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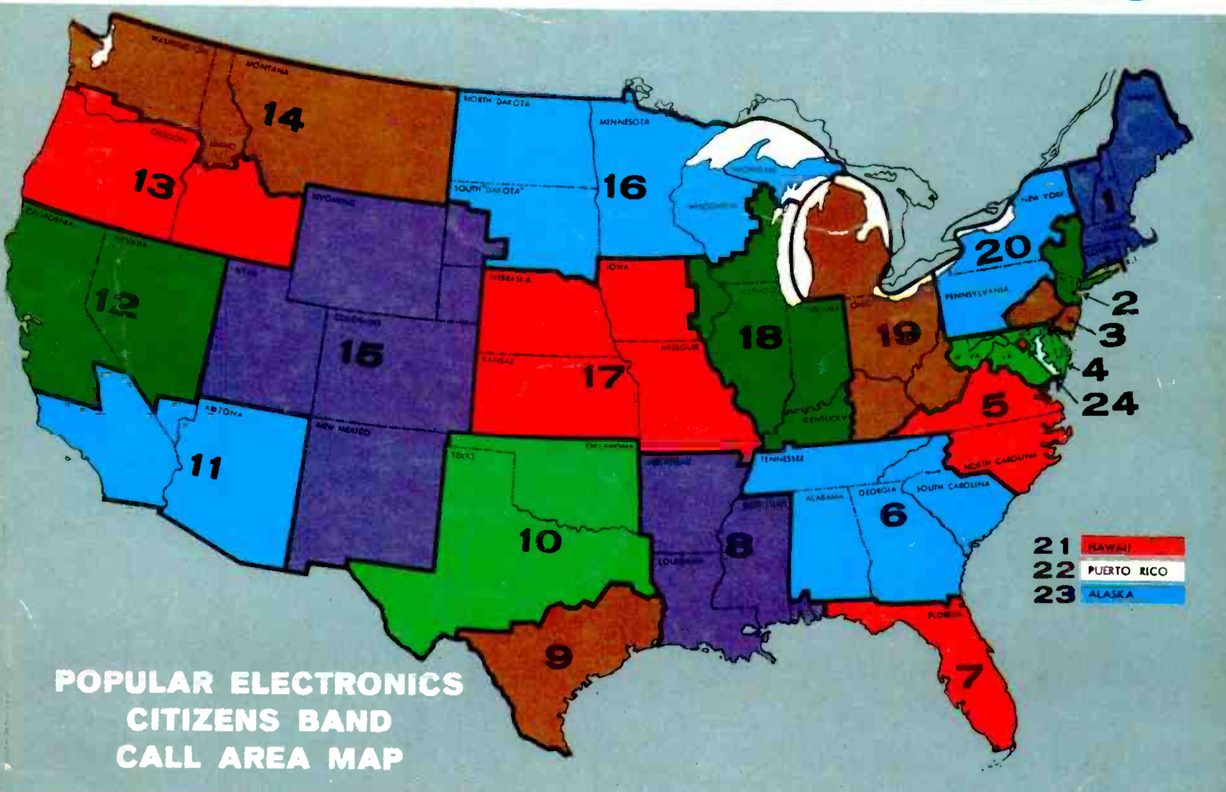

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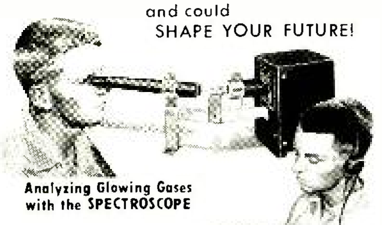

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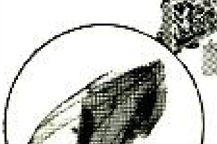

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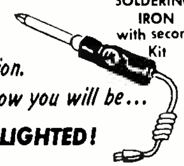

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POPULAR ELECTRONICS

NOVEMBER 1960

VOLUME 13 NUMBER 5

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JULIAN M. SIENKIEWICZ, WA2CQL

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Notes from the Editor

CB AND HAM RADIO. For some time now, I've been pretty thoroughly lambasted from two quarters about the shortcomings of Citizens Radio. Hams say that CB was never intended to be just another ham band. And commercially oriented CB users claim that they can't work through the interference created by dozens of stations simply chit-chatting.

It should go without saying that CB was developed by the Federal Communications Commission with the very best of intentions. Briefly, Citizens Radio was devised to give radio channels to low-budget commercial interests and to private individuals who could show a need for short-range transmitting and receiving facilities. Yet few will deny that something has gone wrong.

In attempting to evaluate why something went wrong, we must consider that interest in electronics as a hobby has far exceeded the most ''educated'' guess of five years ago. Hobbyists and electronics experimenters have been eagerly searching for an outlet where they could have active participation. Shortwave listening is fine—tens of thousands take part in it. And many more thousands are engaged in building gadgets in basement workshops all across the country. But Citizens Radio provides all the ingredients of active participation desired by even the embryonic experimenter. The CB'er experiments with antennas, dual-conversion receivers, mobile installations, and so on. He has the feeling of doing something that shows tangible results.

Viewed in this light, can anyone legitimately criticize the present status of CB activity? My answer is no. I refuse to look on the gloomy side of CB, and my reasons are simple. Sure, the channels are crowded and interference is severe. But maybe this is a good thing—if those CB'ers who want to chit-chat are gradually being weeded out and come to look at ham radio as the next logical step.

In short, the benefit reaped by active participation in Citizens Radio has unwittingly done more to enlarge our nation's reservoir of electronics technicians than any single planned or operating educational program. I say that if only one out of every ten CB operators is sparked into studying electronics more thoroughly, or stirred into getting a commercial or ham ticket, the country as a whole has gained.

Oliver P. Ferrell

FCC Report

By **ROBERT E. TALL**
Washington Correspondent

CB and Civil Defense

THE Federal Communications Commission says that there is a "large degree of misunderstanding" regarding the use of the Citizens Band for civil defense activities, and is answering all inquiries on this score with a pat four-point statement.

The basis for the Commission's statement is Section 19.93 of the CB rules, which provides that stations may be used "for the transmission of messages relating to civil defense activities in connection with official tests or drills conducted by, or actual emergencies proclaimed by the civil defense agency having jurisdiction over the area in which the station is located . . ."

First, the agency points out, it must be kept in mind that civil defense is an official federal and state activity. Civil defense operations are controlled by the states, although there are degrees of delegation of the functions to county and city governments. This means that there cannot be "proper" participation in civil defense communications activities in the Citizens Service by individual citizens or private organizations except as "approved, directed, and supervised by the proper state or local governmental authorities."

Secondly, any civil defense use of the Citizens Band is limited by the rules to operations initiated and directed by the civil defense authority responsible for the particular locality.

Third, the Part 19 rules do not authorize the "routine and continuing use" of CB stations for civil defense communications purposes by anyone except official civil defense organizations properly licensed in the Citizens Service.

Fourth, any civil defense operation during test drills or actual emergencies by any station, even if it is licensed in the name of

a civil defense organization, must be reported to the FCC. Also, any such operation is subject to the agency's Conelrad rules.

The FCC points out that applications from "bona fide" civil defense organizations for Citizens Band facilities "must clearly show their official connection with the sponsoring governmental agencies," and all applications should be submitted in the name of the governmental subdivision having responsibility for the activities of the civil defense organization involved, and must be signed by the governmental official in charge of the activities.

Where privately owned Citizens Band equipment is to be used for civil defense purposes, either under individual licenses or under the license held by a civil defense organization, three additional things must be considered: (1) The licensee must have and maintain control of the station at all times when it is being operated; (2) not more than one person can be eligible as licensee of the same transmitting equipment; (3) except in emergencies or for civil defense, no station in the Citizens Band can be used for the transmission of any communications other than those concerning the business activities or personal affairs of the licensee.

On the third point, the FCC explains that while equipment owned by and licensed to an individual may be used for civil defense purposes, equipment licensed to a civil defense organization can only be used for messages of a personal or business nature *directly* related to civil defense.

The administration of the Citizens Service by the FCC has changed hands due to the retirement of Glen E. Nielsen, veteran FCC engineer, after 31 years of federal service. Mr. Nielsen had been serving as Chief of the Commission's Land Transportation Radio Division, and the Citizens Service had been under his wing, as far as the initiation of rule changes and policy interpretations were concerned.

Ivan H. Loucks, who had been serving as Assistant Chief of the division, was named Acting Chief, and is expected to advance formally to the top spot in the division when the Commission takes action on the vacancy. Mr. Loucks, in government service since 1931, joined the FCC in Washington in 1938. He has been active in amateur radio affairs since 1926, and served as Chief of the FCC's Amateur Radio Branch in 1951 and 1952. —30—

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Letters from our readers

FCC Rules Price Change

■ Although author Lee Craig states on page 47 of your August issue that a copy of Part 15 of the FCC Rules can be purchased for $1.25, he seems to be out of date. The FCC Rules and Regulations are no longer sold separately. Part 15 is now contained in Volume 2 which is sold for $2.00.

Carl A. Clark
Concord, N. H.

Carl is 100% right: Part 15 is not sold as an individual item any more. Incidentally, Volume 2 is available only from the U.S. Government Printing Office, Washington 25, D. C., and not from the FCC.

SWL Call Book

■ I agree with Don Lamprey (July *Letters from Our Readers*) that Popular Electronics is like a club, and I would sure like to see an "SWL Call Book" based on your monitor registration program.

Richard Dilley, VE2PE2P
Pointe Claire, Que., Canada

■ If you publish a list of SWL monitoring stations, please be sure to send me a copy of that list. I would like to exchange cards with other monitors. I think that most hams would appreciate the availability of such a list as well. Several hams I know of have been QSL'd by a monitor, but were unable to reply because of the lack of an address.

James L. Boyer, WPE8BVI
Pontiac, Mich.

Although no specific plans have been formulated to release an SWL Call Book, the idea is being examined by the Popular Electronics *editorial staff. The total number of SWL's registered is now around 20,000. By the time this item is being read, we will probably be asking the first 10,000 monitors to bring us up to date on their equipment, QTH, veries, etc.*

Odd Sounds on CB Band

■ While you could probably make up an interesting article about the various types of interfering signals heard on the 27-mc. Citizens Band, you may be able to enlighten me through your "Letters" column. There seem to be four main types of interference:

Interference A: A severe hum seems to be cen-

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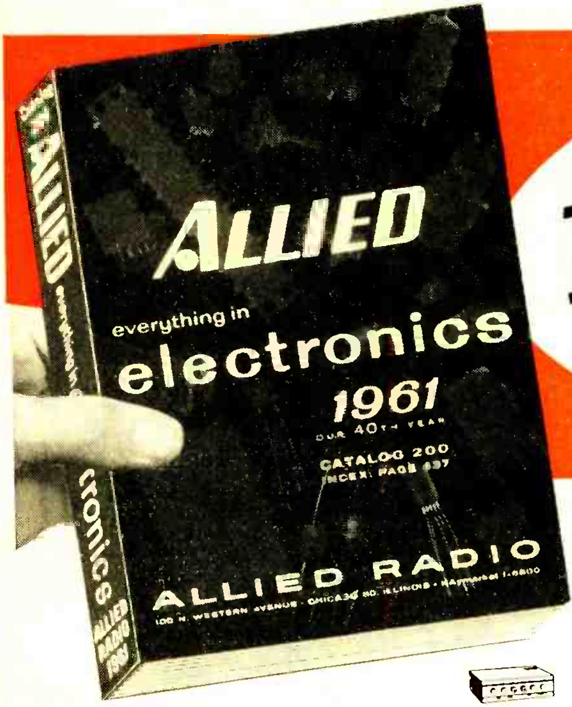

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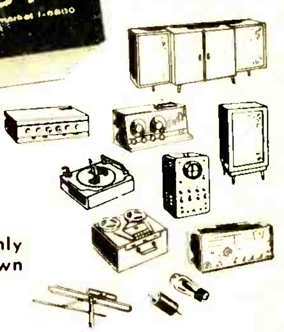

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Letters

(*Continued from page* 12)

tered around channel 14 in my locality. How come?

Interference B: Whistles and "growling" occur when a lot of stations are on the air simultaneously. Is there any way of getting rid of them?

Interference C: "Beep-bop" tones of different audio frequency combinations on strong carriers seem to come and go at all times of the day. What are they?

Interference D: So-called DX or skip signals come into Chicago from only one direction. Shouldn't they come from all points of the compass?

RAY EIDUKAS, 18A5609
Chicago, Ill.

Ray's letter is a very interesting one which we feel deserves a complete answer.

Interference A is caused by the medical diathermy equipment licensed to operate around 27.12 mc. (or near channel 13) with plus or minus frequency variations extending from 26.96 to 27.28 mc. We understand that most new diathermy equipment is being operated near channels 13 and 14.

The low-note growls of interference B result when two or more transmitters are operating on the same channel and their crystals are not exactly "zero-beat." Higher pitched whistles are due to heterodyning from stations operating simultaneously in adjacent channels. There is nothing to be done about the growls (CB is on a shared-channel basis), but the whistles can be curbed by improved receiver selectivity.

Interference C is due to radio-control devices and may be between channels 3-4, 7-8, 11-12, 15-16, 19-20, or right smack on channel 23. Such devices include model airplanes, traffic lights, etc.

Skip interference (D) generally comes from distances of from 400 to 1200 miles, but mainly around 600-700 miles. It is a seasonal interference which reaches a peak in June and July, and again in December. This interference will come from the direction of greatest CB activity within the area involved; thus, from Chicago, it should be more to the east and south than to the west—never to the north.

"Min-O-Scope" Price Change

■ On page 42 of the August issue, you say that the 1CP1 is available from Electronic Tubes Ltd. for $8.40 postpaid. I wrote them and enclosed a

Letters

(*Continued from page* 14)

check for that amount, but they asked me for more money. How come?

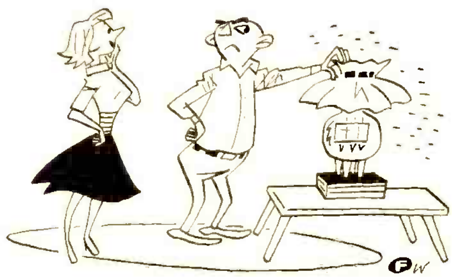
BILL JENKINS
Jeffersonville, Ind.

To Bill, and many other constructors of the "Min-O-Scope," our sincere apologies. Because of a misunderstanding—plus a slight change in the tube type between the time the article was written and published—the price given did not include postage. The tube now being delivered is the 1CP31, and it costs $9.50, including postage to the U.S.A. It is essentially the same as the unit described in our article.

"Radioman's Lamp" Reactions

■ I built the "Radioman's Lamp" (July issue, page 69) and it turned out beautifully. However, I did run into a few problems that some of your other readers might like to know about.

The icepick wouldn't go through the solder in the base pin of the 701A tube I have—it's just not that soft. I used a small hand drill and a



1/16" metal twist drill in all the base pins. Don't try to use a power drill; the 701A won't take much abuse—the elements are liable to collapse or be shaken to pieces.

To circumvent the exasperating job of threading the wires through the tube, I twisted them together and ran them up the tube from the base pin and out the top. By the way, using gray or black wires makes them nearly invisible.

Lastly, the getter starts turning white as soon as the vacuum is released. It flakes and the glass may turn slightly black, but this is unavoidable.

KIM A. BORISKIN, K1PLG
Burlington, Vt.

