W. Schelper, K5BTZ
Box 12282
Fort Worth, Texas

Houston Amateur Radio Club (C)
Harold Tharrett
5922 South Seas
Houston, Texas

Peninsula Amateur Radio Club
Dick Stetson, K4DHO
203 Maney Dr.
Newport News, Va.

Shenandoah Valley Amateur Radio Club
Claude Feigley
P. O. Box 139
Winchester, Va.

Walla Walla Valley Radio Amateur Club
Edwin F. Goodman, W7GYH
712 Whitman
Walla Walla, Wash.

Apple City Radio Club
Al Friedman
1031 Lindy
Wenatchee, Wash.

Blennerhassett Amateur Radio Club
Charles R. Helmick, W8IBF
2511 Oak St.
Parkersburg, W. Va.

Sheridan Radio Amateur League, Inc.
Wayne Hale, K7HDY
P. O. Box 37
Sheridan, Wyo.

Transistor Topics

By LOU GARNER

WITHOUT QUESTION, the cathode-ray oscilloscope is one of the most versatile of all electronic test instruments. Reproducing an image of actual signal waveforms, it is a distinct aid in circuit analysis and trouble-shooting. In addition, the oscilloscope has valuable secondary uses as a voltmeter, as a timer, and as a signal comparator; there is virtually no limit to its applications.

Yet for all its versatility, the scope has been available in few portable (battery-operated) models. Not too long ago, however, a prominent instrument manufacturer, Tektronix, Inc. (P.O. Box 500, Beaverton, Oregon), introduced a completely portable oscilloscope, Type 321. More recently, EI Labs. Division of Electro Instruments, Inc. (1165 Morena Blvd., San Diego, Calif.), announced its version of a portable scope.

The problems involved in designing a practical portable oscilloscope are considerable; hence the comparative scarcity of commercial instruments. Wide-band, high-gain amplifiers must be provided for the horizontal and vertical deflection circuits, and a built-in adjustable-frequency horizontal sweep signal must be available. The chief problems, however, revolve around the cathode-ray tube itself. This component, for which there is not yet a suitable solid-state substitute, requires a relatively high d.c. voltage for operation, high signal voltages for beam deflection, and quite a bit of filament power. Finally, the necessary circuitry must be contained in a package that is physically small, light in weight, and resistant to shock and vibration.

Although the two portable oscilloscopes we just mentioned are basically similar, their respective manufacturers have taken different design approaches to the problems outlined. Both instruments are small and compact. Both are

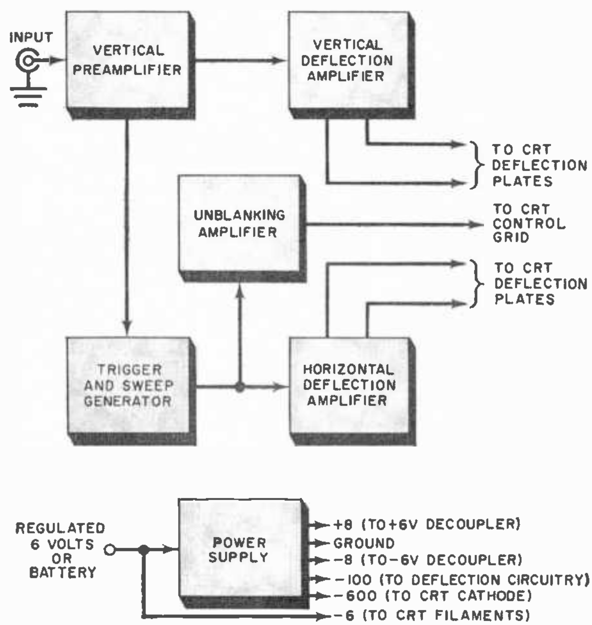


Fig. 1. Block diagram of the Model 150 portable oscilloscope, made by El Labs. Instrument is completely transistorized except for the cathode-ray tube itself.

operated with rechargeable batteries. Both use transistorized circuitry. But with these features, the similarities end.

EI Labs., in developing its Model 150, made a real effort to produce the smallest scope practical for commercial production, while retaining the basic operational features needed. (See Fig. 1.) The vertical amplifier employs direct-coupled, transistorized circuits to provide an overall gain of approximately 0.1 volt per screen division with a bandwidth of from d.c. to approximately 1.5 mc. The built-in sweep is adjustable from 1 microsecond per screen division to 10 milliseconds per division; it can be operated either "free-running" or "slave" by adjustment of a sync level control. A 5-kc. power converter is used to develop the high d.c. voltages needed for the deflection amplifiers and CRT. With a 1-inch CRT and a minimum of front panel controls, the Model 150 is smaller than many VTVM's and general-purpose multitesters. Measuring 2¾" x 3¼" x 5½" overall and weighing only two pounds, it can be carried comfortably in the palm of the hand.

In contrast, the Tektronix Type 321 is a larger, heavier and more expensive instrument, but it has additional circuit features which many engineers and technicians would consider extremely desirable in a general-purpose scope. With a 3-inch flat-faced CRT, Type 321 measures 8¾" x 5¾" x 16"; it weighs just under 17 pounds with batteries installed. Its vertical amplifier, like that in the Model 150, uses transistorized circuitry, but with a higher overall gain of 0.01 volt per screen division and with a bandwidth from d.c. to 5 mc. The built-in sweep is calibrated from 0.5 microsecond per division to 0.5 second per division, with a "magnifier" circuit which extends the lower limit to 0.1 microsecond per division.

These two instruments fill a real need, but their prices are higher than the average service technician or experimenter can afford—a little under $500 for the Model 150 and something over $850 for the Model 321. Battery life between charges is relatively short—about two hours continuous operation for the Model 150, and about five hours for the Model 321. In both cases, the short battery life is due, in large degree, to the power requirements of the CRT used.

If—and the "if" is a big one—a satisfactory, moderate-priced semiconductor substitute for the CRT can be developed, we can look forward to a truly portable scope at a price competitive with present-day service-type instruments.

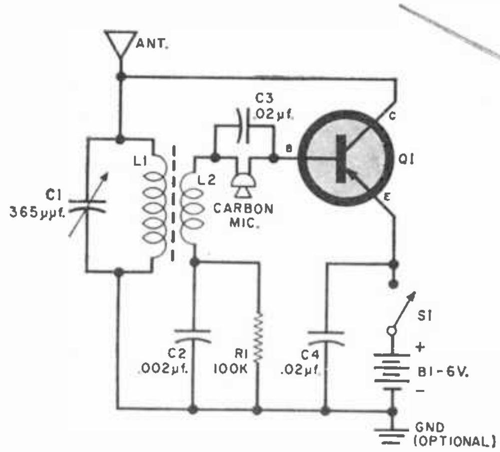


Fig. 2. Wireless microphone circuit submitted by Edward Morris has hand-wound oscillator coil (L1-L2). FCC regulations limit antenna length to 10 feet.

Homemade wireless microphone assembled by Eugene Richardson, of Alexandria, Va., incorporates a circuit similar to the one shown in Fig. 2.

Readers' Circuits. Low-power limited-range "transmitters" operating in the AM broadcast band continue to be popular with home experimenters. This month we have a pair of these circuits: a wireless microphone submitted by Edward

Morris (3758 10th Ave., New York 34, N. Y.) and a phono oscillator designed by Harry Hanson (13019 123A St., Edmonton, Alberta, Canada). Both circuits require only a single *p-n-p* transistor and use relatively low cost components.

Ed's circuit, shown in Fig. 2, uses a r.f. transistor (*Q1*) in the common emitter arrangement as a tuned/not tuned oscillator. In operation, the feedback signal needed to start and sustain oscillation is provided by *L2*; the circuit's operating frequency is determined by tuned circuit *L1-C1*. Amplitude modulation is obtained by varying *Q1*'s base bias

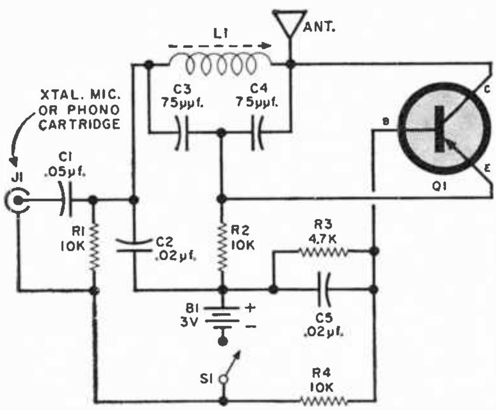


Fig. 3. Designed by Harry Hanson for use with a moderate-to-high-output crystal cartridge, this phono oscillator is tuned to a "dead" spot in the broadcast band by means of adjustable ferrite coil L1.

current by means of a carbon microphone (*Mic.*) in series with its base electrode and bypassed for r.f. by capacitor *C3*. Base bias is supplied through resistor *R1* which is bypassed by capacitor *C2*. The 6-volt battery (*B1*) and switch *S1* are bypassed by capacitor *C4*.

According to Ed, neither circuit layout nor lead dress is especially critical, although good wiring practice should be followed. He used a Raytheon Type CK760 in his model, but indicates that any *p-n-p* r.f. type should work as well; *n-p-n* units will also work if battery polarity is reversed.

Capacitors *C2, C3,* and *C4* are paper, mica, or ceramic units—working voltage is not critical. A standard half-watt resistor is used for *R1* (you may want to experiment with its value if you use different transistors). Capacitor *C1* is a 365-$\mu\mu$f. padder or a miniature variable. Any s.p.s.t. switch will serve as *S1*—push-button, slide, toggle, or rotary. Battery *B1* can be a single 6-volt unit, such as a Burgess Type Z4, or may be made up of four penlight or flashlight cells connected in series.

Coils *L1* and *L2* are both hand-wound. Coil *L1* consists of No. 7/41 Belden litz wire, wound in a single close-spaced layer on a 7" x 0.33" ferrite rod (Lafayette MS-332); a quarter-inch of bare rod is left at each end of *L1*. Coil *L2* is made up by winding about 35 turns of No. 24 enameled wire directly on top of *L1*; Ed suggests experimenting with the exact number of turns on *L2* for optimum performance.

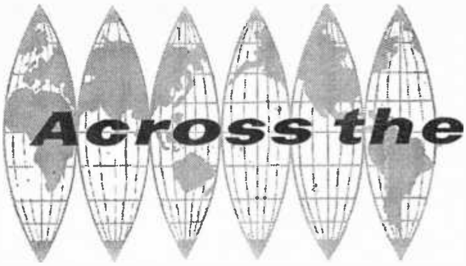
With the wiring completed and checked, the battery and transistor can be installed and the unit tested. The antenna (*Ant.*) is a 2' - 3' length of stiff wire—a straightened coat hanger will do—and a ground connection is optional. Be sure that the antenna you use is no longer than 10 feet including lead-in; this is the maximum length permitted by FCC regulations.

Tune a nearby receiver to a "dead" spot near the low-frequency end of the broadcast band and adjust *C1* until a signal is picked up. If the oscillator doesn't seem to be operating, try reversing the connections to *L2*. Final range depends on the size of antenna used, whether or not a ground connection is employed, on the individual characteristics of the transistor used, and on the sensitivity of your receiver.

Designed for use with a moderate-to-high-output crystal cartridge, Harry Hanson's circuit, shown in Fig. 3, is powered by a 3-volt battery (*B1*) made up of two flashlight cells connected in series. Transistor *Q1* is connected in the common-base arrangement and operates as a modified Colpitts oscillator. Feedback needed to start and maintain oscillation is provided by capacitive voltage divider *C3-C4*. Circuit operating frequency is determined by coil *L1* and the effective series capacity of *C3-C4*.

In operation, *Q1*'s base bias is supplied by voltage divider resistors *R3-R4*; capacitor *C5* bypasses *Q1*'s base circuit to

(*Continued on page* 108)



Across the Ham Bands

By
HERB S. BRIER
W9EGQ

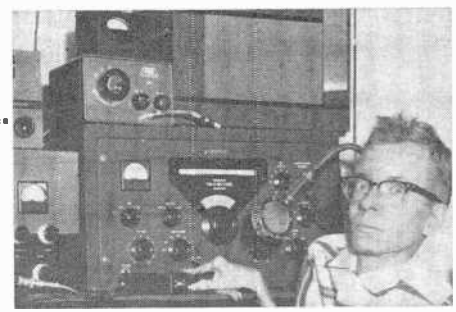
SSB vs. AM PHONE

ONE of the biggest controversies among phone hams for the past several years has been over the relative merits of conventional amplitude-modulated (AM) phone and single-sideband (SSB) phone. According to the latest ARRL ham club questionnaire, approximately 12% of the hams polled now have SSB equipment. Subtracting the number of hams who operate c.w. exclusively, approximately 30% of all *phone* hams can operate SSB.

Personally, I divide my phone operation nearly evenly between AM and SSB. And other hams I have quizzed on the subject do the same. The amount of time spent on each type of operation, however, varies greatly with the phone band involved and the time of day.

During peak operating hours, the number of AM and SSB stations on the 80- 40- and 20-meter phone bands are about equal. But during less crowded periods, the number of AM stations on the 80- and 40-meter bands may exceed SSB stations four to one; on the 20-meter phone band, where there is much activity any time the band is open, the percentage of SSB stations remains high and relatively constant.