■ The builder of the "Radioman's Lamp" (and you, the editor) should be reprimanded for allowing such hazardous connections as those in the lamp base to be printed. An open terminal strip with 117 volts on it automatically invites trouble, and twisting electrical tape around bare wires doesn't make for a safe connection.

R. C. NEELY
Mesa, Ariz.

Many thanks to Kim Boriskin for his helpful comments. And reader Neely has a valid point, since our article failed to indicate that a base plate should be attached to the bottom of the metal chassis.

—30—

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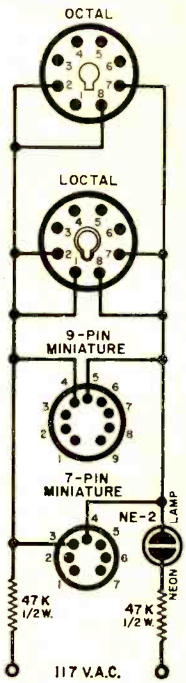

You can make a filament continuity tester from four tube sockets, a neon lamp, a couple of resistors, and a TV a.c. interlock socket (or an ordinary 117-volt line and plug). Mount the parts in a small metal box and wire them as shown. If your TV set develops trouble, disconnect the a.c. interlock line (cheater cord) from the TV set and plug it into the tester. Then plug the tube in the proper socket and look for the glow on the neon lamp—no glow means an open filament. Although the tester will check most tubes, consult a tube manual to be sure of filament connections. —*Salvatore La Manna, N. Tonawanda, N. Y.*

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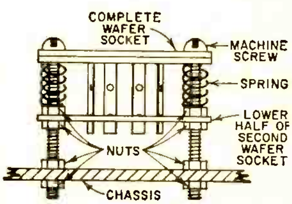

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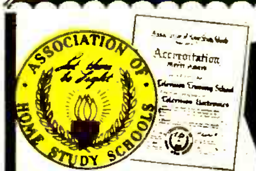

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Tips

(*Continued from page* 20)

the disassembled wafer and align its holes with the terminal lugs on the top wafer socket. Assemble the two with springs and retaining screws, as shown, and mount the assembly on your breadboard or chassis. —*Irving C. Poling, Hermosa Beach, Calif.*

CLEANING PRINTED-CIRCUIT HOLES

When a component is removed from a printed-circuit board, the small terminal holes often clog up with solder. To clean them, simply heat each hole with a small soldering iron and push the point of an ordinary lead pencil into the hole; the solder will flow around the pencil lead and open the hole. Be sure to apply a small amount of heat to prevent damage to the printed wiring and the board itself.—*David Held, Fort Dodge, Ia.*

WATCH THOSE SWITCHES

A salvaged switch mounted on the back of a potentiometer and actuated by the pot's shaft often exhibits a low resistance between terminals when closed. While of little consequence in a 117-volt a.c. circuit, this resistance can prove critical in a low-voltage transistor circuit. Such switches can have resistances of from less than 1 ohm to as much as 30 ohms or more; some-

(*Continued on page* 26)

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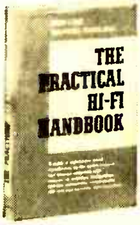

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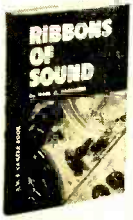

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Tips

(*Continued from page 22*)

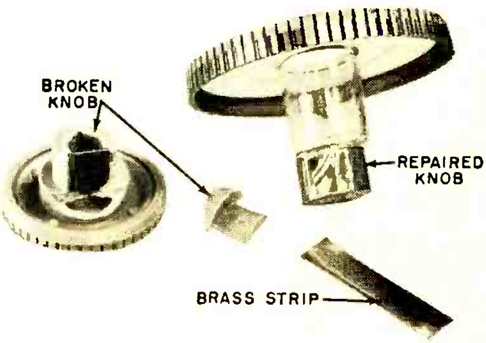
times a slight jar will vary the resistance from 5 to 10 ohms. If a "borderline" switch having an internal resistance of only 5 ohms is put in a transistor circuit draining 150 ma. from a 1.5-volt battery, the current will drop to 100 ma.—seriously affecting the operation of the circuit. The best policy is to test every new or surplus switch before it is used in such circuits.—*Martin H. Patrick, Kulpmont, Pa.*

EMERGENCY PILOT LAMP SOCKET

You can make a handy socket for a pilot lamp by wrapping a few turns of bare wire —No. 14, for example— around the base of the lamp. Push the end of the wire through a hole drilled in a small piece of Masonite; another short length of wire pushed through an adjacent hole will serve as the lamp's center contact.—*J. F. McCleary, San Diego, Calif.*

REPAIRING PLASTIC KNOBS

Most radio and TV sets in current production use special, long-shafted knobs. Replacements are seldom available but you can repair broken knobs by gluing the broken pieces in place with airplane glue or cement. When the cement has hardened, wrap a thin flat strip of brass or copper

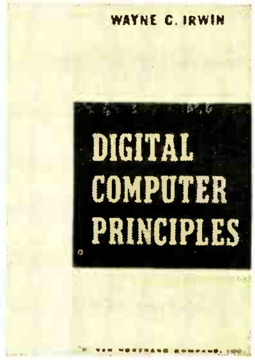


around the broken portion and solder the ends of the strip together. Use a minimum of heat when soldering to prevent damage to the knob. Flat strips of brass can be obtained from automobile parts dealers who sell this material for shimming purposes. —*H. L. Davidson, Fort Dodge, Ia.* —30—

POP'tronics Bookshelf

"DIGITAL COMPUTER PRINCIPLES" by Wayne C. Irwin. Published by D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N. J. Hard cover. 321 pages. $8.00.

This new introduction to the fundamentals of digital computers ranges from basic arithmetic through the operation and programing of general-purpose computers. Written for students and industrial personnel who have had no previous training in computer operation, the book evolved from a training course given by the author at the National Cash Register Company. It begins with a basic discussion of computation methods, including the binary system and the four fundamental arithmetic operations, and then gradually develops each aspect of digital computers. The emphasis throughout is on principles, with examples of circuits, devices, and systems. More than 200 tables and illustrations are included.



"SO YOU WANT TO BE A HAM," Second Edition, by Robert Hertzberg. Published by Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 5, Ind. 188 pages. Soft cover. $2.95.

In this revised and up-to-date edition of "So You Want to Be a Ham," the author explains the various types of ham licenses, tells you where and how to apply for them, and suggests methods of learning and practicing code. The beginner who doesn't know what equipment — receiver, transmitter, converter, antenna, etc.—to purchase will find this book very helpful; it contains criteria for choosing equipment and gives up-to-date specifications and prices on various manufacturers' units. Recommended as a

Bookshelf

(*Continued from page* 28)

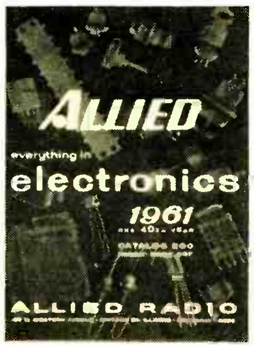
comprehensive introduction to an enjoyable and worthwhile hobby.

"PROFESSIONAL TV REPAIR SECRETS" by Art Margolis. Published by Arco Publishing Company, Inc., 480 Lexington Ave., New York 17, N. Y. Hard cover. 141 pages. $2.50.

A must item for the TV service beginner, this book covers all of the common TV breakdowns in a way that makes them easy to diagnose and fix. Hundreds of TV trouble pictures, symptom and remedy charts, and a master TV trouble chart are included. The book also tells you how to get rid of interference, how to get the best deal on a new picture tube, and how to install lightning protection for a television antenna.

Free Literature

Allied Radio's 1961 catalog of electronic parts and equipment lists over 40,000 items, including Allied's own Knight-Kit line of electronic kits. Equipment covered ranges from stereo hi-fi units to ham rigs; a wide variety of components represent virtually every part of the electronic field. Net prices and shipping weights are given for all items. Copies of the catalog may be obtained on request from Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

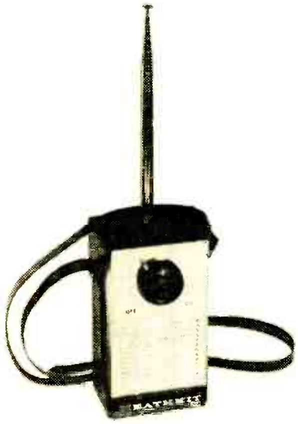


Characteristics and applications of thermistors (thermal resistors) are explained in a 24-page thermistor manual available on request from Fenwal Electronics, Inc., Framingham, Mass. The manual also contains an article on solving thermistor problems, resistance-temperature tables for various types of thermistors, and a cataloging of Fenwal thermistors. Also available is a smaller booklet which lists thermistor probes. —30—

NEW products

PORTABLE CB TRANSCEIVER

A new portable Citizens Band transceiver is available from the *Heath Company,* Benton Harbor, Mich., in both kit and factory - wired form. The unit has a battery-operated, four-transistor circuit, and features a fixed-tuned superregenerative receiver. According to the manufacturer, the crystal-controlled transmitter can be adapted to 10-meter use simply by changing crystals. Enclosed in a black simulated-leather case, the transceiver is equipped with volume control, push-to-talk button, and telescoping whip antenna. Kit Model GW-30 is priced at $32.95 ($64.95 a pair), the fully wired Model WGW-30 at $50.95 ($99.95 a pair).



GENERAL-PURPOSE AUDIO VTVM

A useful piece of hi-fi test equipment is the audio (sometimes called a.c.) vacuum-tube voltmeter. *Simpson Electric Company,* 5200 West Kinzie St., Chicago 44, Ill., now offers a moderately priced ($69.95) unit with all standard ranges from 0.2 millivolt through 300 volts r.m.s., or −40 to +50 db. Model 715 has a high-impedance input and uses ±1% precision multiplier resistors;

(*Continued on page* 36)

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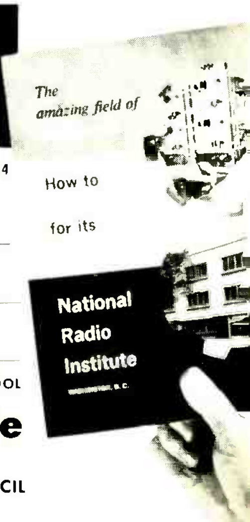

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products

(*Continued from page* 32)

frequency response is nominally flat from 10 to 400,000 cps. Fully portable, the complete unit weighs only 3¾ pounds.

HAM-BAND RECEIVER

A new double-conversion ham-band receiver developed by the *National Radio Co., Inc.* (Melrose 76, Mass.) offers a high degree of selectivity and includes coverage of the 6-meter band. Finished in a duotone

blue with red trim, the NC-270 has a "Flip-Foot" which can be used to tilt the unit from the conventional flat position. Other features include a built-in crystal calibrator, a 6-meter band lateral dial adjustment, and an automatic noise limiter. The receiver measures 8⅝" x 15⅝" x 9", weighs less than 28 pounds, and is priced at $249.95. A matching speaker, Model NTS-3, is priced at $19.95.

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Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y., has introduced a high-impedance dynamic microphone for Citizens Band, ham radio, police, ship-to-shore, public-address, and aircraft use. The PA-77 features a handy slide switch which operates

microphone and relay circuits for transmit and receive switching. Frequency response is 100-9000 cps; impedance is 50,000 ohms. The microphone comes in an attractive impact-resistant polystyrene case with mount-

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630 - 113	15 meters (Amateur) 21 - 21.6 MC
630 - 114	20 meters (Amateur) 14 - 14.4 MC
	15 MC (WWV)
630 - 115	40 meters (Amateur) 7 - 7.4 MC
630 - 116	75 meters (Amateur) 3 - 3.6 MC
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products

(*Continued from page* 36)

ing bracket and 5' single-conductor shielded cable, plus two color-coded switching conductors. Size 3" x 1¾" x 1". Price, $5.95.

CERAMIC STEREO CARTRIDGE

After the success of the Sonotone 8T cartridge, this company is now marketing a new 9T version. Claimed to be virtually free of distortion, the 9T has a frequency response of 20 to 17,000 cps with an output of 0.4 volt. Compliance and dynamic mass permit tracking at 2 grams (in professional-type arms) or 3 - 4 grams in record players. Like the 8T, the new 9T is a turnover cartridge with a sapphire 78-rpm stylus and diamond 33-45 rpm stylus on the flip side. $19.50. (*Sonotone Corp.*, Elmsford, N. Y.)

SIX-HOLE CHASSIS PUNCH

A boon to the experimenter, this chassis punch cuts six different sized holes from ½" to 1⅛" in diameter. Operation involves

drilling a ¼" pilot hole, inserting the pilot rod on the punch, selecting and assembling die and punch, and hammering it through the chassis. The punch costs $4.98 and is available from *"Punches,"* P. O. Box 415, Toledo 1, Ohio.

"PROFESSIONAL" WOOD FINISH

The Watco Danish oil finish, previously available only to furniture manufacturers, can now be used by do-it-yourself'ers. It seals, primes, and finishes wood paneling or furniture, and can be applied to walnut, birch, oak, cherry, teak, mahogany and similar woods, giving them a professional-looking oil, natural, or Danish wood finish. Priced at $2.95 for a quart container, it is also available in 16-oz. Aerosols, pints, and gallons. (*Watco-Dennis Corporation*, 1756 22nd St., Santa Monica, Calif.) —30—