Output Power. Let's see why SSB has become so popular and what advantages it has over AM. First, output power from an SSB transmitter is concentrated in one sideband (hence the name "single-sideband transmission") instead of being divided among the carrier and two sidebands, as in conventional AM signals. Because all power and information is

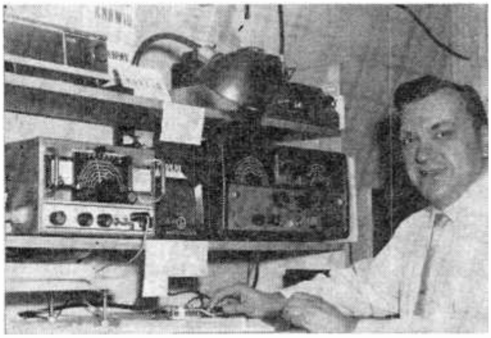


Ham of the Month

When L. "Kent" Zoll, W9AYW, Bluffton, Ind., was 15 years old, he saw his first ham station—about seven years ago. Three months later, he had his Novice license; and six months after that he passed his General Class exam. Since then, ham radio has been one thrill after another for him. Two special thrills were working Hawaii on 75-meter phone with low power, and arranging for a boyhood friend now in the Navy to talk to his parents for the first time in two years via Kent's station.

Kent is especially proud of being the current holder of the Indiana Radio Club's annual "Indiana's Outstanding Amateur Award," given in recognition of his being a credit to amateur radio in every way. To name a few: Kent is an ARRL emergency coordinator and holds several public service certificates; during the past six years, he has done an outstanding job as net control station operator of the morning Indiana Phone Net; and he also holds the Hoosier Courtesy Award. Kent would rather carry on an informal discussion with a nearby station than chase DX; however, he has worked most of the 50 states and some 15 countries.

When not hamming, Kent is assistant manager of a little league baseball team and is active in church doings. He is also co-author of a musical comedy, scheduled to be performed by a local theater group about this time.



Al Bagdon, KN9YJQ, (above), is having fun as a Novice while he prepares himself for the General exam.

George Wlodarski, K8ABR, is much easier to contact now than he was in 1957 as 5A3TF in Tripoli, Libya.

concentrated in one sideband, over twice as many SSB signals as AM signals can be accommodated in a given number of kilocycles. For the same reason, SSB signals enjoy a 6 to 9 db effective power advantage over AM signals. Therefore, the tougher the competition, the better SSB shows up.

To receive SSB signals, we must restore their missing carriers in the receiver by adjusting the receiver BFO precisely. This is the tricky part about receiving SSB signals. We do not have to worry about the missing sideband, because it is a "mirror image" of the one we are receiving.

Because SSB transmitters suppress the carrier and transmit only one of the two sidebands, they cost more than AM transmitters. Also, while AM can be received on practically any ham receiver, SSB cannot.

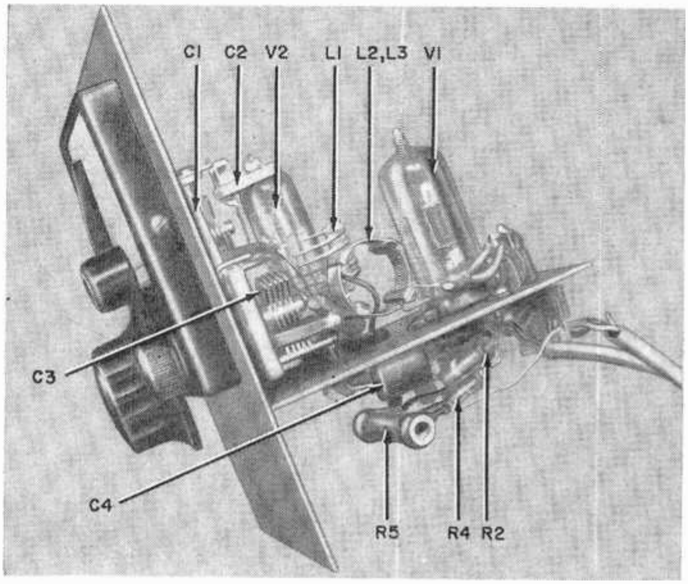
Price Considerations. For a ham on a limited budget, the high intial cost of a SSB rig is a problem. To indicate its magnitude, the least-expensive commercially available SSB transmitter, a 10-watt unit with plug-in coils, costs well over $200.00—including necessary accessories. A 20-watt bandswitching version of this transmitter costs over $300.00, also with accessories. For kits, prices are approximately 20% less. There is nothing currently available between 20 watts and 200 watts, but over that level there are half a dozen SSB transmitters in the $450.00 to $800.00 price range.

In contrast to these figures, several AM transmitters are available in kit or wired form, with power ratings up to 150 watts, which cost only $70.00 to $200.00. And don't let anybody tell you that you can't have a lot of fun on low-power AM, especially if you pick your operating times and bands carefully.

Most AM transmitters sold in recent years incorporate provision for SSB operation with an external SSB generator. However, unless a matching SSB generator is made for your rig, or its c.w. power rating is well over 200 watts, it will probably cost you less to trade in the old transmitter for a new SSB transmitter than to install an external generator on it. Nevertheless, an AM rig equipped with such a generator does make for flexible AM-SSB operation.

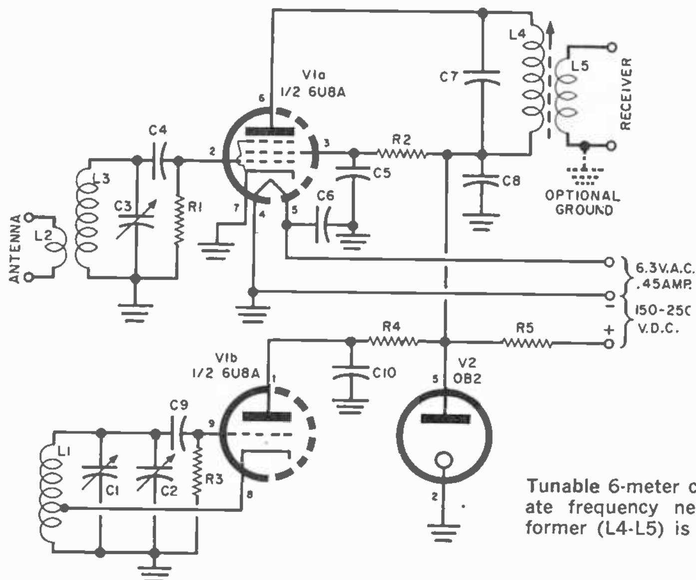
Tuning Technique. As I said earlier, almost any ham receiver will tune in AM signals, but SSB signals are extremely difficult to pick up on some of the older receivers designed before SSB became popular. This is also true of some of the less-expensive newer ham receivers.

Some hams believe that SSB signals are broader than AM signals. This is not true. Since an SSB signal varies from zero to maximum output in step with modulation, it constantly triggers the a.v.c. circuit of AM receivers tuned to ad-



PARTS LIST

C1—10-µµf. midget variable capacitor (Hammarlund HF-15 or equivalent—see text)
C2—35-µµf. ceramic trimmer capacitor (Centralab 820-C or equivalent)
C3—15-µµf. midget variable capacitor (Hammarlund HF-15 or equivalent—see text)
C4, C7, C9—100-µµf. mica capacitor
C5, C6, C8, C10—0.005-µf., 500-w.v.d.c. disc ceramic capacitor
L1—4¾ turns of No. 18 wire, ⅝" diameter, tapped 1¼ turns from ground end (B & W 3006 or equivalent)
L2—2 turns of No. 20 wire, ¾" diameter, at ground end of L3 (see text)
L3—5 turns of No. 20 wire, ¾" diameter, 5/16" long (B & W 3001 or equivalent—see text)
L4—25 turns of No. 26 enameled wire close-wound on a ⅜"-diameter slug-tuned coil form (Cambridge Thermionic LS3 or equivalent)
L5—5 turns of No. 22 insulated hookup wire wound over L4 at ground end
R1—1-megohm, ½-watt resistor
R2—100,000-ohm, ½-watt resistor
R3—27,000-ohm, ½-watt resistor
R4—1000-ohm, ½-watt resistor
R5—5000-ohm, 10-watt resistor
V1—6U8A tube
V2—OB2 tube
1—6" x 5" x 4" steel utility cabinet with attached chassis (Bud C-1796 or equivalent)
1—5-lug insulated terminal strip
1—2-lug insulated terminal strip
1—Vernier dial for C1 (Millen 10039 or equivalent)
Misc.—Tube sockets, hardware, etc.



Tunable 6-meter converter operates with intermediate frequency near 7 mc. Slug-tuned i.f. transformer (L4-L5) is hidden behind tube V2 in photo.

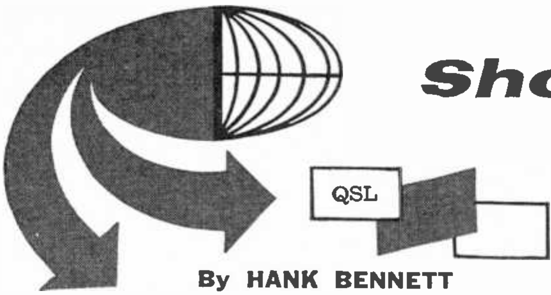
jacent channels—which makes the SSB signal seem excessively broad. The way to handle the problem is to turn off the receiver a.v.c. circuit, advance the audio-gain control, and regulate volume manually with the r.f. gain control. This tuning technique will sharpen up many signals that seem broad—AM as well as SSB.

SIMPLE 6-METER CONVERTER

This tunable converter will extend the tuning range of low- and medium-priced ham receivers to include the 50- to 54-mc. band. The tunable feature combats the i.f. feedthrough problem often encountered with crystal-controlled converters.

Construction. Rigidity of construction is a must for good frequency stability. Therefore, the converter is built in a steel utility cabinet rather than an aluminum box. The 6" x 5" x 4" cabinet (Bud C-1796 or equivalent) has a chassis attached to its front panel; mount all the components on the chassis and front panel as shown.

Capacitor *C1* is the main tuning con-
(*Continued on page* 116)



Short-Wave Report

By HANK BENNETT
W2PNA/WPE2FT

BETWEEN THE MISSIONS

IN midwestern Canada there is a vast territory of 350,000 square miles served by a group of religious missionaries. This area stretches westward for some 700 miles from northwestern Ontario to the Saskatchewan-Alberta border and northward for about 500 miles from the 53rd parallel.

Heading up the huge mission area is the Rev. Paul Dumouchel. Serving under him are 80 men and 150 women. This relatively small band of missionaries must cover the 35 missions located within the territory. Imagine the almost impossible task of communicating in an area of this size where roads are few and far apart, and where such everyday conveniences as telephone, bus, rail, or air lines are almost nonexistent.

About three years ago, to overcome this tremendous communications problem, Rev. Dumouchel was given permission by the Canadian Department of Transport in Ottawa to establish a two-way short-wave radio network. At the moment there are about 24 stations in operation; others will be added as needed.

The frequencies assigned to this private network are 2240 and 4356 kc. The transmitters are rated at 25 watts and they, as well as the receivers, were manufactured by Spilsburry and Tindall of Vancouver. The equipment will operate on either 117 volts a.c. or 12 volts d.c. (Some of the outlying missions have no a.c. available; hence the 12-volt systems.) A half-wave, off-center-fed Hertz antenna is used at most of the stations.

Station operating hours are limited to 0800-0900 (emergency calls only) and 1900-2100 EST. The latter period is so divided that any station may call any other station for a contact not to exceed ten minutes. The Rev. Dumouchel is allotted thirty minutes to contact all of the stations.

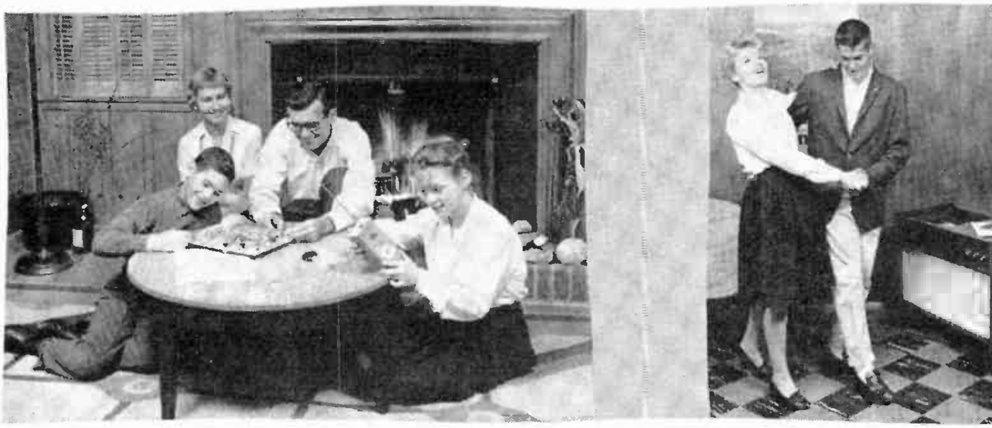
Remember that this is a private network and roughly in the same category as some of the utility stations (aero, ship, telephone, and others). Therefore, anything heard may not be repeated by anyone other than the party for whom the message is intended. The Canadian Government, as well as our own Federal Communications Commission, has strict regulations governing the secrecy of transmissions from private stations.

QSL cards from just two of the many religious short-wave stations.

Reports of reception may be addressed to Rev. Paul Dumouchel, The Pas, Manitoba, Canada.