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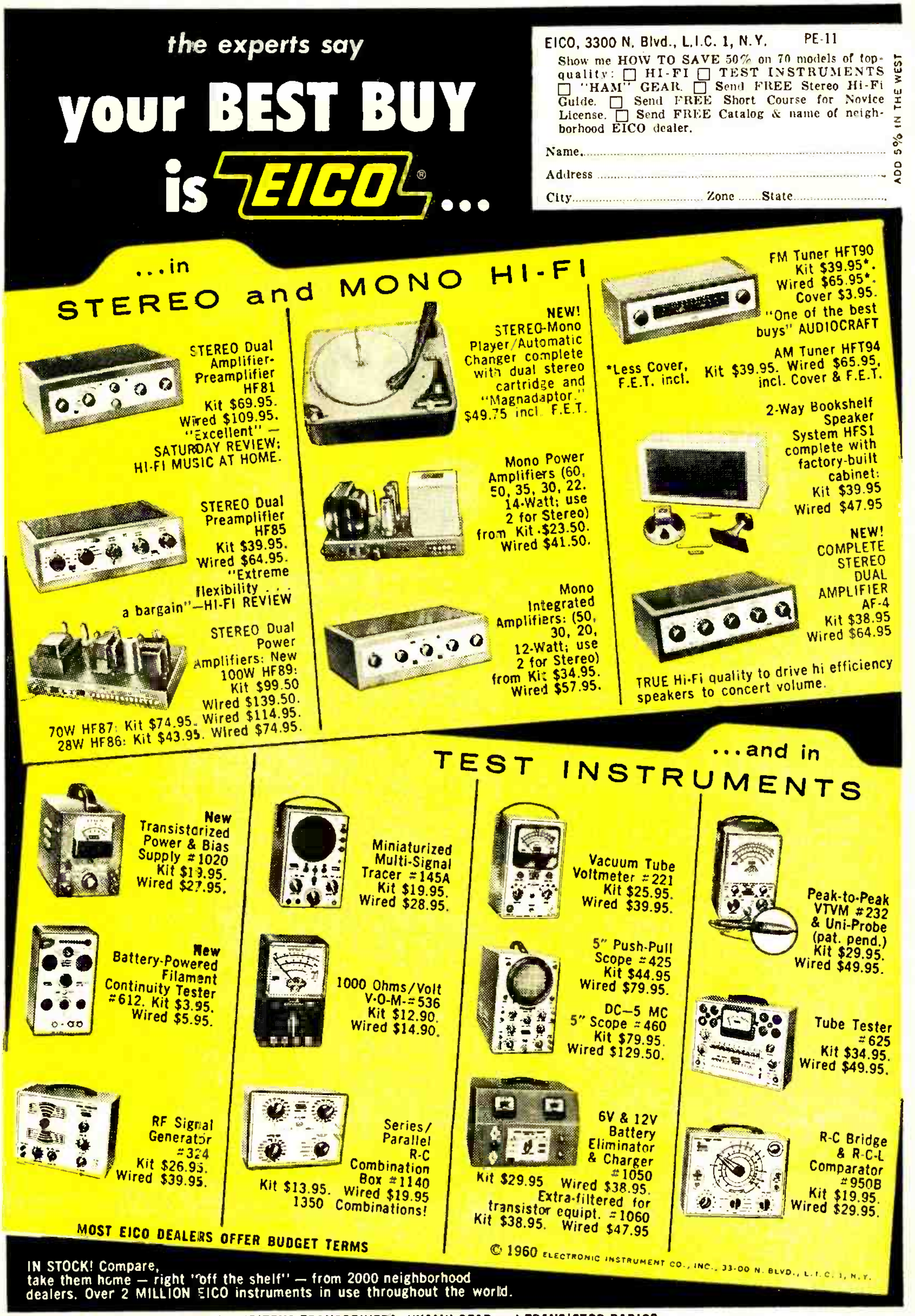
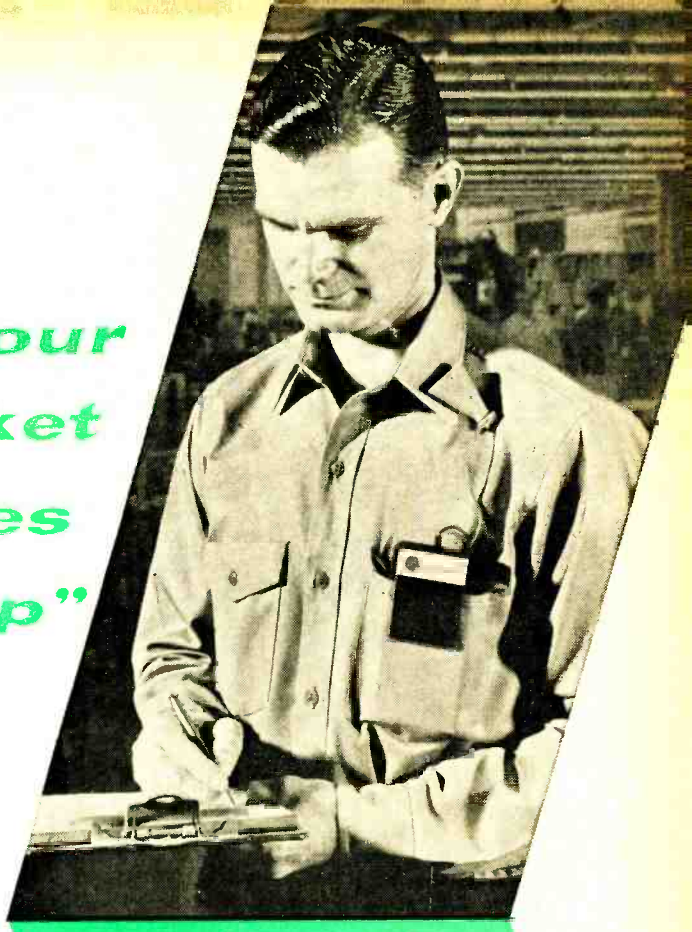


See Page 38 for the BEST BUYS in CITIZENS TRANSCEIVERS, "HAM" GEAR and TRANSISTOR RADIOS

Your Shirt Pocket Goes "Beep-Beep"



General Electric photo

Expansion of radio signaling services heralds new era in personal communications

By
LEO G. SANDS

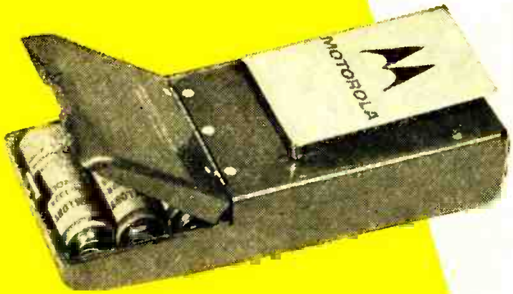
IT MAY not be long before every citizen of the U.S.A. will be assigned a *personal* telephone number. Regardless of where you go, your family or co-workers will be able to reach you by dialing your number.

Already, in Columbus, Ohio, Allentown-Bethlehem, Pa., and Binghamton-Endicott-Johnson City, N. Y., the Bell Telephone System is providing *personal* radio signaling services. What's more, they plan to extend the services to 14 more cities by the end of 1960. Subscribers to the service pay only a $15 per month service charge, which includes rental of a special pocket radio receiver and service on up to 80 signals a month.

If you are a subscriber, anyone wanting to contact you when you are "on foot" or away from routine phone service simply dials *Operator* and asks for the *mobile service operator*. She presses four buttons which cause coded tone signals to be transmitted. These tone signals are intercepted by all of the pocket receivers tuned to the same channel, but only yours goes "beep." This is because the signals match the vibrating reed decoder in your pocket receiver and close the circuit that actuates the "beep." When you hear the "beep," you know someone wants you on the phone. So you simply go to the nearest telephone booth and call the *mobile service operator* or a prearranged number.

The pocket receiver is commonly called a "Bellboy." It is fully transistorized, operates from self-contained mercury cells, and weighs only 7½ ounces. The equipment at the central office is usually a 250-watt amplitude-modulated transmitter operating on a frequency near either 35 or 43 megacycles. Signaling range is about 20 miles.

The receiving antenna is contained in the tiny pocket radio and is therefore less sensitive than a CB or ham quarter-wave whip. In some metropolitan areas, several base transmitters operating simultaneously in different locations are required to saturate the area with a radio signal.



Radio paging receiver is carried by each individual in a remote paging system. This completely transistorized superheterodyne unit, made by Motorola, delivers ½-watt output to built-in speaker.

An encoder, such as the Stromberg-Carlson unit below, enables mobile service operator to contact any person carrying a paging receiver. Signal is picked up by all receivers, but only one "beeps."

Radio paging service is not new; it has been available for several years in many cities. But, here, instead of listening for a single beep, a subscriber holds a tiny pocket AM receiver to his ear, presses a button, and listens to a continuously repeated tape-recorded broadcast of names or call numbers.

If you are a subscriber to the older-style paging service and you hear your name or number broadcast, you go to a telephone and call the base station operator to get the message. It is different with the new "beep" service. You don't have to monitor a station. Instead, you leave your pocket receiver turned on. You hear nothing until the base station transmits the code which actuates the decoder in your receiver.

The Bell System and some independent telephone companies also offer another kind of one-way radio signaling service. A v.h.f. receiver is installed in your car. But there is no loudspeaker or handset. Instead, there is a bell and a call indicator lamp. A decoder connected to the receiver rings the bell and turns on the lamp when the mobile service operator sends out your code signal. Then you go to a telephone and call the operator to get your message.

Recently, Motorola and General Electric have introduced tiny v.h.f. pocket receivers which can be used for paging. They are miniature superheterodynes. The G.E. receiver is available with a tiny horn speaker that is worn on a shoulder harness or clipped to a shirt pocket. The Motorola set is available with a decoder which silences the set except when the call is directed to your personal number. A belt receiver has also been introduced, by RCA, which is being used by police officers directing traffic at the entrance to the Lincoln Tunnel in New York. These sets all employ FM transmission instead of AM as used by the Bell System and other radio paging systems.

You can set up your own radio signaling or voice paging system. A beep-beep system can be operated in the 27-mc. Citizens Band if the base station is licensed as a Class C station. (Six frequencies have been allocated Class C stations: 26.995, 27.045, 27.095, 27.145, 27.195 and 27.255 mc.) If you want to employ radio signaling or paging in

If you are interested in obtaining more complete information on the cost and features of radio signaling service, you can write to:

Motorola Communications & Electronics Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.

Richard Page, General Electric Co., Lynchburg, Va.

Norman Caplan, Radio Corporation of America, Canonsburg, Pa.

F. L. Granger, Stromberg-Carlson, 1400 N. Goodman St., Rochester 3, N. Y.

Robert Feistel, Budelman Electronics Corp., 375 Fairfield Ave., Stamford, Conn.

H. G. Boyle, Shirdan Corp., Rt. 46 at Dye Ave., East Paterson, N. J.

Robert Dollar Co., 50 Drumm St., San Francisco 11, Calif.

American Telephone & Telegraph Co., 195 Broadway, New York 7, N. Y.

connection with a business, you can operate the system in the 25-50 mc. or 150-174 mc. band using AM or FM. Check the FCC rules for specific regulations.

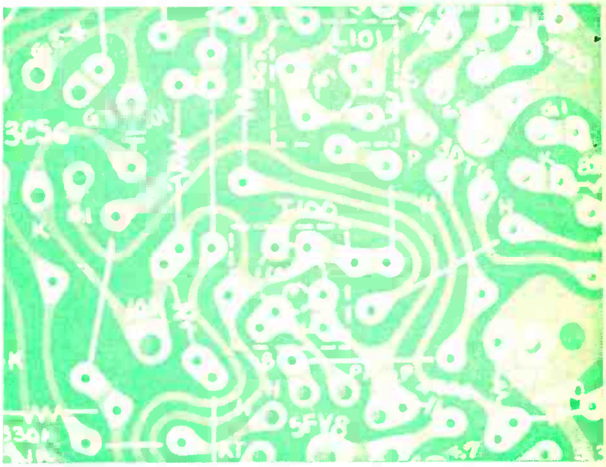
Pocket paging receivers for voice reception (AM) in the 25-50 mc. band cost around $40. Selective beep-beep receivers, such as the Stromberg-Carlson Pagemaster (AM) cost $125 each. The RCA, G.E., and Motorola FM receivers cost more. Base station equipment runs from $75 for a CB unit to more than $2500 for a professional 250-watt installation.

Perhaps in the not-too-distant future you will be able to carry your telephone in your pocket. You will not only be reached wherever you are, but you will be able to call anyone who has a telephone. —30—

Once signaled, subscriber carrying paging receiver can step into telephone booth and obtain message from mobile service operator. System is a means of contacting rather than communicating.

Mobile service operator delivers message when contacted by telephone. An individual phones the operator only when his particular receiver indicates that there is a message waiting for him.

PRINTED



ACCEPTED and used almost universally, printed circuits are one of electronics' newest major triumphs. It was only eight years ago that a leading manufacturer first incorporated circuit boards in home radio receivers. Today, these ultra-compact devices are simplifying construction of hearing aids, electronic organs, vacuum-tube voltmeters, aircraft radios, industrial automation controls, and many other types of equipment.

This pace-setting electronic advance—the printed circuit—is a relatively simple gadget. It is nothing more than a sheet of insulating material—paper base phenolic, fiberglass, ceramic, plastic, etc.—to which thin strips of conducting metal are bonded. Resistors, capacitors, and other components are soldered directly to these conducting strips which replace conventional wiring.

Printed-circuit boards are easy to make. They can be turned out rapidly by automatic machinery, or you can easily and conveniently make them yourself, at home. But whether they are made by hand or by machine, the result is the same: light, simple, compact, reliable pieces of electronic hardware with a hatful of valuable features.

Machines turn out printed-circuit boards by the thousands, cheaply. Components are attached and soldered, and the manufacturer's job is done. Slow, inefficient, and costly point-to-point wiring is eliminated or appreciably reduced; wiring errors are minimized. Finally, the entire circuit takes up less space, so engineers can design smaller, easier-to-use equipment. The popular transistor pocket radio, for instance, was made possible by printed circuits.

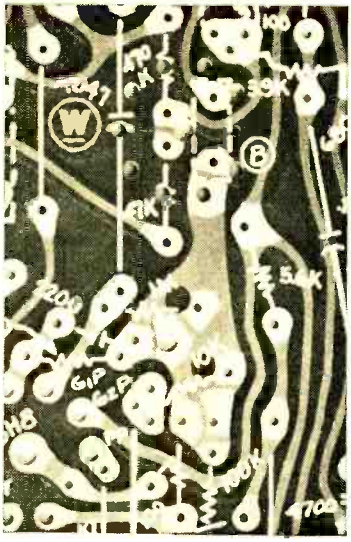
How They Developed. Printed circuitry, like so many other electronic advances, is a product of World War II. The proximity fuse made it necessary to pack a whole radar set and triggering device into a tiny hollowed-out pocket in the nose of a shell. This equipment had to be far smaller and lighter than anything ever built before, and rugged enough to work reliably after literally being shot out of a cannon.

Scientists at the National Bureau of Standards in Washington recalled that back in the 1920's someone had an idea for printing an electrical circuit directly on an insulating board, saving both space and weight. They dusted off the old idea and set out to eliminate the bugs that had plagued the method. By 1945, most of the problems were solved. Shortly afterward, printed circuits began to appear in military equipment.

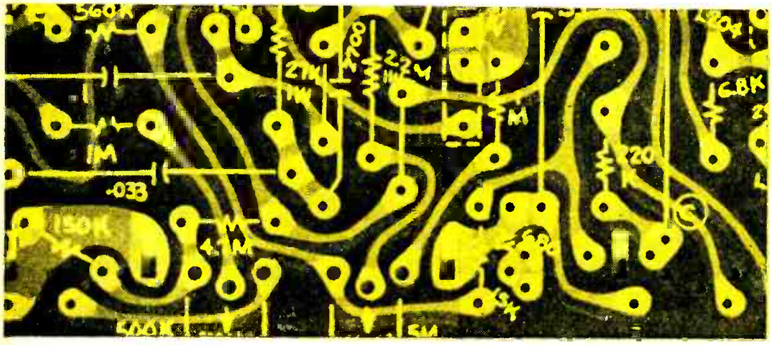
Now printed circuits are available in a wide range of sizes, shapes, and types, and they are used in almost as many ways as there are receivers, amplifiers, and other electronic devices to use them. One television set, for example, may contain several large boards, each bristling with resistors, capacitors, tubes, transistors, and other parts. Such boards form the heart of the instrument, since virtually all components are mounted on them. There is almost no conventional wiring except for interconnections between individual boards.

Some sets may appear to use conventional chassis and regular point-to-point wiring. Yet if you look closely, you'll probably find a printed circuit or two. Generally, they will be in the form of small networks containing a few resistors, capacitors, and conductors bonded to a ceramic base plate and sealed in a protective coating. One such network, for example, may form the entire plate circuit for one tube, the grid circuit for the next, and the coupling between them. Substituting a block half the size of a match book for a handful of components

CIRCUIT PRIMER



In the past few years printed circuits have become a password to space-saving, cost-cutting circuitry



By
J. K. LOCKE

and connective wiring saves time and space as well as money.