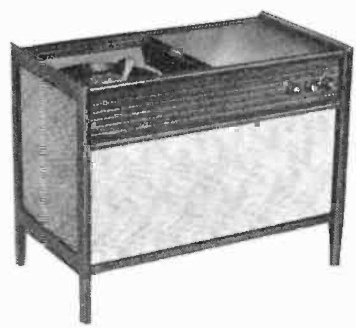
(Continued on page 122)

THERE'S A NEW HEATH KIT FOR EVERYONE IN THE FAMILY!



fits both space and dollar budgets!

COMPLETE STEREO-PHONO CONSOLE WIRED OR KIT



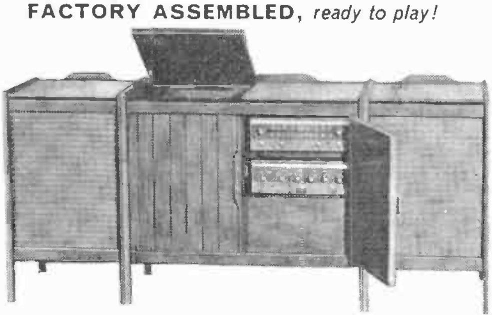
Less than 3' long and end-table height, yet its *six* speakers assure rich, room-filling stereo! Smooth "lows" are delivered by two 12" woofers, "mid-range" and "highs" are sparklingly reproduced by two 8" speakers and two 5" cone-type tweeters mounted at wide dispersal angles in the cabinet. The "anti-skate" 4-speed automatic stereo/mono record changer has diamond and sapphire styli. Concentric volume and separate dual bass and treble tone controls are within easy reach. Superbly styled with solid genuine walnut frame, walnut veneer front panel, and matching "wood-grained" sliding top, the cabinet measures just 31¾" L x 17⅝" W x 26¾" H. Whether you buy the ready-to-play or kit form, the cabinet is factory assembled and finished; to build the kit, just wire the amplifier and install the changer and speakers. 70 lbs.

Model GD-31 (kit)...$13 dn., $11 mo. **$129.95**
Model GDW-31 (wired)...$15 dn., $13 mo. **$149.95**

INTRODUCING

. . . a superb new line of Stereo Hi-Fi Consoles . . .

FACTORY ASSEMBLED, *ready to play!*



COMPLETE 28-WATT AND 50-WATT STEREO CONSOLES

Now you can buy Heath stereo components factory-wired and tested with beautiful preassembled, prefinished cabinets . . . ready to plug in and enjoy. The consoles are available in both 28 and 50 watt models, with money-saving optional kit plans. The 28-watt model (HFS-26) contains the Heathkit AJ-10 stereo AM/FM tuner, SA-2 stereo amplifier, AD-50A stereo record changer and two US-3 12" coaxial hi-fi speakers. The 50-watt model (HFS-28) contains the Heathkit AJ-30 Deluxe stereo AM/FM tuner; AA-100 Deluxe stereo amplifier; AD-60B Deluxe stereo record changer and two Jensen H-223F coaxial 2-way 12" hi-fi speakers. Specify walnut or mahogany.

Model HFS-26 (wired)...215 lbs....$47.50 dn. **$475.00**
Model HFS-27 (kit)...$37.00 dn. **$370.00**
Model HFS-28 (wired)...264 lbs....$75.00 dn. **$675.00**
Model HFS-29 (kit)...$55.00 dn. **$550.00**

Cabinets available separately, write for information.

HEATHKIT® by DAYSTROM **HEATH COMPANY** / Benton Harbor, Michigan

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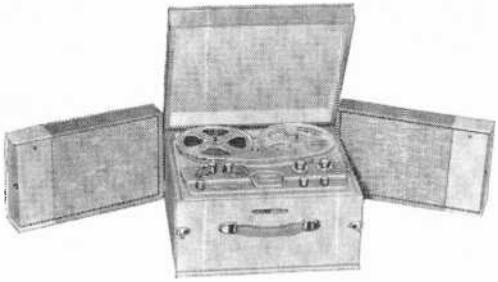
2. HEATHKIT factory-built, ready to use.

3. HEATHKIT learn-by-doing Science Series for youngsters.

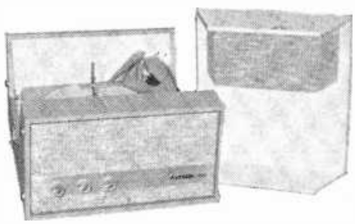


PORTABLE 4-TRACK STEREO TAPE RECORDER KIT

Delight to the vast treasures available to you in popular 4-track pre-recorded stereo tapes . . . make your own 4-track stereo home recordings . . . (you can even use it as a hi-fi center to amplify and control hi-fi tuners, record players, etc.) Has "record," "play," "fast-forward" and "rewind" functions, 2 speeds (3¾" and 7½" per second). Controls include: individual tone balance controls for each channel; level controls; monitoring switch for each channel to let you hear programs as they are being recorded; and a pause button for tape editing. Two "eye-tube" indicators provide control of recording levels. Speaker wings may be detached. Cabinet and tape mechanism are completely preassembled. A storage compartment is provided for tape and accessories. 49 lbs.

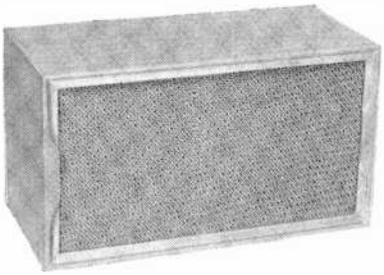
Model AD-40...$18 dn., $16 mo. **$179.95**

STEREO/MONO PORTABLE PHONO KIT



From jazz to classics, the younger set will have stereo wherever they go! Plays either stereo or mono records on its top quality 4-speed automatic changer with diamond and sapphire styli. Has detachable stereo speaker wing and complete tone and stereo balance controls. Record changer and cabinet are factory-assembled, the kit is a "snap" to build. 15½" x 18" x 8⅛". 28 lbs.

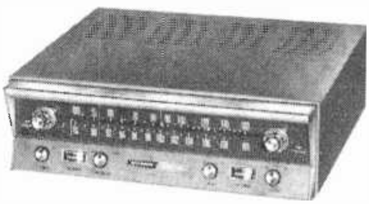
Model GD-10...$7 dn..... **$69.95**



ACOUSTIC SUSPENSION SPEAKER SYSTEM KIT

Using the revolutionary "acoustic suspension principle" licensed to Heath by Acoustic Research, Incorporated, the AS-10 meets and surpasses performance of speaker systems three to four times its size. The 10" bass speaker and two 3½" hi-frequency speakers cover 30 to 15,000 cps with fantastic brilliance and fidelity! Use in upright or horizontal position. Cabinets preassembled and prefinished. 32 lbs.

Model AS-10U (unfinished)...$6 dn., $6 mo. **$59.95**
Model AS-10M (mahogany)...$6.50 dn., $6 mo. **$64.95**
Model AS-10W (walnut)...$6.50 dn., $6 mo. **$64.95**



DELUXE AM/FM STEREO TUNER

Exciting new styling and advance-design features rocket this new Heathkit to the top of the stereo hi-fi value list! Featured are: complete AM, FM and simultaneous stereo AM/FM reception, plus a multiplex adapter output; individual flywheel tuning; individual tuning meters on each band; FM automatic frequency control (AFC); and AM bandwidth switch. 24 lbs.

Model AJ-30 (kit)...$9.75 dn., $9 mo. **$97.50**
Model AJW-30 (wired)...$15.30 dn., $13 mo. **$152.95**

DELUXE 50-WATT STEREO AMPLIFIER

Look-alike companion to the tuner above, here's two 25-watt channels hi-fi-rated and loaded with extras! Mixed-channel center speaker output; "function selector" for any mode of operation; stereo reverse, balance and separation controls; ganged volume and separate concentric bass and treble tone controls. 5½" H, 15¾" W, 13½" D. 31 lbs.

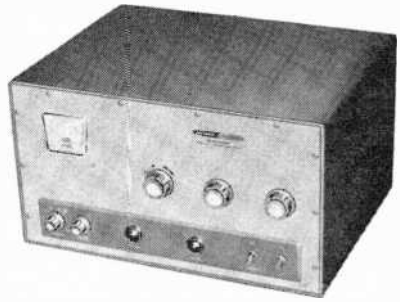
Model AA-100 (kit).. $8.50 dn., $8.00 mo. **$84.95**
Model AAW-100 (wired)...$14.50 dn., $13.00 mo. **$144.95**

8 new, exciting Heathkit® products on following pages

HEATHKIT®... pioneer in do-it-yourself

NOW . . . BUY YOUR HEATHKIT FOR as low as $2.50 DOWN! Yes, under the new, easy Heath Time Payment Plan, orders of $25.00 or more can be purchased for just 10% down . . . and up to 18 FULL MONTHS ON BALANCE for orders of $300 to $600.

So, don't wait . . . enjoy that Heathkit you've wanted so long NOW . . . for just a small amount down, and pay the balance in easy monthly installments!



ANNOUNCING THE ALL-NEW HEATHKIT "WARRIOR" GROUNDED-GRID KILOWATT LINEAR ....ONLY $229.95

Here's news to rock the entire Amateur Radio world! The new desk-top Heathkit "Warrior" matches any unit on the market feature for feature with no quality short cuts and slashes the price in half! *Completely Self-Contained*—amplifier *and* HV, filament, and bias supplies are built in. *Versatile*—drives with 50 to 75 watts, no matching or swamping network required. *Efficient*—stable g-g circuit puts part of drive in output for up to 70% efficiency. *Inexpensive Tubes*—four paralleled 811A's and two 866A's. *Dynamic Regulation*—big oil-filled capacitor and 5-50 henry swinging choke for high peak power output with low distortion. *Design*—special low-capacity filament transformer requires less driving power and eliminates broad-band filament RF choke. *Monitoring*—gives constant output to scope regardless of frequency. *Easily Assembled*—average time 8 hours. *Bands*—80 through 10. *Max. Power Input*—SSB-1000 watts PEP; CW-1000 watts; AM-400 watts (500 using controlled carrier mod.); RTTY-650 watts. *Write for Complete Information.*

Model HA-10...100 lbs....$23.00 dn., $20.00 mo......... $229.95

NEW FOR THE SIX & TWO METER VHF NOMADS . . .

The new "Shawnee" 6-meter and "Pawnee" 2-meter Heathkit transceiver kits bring a new definition to *superior performance*. And each offers complete AM and CW facilities with the greatest array of features anywhere! *Single Knob Tuning*—tracked VFO and exciter stages. 10 *Watt Output*—6360 dual tetrode. *Built-In Low Pass Filter. Three-way Power Supply*—built-in for 117vac, 6vdc or 12vdc with separate DC and AC plugs and cables included. *Dual-Purpose Modulator*—10 watts for high level plate modulation or 15 watts for PA operation. *Double Conversion Receiver*—crystal controlled first oscillator. *Voltage Regulation*—on all oscillators. *Complete Controls*—up front on the panel for transmitter and receiver. *Tuning Meter*—auto-switched for signal strength or relative power output. *Slide Rule Dial*—seven inches of spread for receiver and VFO, edge lighted. VFO *or Crystals*—front panel switch of vfo or four crystals for novice, CAP, MARS or net operation. *Spot Switch*—zero in signals with transmitter off. *Complete Shielding*—power supply, final and receiver front end. *Ceramic Microphone*—push-to-talk with coiled cord. *And many more*—*Write for Information*. 34 lbs.

Model HW-10...6 meter, or HW-20...2 meter $20 dn., $17 mo.................. $199.95

DELUXE SERVICE BENCH VTVM KIT

Greater accuracy and convenience for precision testing. Big 6", 200 ua meter has longer scales plus separate 1.5v and 5v AC scales. Wider frequency coverage with greater precision is made possible through use of 1% resistors and husky capacitors. Other deluxe features include high-visibility meter and controls; recessed thumbwheel "zero" and "ohms adjust" controls. Measures AC and DC volts to 1500 in 7 ranges; resistance from .1 ohm to 1,000 megohms in 7 ranges. Db calibrations for relative voltage measurements selected to give 10 db steps between ranges. Test leads included. 9½" H x 6½" W x 5" D. 7 lbs.

Model IM-10...$3.30 dn., $5.00 mo....... $32.95

NEW ISOLATION TRANSFORMER KIT

The IP-10 presents a significant improvement in isolation transformers. Provides output voltage from 90-130v in 0.75v steps at 300 watts continuous duty, 500 watts intermittent duty, with 117v input—ample power for even color TV servicing. Built-in meter continuously monitors output voltage with ± 1 volt accuracy (linear scale is electronically expanded to cover 90-140v). Power line input voltage can also be measured by operating spring-return slide switch on front panel. Fused primary. Measures 6½" W x 9½" H x 5" D. 22 lbs.

Model IP-10...$5.50 dn., $5 mo........ $54.95

HEATH COMPANY / Benton Harbor, Michigan

electronics—always the leader!

now a new improved 6 meter model joins this famous transceiver series

ATTENTION MARINERS! Keep a "weather-eye" peeled for announcement of a new Heathkit SHIP-TO-SHORE RADIOTELEPHONE . . . COMING SOON!

2, 6 & 10 METER TRANSCEIVER KITS

The new 6 meter HW-29A joins "Tener" and "Twoer" to bring you top transceiver values. Like "Twoer," the new HW-29A multiplies to its output frequency from an 8 mc crystal for greater stability. All models have crystal-controlled, 5 watt input transmitters and tunable super-regen receivers that pull in sigs as low as 1 uv . . . FB for emergency work and "local" nets. Each includes transmit-receive switch, metering jack, ceramic mike and two power cables. Less crystal. 10 lbs.