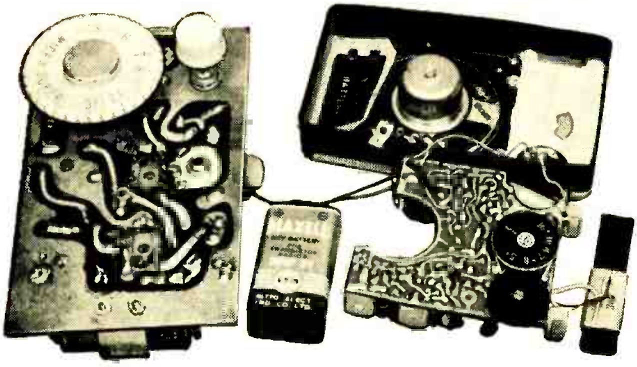
How They Are Made. Printed circuits are divided into several different classes according to how they are made. Possibly the simplest is the *painted board.* Here, metallic strips are either brushed or sprayed onto the board, using a conducting paint which contains finely ground silver or copper. These painted lines conduct current and take the place of conventional wiring.

Imprinted-circuit inlays are made by cutting strips of the proper size and shape out of large, thin sheets of metal, then simply pressing these pre-shaped strips into the base board with pressure and heat.

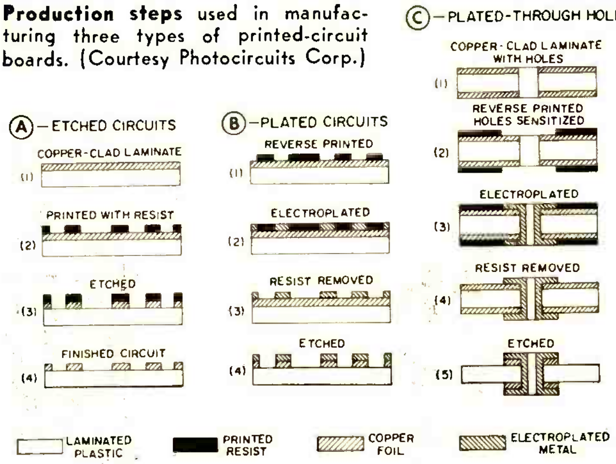
Spray-milled boards use still another method. First, grooves are cut in the board where conducting strips will be located. The board is sandblasted, then sprayed with molten metal which forms a thin coating over everything. Finally, all of the metal deposited on the surface is milled off, leaving only that in the pre-cut grooves.

Although all of these boards—and several other types—are in use, the most widely used of all is the *etched board.* There are several ways of making etched-circuit boards, but the principle is the same in each case. First, a thin copper sheet is laminated to a baseboard. An acid-proof

Etching techniques were identical for printed-circuit radios shown here, although model at left is a home-brew unit.



Production steps used in manufacturing three types of printed-circuit boards. (Courtesy Photocircuits Corp.)



substance called a "resist" is applied to the copper wherever conductors are to be located on the final board. The entire sheet is then dipped into an acid bath which eats away the copper not protected by the resist.

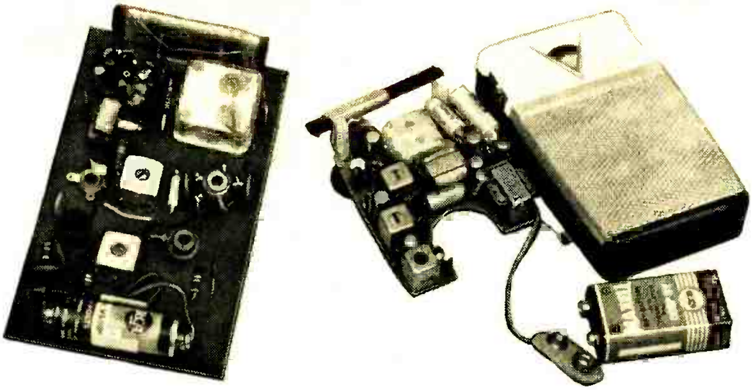
The resist can be applied in many ways. For the most popular method, circuit-board makers borrow the tricks of the photographer. The copper plate is coated with a light-sensitive emulsion very much like the substance used on photographic film. A negative of the wiring pattern — black paper with strips cut out where the wires are to be—is put over the sensitized plate and the whole thing exposed to light. When it is developed, the portions of the negative which were covered by the black paper soften and wash away, exposing the bare copper. But where light got through the slits, the emulsion hardens into an effective resist.

Another kind of resist is put on by a silk screening process similar to that used in reproducing pictures. A heavy line drawn with a china marking crayon makes a good resist. In a pinch, home experimenters sometimes use fingernail polish, asphalt-base paint, roofing tar, rubber cement, Duco cement, or wax crayons. Some manufacturers have now made available thin strips of special tape which can simply be stuck on wherever you want the copper to remain. There is even a ball-point pen on the market which lays down an acid-resistant strip of a special ink about 1/16" wide.

Printed Components. As the art of printed circuitry has gathered steam, engineers have developed ways to deposit not only conductors but resistors, capacitors, and even coils on printed-circuit boards.

Resistors are made with paints containing carbon powder. You simply paint on your resistors: the longer the line, the greater the resistance! One medium-resistance paint on the market, for example, will give a resistance of 100,000 ohms for a line 1/8" wide and 1" long. A line 1/2" long would give 50,000 ohms, as would a line 1" long but 1/4" wide. Complete tables of resistance values and voltage ratings for lines of different lengths and widths come with the paint. Of course, resistance values won't be exact, but they are close enough for most purposes.

Printed-circuit capacitors are a little



Another view of pocket radios at left. Note that placement of parts is more compact in commercial unit.

more complicated, but you can make these, too. You paint one side of each of several small sheets of paper, mica, glass, or some other insulator, with a conducting paint; stack the layers; and connect alternate layers together. To find the capacitance in $\mu\mu$f., you multiply the area of *one* of the painted plates in square inches by 0.224. Multiply this result by the dielectric constant of the insulating material you are using (most electronic handbooks supply this information), then multiply again by the number of plates, minus 1.

If you use six plates, multiply by 6 minus 1, or 5. Divide this final figure by the thickness of one of the dielectric sheets, in inches. The answer is the capacitance of the unit. For the mathematically inclined, the formula is: $C = A \times 0.224 \times K \times (N\text{-}1)/d$; where C = capacitance in $\mu\mu$f., A = area of one plate in square inches, K = dielectric constant, N = number of plates, and d = dielectric thickness.

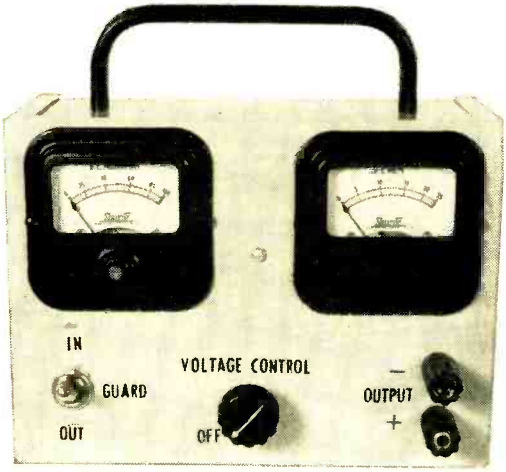
Compact, flat inductors can be made by painting a spiral on an insulating board. The formula for calculating inductance is: $\mu h. = 0.02 \times N^2 \times d \times p$; where $\mu h.$ = inductance in microhenrys, N = number of turns, d = mean diameter in inches (this figure is obtained by adding the inside diameter to the outside diameter of the spiral, and dividing the sum by 2), and p = permeability. Since this inductor has no core, the figure for the permeability of air, 1, is used.

Recent Improvements. Although printed circuits, because of their many advantages, have now become almost universally accepted, they did not win this general approval easily. As is the case with any new development, good features are usually balanced by bad ones, and printed circuits are no exception.

Printed circuits may break or crack if not handled properly—and such a catastrophe can simultaneously open dozens of circuits! More commonly, segments of the printed conductors may pull loose from the base material and either break or possibly form short circuits. In either case, the damage may be difficult to repair. For this reason many service technicians have been quick to say what they think of printed circuits, and their remarks have sometimes been blistering. Some manufacturers have hesitated to use large component-packed boards, also for this reason, although all use the smaller printed-circuit networks.

In the last few years, however, there have been two substantial improvements. First, better boards using advanced materials and manufacturing methods have been developed which make failures rare. Second, special techniques and tools have been introduced for repairing the troubles that do occur, making the servicemen's job much easier. Then, too, technicians are becoming more skilled; books are now on the market devoted entirely to describing in detail the tricks and tools used in making ailing printed circuits behave themselves.

Perhaps even more startling are advances in micro-miniaturization using printed-circuit techniques. RCA and U.S. Army Signal Corps missile scientists, by reducing the size of printed resistors, capacitors, and other components to the minimum, then stacking a number of boards as close together as possible, have been able to pack an amazing total of 300,000 to 600,000 separate components into one cubic foot! —30—



TRANSISTORIZED DUAL-METER POWER SUPPLY

Battery substitute features regulated output and a built-in guard circuit

By R. J. SHAUGHNESSY

IF you like to experiment with transistors, you'll find this dual-meter power supply a valuable tool on your workbench. The output of the unit—a low-power battery substitute—can be varied continuously from 1 to 20 volts at currents up to 100 milliamperes. Output voltage is maintained at a constant level by a pair of inexpensive stabistors which regulate the output within 1 to 2 volts even when the load varies from 0 to 50 ma.

One of the unit's meters monitors the output voltage, while the other keeps tabs on the current drain of the circuit under test. A built-in guard circuit keeps current drain down to a safe value if you should accidentally short-circuit or overload the supply.

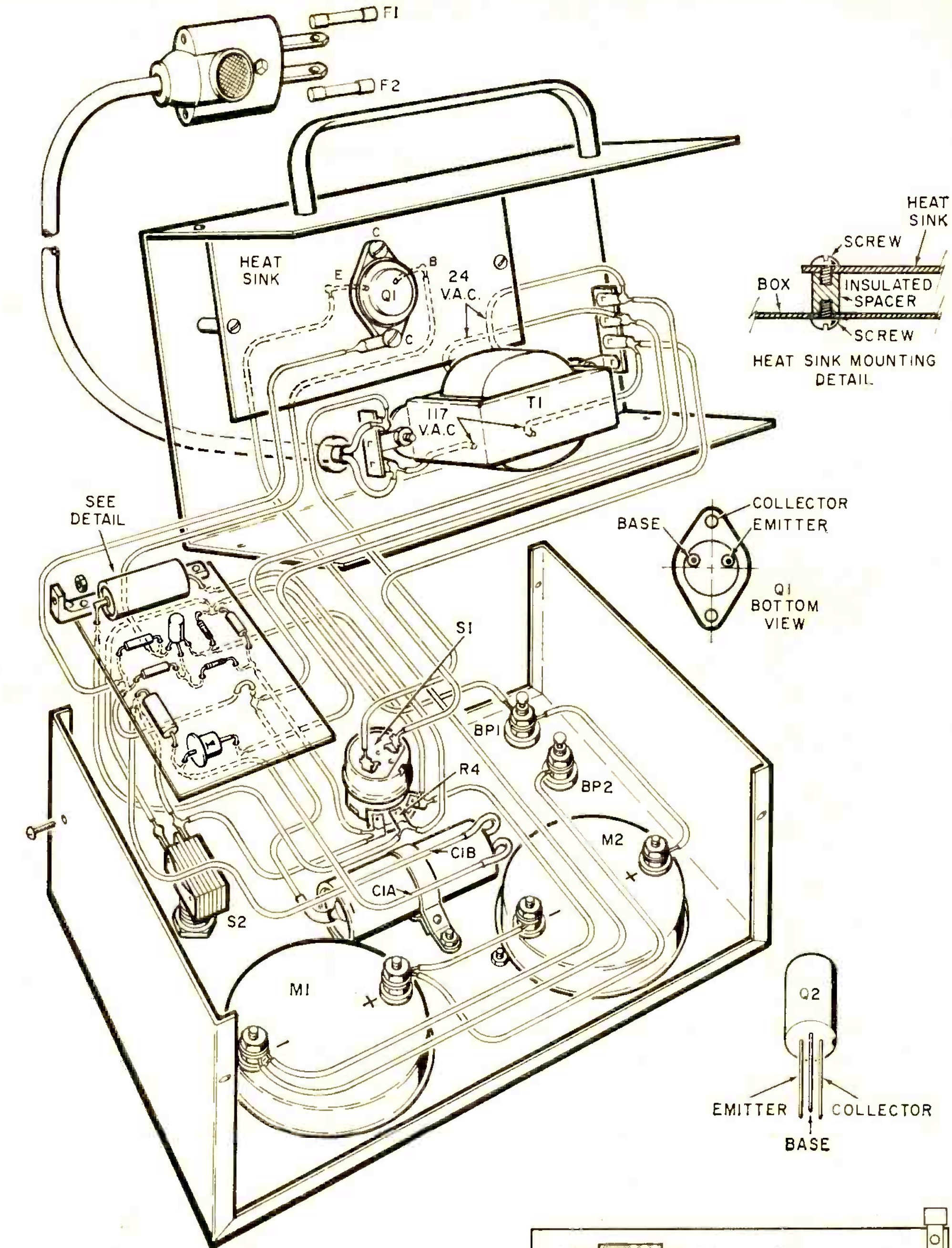
Although parts for the unit cost around $20—as much as commercially available kits—the dual meters and voltage regulation characteristics of the power supply should make its construction worthwhile. And it's easy to build—you can probably finish it in a few evenings.

Construction. The power supply is housed in a 5" x 7" x 3" aluminum box. Begin by cutting holes in the front half of the box for meters *M1* and *M2*, binding posts *BP1* and *BP2*, potentiometer *R4*, and switch *S2*. The meter holes are 2⅛" in diameter; smooth out any roughness on their edges after cutting the holes.

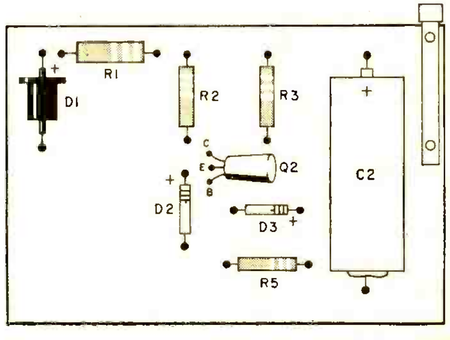
All of the other components, with the exception of power transistor *Q1*, transformer *T1*, and filter capacitor *C1*, are mounted on a 2¼" x 3½" piece of perforated phenolic board as shown in the pictorial diagram.

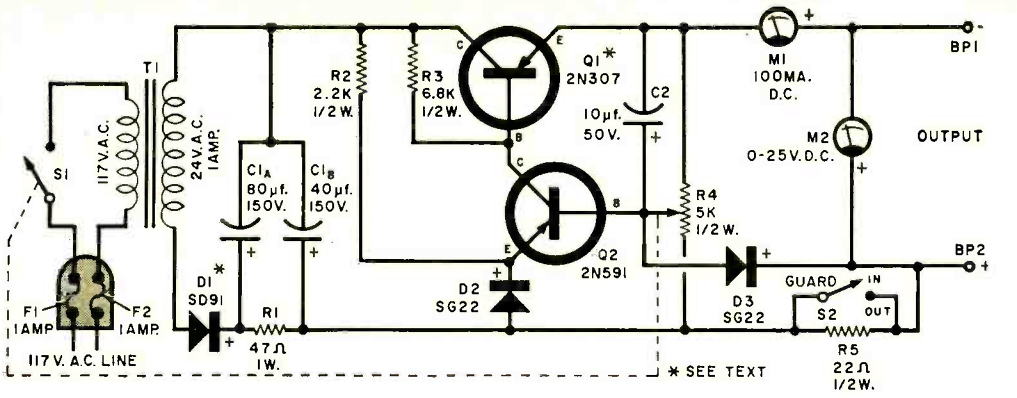
If the Transitron SG22 stabistors (*D2* and *D3*) are not available locally, you can buy them from the Harrison Radio Corp., 225 Greenwich St., New York 7, N. Y.; they sell for $1.30 each plus first-class postage. Rectifier diode *D1* may be any 100-PIV unit with a 500-ma. to 1-amp. current rating.

Power transistor *Q1* is given as a 2N307



The power supply is built into both halves of the aluminum box. Power transistor Q1 mounts on heat sink which is insulated from box. Perforated phenolic circuit board (detail at right) mounts small components and is fixed to the chassis by means of an L-bracket.

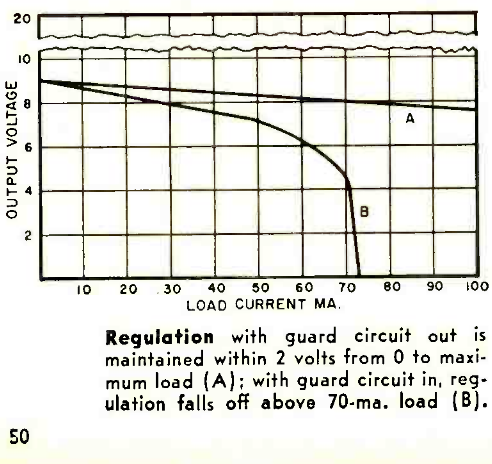




Stabistor D2 provides reference voltage for Q2. Voltage variations on base of Q2 are amplified and control Q1.

PARTS LIST

BP1, BP2—Five-way binding posts, one red, one black (Lafayette PJ37 or equivalent)
C1a/C1b—80-40 µf., 150-volt dual electrolytic capacitor (Sprague TVA 2461 or equivalent)
C2—10-µf., 50-volt electrolytic capacitor (Cornell Dubilier BR105 or equivalent)
D1—Silicon diode, 1-amp., 100 PIV (IRC SD91 or equivalent—see text)
D2, D3—SG22 stabistor (Transitron)
F1, F2—1-amp., 125-volt, 3AG fuse, slow-blow type (Littlefuse or equivalent)
M1—0-100 d.c. milliammeter (Shurite 950-MT122 or equivalent)
M2—0-25 d.c. voltmeter (Shurite 950-MT210 or equivalent)
Q1—2N307 power transistor—see text
Q2—2N591 transistor
R1—47-ohm, 1-watt resistor
R2—2200-ohm, ½-watt resistor
R3—6800-ohm, ½-watt resistor
R4—5000-ohm, ½-watt potentiometer, linear taper, with switch S1 (Mallory Midgetrol U-14 or equivalent)
R5—22-ohm, ½-watt resistor
S1—S.p.s.t. switch (on R4)
S2—S.p.s.t. toggle switch (Lafayette SW-21 or equivalent)
T1—Step-down transformer, 117-volt a.c. primary; 24-26 volt, 1-amp. secondary (Stancor P6469 or equivalent)
1—5" x 7" x 3" aluminum box (Bud CU-3008 or equivalent)
1—5" x 2½" sheet of 1/16"-thick aluminum
1—Fused plug (El-Menco)
Misc.—Terminal strips, knob, carrying handle



Regulation with guard circuit out is maintained within 2 volts from 0 to maximum load (A); with guard circuit in, regulation falls off above 70-ma. load (B).

in the parts list. For greater voltage stability, the higher gain 2N176 can be used instead, but at greater cost. Voltage stability is also dependent on the gain of control transistor *Q2;* overall stability is a function of the product of the gains of the two transistors.

Mount *Q1* on a heat sink made from a 5" x 2½" piece of 1/16"-thick aluminum. The heat sink itself is mounted on the back half of the box using two ½"-long threaded insulated spacers; this electrically isolates *Q1*'s collector from the box.

Power transformer *T1* also mounts on the back of the box next to power transistor *Q1*. Drill a ⅜" hole for the a.c. line cord grommet near *T1* when you drill *T1*'s mounting holes, and use a three-lug terminal strip under each of *T1*'s mounting screws.

Testing. To check the unit after assembly, connect a 470-ohm, 2-watt resistor as a dummy load across the output terminals. Now set guard switch *S2* to "in" and switch on the supply, but do not advance the voltage control. If everything is in order, the voltmeter should indicate between 1.0 and 1.5 volts and the milliammeter under 5 ma. If either meter "pegs" to the end of the scale or drifts from its initial reading, switch the supply off and recheck for wiring errors or an incorrect component value.

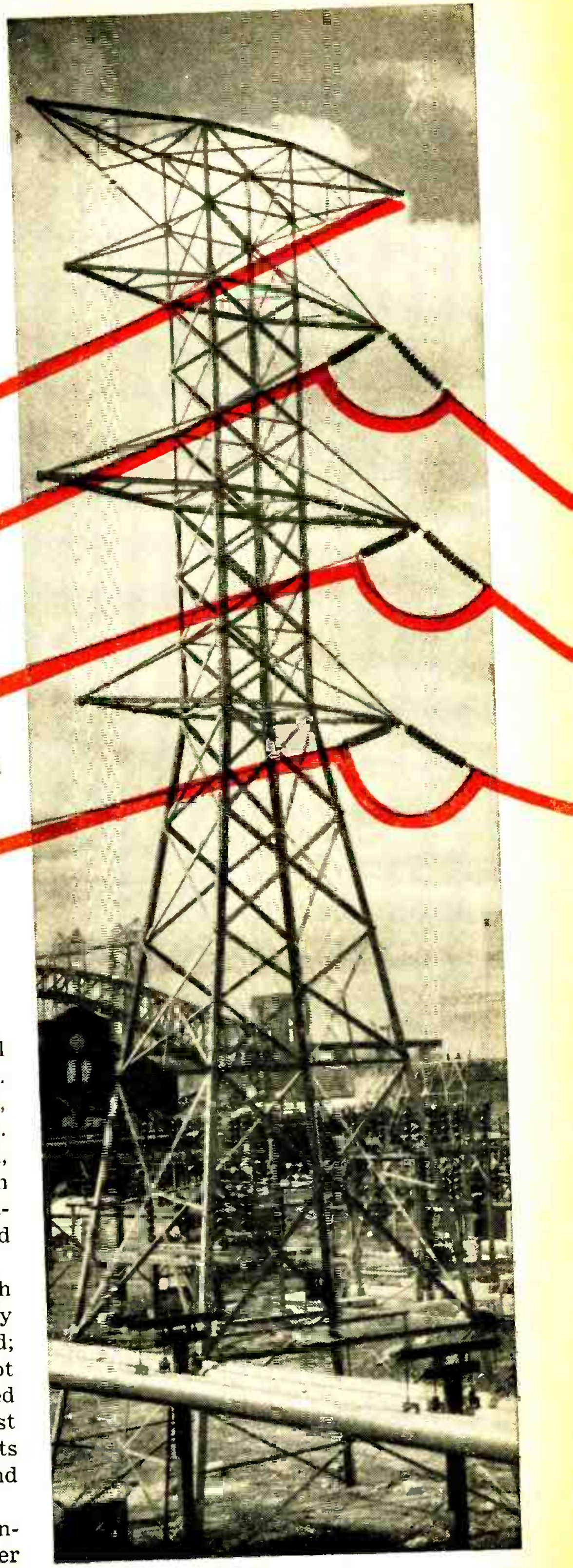
When the proper output conditions are restored, set *S2* to "out" and advance the voltage control slowly until the meters indicate 6 volts and 14 ma. To check the regulation, shunt the 470-ohm load resistor with another resistor of the same value.

(*Continued on page* 127)

Electric Power

The Lifeblood of Civilization

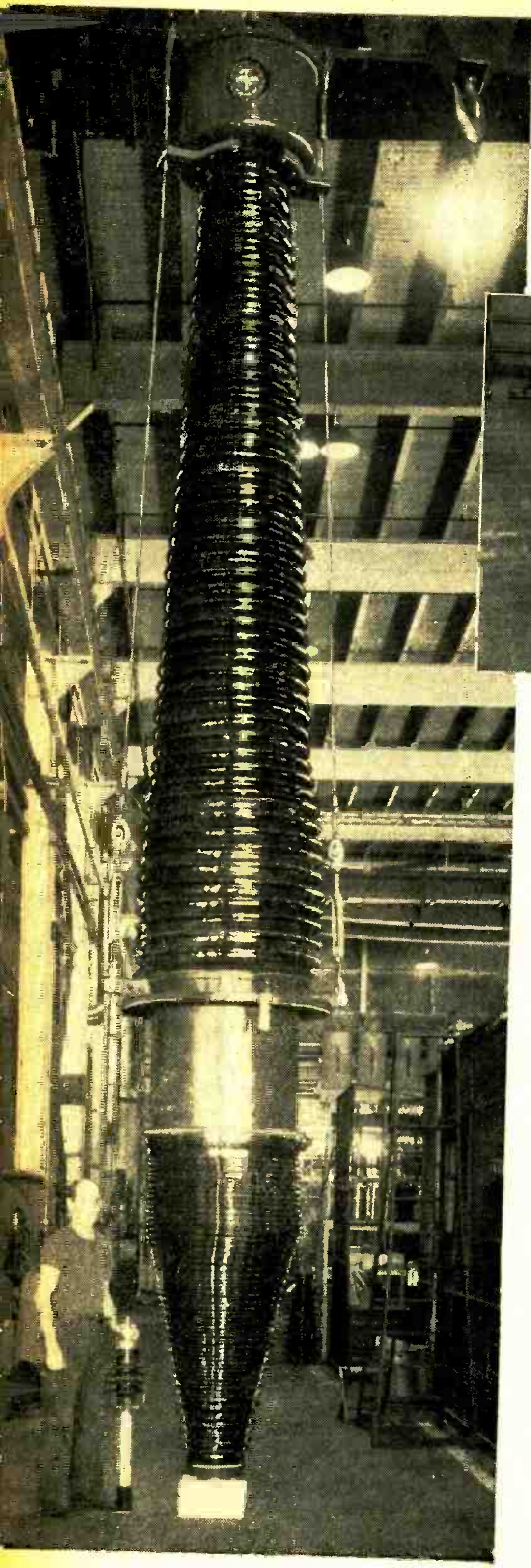
By ART ZUCKERMAN



IT WAS a Monday afternoon, a typical August afternoon in New York City. Thermometers hovered in the high 80's, and air conditioners were pumping away. Drivers steered their autos with one hand, daubed at perspiration with the other. In Flower and Fifth Avenue Hospital, operating room lights glinted off a scalpel poised for an incision.

And then a 500-block area, teeming with over half a million people, was suddenly paralyzed. The operating room lights died; subway trains ground to a halt in hot humid tunnels as their signal lights blinked out. Honking auto horns tried to blast through jams that formed as traffic lights failed. Television station WABC-TV found itself off the air.

New York's Central Park district, spanning Manhattan Island from the East River



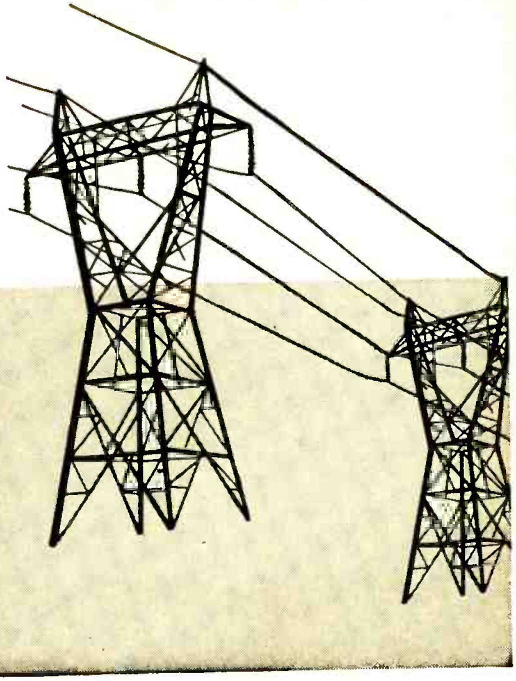
Combination turbine and generator units (below), part of the Consolidated Edison Company's Astoria, N. Y., station, can generate up to 360,000 kilowatts. Huge 650-kilovolt bushing (left) is destined for service in the General Electric Company's experimental extra-high-voltage line between Lee and Pittsfield, Mass.; weighing 10,000 pounds, the 28-foot unit dwarfs workman holding a 23-kv. bushing.

to the Hudson River, had suffered a mammoth power failure. Seven of the 20 "feeder" cables supplying "juice" from the Hell Gate generating station had shorted out, and the entire district had to be shut down to protect the remaining lines. What followed in the next 12 hours was a spectacular demonstration of our everyday reliance on electricity.

Fortunately, an emergency power system quickly restored the hospital operating room lights. Station WABC-TV, with the help of a mobile transmitter and generous competitors, managed to get back on the air. But food went bad in thousands of refrigerators and freezers. Scores of people had to be rescued from elevators frozen high in towering shafts. Others, returning to high-up apartments, found themselves stranded in their apartment-house lobbies. Throughout the area the magic of candlelight was rediscovered, and people found out what they used to do before the advent of television.

We've all grown to depend heavily on our electrical servants, and it is a hard day indeed when we are forced to "go it alone." We can count ourselves lucky that these servants hardly ever take a day off, thanks to the nation's hard-working power companies. Their generators are the hearts

Command post of the Consolidated Edison Company's electrical system is this operator's board, centrally located in Manhattan; the system operator and his assistants exercise complete control of all generating and distributing facilities from this point. Recorder-like units at far right in photo furnish automatic load frequency control, causing generators to increase or decrease power automatically.



of civilization, pumping a vital electrical bloodstream through copper arteries. Here's how this vast circulatory system works.

Power Generation. Power is generated today pretty much as it has been ever since Michael Faraday discovered he could induce an electric current in a wire coil by moving it through a magnetic field. But Faraday used a stationary magnet and moved his coil past it. Today, it's the magnet that moves, rotating at the end of a powered shaft past banks of wire coils. The power for our present generators comes from one of two sources—either from a hydroelectric turbine using water under pressure (a dam or waterfall, for instance) or from a steam turbine using coal, oil, or natural gas for fuel.

Modern electric generators produce alternating current. As the magnet spins through the first half of its arc, it induces a current that travels through the surrounding coils in one direction. As the magnet enters the second half of its spin, the current reverses direction, forming the second half of an electrical cycle. American equipment generates 60 such cycles a second.

The amount of electrical current flow is measured in amperes, while the pressure responsible for this flow is expressed in volts. It is the combination of electrical pressure—voltage—and current flow—amperage—that produces the unit of actual working electric energy called the watt. Voltage multiplied by amperage equals wattage, or $EI = W$. This volt-ampere-watt relationship is important.

Let's say we want to transmit 10,000 watts of usable energy through our electrical system. If we push it through with only 100 volts of pressure, we'll have 100 amperes of current flow on our hands. But the more amperage we play with, the bigger—or the more numerous—our conductors must be to handle it. Obviously, 100 amperes calls for an awful lot of conductor.