Model HW-19...10 meter...$4 dn., $5 mo............**$39.95**
Model HW-29A...6 meter...$4.50 dn., $5 mo.........**$44.95**
Model HW-30...2 meter...$4.50 dn., $5 mo...........**$44.95**
Model HWM-29-1...Converts early "Sixer" to "A" model. 1 lb.........**$4.95**

be your own "tune-up" specialist!

NEW ELECTRONIC IGNITION ANALYZER KIT

Checks ignition faults quickly and accurately. One simple hook-up to ignition wiring, and the 10-20 does the rest! No removing plugs, wiring or other engine parts. Checks engine in operation. Switch selection of primary, secondary, parade or superimposed patterns without changing leads to the engine. Detects shorted plugs, defective distributor points, defective wiring, coil and condenser problems, incorrect dwell time, worn distributor parts, etc. Features improved trigger circuit for locked-in patterns without trigger level adjustment; 2-1 vertical and 10-1 horizontal expansion. 8" H x 9½" W x 16" D. 22 lbs.

Model 10-20...$8.95 dn., $9.00 mo.............. ...**$89.95**

HEATHKIT BASIC RADIO COURSE

Here's a new 2-part series in basic radio for youngsters and adults. "Basic Radio—Part I," available now, teaches radio theory in everyday language, common analogies, and no difficult mathematics. Experiments performed with radio parts supplied result in a regenerative radio receiver. "Part II" of the series, which will be ready March 1, advances your knowledge of radio theory and supplies additional parts to extend your Part I receiver to a 2-band superheterodyne circuit.

Model EK-2A..."Part 1"...8 lbs......................**$19.95**

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Send today for your Free Copy of the latest Heathkit Catalog showing over 200 Heathkit items for hi-fi fans, amateur radio operators, students, technicians, marine enthusiasts, sports car owners and hobbyists. Many Heathkit products are now available in both kit and wired form!

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Dealer and export prices slightly higher.

By
JOHN T. FRYE
W9EGV

Carl and Jerry

Below the Red

CARL AND JERRY had rushed into their basement laboratory with a parcel post package that had just been delivered. They were so busy tearing open the package that they didn't notice their friend, Chief of Police Morton, standing in the still-open door until he coughed politely.

"Hey, Chief, how did you sneak up on us like that?" Carl demanded. As Chief Morton came in, Carl closed the door behind him.

"It wasn't hard," the chief said, sitting down on the worn leather sofa. "You two were so intent on getting into that box that seventy-six trombones could have marched in without your noticing."

Carl and Jerry parked themselves on either side of him. "Is this a social visit?" Carl asked bluntly.

"Nope. None of my visits here are. I only come when I have a problem and need your particular brand of help."

"Good!" Jerry said eagerly. "What's the problem?"

"It's a nasty one," the chief began with a deep sigh. "Dope peddlers have hit our town in the last few weeks. As usual, they're starting out with 'reefers,' or marijuana cigarettes, and are concentrating on the young crowd.

"The peddlers can always depend on finding a few characters with infantile minds who are willing to jeopardize their sanity, health, and even life itself by messing around with the stuff, either out of curiosity or for a so-called thrill. Once the youngsters are hooked, of course, the dope syndicate will move in with cocaine, heroin, and the other big money-makers.

"But we're determined to smash this thing before it gets started. If we can catch a 'pusher' getting the stuff from his contact, one or both may talk and drag in some of the bigger boys; but even if they make like clams, the syndicate will receive notice that the town is too hot for them to get a foothold and will pull out."

"So where's the problem?" Jerry asked impatiently.

"So we've got to see the contact man give the cigarettes to the pusher and then catch the pusher with the stuff on his person. We haven't been able to do this in spite of a big break we got. A friend of mine on the Chicago narcotics squad happened to be passing through town and spotted a syndicate man, whose specialty is opening up new territories, at a down-town hotel. He identified the man in our mug book, and we've quietly kept him under surveillance ever since. He goes under the name of Rossi, and we've actually seen him passing reefers to pushers."

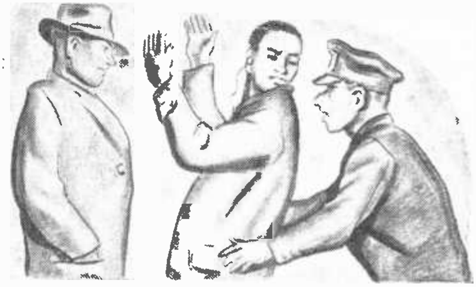
"Then why didn't you arrest him?" Carl demanded.

"We've got to catch the receiver with the goods on his person before we can make an arrest of either party stick. And we must move carefully so as not to tip off Rossi we're on to him. If he's scared off before we can nail him, we've lost our only contact with the ring.

"He passes the stuff while walking along with that big crowd that pours out of the office buildings on both sides of his hotel at lunch time. You know what a pushing, shoving, shoulder-to-shoulder proposition that is for about ten minutes. He simply brushes past the pusher and drops the package of reefers into the latter's overcoat pocket.

"We saw him do it as we watched from a second-floor room overlooking the street. Next day we had a man right on this same pusher's coat-tail when he and Rossi were taking their noonday saunter, but they never went near each other. Somehow one or both of them knew the pusher was being tailed.

"Then we played it another way. Our man was stationed up the block in the direction that lunch crowd moves. We were in contact with him by means of a tiny radio receiver he carried in his pocket. When we saw Rossi pass the cigarettes, we flashed the word to our man along with a description of the guy who got them. This was easy because the guy was wearing a hearing aid and a light tan overcoat.



"Our man grabbed him and made a quick search there and a more thorough search down at headquarters, but he was clean. Later, in the gutter close to where the contact had been made, we found the package of reefers. The pusher had been tipped and had gotten rid of them."

I STILL don't see where we come in," Carl complained.

"You will," retorted Chief Morton. "So we pretended we were shaking down all suspicious characters looking for some hot jewels. This gave us an excuse to examine the pusher's hearing aid in our laboratory and discover that it wasn't a hearing aid at all but a miniature radio receiver. We checked the operating frequency and gave it back without letting on; but the next day, while Rossi was trying to make a contact, we listened on that frequency and made some interesting discoveries.

"The dope ring has a member concealed where he can watch the street just as we are doing. He uses a short-range transmitter to talk to both Rossi and the man he's to contact and to direct them toward each other. If this watcher sees that either of the two is being tailed, he passes the word and contact is avoided.

"When Rossi and the pusher were apparently getting close to each other, we played a hunch and said a few words on our short-distance transceiver. Instantly we heard the voice of the concealed man bark, 'No contact! I hear the cops close by.' When Rossi heard this, he wheeled right around and went back to his hotel. At the same time we saw another guy, altogether different from the one we had picked up but wearing the same kind of 'hearing aid', turn around and start in the other direction.

"Obviously that concealed joker monitors our frequencies, too. That's how the pusher knew we were going to grab him and ditched the cigarettes before we could do so. We could change frequency, of course, but our technician doubts it would do any good. He says the syndicate man is probably using a gadget he calls a "Panadaptor" that permits the man to scan a whole broad band of frequencies displayed on a cathode-ray oscilloscope and to spot instantly any strange radio signal that pops on."

"How about jamming his frequency?" Jerry suggested.

"That would just reveal that we're on their trail. No, what we need is some means of short-range communication that's reliable, fast, and secret. It must be fast enough to relay a complete description of the person carrying the dope in a few seconds. That rules out hand signs and blinker signals. I was hoping you boys could come up with an idea."

The boys looked at each other. Then

suddenly, with one accord, they both jumped up and fell on the package that they had just unwrapped when Chief Morton came in. Soon each was clutching an object made of styrene plastic that looked like an oversize movie camera. At any rate, each of the objects had a large and small red lens on the front, a streamlined viewfinder on top, and a pistol-grip handle on the bottom.

Carl opened the door leading into the furnace room, walked to the opposite end of the large basement, then turned around and drew a bead on Jerry. Jerry aimed back, and the two boys muttered to themselves.

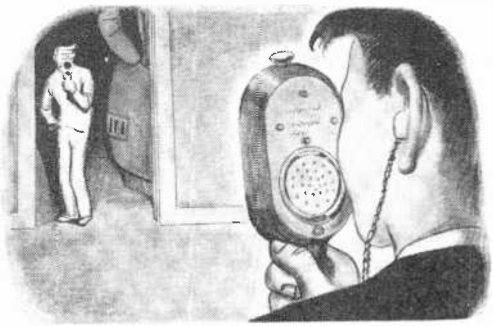
"Aren't you two a little old for Buck Rogers ray pistols?" the chief asked sarcastically.

"Not this kind," Jerry answered as he took a hearing-aid earphone connected to the back of the ray gun out of his ear. "Put this in your ear, sight at the thing Carl is holding, squeeze the trigger on the handle, and whisper something."

The chief followed instructions and muttered, "I feel pretty silly."

A look of amazement spread over his face as he heard Carl's voice whisper back in the earphone: "You needn't; you're talking on a light beam."

"That's right," Jerry answered the chief's questioning look. "These 'Infra-



phones' were developed by the Infrared Industries of Waltham, Massachusetts. They permit talking over distances of several hundred feet by means of beams of infrared radiation.

"As you know," Jerry continued, "white light from an incandescent bulb is produced by a blending of all colors of

(*Continued on page* 104)

83 YX 929. Stereo Tape Record-Play Preamp Kit. $79.95 (less case)

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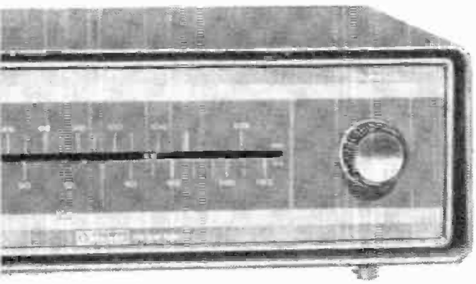

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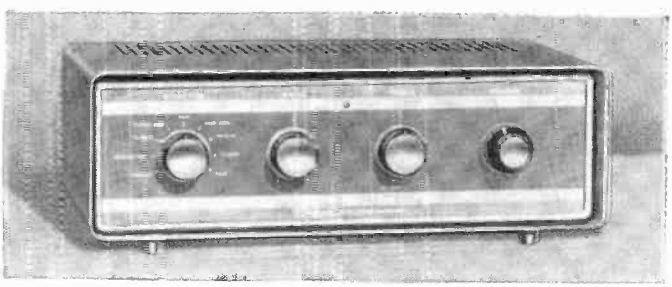

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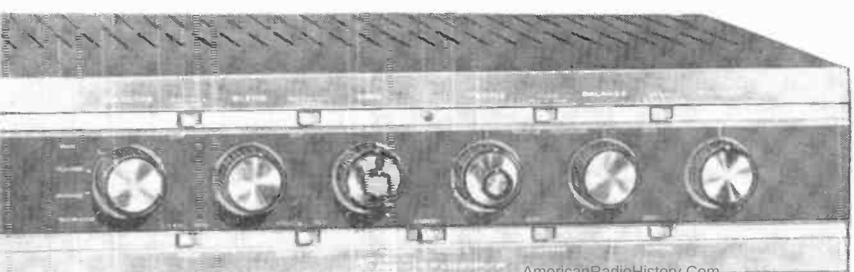

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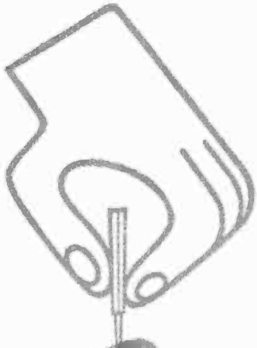

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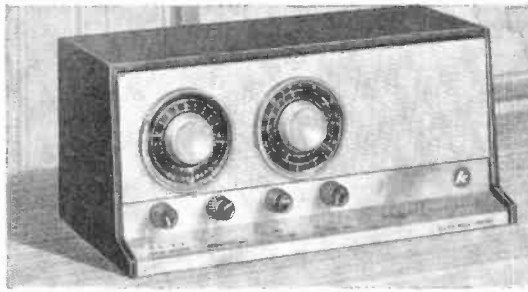

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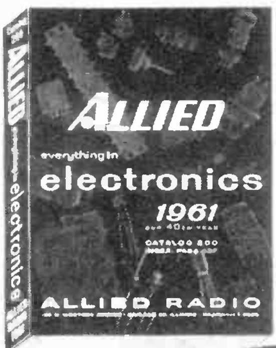

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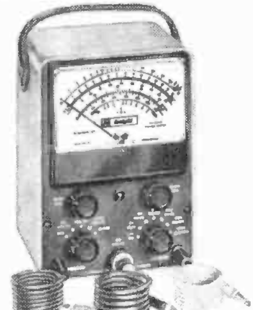

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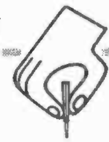

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light being radiated from the hot filament. Each color is determined by the frequency of its radiation. Violet is the highest frequency the eye can see; red is the lowest. But radiation occurs beyond these limits of visible light. On the high side, it's called 'ultraviolet'; on the low side, the invisible radiation is termed 'infrared.'

"Behind the small bottom lens of the Infraphone is a focused flashlight bulb, battery, and microphone reflector plate. The brilliance of the bulb varies in step with the sound waves striking the mike reflector. The red lens is actually a filter that passes a narrow beam of infrared rays readily, but greatly attenuates all other radiation.

"Back of the larger filter at the top is a lead sulfide infrared radiation detector. It produces a voltage proportional to the amount of infrared radiation reaching it from the other Infraphone. This audio voltage is amplified by transistors in a printed circuit and fed to the earphone. As you can see, each unit is a combined transmitter and receiver; so with a pair of them aimed at each other, you can carry on a conversation as if you were using the telephone."

"By golly, that should do it!" the chief exclaimed; "but you two will have to work the gadgets. Now here's what we'll do—"

WELL BEFORE NOON the next day, Carl and his Infraphone were installed in the room the police were using. It had a bay window that jutted out over the sidewalk and permitted observers to look down on the heads of the people below. A radio operator and two officers with binoculars were also in the room.

A good hundred yards down the block, on the same side of the street, Jerry was parked in a spot that gave him an unobstructed view of the bay window. His Infraphone, apparently lying casually on the dash, was carefully aimed at the bay window. Chief Morton was hunkered down out of sight in the back seat of the car wearing an extra earphone that Jerry had connected to his unit.

Jerry was careful not to pay attention to the people passing by. As he gazed across the street, he noticed a large mirror display in a shop window that gave him a good reflected view of the buildings and sidewalk on his own side.

Time went slowly while they waited, but finally a church clock struck twelve. People began pouring from the office buildings.

Jerry reached over and fastened the trigger of his Infraphone back with a clip. A hissing sound told him the receiver was working, and a few moments later Carl's voice came in loud and clear:

"Rossi just left the hotel . . . he's walking your way . . . the guy on the radio is telling him to walk slowly, and he's telling the pusher to hurry up. We're trying to spot the pusher. Now the radio guy's saying the coast is clear . . . they're to make contact . . . oh, oh! . . . I think we've spotted the pusher. A fellow just hurried past Rossi and then slowed down . . . we're looking right down on them. Yep, that's the guy. Rossi dropped a package into his pocket. Here's what your man looks like. . . ."

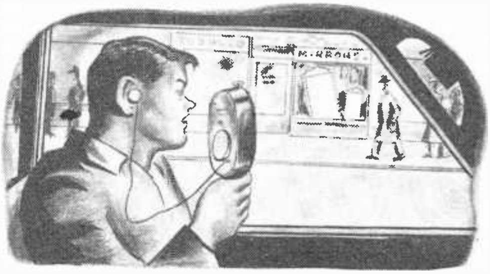
At this instant the voice stopped abruptly as a huge furniture van pulled into the curb in front of Jerry's car and cut the infrared beam entirely.

"What's wrong?" the chief fumed from

the rear of Jerry's car. "Do something, quick!"

Jerry grabbed up the Infraphone and looked around desperately. Suddenly he lowered the small red transmitter filter with his thumb and aimed the bare beam from the bulb across the street at the mirror display. He frantically worked the trigger on and off.

"Jer, is that you flashing the light in the mirror?" Carl's urgent voice suddenly came through the earphones. "I'm aiming at it. Can you hear me?"



"Yes, yes!" Jerry answered, as he slid the filter back in place. "Give us the description."

"He's a tall man with a little mustache wearing a black Homburg hat and dark overcoat. He's walking along the curb almost up to you—"

"Now!" Jerry shouted, as out of the corner of his eye he saw a man fitting this description coming past the side of the furniture van. Chief Morton literally exploded out the back door of the car and wrapped his strong arms around the stranger before the latter knew what was happening.

TRIUMPHANTLY the chief took a package from the man's overcoat pocket and tore it open to reveal the brown-paper cigarettes. A few minutes later two more policemen came up with Rossi between them, and the two prisoners glared balefully at each other.

"You and your foolproof system!" the man in the Homburg grated. "I'm not taking the rap for this. Some low-life ratted on us. I'm going to sing plenty."

"You know, Jer, he's right," Carl said as the boys drove away. "Something low-down *did* trip them up. It was away down below the red," he finished with a grin, and patted the Infraphone in his lap. —30—

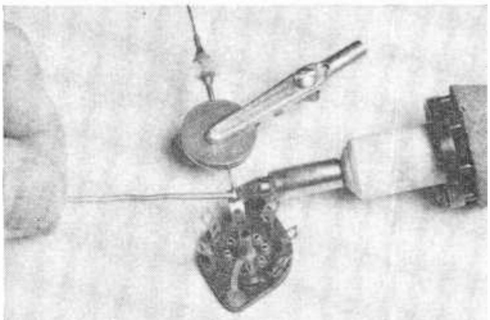
(Continued from page 38)

tool will be turned off the instant you release your foot.

—*Glen F. Stillwell*

HANDY HEAT SINK

Before you solder heat-sensitive components, clamp a couple of pennies on their leads with a small alligator clip. Since copper is a fine conductor, the pennies will serve as a heat sink and will pro-

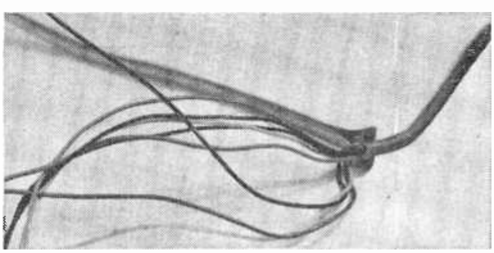


tect diodes and transistors from the heat of your soldering iron. The heat will not harm the coins either, but you can use a couple of scraps of copper instead if you wish. Small iron washers will also do the trick, but with reduced efficiency.

—*Art Trauffer*

INEXPENSIVE COLOR-CODED WIRE

Hookup wire is often needed in short lengths and in several different colors. To avoid buying many spools of wire for a small project, simply purchase a few feet of multiconductor cable, slit the cable



jacket down the side, and remove the color-coded hookup wire. The cable can be obtained at most radio parts suppliers for a few cents a foot.

—*H. L. Davidson*

Transistor Topics

(*Continued from page* 86)

signal ground. The emitter of $Q1$ is raised above ground by resistor $R2$. Capacitor $C2$ bypasses resistor $R1$ which serves as a load for the crystal phono cartridge connected to input jack $J1$. The audio signal appearing across $R1$ is in series with $Q1$'s collector bias. Capacitor $C1$ serves to block d.c.

Jack $J1$ is a standard phono jack. Capacitors $C1$, $C2$, and $C5$ are paper or ceramic units, while $C3$ and $C4$ are small mica or ceramic capacitors; working voltages are not critical. The resistors ($R1$, $R2$, $R3$ and $R4$) are all half-watt units. Transistor $Q1$ can be a G.E. Type 2N107 or 2N188A. Any s.p.s.t. switch will do for $S1$. The tuning coil, $L1$, is a standard ferrite antenna coil, such as a Superex "Vari-Loopstick."

The circuit can be assembled on a Bakelite, fiberboard, plastic, or metal chassis, as preferred. Layout and lead dress are not critical. The antenna (*Ant.*) is a short length of flexible wire—from two to no more than ten feet long, as determined by experiment. As with the wireless microphone, the completed unit is adjusted to radiate a signal at a "dead" spot on the broadcast band. However, in this circuit, $L1$'s slug is adjusted to shift frequency.

Transistor Books. General Electric Company has announced publication of the fifth edition of its world-famous "Transistor Manual." Over half a million copies of this publication have been distributed throughout the world since its introduction in 1957, with translations made into Japanese, Spanish, Portugese and Turkish. The latest edition has been expanded to 339 pages, with four new chapters added—on tunnel diode theory, tunnel diode amplifiers, feedback and servo amplifiers, and test circuits. It's available for one dollar from your local G.E. distributor or direct from the Semiconductor Products Dept., General Electric Co., Kelley Building, Liverpool, N. Y.

If your preferences lean towards power transistors, you'll be interested in Motorola's new "Power Transistor Handbook." A 200-page manual devoted exclusively to power transistor theory, circuits, applications, and characteristics, it sells for two dollars through locally franchised Motorola semiconductor distributors.

Overseas News. The Japanese have developed a "voice typewriter" which converts spoken Japanese words into printed form. Developed by Kyoto University's engineering department, this instrument uses 3000 transistors and 6000 diodes.

Anything special planned for February? If you happen to be traveling to Europe, perhaps you'd like to attend the International Symposium on Semiconductor Devices. Sponsored by the Fédération Nationale Des Industries Eléctroniques and organized by the Société Française Des Eléctroniciens et Radio-Eléctriciens, the symposium will be held at the Unesco House, 125, Av. De Suffren, Paris, France, from February 20th through the 25th.

With the importation of radios banned by the New Delhi government, seven firms in India have entered into technical collaboration with foreign firms to manufacture transistor radios. Some of the companies participating are Philips (Netherlands), British General Electric, Gramaphone Company, Murphy Radio, Ltd., and the West German firm of SABA.

Product News. Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) is now offering a nine-transistor personal portable radio at $26.95 (plus postage). Dubbed the "Mighty-9," the receiver operates in the AM broadcast band and features nine transistors and two diodes, including two i.f. stages, amplified a.v.c., and four audio stages.

Electronic Transistors Corporation (North Bergen, N. J.) has announced a line of more than 100 U.S.-made replacement transistors for Japanese receivers.

Minneapolis-Honeywell (2747 Fourth Ave. South, Minneapolis 8, Minn.) has cut the prices of eleven of its transistors. Type 2N538A has been cut from $6.45 to $3.90, and similar reductions have been made for six other triode types and four tetrodes.

Delco Radio Division of General Motors Corp. (Kokomo, Ind.) has introduced a series of high-power tunnel diodes, some of which have peak current ratings as high as 20 amperes!

—Lou

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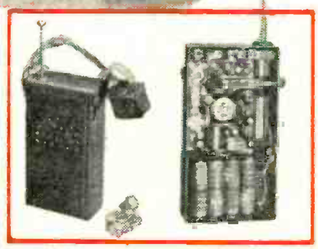

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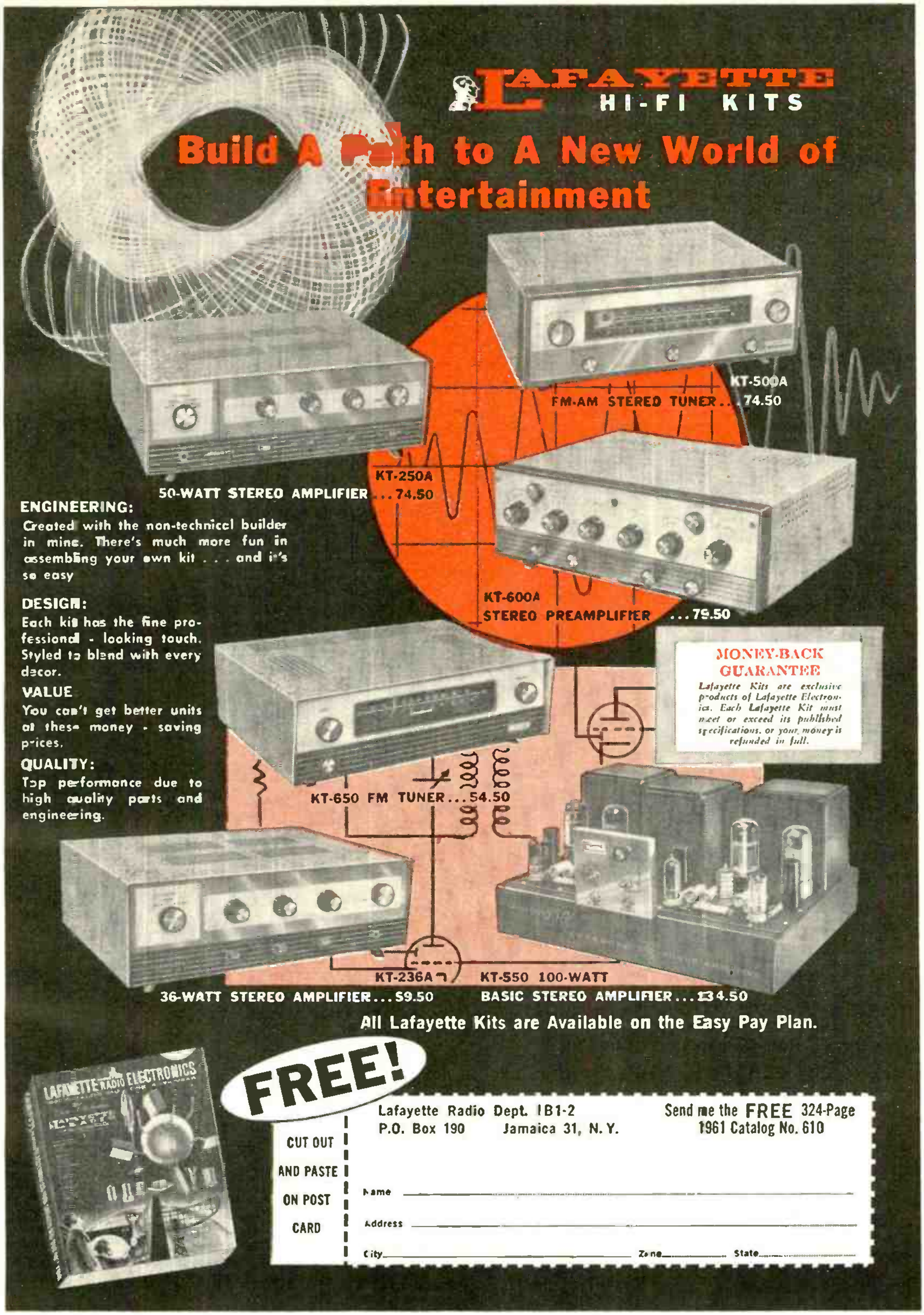
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Introducing the Laser

(*Continued from page* 53)

would be put out of commission by fog, or perhaps even by rain.