But, instead of 100 volts, suppose we kick our power through with 4000 volts. Then all we'll be carrying through our lines is 2½ amperes, and we can get by with considerably smaller conductors. Yet we still get our 10,000 watts total working power. This is where alternating current comes into the picture.

One of the endearing peculiarities of a.c. is the fact that transformers can step its voltage up or down with little loss (this is not the case with d.c.). We can therefore step up our generator output to extremely high voltages so that we can push the juice

very great distances through relatively light conductors. Then we can use other transformers en route to step down the voltage to usable levels. In actual practice, voltages are stepped down several times on their way to the ultimate user.

Distribution of Power. There are two basic approaches to power distribution: overhead lines and underground networks. The overhead line is relatively inexpensive to build, but because its cables aren't interconnected, it's particularly vulnerable to breakdowns. Underground networks, with their buried conduits, are very expensive to build but are extremely reliable because they're interconnected.

Because of the economic facts of life, most areas of the country are served by overhead lines. You'll see them in all rural and suburban areas and in cities where there are back alleys in which to run pole lines.

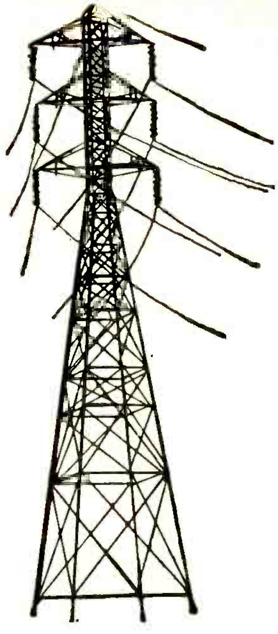
New York City, thanks to local laws and an absence of back alleys, has the country's most extensive underground system. Smaller versions can be found in such cities as Chicago, Philadelphia, Boston, Baltimore, Detroit, Washington, and San Francisco.

Both pole lines and underground networks get their electricity from the same basic sources. At the top of the power pyramid are the generating stations, usually interconnected with other generating stations. Heavy cables built to carry from 69,000 to 138,000 volts run like umbilical cords from these stations to groups of bulk power substations. In city areas, these high-voltage cables run underground. In open areas, they take the form of high-tension lines spanning the countryside on tall steel towers.

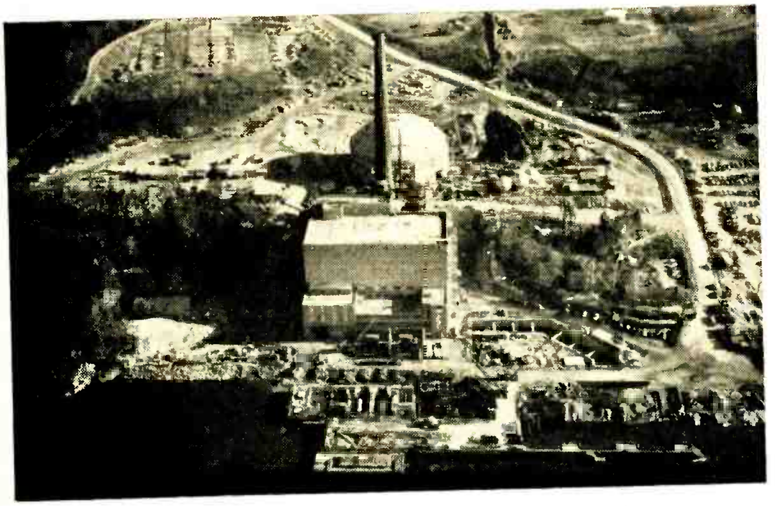
The bulk power substation is the main distribution point. Usually interconnected with other substations, it takes the high-voltage juice, steps it down to perhaps 13,000 or 27,000 volts, and sends it on in feeder cables. The feeders may terminate either at pole lines or at underground networks.

Let's consider a pole system. At the point where the feeder cable meets it, the pressure is stepped down to 4000 volts, and the electricity is then sent up the poles to travel along primary lines. Unfortunately these primaries are not interconnected; if one fails, the juice has nowhere to go, and everything along the route is deprived of power. When all is in order, however, the primaries make junctions with secondary lines through transformers that step the pressure down to about 117 volts. The secondaries then deliver the power to customers.

An underground network differs from a pole system in more than its physical location. For one thing, there are no primary



Latest developments in power distribution systems include portal-type towers and nuclear generating stations. Mammoth towers are being used experimentally by General Electric in Massachusetts; note how the scale model at left compares in size with a standard transmission tower. A 275,000-kw. nuclear generating station (below) is currently under construction by Consolidated Edison at Buchanan, N. Y.



lines. A network consists entirely of a web of interconnected 117-volt secondary lines. A number of high-voltage feeder cables will supply one network, as in the case of the 20 cables going to New York's star-crossed Central Park district. If any secondary line within the net breaks down, the current immediately shunts around the break through another part of the spider web.

However, the network's interconnections pose a problem of their own. Should a feeder cable short out, current is attracted to the short from all parts of the network. The converging amperage can build up to a point where secondary lines leading to the shorted cable's transformer will burn out. To prevent this burn-out a switch automatically disconnects the transformer from the cable.

It was the fantastic failure of seven out of the 20 feeder cables supplying the Central Park district that caused New York's great power failure of 1959. Moisture, seeping through cracks in the lead sheathing, shorted out four of the cables. A fifth apparently failed because it was weakened by a bad bend near a joint. The other two cables were down for routine maintenance. Rather than risk an overload in the remaining 13 feeder cables and a chain reaction of burnouts, the power company shut down the district.

Peak Loads. The reason that generating stations and bulk power substations are usually interconnected is so generating capacity will be used to maximum efficiency throughout the system. A peak load in one area naturally attracts current from other areas through a sort of electrical suction. As the load increases, the generators begin to feel a physical burden, just as your automobile's motor does when you climb a hill in high gear. Like your car's motor, the generators slow down.

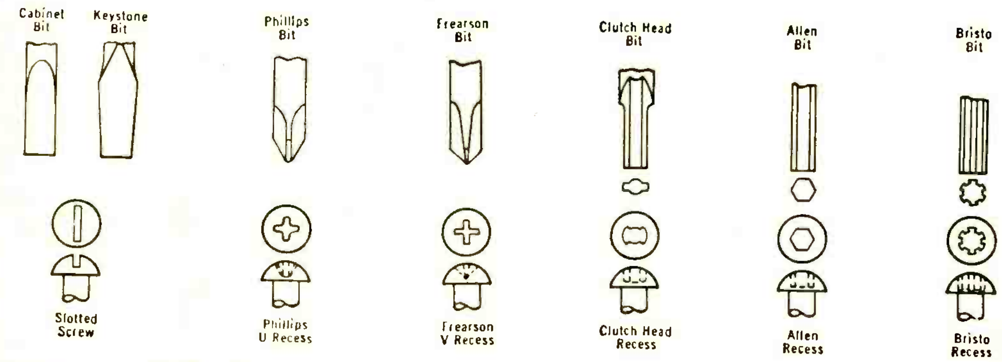
In the old days, the powerhouse crew would spot this slowdown and pour on more steam power to keep electric output constant. The job of keeping output uniform is easier these days, thanks to an automatic sensing system. When the power load reaches a point that causes the generators to slow down, frequency-measuring devices

(*Continued on page* 133)

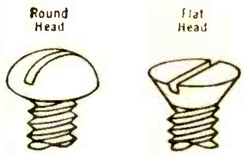
SCREWS styles, sizes and shapes

Handy reference diagrams you can use

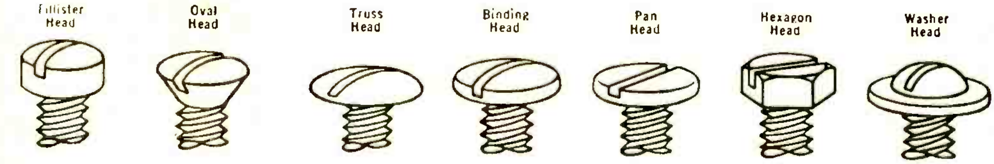
STANDARD TYPES OF SCREW DRIVER BITS AND SCREW OPENINGS



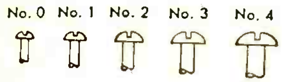
STANDARD METAL SCREW STYLES



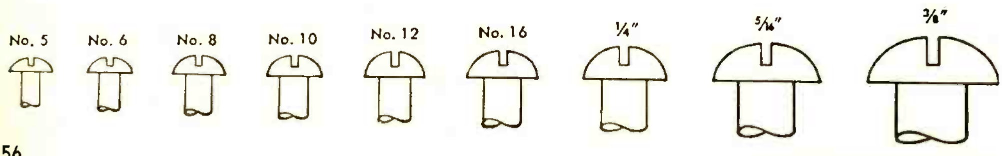
Metal screws are made in a wide variety of head styles, diameters, and lengths. Both stove bolts and machine screws are available in most head styles in numbered sizes from 0 to 16 and in fractional-inch sizes from 1/4" to 3/4".



SIZE IDENTIFICATION CHART FOR METAL SCREWS



Screw heads shown here have been reproduced full scale to simplify the problem of determining exact screw sizes.



WOOD SCREW STYLES

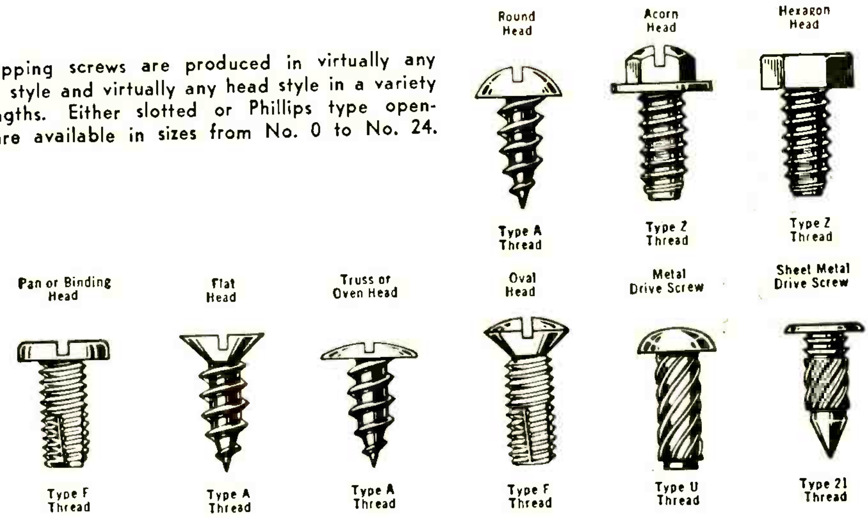
Wood screws are available in a wide variety of diameters—from No. 2 to No. 8—and lengths of from 1/4" to 4".

SOCKET SCREW STYLES (Allen or Bristo Openings)

Socket screws come in numbered sizes from 4 to 10, inch sizes from 1/4" to 1", and in almost any length.

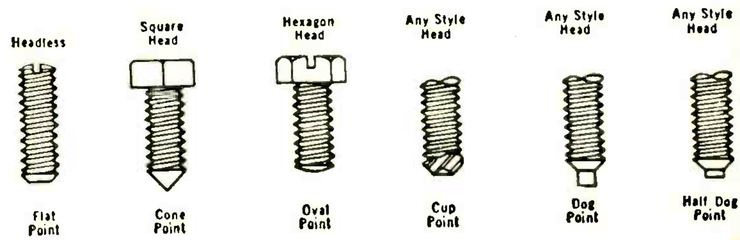
SELF-TAPPING METAL AND SHEET METAL SCREWS

Self-tapping screws are produced in virtually any thread style and virtually any head style in a variety of lengths. Either slotted or Phillips type openings are available in sizes from No. 0 to No. 24.

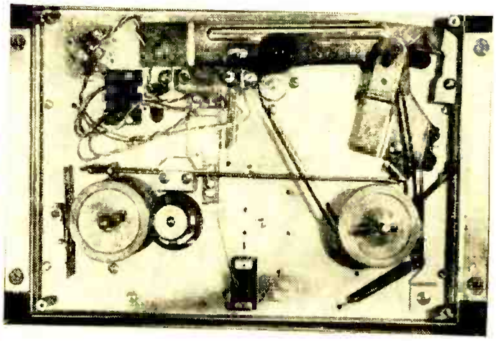


SET SCREW STYLES (Head and Headless)

Set screws come in diameters from No. 4 to 1", lengths from 1/8" to 3". Both headed and headless styles are available in the point types shown.



Courtesy of Vaco Products Company, Chicago, Ill.



Top view of tape deck with cover removed. Drive belt must be moved from larger to smaller diameter pulley to change tape speed from 7½ to 3¾ ips.

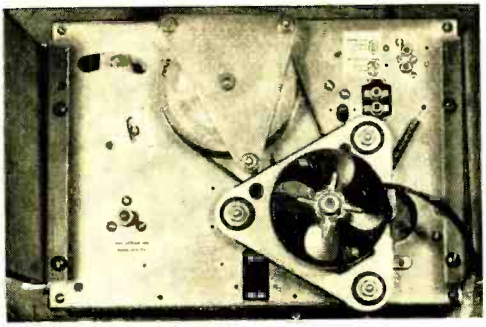
Heath TR-1AQ tape recorder kit, including two TE-1A record/playback preamps, makes an inexpensive

STEREO TAPE

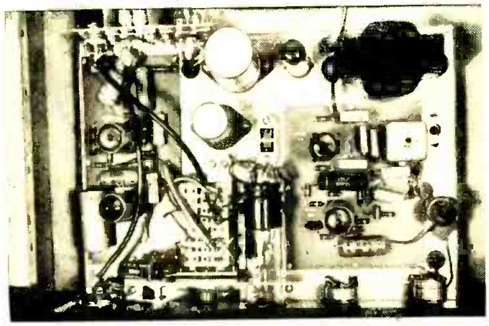
ALTHOUGH most stereo enthusiasts are convinced that tape is the ideal recording medium, many are equally convinced that discs still have the edge price-wise. But the new four-track tape systems—the tape industry's answer to disc stereo—have done much to equalize the price differential between discs and tapes. The result is that tape is once again very much back in the picture.

Another factor in the growing use of stereo tapes is generally lower prices for tape equipment itself, and the TR-1AQ tape recorder kit is no exception. Supplied complete with two TE-1A record/playback preamplifiers, the assembly is available from the Heath Company (Benton Harbor, Mich.) for only $149.95—a price that compares favorably with the cost of monophonic tape equipment of just a few years ago. A cinch to build and operate, the TR-1AQ will play and record four-track stereo and monophonic tapes with excellent fidelity.

As bonus features, a safety interlock on the preamplifiers guards against erasing valuable prerecorded tapes, and a fan-cooled motor drives up to 7" reels at the popular 7½- and 3¾-ips speeds. A single control lever gives instant selection of "play," "fast-forward," and "rewind," while separate record and playback volume controls simplify operation. The recorder holds wow and flutter to less than 0.35%, distortion (at full output) to less than 2%. A magic-eye indicator in each preamp



Bottom view of tape deck; note shock-mounted, fan-cooled motor and large capstan flywheel. Pin jacks at upper right are for connection to preamp.