But there are ways of getting around this problem. Bell scientists have already demonstrated that laser beams, like microwaves, can be transmitted through hollow pipes or "waveguides." Thus, communications engineers may simply lay waveguides from city to city and literally pipe through huge amounts of information, regardless of weather or other conditions.

What Lies Ahead? As is the case with most new developments, no one knows for sure in just how many ways the laser will turn out to be useful. Dr. Townes predicts that it will push back the frontiers of spectroscopy, revealing further secrets about the basic nature of matter. Distances will be measured with far greater precision than ever before, using Doppler-type radar. And there will undoubtedly be many other as yet undreamed of applications for this newest wonder child in the field of electronics.

When will the laser actually go to work? Although it is still in the experimental stage, it should soon be earning its keep. Out at Hughes Aircraft, Dr. Maiman is investigating laser radar. Because of the extremely narrow width of the laser beam, such a radar would be able to pinpoint the location of a distant target to within a few feet, far more accurately than present-day equipment.

How great an impact is the laser likely to have on the field of communications? Right now, it's anybody's guess. But those in the field make no secret about the fact that they are tremendously enthusiastic about this new gadget. With usable frequencies already badly overcrowded in many regions of the present radio spectrum, any system that promises to open up vast new chunks of space is something to get excited about.

Perhaps the potential role of the laser in communications is best illustrated with a remark made by Dr. R. J. Collins of Bell Labs' laser development team. Said Dr. Collins, "We're not ready to start replacing telephone lines yet. But," he added with a smile, "we're beginning to think about it." —30—

Short-Wave Monitor Registration

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Make .... Model ....

Principal SW Bands Monitored .... Number of QSL Cards Received ....

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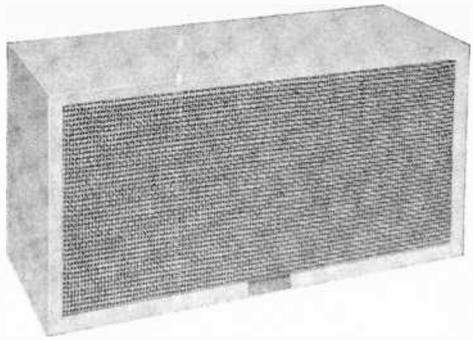

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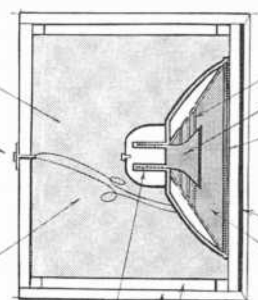

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On the Grid

(*Continued from page* 67)

"I don't know," the Professor said. "It isn't very clear."

"No, but don't forget that record was pretty beat up. With a new record, I'll bet we'll really see something."

Mike reached over and flicked off the master switch. As the soft glow and Pablo Casals slowly faded, he shrugged into his coat and headed for the door.

"Let's not waste any time on that low-fidelity signal source, Prof. I'll buzz down to the record shop and pick up some discs in mint condition." Mike quickly strode out of the room, an expectant smile on his face as he recalled all the interesting record jackets whose contents he would like to examine.

A SHORT TIME LATER, loaded down with records, Mike pushed open the door to the professor's room and stopped in amazement.

Acrid fumes of burnt rubber mixed with hot oil struck him in the face. Some of the furniture in the room was tossed about in wild abandon, and across the floor, rough, black marks seemed to emerge from one side of the gridwork only to inscribe a complete semicircle and converge back into the opposite side. The equipment was still intact and a soft glow was playing over the ionizing grid.

At first he didn't see anyone in the room, and it wasn't until he heard groaning issuing from under one of the upturned chairs that he realized the Professor was still there. Pulling away the chair, he found the Professor clutching his leg and swearing softly in German.

"What the devil happened here?" Mike shouted. "Are you hurt?"

"I think my leg is broken, thanks to your stupid quest for realism," the Professor gasped through clenched teeth. "After you left, I looked around to see if I could find a better record to test the system with. I found one that I had bought just recently to send to my nephew."

As the Professor groaned again and sank back against the chair, Mike stepped over to the still spinning turntable. He reached down, lifted the record off the spindle and read the label: "SPORTS CARS IN STEREO." —30—

Across the Ham Bands

(Continued from page 89)

trol; it is a 15-$\mu\mu$f. midget variable with one rotor and one stator plate removed for increased bandspread. For ease of tuning *C1*, use a vernier dial with it; the Millen 10039 is recommended since this dial has a self-contained gear mechanism and is easier to mount than other types. Ceramic trimmer *C2*, a 35-$\mu\mu$f. unit, is the bandset capacitor. The antenna tuning circuit is peaked with capacitor *C3* which can be a 35-$\mu\mu$f. unit as shown or a 15-$\mu\mu$f. variable capacitor.

Coils *L2* and *L3* are constructed from a B & W 3011, ¾"-diameter Miniductor. Cut 2½ turns for *L2* and 5½ turns for *L3* next to it, without cutting the plastic between them. Unwind ¼ turn from both ends of each coil, and bend the ends at right angles to the coils for connections. Remove the unwanted portion of the coil stock by cutting the plastic retaining it.

Drill a pair of ⅜" holes in the chassis near variable capacitors *C1* and *C3* to pass leads between them and the tube socket. The fixed capacitors and resistors are supported by their leads, and all ground connections are made to solder lugs placed under the nearest mounting screw.

Use a 5-contact terminal strip for the converter's heater and plate power connections and for the r.f. output leads (*L5*). The converter's antenna coil (*L2*) should be connected to a separate two-lug terminal strip. If your receiver and antenna are fitted with coax connectors, use two coax connector jacks on the converter, one for *L2* and one for *L5*, instead of the terminal strips.

Operation and Alignment. Connect the converter's output to your receiver through a length of RG-58 or RG-59 coaxial cable. Tune the receiver to about 7 mc. with the BFO on. Then connect a

VACUUM TUBE QUIZ ANSWERS

1. F Triode
2. H Kinescope (magnetic deflection type)
3. G Diode
4. E Pentode
5. C Electron-ray "tuning eye" (6E5)
6. A Tetrode
7. B Kinescope (electrostatic deflection)
8. D Pentode with remote cutoff grid

6-meter antenna to the converter. Set capacitors *C1* and *C3* to mid-range and put *L4*'s slug half-way in. Place a grid dip meter (GDM) or other signal source tuned to 52 mc. near the converter, and adjust *C2* with a non-metallic alignment tool until you hear the GDM signal in the receiver. Now move the GDM away from the converter to reduce signal strength and adjust the slug in *L4* for maximum signal strength.

To operate the converter, tune in signals with *C1* and adjust *C3* for peak signal strength. You'll find that *C3* tunes fairly broadly and doesn't require readjustment when *C1* is retuned slightly.

News and Views

Steve Peitzman, KN3LSI, reports that Dick, KN5CGI, mentioned in last November's "News and Views," takes his QSL's seriously. Steve worked him last spring. When he didn't get a reply to his QSL, he sent Dick another one, in a follow-up letter. So Dick phoned all the way from Texas to tell Steve that he had sent one card, which must have got lost, but would send another! Steve's states-worked record is 38, with 36 confirmed. His best DX is the Panama Canal Zone, KZ5. Being secretary of the Central High School "807" Society cuts down on his on-the-air time. . . . Another **Steve, KN4WVT,** reports that Cave Spring High School, Roanoke, Va., is well represented on the 80-meter Novice band with KN4YDS, KN4YDR, KN4YAM, and KN4WVT; a fifth student is waiting for his license to arrive. They all have Heathkit DX-40 transmitters. . . . If you worked 5A3TF in North Africa between September, 1957, and April, 1958, and did not get a QSL card, send your card and QSO data to **George Wlodarski, K8ABR,** 4337 289th St., Toledo 11, Ohio. *He* was 5A3TF—see photo on page 88.

Bill Crews, KN4ZDT, 1301 "G" Ave., West Columbia, S. C., has worked 28 states and Australia in two months on the air. He operates on 15 and 40 meters, transmitting with a Knight T-50 feeding a 40-meter doublet and receiving with a Hallicrafters S-85. He worked the VK (Australia) on 15 meters one night when the band seemed "dead." . . . . **Steve, K5CZW,** points out that someone's typewriter slipped in November "News and Views." Doug, KN7LEL, has a Hallicrafters SX-100, not a Heathkit receiver. . . . **Craig Cool** dug up a 30-year-old RCA-Victor 87T "all-wave" receiver and has logged over 800 hams in all states with it.

Larry E. Reagan, Jr., WV6NQF, 4633 Hazelbrook Ave., Long Beach, Calif., runs 75 watts to his Globe Chief Deluxe transmitter to excite a 15'-high antenna on 40 meters only. He receives on a Heathkit AR-3, plus a QF-1 Q-Multiplier. In two months on the air, he has worked 70 stations in four states. He is already a member of the Rag Chewers Club, proving that he's not a DX chaser. . . . **Jim Fenstermaker, K9TZH,** 4405 Dodge Ave., Ft. Wayne, Ind., transmits on a DX-40 and receives on a National NC-98. Dipoles for 40 and 20 meters, and a 3-element, 15-meter beam take care of his antenna problems. He has all 50 states worked and confirmed, and 48 countries worked, in just about a year on the air. Jim also has 43 states on phone.

Jim Briley, KN5DYZ, 1100 Ruth Ave., Austin 5, Texas, did not include a "brag list" with his report. But he works 80 and 15 meters with his T-50 transmitter and Span-master receiver. He especially likes to rag-chew on 15 meters. . . . **Harry Leiser, WV2MEW,** 884 West End Ave., New York 25, N. Y., proved to himself that the early bird gets the worm by getting up very early one morning and working KH6DNO on 40 meters at 4:00 a.m. He got an RST599 report and has the card to prove it. That same morning he worked California. A 200'-high dipole—Harry must live in a skyscraper—may help his EICO 720 transmitter and National NC-125 receiver. He has 25 states worked and is waiting for his General to come. . . . **Mike De Paolis, K3LKA,** 535 Graham St., Allentown, Pa., closed out his Novice career with 25 states and Canada worked. Twenty-one of the states were confirmed. His equipment includes a DX-40 transmitter and a Hallicrafters SX-99 receiver, aided by a home-built Q-multiplier. Now that his General Class license is on the way, he is planning to build a VFO and possibly a 15-meter beam.

Norman Kelley, WA2KNH, 3 Golton Rd., New Hartford, N. Y., spent the three months between getting his Novice and General Class licenses in working 25 states. His tools included a Heathkit DX-20 and a DX-35 transmitter, an AR-3 receiver, and a 40-meter dipole, 40' high. Norm now has a Hallicrafters SX-100 receiver and is assembling a new Heathkit DX-60 transmitter. . . . **Al Bagdon, KN9YJQ,** 5546 S. Nottingham Ave., Chicago 38, Ill., calls himself a 40-year-old Novice and has enjoyed every minute of the five months he has been on the air. Al operates an Elmac AF-67 transmitter, for which he built the power supply, and a SX-99 receiver. His antenna is a 32' 6" vertical constructed of heavy-duty, aluminum conduit; Al uses a loading coil with it for 80 meters. He has worked 30 states, with 27 confirmed. . . . **Howie Berlin, KN3NEZ,** 207 W. 38th St., Wilmington, Del., uses a home-built, 50-watt transmitter and a "surplus" BC-348 receiver. In spite of antenna problems, he has worked nine states in about six weeks on the air.

Ranny Chitwood, KN4VBS, Box 138, Wytheville, Va., is getting the most out of his DX-20 transmitter and AR-3 receiver, plus Q-multiplier. To prove it, he has worked 42 states, England, Puerto Rico, Panama Canal Zone, Morocco, Venezuela, Bermuda, Canada, France, and Germany. His antenna is a simple 40-meter dipole, and he likes 15 meters.

That does it for this month. Don't forget to send in *your* reports and pictures.

Herb, W9EGQ

The Flexiformer

(*Continued from page* 62)

winding data by using the following three steps. Let's check out Table 1 by computing the values for a 5-volt output.

1. Adding 25% of 5 volts to 5 gives 6.25 volts.
2. Dividing 6.25 volts by .3 gives 20.8 turns (nearest whole turn is 21 turns).
3. Dividing 150 amperes by 5 gives 30 amperes.

Since the smallest wire size that can handle 30 amperes is #10, you simply wind 21 turns of #10 wire on the Flexiformer—and you have a 5-volt, 30-ampere transformer, custom-tailored to your specifications.

The secondary can be wound by simply threading the wire through the center hole, around the outside of the unit, and through the hole again.

Current Transformer. To use the Flexiformer as an accurate current transformer, you merely thread the current-carrying conductor through the center hole, and connect a 0-1 ampere ammeter between the terminals of the primary winding. The ratio then becomes 400 to 1. If a 400 to 1 ratio is too high, you can lower it by looping the a.c. lead around the core. Table 2 lists several ratios and turns required.

There are many useful variations of windings which can be applied to the Flexiformer. For instance, a center-tapped winding can easily be obtained by applying two identical windings to the Flexiformer and connecting the end of the first winding to the start of the second. Then a lead is brought out from this connection as the center tap.

MAXIMUM CURRENT (Amperes)	NUMBER OF TURNS	RATIO
400	1	400
200	2	200
100	4	100
50	8	50
25	16	25

Table 2.