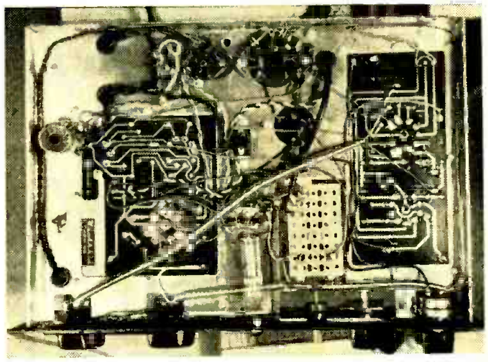


TE-1A preamplifier employs printed-circuit boards for both the bias-erase oscillator and the record amplifier circuits. Magic-eye tube is in center.

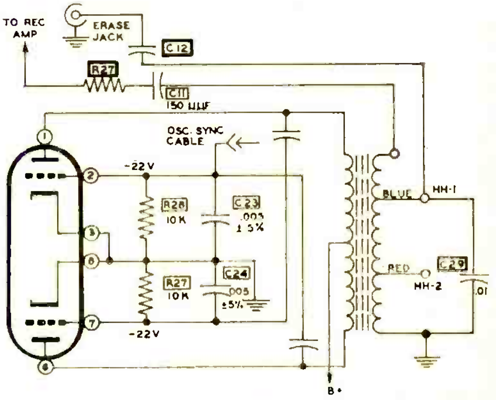
SYSTEM

gives visual indication of proper recording levels. Other features include a low-noise EF-86 preamplifier tube, and a 12AU7 push-pull, low-distortion bias-erase oscillator.

Due to the small size and mechanical arrangement of the three basic components, they are ideally suited to custom installations. Heath will supply a mounting base for the tape deck in a choice of finishes, but a small cabinet can be assembled for both the deck and the preamps with a minimum of woodworking skills (see photo on opposite page). The deck itself measures only 15½" x 9½", and a cabinet about 30" high will house the preamps and provide space for tapes as well. —30—



Underchassis wiring is simple; the majority of connections are already on printed-circuit boards.



Push-pull bias-erase oscillator employs a single 12AU7 tube in a special low-distortion circuit.

Electronic

IMAGE 1 B

In a multiplication the two numbers that are multiplied together may be called the "factors" and the result is called the "product."

Thus in

2 × 3 = 6

the numbers 2 and 3 are called "factors" and the number 6 is called the "product."

Below you will find a question. Pick what you think is the right answer to the question, and go to the image number given in front of that answer. The question is:

What result (product) would we get if we used 3 as a factor twice in a multiplication?

D Image 3 — 6

Image 5 — 9

Image 7 — I don't understand.

IMAGE 3 F

Your answer on Image 1 was "6."

You seem to have merely used 2 and 3 as factors in a multiplication. The problem was to use the number 3 as a factor twice. In other words, we want the result of the multiplication

3 × 3 = ?

Now return to Image 1 and try again.

WRONG ANSWER

IMAGE 7 H

You answer on Image 1 was "I don't understand."

We are asking you what product you get from a multiplication in which you use the number 3 as a factor twice. In other words, what is the result of the multiplication in which the numbers that are multiplied together are both 3's? That is, what is the product of 3 × 3?

Now return to Image 1 and choose the right answer.

STUDENT NEEDS MORE INSTRUCTION

IMAGE 5

Your answer on Image 1 was "9."

You are correct. If we use 3 as a factor twice in a multiplication, we get

3 × 3 = 9

as a result.

Now, what result would we get if we used the number 2 as a factor three times?

Image 4 — 6

Image 10 — 8

Image 13 — 9

RIGHT ANSWER

Teaching Machines

Blessing or Curse?

By KEN GILMORE

A FEW WEEKS AGO, thousands of school children in scores of classrooms from coast to coast were quietly subjected to what will probably turn out to be the greatest educational revolution in history. They began the first large-scale experiment in learning, not from human teachers, but from teaching machines.

These machines—mechanical, electrical, and electronic devices which have ushered in the most-talked-about educational concept since the advent of co-education—come in a wide variety of types, sizes, shapes, and prices. They range on the one hand from simple plastic mechanical gadgets costing a mere $7, to highly complex, computer-controlled giants using print, photographs, drawings, movies, and recorded voices in the teaching process, and costing enough to send any economy-minded school board into orbit.

But regardless of size or complexity, the machines causing all the excitement are merely symbols of a bold, new approach to the learning process. And it seems clear from the evidence now piling up that this approach will result in a substantial improvement in the quality of our entire educational system.

Backers of the new concept say that teaching machines will, among other things: (1) result in better, more efficient learning for all students; (2) help solve the problem of the more gifted student by letting him go at his own pace; (3) lower the per-pupil cost of education; and (4) help alleviate the teacher shortage.

Machines Quiz Students. What are these teaching machines which promise so much? They are devices, electronic or otherwise, which present small bits of information to a student, one at a time, then immediately quiz him to make certain he understands each step. With one machine, he may write his answers on a roll of paper; with another, he may have to respond by pushing the proper button. The important point is that he *must* understand each step before proceeding to the next one.

Let's see exactly how this is done, using, for example, the Autotutor, a teaching machine marketed by the Western Design Division of U. S. Industries. Refer to the chart on page 60. A student sits down and presses button 1 (A). Image 1 (B) flashes on the screen (C.) He reads the text, then answers the question by selecting one of the multiple choices. Let's say he thinks the right answer is 6. Next to this answer is printed Image 3 (D). This is his cue to press button 3 (E). The answer he chose, says Image 3 (F), is not right. It then explains why he probably selected this answer and shows in what way his reasoning was off. Armed with this additional information, he is instructed to go back and try the original question again.

If he didn't understand at all after the first explanation, he can press the proper button (G) and bring up image 7 (H) which is an even more basic explanation. In this way each student gets enough information for him to grasp the concepts offered, but no more. Fast learners, therefore, go from step to step skipping the additional information which the slow learners get by selecting the wrong answers. And each can proceed at his own best pace.

Although some teaching machines now on the market are considerably less complex than the Autotutor, they all work along similar principles. That is, they present carefully organized material, one bit at a time, and quiz the student to make sure he understands before proceeding.

Does the Method Work? Is this immediate quizzing really important? Kenneth Komosky, head of the New York Collegiate School's automated teaching division, has this to say about the shortcomings of conventional teaching methods:

"A student is required to absorb knowledge for weeks or months at a stretch before he finally is given a test. Then it may be another week or so before he learns whether he passed. Now suppose you were on a rifle range learning marksmanship, and they only told you at the end of the day whether you ever hit the target. That is the way we have been asking children to learn, and the only stimulus we have been giving them has been to punish them when they failed."

Does the promising new method, programed machine teaching, really work? Scores of tests, some with hundreds of students, indicate that the answer is an emphatic "yes." One study at Harvard, for example, showed that children learned spelling three times as fast by machine as by conventional methods. In addition, they ended up better spellers than their classmates who had not had machine teaching.

Students at the Collegiate School, a pioneer institution in the movement, took only about two weeks to finish an introductory course in modern math that had taken about six weeks with traditional methods. And results of tests all over the country confirm the principle: machine teaching, when used with subjects for which it is suited, is faster and more efficient than traditional methods.

There are also a number of "fringe benefits." Students who are unavoidably absent from classes do not miss anything. They pick up exactly where they left off. More important, since each student proceeds independently, the host of emotional and learning problems which have plagued both the exceptional student who had to plod along at a rate too slow to hold his attention, and the less gifted who has been frustrated by his inability to keep up at normal class speed, are eliminated.

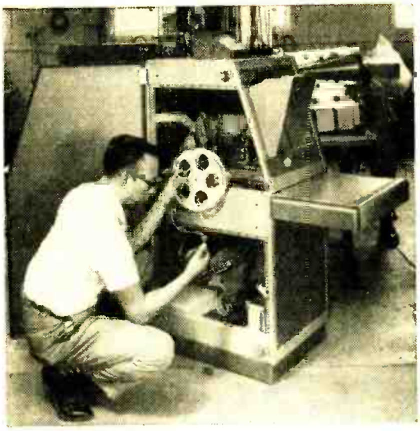
Non-verbal teaching machine developed by the Rheem Manufacturing Company teaches association and discrimination skills to children of from four to six years of age.

"Autotutor," made by U. S. Industries, includes unit (on top) which records the length of time a student takes to answer a question as well as the answer he chooses.

How It All Started. Teaching machines, in spite of the flurry of interest and activity surrounding their recent wide-scale introduction, are not new. They were used experimentally back in the 1920's, but failed to catch on. Then, during World War II, work that was to have a profound effect on the entire world of education began in—of all the unlikely places—a guided missile laboratory. Dr. B. F. Skinner of Harvard began to work on the problem of guidance of the then non-existent missiles.

Interestingly enough, Dr. Skinner's system was built around pigeons. A bird was placed in a harness where it could see a screen with a luminous dot. Whenever the dot strayed from the center, the pigeon was trained to peck at it. The pecking set off a control circuit that forced the dot back in the direction of the center. The dot, of course, was a cathode-ray-tube presentation of the missile's target as seen by radar. When the dot wandered off center, the missile was drifting off course. The pigeon's pecking actuated the proper control circuits to bring it back on course.

Dr. Skinner's pigeon system never got off the ground, however. The war ended, and soon all-electronic devices proved themselves far more reliable than pigeons. But the experiment was not wasted. Dr. Skinner had trained hundreds of pigeons to peck at the dot. Some learned rapidly; others,



Information incorporated in "Autotutor" is stored on film. Any one of 10,000 frames can be located and flashed on the screen by pushing a button on the front panel.

Three-part psychomotor skill trainer of Rheem Manufacturing Company includes: (1) a program display unit; (2) a standard IBM keyboard; (3) a computer control unit.

Electromechanical machine using multiple-choice principles was demonstrated by Rheem at American Psychological Association meeting in Cincinnati earlier this year.

slowly. Gradually he worked out training methods that gave consistently good results.

In time, Dr. Skinner began to wonder if the general rules of learning he had formulated from his pigeon studies were applicable to human beings. He applied them to his students and found a marked increase in learning efficiency. Here are the four cardinal rules of his new approach:

(1) The student must be both alert and busy; that is, he must actually participate in the instruction by responding at every step. Merely listening is not enough.

(2) The material must be carefully controlled so that the student is given only one small step at a time and is not forced to swallow large chunks of complex material at one gulp.

(3) Each item of information must come in carefully controlled order so that the student has the necessary background information to understand it completely and easily.

(4) The student must have *immediate* reinforcement; that is, he must know right away whether or not his answer is correct.

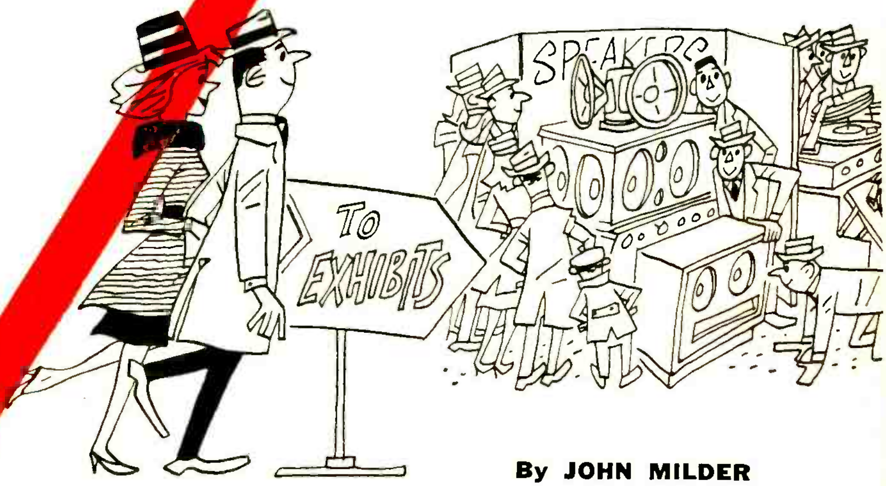
In 1958, Dr. Skinner published an article outlining his investigations and results. The response was immediate and enthusiastic. Others who had independently reached the same or similar conclusions rallied around, and a new movement was under way.

One thing was obvious to all: the teaching machine was an ideal device for putting these principles to work. It could easily be programed to give the information in small, well planned steps. It could also quiz the student after presenting each new bit of information, and this constant query-

(*Continued on page* 130)

STEREO 1961

A quick look at the year ahead in stereo and high fidelity



By JOHN MILDER

EVER SINCE the beginning of the hi-fi era, the fall audio show in New York has signaled the start of the audiophile's New Year. Judging from both the exhibits and the crowds at this year's show, stereo's *big* year has arrived. The raft of new equipment was enough to stagger any stereo enthusiast, and manufacturers were pleasantly surprised by sharp queries on stereo from a generally keen audience.

A number of trends were in evidence at this year's show. Biggest, of course, was the emphasis on simplicity in stereo equipment—both for the total newcomer and the audiophile intent on going stereo with a minimum of pain and strain. There was also the strong comeback of stereo tape, evidenced by the crowd's interest wherever four-track machines and tapes were in action. And the kit-building bandwagon was rolling faster than ever, with everything from the simplest speaker enclosure to the most massive power amplifier drawing plenty of well-deserved attention.

Let's take a closer look at some of the roads to stereo enjoyment that were opened up at the show.

Tape. After absorbing an early walloping at the hands of stereo records, tape is solidly on its feet again. With the four-track system bringing stereo tape within reach of the average pocketbook for the first time, visitors to the show found a tremendous variety of prerecorded tapes and machines to play them.

The tape ranks were bolstered by the entry of *RCA Victor* and *Capitol* into the four-track field, and *London Records* displayed a sizable slice of its catalog on tape. New machines ranged from simple decks by *Heath* and *Sony* to ambitious and expensive jobs by *Tandberg* and *Concertone.*

There also seemed to be the start of a trend toward playback decks for those not interested in doing their own stereo recording. Naturally the price tags on these units were pleasingly low.

Record Equipment. The latest trend in record-playing equipment was represented by a number of tone arms featuring automatic raising and lowering gadgets. *Rek-O-Kut, Fairchild, EMI,* and *SME* all displayed semi-automatic operation of their tone arms, designed to protect the delicate grooves of stereo records from damage by fumbling fingers. *Shure* was on hand, of course, with its push-button-operated arm and cartridge combination. Conventional arms, such as the new *ESL* and *Audio Empire* models, also attracted attention with their amazing tracking properties.

The variety of turntables and players continues to grow. *Garrard* presented a changer designed for perfectionists; *Audio Empire* featured a new belt-driven turntable; *Thorens* offered everything from simple manual players to a luxurious transcription turntable.

Kits. For the budget-conscious or fans who just like to spend a few hours with soldering iron in hand, the flood of kits at this year's show was welcome news. Combined with the wealth of units from old hands like *Heath, EICO, Dyna,* and *Lafayette,* the entrance of companies like *Scott* and *MacIntosh* into the kit field suggests that everything but the proverbial kitchen sink will eventually appear in kit form.

Scott's entry was represented at the show by a top-quality FM tuner kit. In addition to offering prealigned front-end circuitry and a built-in meter for final alignment, the kit comes in a carton that opens up into a workbench.

Harman-Kardon has expanded its "Citation" line of perfectionist, cost-no-object kits with four new units, including FM and AM-FM tuners and a power amplifier with 30 watts per channel; the Citation kits offer options not available in factory-wired jobs to justify the extra bit of effort required from the do-it-yourself'er. *EICO, MacIntosh,* and *Lafayette* have also come up with luxury power-amplifier kits, and it looks as though the perfectionist-kit field will keep on growing.