In addition, a one- or two-turn secondary winding of heavy wire can provide a high current source for checking the current-carrying capacities of soldered connections and contacts. —30—

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An introductory text on the fundamentals of electricity and electronics for technicians in radio, television and industrial electronics. $9.25

2511. UNDERSTANDING RADIO, 3rd Ed., Watson, Welch and Eby

For those with little or no technical knowledge who wish to know the fundamentals of radio theory and servicing. $8.25

2404. FM RADIO SERVICING HANDBOOK, King

A practical guide to FM V.H.F. receivers, their design, construction, alignment and repair. $5.00

2442. BASIC ELECTRONIC TEST INSTRUMENTS, Turner

Over 60 instruments described, their uses fully explained, and valuable work-saving short-cuts outlined. $6.25

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Up to date discussion of installation, servicing and repair of T.V. receivers designed for the practicing serviceman. $8.[illegible]

2407. HOW TO GET AHEAD IN THE TELEVISION AND RADIO SERVICING BUSINESS, Marcus

Shows the easy way to get started as a TV-Radio repairman, how to earn while you learn, how to get and keep customers. $3.50

2415. MANDL'S TELEVISION SERVICING, Mandl

This standard text book in the T.V. servicing field provides clear descriptions of the fundamentals of T.V., and practical instruction on the diagnosis and correction of typical trouble. $7.50

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2651. MAJOR APPLIANCE SERVICING, Brockwell

Gives essential information for a career in major appliance servicing. Explains methods of repairing appliances, organizing and managing a service business. $5.95

2667. ELECTRIC MOTOR REPAIR, Rosenberg

All details of modern motor repair work. Actual demonstrations of what to do and why. Designed for bench use with a duo-spiral binding that lies flat. $9.25

2011. STEREO & HI-FI DIRECTORY, 1961, Ziff-Davis

New! Over 1200 component listings, 800 photos; latest models, prices! Entire sections on every phase of stereo and monaural high fidelity. $1.00

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Brand new edition. Advanced discussions and instructions on every phase of audio. Special features make this an excellent guide for the advanced audiophile. $1.00

2755. THE PRACTICAL HI-FI HANDBOOK, King

A guide to high fidelity sound reproduction for the service engineer and amateur. Chapters on amplifiers, loudspeakers, pick-ups, microphones, record players, disc, tape and stereo. $5.95

2765. YOUR TAPE RECORDER, Marshall

This book helps to eliminate trial and error under all conditions. Includes illustrations of 55 magnetic recorders with specifications. $4.95

2750. ELEMENTS OF MAGNETIC TAPE RECORDING, Haynes

How to get professional results with tape the way the experts do. Basic techniques, how to splice and edit, how to repair and maintain your recording equipment. $7.95

2752. HIGH QUALITY SOUND REPRODUCTION, Moir

A perfect manual for both the professional engineer and the serious amateur in high fidelity. Complete coverage of sound reproduction in 591 pages. $15.00

2002. ELECTRONIC KITS DIRECTORY, Ziff-Davis Publishing Company

New 1960 edition lists over 750 kits, latest models, prices and features for hi-fi, ham radio, SWL, shop improvement, Citizen's Band, fun and education. $1.00

2006. ELECTRONIC EXPERIMENTER'S MANUAL, Findlay

With a few dollars worth of basic tools and this book to guide you, you can explore electronics experimentation more completely than ever before. 10 big sections. $4.95

2351. RADIO PROJECTS, Marcus

10 easy-to-construct radios described in this book cover the field thoroughly and completely, progressing in difficulty from the simple crystal detector to the superheterodyne receiver. $3.85

2001. 1960 ELECTRONIC EXPERIMENTER'S HANDBOOK, Ziff-Davis Publishing Company

40 projects for home and shop, 20 of which are transistorized. Special section on understanding transistor circuits. $1.00; 2009. cloth, $1.95

2004. HI-FI ANNUAL & AUDIO HANDBOOK, Ziff-Davis Publishing Company

1960 edition. Prepared by the editors of Electronics World. An excellent advanced guide to theory, construction and circuitry. $1.00.

2008. CLASS D CITIZENS RADIO, Sands

First complete book on Citizens Radio operation. Covers Class D history, rules, applications, how it works. Many illustrations. $4.95

2901. HAM RADIO, Hertzberg

Tells exactly how to become a "ham"—how to obtain a ham "ticket," how to learn code, how to select receivers and transmitters—everything you need to know is between the covers of this handy guidebook. $2.50

2907. RADIO OPERATING QUESTIONS AND ANSWERS, Hornung & McKenzie

Presents specific information on radio law, operating practices and theory for those studying to pass the FCC commercial radio operator exams of the various license grades. $6.25

2600. TRANSISTORS, Gillie

Describes and analyzes semi-conductors and transistors and how they behave. 300 pages, illustrated. $7.95

2000. STEREO-HI-FI GUIDE, Ziff-Davis Publishing Company

Just published! 1960 edition features 60-page exclusive by Joseph Marshall on components and how they work. $1.00

2501. ELEMENTS OF ELECTRONICS, Hikey and Villines

This basic electronics text offers an excellent course for training radio and electronics technicians and for students in television, radar and sonar. $6.95

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Short-Wave Report

(Continued from page 90)

The following is a resume of current reports. All times shown are Eastern Standard and the 24-hour system is used. At time of compilation, all listings are as accurate as possible. Stations may change schedule and/or frequency with little or no advance notice. Please send all reports to P. O. Box 254, Haddonfield, N. J., in time to reach your Short-Wave Editor by the eighth of each month.

Bechuanaland—ZNB, Mafeking, operates on 5900 kc. only and not on 8225 kc. as often reported. In South Africa it is heard at 0555 s/on with Morse ID to 0600, music to 0615, relayed news from South Africa to 0635, music to 0700 s/off; s/on again at 1155 with Morse ID, news from Johannesburg to 1220, music to 1430 s/off. On Sundays there is no program at 0555; the later program runs from 1300 to 1430. *(ZSPE1A)*

Canada—The Canadian Broadcasting Corp. carries Eng. daily to Europe at 1530-1600 (1530-1615 Saturdays and Sundays) on 15,320 and 11,720 kc.; to the Caribbean and Latin American areas daily at 1800-1830 on 15,190 and 11,760 kc.; to Eastern and Central areas of Northern Canada daily at 1700-1745, and to Central and Western areas daily at 2000-0205, on 11,720 and 9585 kc. There is also an Eng. mailbag on Sundays to Europe at 1530-1600 on 15,320 and 17,820 kc. *(WPE2DPS, WPE5AWM, WPE6BO, WPE6BPN, WPE6UD, WPE8AGY, WPE9AGB, WPE9IP, WPE9WR, and R. Canada)*

Central African Republic—There are conflicting reports on *R. Bangui.* A letter from the station gives the schedule as 0030-0700 on 9513 kc. and 1245-1500 on 5982 kc. However, the latest SORAFOM schedules show it to be Mondays, Wednesdays, and Fridays at 0030-0130, 0630-0730, and 1145-1500, Sundays at 0200-0700, other days at 0030-0130, 0630-0730, and 1200-1500 on 5035 kc. (4 kw., 0030-1500) and 9515 kc. (4 kw., 0630-0730; Sundays at 0200-0700). *(WPE1BM)*

Colombia—*R. Sutatenza,* Calle 20 No. 9-45, Bogota, is presently testing a 50-kw. xmtr on 5095 kc. and may be in operation on a regular schedule by the time you read this item. In addition, they will operate on 3250 kc. (10 kw.), 6075 kc. (10 kw.), and 5075 kc. (25 kw.). Their schedule reads 0550-0900 and 1350-2210 only in Castellana. *(WPE8MS)*

Congo—Brazzaville was noted on 9605 kc. to 1655 s/off with African music *(WPE1BM).* The 11,725-kc. outlet was noted with Eng. and French news at 2015-2030. On Fridays there is an American Letterbox program at 2030-2045 followed by French lessons to 2100. *(WPE1ARL, WPE2CGG, WPE4SP, WPE6UD, WPE8BZP, VE3PE1BQ, VE3PE6D)*

Dominican Republic—Just at press time we found a new outlet of *R. Caribe,* Ciudad Trujillo, in the 19-meter band at 2000-2030. But a severe aurora display completely wiped out all 19-meter band stations before we could get a frequency check on this outlet—our guess is between 15,200 and 15,250 kc. *(Ed.)*

Ecuador—*La Voz de la Democracia,* Quito, was noted on 6075 kc. (listed as 6070 kc.) at 0325 with a variety program. *(WPE9KM)*

Ethiopia—*R. Addis Ababa* is testing at 1320-1340 with music and requests for reports in Eng. on 11,875 kc. to W. Europe and 15,345 kc. to W. Africa. Reports go to Ministry of Information, P. O. Box 1364, Addis Ababa. *(WPE1AAC, WPE1BM, WPE1BY, WPE1CR, WPE1KO, WPE2AXS, WPE4BKJ/DL4, WPE4HJ, WPE9KM)*

Formosa—*The Voice of Free China,* Taipei, is noted on 11,735, 15,345, 17,785, and 17,890 kc. at 2030-2100 broadcast to N.A. and Hawaii. *(KL7PE1K)*

Germany—*Deutsche Welle,* Cologne, now broadcasts to Japan at 0445-0745 on 17,815 and 15,295 kc.; to Africa at 1215-1515 on 15,275 and 11,870 kc.; to W. Africa at 1415-1715 on 11,925 and 9605 kc.; to Near East (second program)

QSL CARDS FOR YOU?

Your Short-Wave Editor has received a number of QSL cards addressed to WPE call-signs. Check the following list to see if your call is among them. If so, please write us and ask for your cards. A postage stamp included with your request will be appreciated.

WPE1AM	WPE2EC	WPE6AGA
WPE1ANK	WPE2EG	WPE6BS
WPE1AOD	WPE2GY	WPE8BKH
WPE1KR	WPE3ABH	WPE9AKS
WPE1NM	WPE3AGB	WPE9ASN
WPE1NO	WPE3AGE	WPE9BDA
WPE2ABZ	WPE3AU	WPE9FJ
WPE2ATS	WPE3GO	WPE9HC
WPE2BPQ	WPE3UY	WPE9MA
WPE2CA	WPE3ZR	WPE9TV
WPE2CBP	WPE4DV	WPE9UL
WPE2CCO	WPE5LU	WPEØABC
WPE2CFZ	WPE5NM	WPEØACM
WPE2CIJ	WPE5OY	WPEØAQJ
WPE2CSL	WPE5PM	WPEØOI
WPE2DB	WPE6AFB	WPEØOR

Send your request to Box 254, Haddonfield, N. J., and be sure to include your call as well as your name and address.

at 0845-1015 on 17,815 and 15,275 kc. All other xmsns remain unchanged. *(WPE1BY, WPE2AXS, WPE4CGX, WPE6AA, WPE9BVS, VE3PE6D)*

Ghana—Accra gives this schedule: 0030-0300 and 1130-1715 on 4915 and 3366 kc., and 0700-1130 on 4915 and 9640 kc. *(WPE4BMR, VE3PE1BC)*

Greece—The new schedule from Athens reads: to Cyprus at 0200-0315 and 0530-0800 on 9605 and 15,345 kc., and at 1315-1345 on 9605 and 11,720 kc.; to Near Eastern areas at 0400-0500 and 0830-1015 on 11,720 and 15,345 kc., at 1100-1200 on 9605 and 15,345 kc.; to Europe at 1215-1245 on 11,720 and 15,345 kc.. and at 1400-1500 on 11,720 and 9605 kc. English is aired at 1230. *(WPE8HF)*

Honduras—*R. America,* Tegucigalpa, is heard at 6045 kc. (listed as 6050 kc.) at 0000 with ads and pop music. This may be a move to avoid QRM with HCJB, Ecuador. *(WPE9KM)*

Iceland—TFJ, Reykjavik, has definitely moved to 11,780 kc. from 11,785 and 12,175 kc. The program opening at 1455 is seldom in the clear but you might try for the 0815-0925 segment on Sundays. *(WPE1BM)*

Indonesia—A rarely-tuned station is YDR3, Ambon, 3241 kc., noted around 0615 with Indonesian songs and native language. *(WPE3NF)*

Italy—Rome has English as follows: to N.A. at 1930-1950 and 2205-2225 and to N. Africa, Near East, and Malta at 0420-0440 on 11,905 and 9575 kc.; to Australia, New Zealand, and the Far East at 0400-0440 on 21,560, 17,800, and 15,325 kc.; to the Middle and Far East at 0545-0602 on 21,560, 17,800, and 15,400 kc.; to South Africa at 1035-1055 on 21,560 and 17,770 kc.; to Great Britain at 1320-1340 on 9515 kc. Problems of NATO are broadcast on Thursdays at 1255-1302 and problems of "European Unity" on Mondays at 1302-1310 on 9710, 7275, and 5960 kc. *(WPE2BAZ, WPE4CGX, R. Rome)*

Kuwait—Kuwait has been noted on 4967 kc. at 1557 with Arabic chanting; clock chimes at 1600; Arabic ID; then news. The station closed at 1620 with a short march number. *(WPE3NF)*

Lebanon—Beirut is currently on 8022 kc. and was noted at 1655 with Eastern music; closing is abrupt at 1730, often with no announcement. *(WPE4BC)*

Martinique—*R. Martinique,* Fort-de-France, is heard well on 5994 kc. from 0515 s/on with guitar IS and the French anthem until about 0600 when it fades. *(WPE8MS)*

Mauretania—*Radiodiffusion de la Republique Islamique de Mauretanie,* Saint Louis, is scheduled to operate at 0200-0300 and 1455-1845 on 4855 kc. and at 0715-0830 on 9610 kc. They will verify correct reports with a nice letter in Eng. if an IRC is enclosed with the report. *(WPE8MS)*

Monaco—*Trans-World Radio,* Monte Carlo, is operating on 9705 kc. to Great Britain from 1430 to 1745 s/off, mostly with Eng. religious programs. Another outlet is on 7215 kc., heard at 1600-1630. *(WPE1AAC, WPE1BY, WPE1KO, WPE4HJ, WPE9KM, BB)*

Netherlands—*R. Nederland* carries Eng. as follows: to New Zealand and Australia at 0500-0550 on 21,480 and 17,775 kc.; to Africa and India at 0900-0950 on 25,610 and 15,445 kc.; to N.A. and Europe at 1615-1705 on 11,730, 9590, and 6020 kc.; and to N.A. at 2030-2120 on 9590 and 6025 kc. The "Happy Station Program" is radiated on Sundays to the Far East and Europe at 0530-0700 on 21,565, 17,775, and 6020 kc.; to India, Africa, and Europe at 1100-1230 on 21,565, 21,480, and 6020 kc.; to Spain and South America at 1600-1730 on 15,425, 11,950, and 6020 kc.; and to N.A. at 2100-2230 on 9590 and 6025 kc. *(WPE6UD, VE4PE2U, R. Nederland)*

New Caledonia—*R. Noumea,* Boite Postale 327, Noumea, operates on 6035 kc. in French at 1400-1500 and 1900-2100 Monday through Saturday, at 1600-2100 on Sundays, and at 0200-0530 daily. News is given at 1430 and 1455 Monday through Saturday, and at 2000 and

0300 daily. According to M. R. Le Leizour, the director, they will have Eng. early in 1961 for listeners in New Zealand, Australia, Fiji, and the Solomon Islands. *(WPE8MS)*

Nigeria—Eastern Nigeria B/C Service, Enugu, is being noted on 4855 kc. from as early at 1430 to 1730/close, all English. News is given at 1800. QRM from *R. Mauretanie* after 1630 makes it impossible to catch the mailing address. *(WPE1AAC, WPE1BM, WPE1BY)*

Peru—The "traveler," OAX4J, *R. La Cronica,* Lima, is on the move again and currently checks in on 9402 kc., where it is heard at

SHORT-WAVE ABBREVIATIONS

Anmt—Announcement	L.A.—Latin America
Eng.—English	N.A.—North America
ID—Identification	QRM—Interference
IRC—International Reply Coupon	R.—Radio
IS—Interval signal	s/off—Sign-off
kc.—Kilocycles	s/on—Sign-on
kw.—Kilowatts	xmsn—Transmission
	xmtr—Transmitter

1930-2145 with L.A. and native music, ads, and all-Spanish programing. *(WPE9KM, WPEØAE)*

Portugal—*Emissora Nacional,* Lisbon, is heard well on 9755 kc. around 2000 in Portuguese. English is beamed at 0845-0930 on 21,495 kc. to India, Pakistan, and the Persian Gulf area, and at 1215-1300 on 17,895 kc. to E. Africa. *(WPE4BKJ/DL4, WPE8MS)*

Rumania—Bucharest airs Eng. to Europe at 1430-1500 on 9510 and 6190 kc., and at 1600-1630 and 1730-1800 on 7195 and 5990 kc.; to N.A. at 2030-2130, 2200-2230, and 2330-0000 on 11,810, 9570, 9510, 7225, 7195, 6190, and 5980 kc. (9570 kc. not used at 2030-2130); to the Near and Middle East at 1230-1300 on 7195 kc., and at 1400-1430 on 9510 and 6190 kc. A concert is given daily at 1100-1130 on 11,937, 9510, 7195, 6190, and 5990 kc. The Letterbox program is broadcast on the first and third xmsns on Tuesdays. *(WPE2BRH, WPE8BBL, WPE8BJJ, WPEØARS)*

Spanish Guinea—Juan Medem, Director of *Emisora de Radiodiffusion de Santa Isabel,* writes that they operate on 7160 kc. (I heard them on 6240 kc.) with either a 1-kw. or 3-kw. xmtr into either a vertical antenna or a medium-wave dipole. Their schedule reads: 0130-0230 daily except Sundays; 0700-0900 (Sundays to 0930); 1200-1600 Mondays, Wednesdays, and Fridays; 1200-1715 Tuesdays, Thursdays, and Saturdays. *(WPE1BM)*

Surinam—AVROS, Paramaribo, has moved from 15,405 kc. to 15,463 kc. and was noted at 1930 with music. The 4852-kc. channel was also tuned with good signals from 0425 s/on, trumpet fanfares and chimes, then into Dutch. *(WPE8MS, WPE9KM)*

Switzerland—Berne now operates to N.A. at 2030 and 2315 on 6165, 9535, and 11,865 kc. (15,315 kc. has been deleted from the schedule). The Tuesday DX program has been switched to Fridays to avoid conflict with another station. *(WPE1BBB, WPE1II, WPE2DDV, WPE2DJD, WPE3BQQ)*

United Arab Republic—Damascus has moved from 5675 to 5704 kc. and is strong at 1645 with Arabic music and ID; it was also noted at 2325. *(WPE3NF)*

Cairo has moved from 11,940 to 11,915 kc. (announcing as 11,920 kc.), and has been noted at 1530-1700 with German to 1600, Italian to 1630, Eng. to 1700. Another Eng. program (to Africa) was heard at 1650-1715 on 17,690 kc. *(WPE9KM, WPEØAE, JB)*

USA—KEYS, Corpus Christi, Texas, has been heard on or near 26,380 kc. with some remote-pickup relays. *(WPE2ALE)*

Vatican City—*Vatican Radio* has moved from 11,685 to 11,740 kc. for its two Eng. programs at 1000 and 1315. Meanwhile, Tashkent, USSR, has moved slightly to avoid QRM from *Vatican Radio*, no longer on 11,685 kc. *(WPE2BRH, WPE4BC, WPEØAE)*

The transmission to India, Pakistan and Ceylon at 1100-1115 on 17,840 kc. (Mondays, Wednesdays, and Saturdays) is strong most days. This is in English. *(WPE8AGY)*

Clandestine—*R. Cuba Independiente,* 6145 kc., has been heard infrequently from about 1530 to after 1900 with Spanish speeches. *(WPE4HJ)* —30—

SHORT-WAVE CONTRIBUTORS

Stanley Schwartz *(WPE1AAC)*, Bridgeport, Conn.
C. W. Green *(WPE1ARL)*, Pittsfield, Mass.
Richard White *(WPE1BBB)*, Pawtucket, R. I.
Jerry Berg *(WPE1BM)*, West Hartford, Conn.
Alan Roth *(WPE1BY)*, Bridgeport, Conn.
Jim O'Mara *(WPE1CR)*, So. Boston, Mass.
Gregory Killam *(WPE1II)*, Reading, Mass.
Edward Bowker *(WPE1KO)*, Keene, N. H.
Richard Roll *(WPE2ALE)*, Hamburg, N. Y.
Robert Newhart *(WPE2AXS)*, Merchantville, N. J.
James L. Bauer *(WPE2BAZ)*, Forest Hills, N. Y.
Albert Mencher *(WPE2BRH)*, Bayside, N. Y.
Billy Hudzik *(WPE2CGG)*, Plainfield, N. J.
Linda Levine *(WPE2DDV)*, Forest Hills, N. Y.
Joseph Eggert *(WPE2DJD)*, Newark, N. J.
Ed Seeger *(WPE2DPS)*, Haddonfield, N. J.
R. M. Bingaman *(WPE3BQQ)*, Stillwater, Pa.
George Cox *(WPE3NF)*, New Castle, Del.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Jay Worrall *(WPE4BKJ/DL4)*, U. S. Army, Europe
Johnny Futch*(WPE4BMR)*, Nashville, Ga.
A. V. Dunaway *(WPE4CGX)*, Mableton, Ga.
Alan Knapp *(WPE4HJ)*, Roanoke, Va.
Albert Balkema *(WPE4SP)*, Norfolk, Va.
Wesley Hutson *(WPE5AWM)*, San Antonio, Texas
Stewart MacKenzie *(WPE6AA)*, Long Beach, Calif.
Ray Lundquist *(WPE6BO)*, Los Angeles, Calif.
Shaler Hanisch *(WPE6BPX)*, Pasadena, Calif.
James Saindon *(WPE6UD)*, Coronado, Calif.
Ronald Luyster *(WPE8AGY)*, Flushing, Ohio
Robert Kipp *(WPE8BBL)*, Detroit, Mich.
Walker Johns *(WPE8BJJ)*, Lima, Ohio
Bill Sweitzer *(WPE8BZP)*, Cleveland, Ohio
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Mike Kander *(WPE8MS)*, Dayton, Ohio
Earl Kinmonth *(WPE9AGB)*, Joliet, Ill.
George Chesley *(WPE9BVS)*, Bloomington, Ill.
Robert Frey *(WPE9IP)*, Niles, Ill.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind
Donald Sullivan *(WPE9WR)*, Villa Park, Ill.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Jack Hubby *(WPEØARS)*, Colorado Springs, Colo.

Edward Tilbury *(KL7PE1K)*, Anchorage, Alaska
Russ Smith *(VE3PE1BC)*, North Bay, Ont.
Ron Walsh *(VE3PE1BQ)*, Kingston, Ont.
Donald Golding *(VE3PE6D)*, Oshawa, Ont.
Jim Roik *(VE4PE2U)*, Winnipeg, Manitoba
Dave Brooks *(ZSPE1A)*, Johannesburg, South Africa
Bernard Brown *(BB)*, Derby, England
John Black *(JB)*, Brunswick, Ga.

R. Canada, Montreal, Que.
R. Rome, Rome, Italy
R. Nederland, Hilversum, Netherlands

POPULAR ELECTRONICS

Advertisers' Index

FEBRUARY 1961

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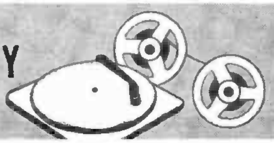

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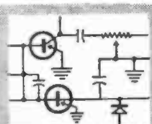

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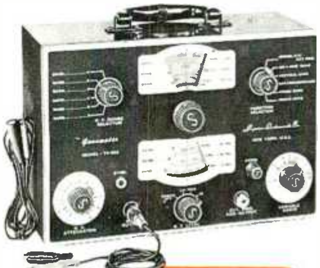

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This Versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

• A.M. RADIO • F.M. RADIO • AMPLIFIERS • BLACK AND WHITE TV • COLOR TV

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency)

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

Complete with shielded leads **$47.50 Net**

Model TW-11—Tube Tester
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

Superior's New Model TW-11 **STANDARD PROFESSIONAL**

TUBE TESTER

• Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity Fuse Types, etc.

• Uses the new self-cleaning Lever Action Switches for individual element testing. All elements are numbered according to pin-number in the RMA base numbering system. Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

• Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Housed in handsome, Saddle-Stitched Texon case. Only **$47.50**

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

MOSS ELECTRONIC, INC.
Dept. D-843 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

☐ Model 88 . Total Price $38.50
$8.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ Model TW-11 .... Total Price $47.50
$11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model 70 ... Total Price $15.85
$3.85 within 10 days. Balance $4.00 monthly for 3 months.

☐ Model 77 Total Price $42.50
$12.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ Model TV-50A .. Total Price $47.50
$11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model 80 Total Price $42.50
$12.50 within 10 days. Balance $6.00 monthly for 5 months.

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Address ....

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

All prices net, F.O.B., N. Y. C.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Model 80 ALLMETER
Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

THE *ONLY* 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES *ALL* THE FOLLOWING FEATURES:

- 6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.
- MIRRORED SCALE permits fine accurate measurements where fractional readings are important.
- CAPACITY RANGES permit you to accurately measure all condensers from .00025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.
- HANDSOME SADDLE-STITCHED CARRYING CASE included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

SPECIFICATIONS:

7 D.C. VOLTAGE RANGES
(At a sensitivity of 20,000 Ohms per Volt)
0 to 15/75/150/300/750/1500/7500 Volts.

6 A.C. VOLTAGE RANGES:
(At a sensitivity of 5,000 Ohms per Volt)
0 to 15/75/150/300/750/1500 Volts.

3 RESISTANCE RANGES:
0 to 2,000/200,000 Ohms. 0-20 Megohms.

2 CAPACITY RANGES:
.00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES
0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 DECIBEL RANGES: — 6 db to + 18 db. + 14 db to + 38 db + 34 db to + 58 db

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only **$42.50**

Model 77—VACUUM TUBE VOLTMETER. . Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Superior's New Model 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to *any* peak-to-peak V. T. V. M. made by *any* other manufacturer at *any* price!

- Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Employs a 12AU7 as D. C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
- Meter is virtually burn-out proof. The sensitive 400 micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, Intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

SPECIFICATIONS

- DC VOLTS—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance.
- AC VOLTS (RMS)—0 to 3/15/75/150/300/750/1,500 volts.
- AC VOLTS (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts.
- ELECTRONIC OHMMETER—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms.
- DECIBELS: -10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v).
- ZERO CENTER METER—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle. Only....... **$42.50**

TRY FOR 10 DAYS

BEFORE you buy! *THEN* if satisfactory pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

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