The general trend in kits continues to be the move to prefabricated subassemblies which assure uniform results with a minimum of fuss for the kit-builder. The prewired front end was a feature offered by all of the tuner kits at the show, including the simple but high-performance "Dynatuner." And new tape recorder kits from *Heath* and *EICO* were made possible largely by carefully planned prewiring.

Speaker Systems. The one trend made clear by the staggering number of speakers at this year's show was the growing diversity of speaker systems for virtually every purpose. With bookshelf units, satellite systems, and six-foot monsters, there was no stereo problem at the show that *some* speaker couldn't answer.

Probably the biggest surprise of the show was the newest entry from *KLH*. Completely ignoring its reputation for fine bookshelf systems, *KLH* introduced as its only exhibit a pair of 6'-high, full-range electrostatic speakers. Just 3" deep, the systems look like room-divider screens for an apartment. Sold only in pairs for slightly over a thousand dollars, these first full-range American electrostatics are aimed squarely at the man who is prepared to pay for perfection.

Also aimed at the well-heeled audiophile was a new speaker system presented by *Harman-Kardon* to top off its "Citation" line. The system uses a British-made Lowther driver in a complicated and effective horn enclosure that's available only in factory-built form.

Another pair of radically designed speakers attracted a lot of attention at the show and promise to interest audio experimenters across the country. One of them, the "Ionovac," is a tweeter which uses the corona discharge of a quartz cell to modulate the air around it—doing without the usual vibrating surface which sets air in motion. Earlier models of the Ionovac did not stand up in home use, but its manufacturer, the *DuKane Corporation,* now offers a full guarantee of performance and durability, together with a new low price.

The other speaker attention-getter was the "Integrand" (available from *Brand Products*), a three-way system which employs a servo-amplifier with each speaker. The servo units are intended to correct automatically for any deficiencies of the speakers in a living room, concentrating on transient response and elimination of room effects on the speakers' sound. It's an initial attempt to bring servo techniques into the hi-fi field.

For anyone with high hopes and a low budget, the show offered plenty of systems which made it easier than ever to take a low-cost short-cut to good stereo. In addition to satellite and common-bass systems, the exhibits were full of small-scaled but big-sounding bookshelf units, with new entries from *Fisher, Pilot, EMI,* and *Tannoy.* From the fact that makers of luxury pickups and amplifiers were using many bookshelf units to demonstrate their products, it was easy to see that no one thinks that these space-savers excessively sacrifice quality for size.

Reverberation Units. The newest approach to the problem of turning a living room into a concert hall was represented by a number of units designed to add controlled reverberation to stereo sound. These units (which POPULAR ELECTRONICS plans to cover fully in the next issue) allow the listener at home to introduce some extra depth and spaciousness into the sound from his stereo speakers.

Fisher, Motorola, and *Sargent-Rayment* all displayed prototype reverberation units at the show, and other companies are planning to introduce them during the year. All of the show units centered around a special mechanical unit made by the *Hammond Organ Company,* but they naturally varied in their circuitry.

Stereo Broadcasting. The only discouraging word for audiophiles at this year's show concerned stereo broadcasting. Although *Heath, Crosby* and *Karg* offered FM-multiplex adapters, and all tuners featured provisions for adding an adapter, there was no word of a go-ahead from the Federal Communications Commission for multiplex stereo broadcasting.

Since the FCC is still delaying its decision between competing multiplex systems, it's partially up to the audiophile to speed the arrival of FM stereo by dropping a postcard to the FCC and urging the Commission to make a quick decision. To most stereophiles, the *Crosby* multiplex system seems to offer the best route for stereo on the FM band.

The Big Year. Anyone who managed to squeeze into this year's hi-fi show couldn't help but come away with the feeling that stereo is in for its biggest season. Now in its third year, stereo seems to be following the route of the original LP record, which became a smashing success during its third go-round.

Thanks to a tremendous variety of carefully planned and well-designed equipment —and not to mention a gigantic catalog of records and tapes—the stereo picture for 1961 is brighter than ever. —30—

CITIZENS BAND RADIO

A Two-Way Service for Everyone

Today's Citizens Radio permits you, as the man-on-the-street, to obtain and operate your own two-way communications system at low cost. You can install sets in your car and home for the sole purpose of telling your wife that you're bringing company home for dinner. You can install sets in your TV shop and service truck for improved service to your customers. You can install sets in boats, in airplanes, on farms—almost anywhere—and you can even carry the new small portable models around with you. In short, you can use Citizens Radio to suit any worthwhile communications need.

By TOM KNEITEL, 2W1965

Drawings by Steve Du Quette

BACKGROUND

Two-way radio for everyone has long been an American dream. Since the 1930's, citizens everywhere have looked forward to the day when there would be inexpensive two-way radio for the home, store, car, factory, truck, or office. Today, this dream has become a reality. For with Class D Citizens Radio, any American citizen over 18 years of age can obtain a license to own and operate a two-way radio for any legitimate purpose.

Perhaps the biggest news in communications since the end of World War II, this new radio service has been in existence only two years. In this short period, some 100,000 citizens have acquired licenses. In fact, there are more than half as many Citizens Band stations today as ham stations—and hams got their start more than 50 years ago!

Class A and B Services

Although Class D Citizens Radio as we know it today is relatively new, it dates back to 1949 when the Class A and B Citizens Radio Services were created by the Federal Communications Commission. These services were allocated frequencies in the ultra-high-frequency ("u.h.f.") portion of the radio spectrum.

Although the FCC had good intentions when it established the services, it could not take into account a basic problem which confronted manufacturers and users. The transmission range of reasonably priced equipment operating on the u.h.f. frequencies is practically limited to direct line-of-sight; more expensive equipment, which gives better range, is beyond the reach of the average citizen.

In short, Citizens Radio, 1949 style, was either too expensive or too limited in range to meet the public's need. What was to be done about it?

Class D Service

CB CHANNELS

Channel No.	Frequency (mc.)
1	26.965
2	26.975
3	26.985
4	27.005
5	27.015
6	27.025
7	27.035
8	27.055
9	27.065
10	27.075
11	27.085
12	27.105
13	27.115
14	27.125
15	27.135
16	27.155
17	27.165
18	27.175
19	27.185
20	27.205
21	27.215
22	27.225
23*	27.255

** Shared with radio control and stations in other radio services.*

Several plans were considered and rejected. One plan, however, did seem to offer a practical solution—it called for the appropriation of the little-used "11-meter" amateur radio band for general-purpose two-way use. This plan went into effect in September, 1958, and so the Class D Citizens Radio Service was born.

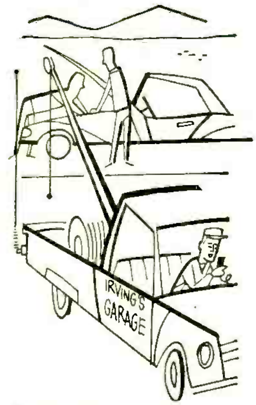
The new service is comprised of 23 frequency channels in the former "11-meter" band, covering the frequency range from 26.965 to 27.255 mc. Each of the channels is available to every Class D station, and there is no need to secure FCC approval to switch from one channel to another. Since all stations share the channels equally, the service might be likened to a giant "party line."

Let's start from scratch and see what you have to know, what you have to do, and what you need to get on the air.

FCC REGULATIONS

The FCC has established the Citizens Radio Service to serve the public's "interest, convenience, and necessity." To insure that every station will be operated in a manner which will maintain these principles, the FCC has devised a set of rules and regulations that must be followed by each Citizens Band operator (usually called a "CB'er").

These rules, which comprise Part 19 of the FCC's regulations governing the various radio services, are available for $1.25 from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.; ask for Volume VI, Catalog No. CC-1.6/6:959. The rules must be read *before* you apply for your license.



The major points made in the regulations are:

1 You may use your station anywhere in the United States.

2 You may contact any other licensed CB station; however, if you talk to a station operated by another licensee, you must take a two-minute "breather" every five minutes.

3 You should transmit only necessary communications over your station; you may not use it as a ham station to make random contacts, call "CQ," or work stations for "DX."

4 You may not knowingly interfere with a station transmitting an emergency message.

5 You have no priority rights to any CB channel; all stations have equal claim to all channels.

6 You may not "lend" your station's FCC-assigned call sign to another station.

7 You may not transmit music or other entertainment over a CB station.

8 You may not collect any charges or tolls for services performed or messages transmitted over a CB station.

9 CONELRAD, the Civil Defense radio warning system, must be monitored at all times while you are transmitting. Such monitoring can be done with a standard AM radio tuned to either 640 kc. or 1240 kc., or by listening to an FM or TV station. This does not apply to mobile units affiliated with an on-the-air base station, since these mobile units can receive a CONELRAD alert via relay from their base station.

LICENSING

The FCC has simplified the CB licensing procedure to the utmost. There are no examinations to sweat over for a CB license—in fact, you don't even have to make a personal appearance at an FCC office. The whole procedure is strictly a mail-order affair.

To apply for a license, write to the Federal Communications Commission, Washington 25, D. C., and ask them to send you "Form 505." If you have a local office of the FCC in your city, you can obtain the form there.

"Form 505"

When you receive "Form 505," you will notice that it is nothing more than an instruction sheet attached to a form with carbon paper insertions. As a matter of fact, you won't even have to answer all the questions on the form.

First, take a pencil and complete the "Work Sheet" page of the "505." You can then use the Work Sheet as your guide when you type up the application itself.

Here's how you should answer each question:

1a "Class D"

1b "Class D"

1c Write only in the column marked "Mobile," regardless of where you intend to operate your stations. Ask for at least one or two stations more than you intend placing in immediate operation if you contemplate future expansion of your system.

2a, 2b Fill in your name and address.

3 Leave blank.

4 Place an "X" in box "D."

5 Write in the general geographic area where you intend using your equipment, such as your city or county, or the general area in which you plan to operate. The general geographic area should agree with the intended use which you give in your answer to question 9. If you plan to use your CB units for a business located in Phoenix, Arizona, for example, state in your application, "Phoenix, Arizona, and surrounding area."

6 Leave blank.

7 Place an "X" in the appropriate box.

8a, 8b, 8c Place "X's" in appropriate boxes.

9 You must state exactly to which stations you expect to speak—not simply that you need CB for "business" or "personal" use. A proper answer to this question would be something like, "For necessary business communications between my TV service shop and my truck," or "For necessary personal communications between my home, car, and boat."

10 Leave blank, unless you are modifying a previously issued Class D license.

FCC Form 505
September 1958

CITIZENS RADIO LICENSE

This authorization permits the use of only such transmitters as are specified under "Special Conditions" and those appearing in the Commission's "Radio Equipment List, Part C," and designated for use in the Citizens Radio Service.

4. Class of station (Check one)
A ☐
B ☐
C ☐
D ☒

APPLICANT'S FILE COPY
FOR COMMISSION USE ONLY
CALL SIGN

1(a) FREQUENCIES	1(b) EMISSION	1(c) NO. OF TRANSMITTERS: BASE	MOBILE	FIXED
Class D	Class D		3	

5. If mobile units, or other class of station at temporary locations, are included in this authorization, show area of operation
Chicago Area

6. Location of control point(s)
X

FOR COMMISSION USE ONLY
Special Conditions:

2(a) Name (see instructions)
John Doe
(b) Mailing address (number, street, city, zone, county, state)
72 East 3 Street
Chicago 4, Ill.

3. Location of transmitter(s) at a fixed location
Number and street (or other indication of location)
X
City | County | State
Latitude ° ' " | Longitude ° ' "

Term of authorization. This authorization is effective ______
and will expire 3:00 A. M. EST. ______ and is subject to further conditions as set forth on reverse side.
By direction of the FEDERAL COMMUNICATIONS COMMISSION

SECRETARY

SPECIMEN WORK SHEET

--FOLD HERE--

7. State whether applicant is (Check one)
Individual ☒ Partnership ☐ Association ☐ Corporation ☐
Governmental-Entity ☐
(If applicant is a corporation or an unincorporated association, Part II on the reverse side of this form must be filled out.)

8. (a) Will applicant own the radio equipment? YES ☒ NO ☐
If answer is "No", give name of owner ______
(b) If not the owner of the radio equipment, is applicant a party to a lease or other agreement under which control will be exercised in the same manner as if the equipment were owned by the applicant? YES ☐ NO ☐
(c) Will applicant have unlimited access to the premises/station and will effective measures be taken to prevent use of the radio equipment by unauthorized persons? YES ☐ NO ☐

9. How is radio to be used in connection with applicant's business or personal activities? (Use space on the reverse of this page or attach additional sheet if necessary.)
Communications between my TV store and trucks.

10. If you are now authorized to operate the station referred to in this application, give call sign and present frequency, and state why you are filing this application
X

FOR COMMISSION USE ONLY

11. If for Class C or Class D stations, are transmitters crystal controlled? YES ☒ NO ☐

12. If antenna will extend more than 20 feet above ground or more than 20 feet above an existing man-made structure on which it will be mounted, give the following:
(a) Overall height above ground of tip of antenna X feet. (b) Elevation of ground above mean sea level at antenna site X feet.
(c) If mounted on an existing
(1) antenna structure, give call sign of user ______
(2) man-made structure, submit profile sketch showing structure height and antenna height.

13. If this application is for a fixed station, attach a diagram showing the locations of all the other stations at fixed locations (base or fixed) in the system and the area of operations of the mobile units, if any. X

14. If it is proposed to use a transmitter which does not appear on the Commission's "Radio Equipment List, Part C", or a non-crystal-controlled transmitter in a Class C or D station, describe such transmitter in detail. (See Subpart C of Rules). Attach Additional Sheets. X

All the statements made in the application and attached exhibits are considered material representations, and all the exhibits are a material part hereof and are incorporated herein as if set out in full in the application.
I certify that I have a current copy of Part 19 of the Commission's Rules governing the Citizens Radio Service.
If an individual or partnership applicant, I also certify that I, or each partner, is a citizen of the United States, and eighteen or more years of age (or twelve or more years of age if for Class C). I also certify that I am not (or if a partnership, corporation, or association is the applicant, that each partner, the corporation, or the association is not) the representative of any alien or any foreign government; that I waive any claim to the use of any particular frequency or of the ether as against the regulatory power of the United States because of previous use of the same, whether by license or otherwise; that I accept full responsibility for the operation of, and will retain control of any Citizens Radio Station licensed to me pursuant to this application in accordance with the law and the Rules of the Federal Communications Commission. I further certify that said station will not be used for any purpose contrary to federal, state or local law.

Subscribed and sworn to before
me this ______ day of ______, 19__
Notary Public ______ SEAL
(OR NAME AND TITLE OF OTHER PERSON COMPETENT TO ADMINISTER OATHS)
My commission expires ______

John Doe
SIGNATURE OF APPLICANT (MUST AGREE WITH NAME AS SHOWN IN ITEM 2(A))
By individual owner
(DESIGNATE APPROPRIATE CLASSIFICATION BELOW)
☒ Individual Applicant
☐ Member of Applicant Partnership
☐ Officer of Applicant Corporation or Association
☐ Official of Governmental Entity
(OVER)

11 Check "Yes," unless you are using a non-commercially manufactured piece of equipment which is not crystal-controlled (all commercial CB transmitters are crystal-controlled).
12 Answer if applicable.
13 Leave blank.
14 Answer only if Question 11 is answered "No."

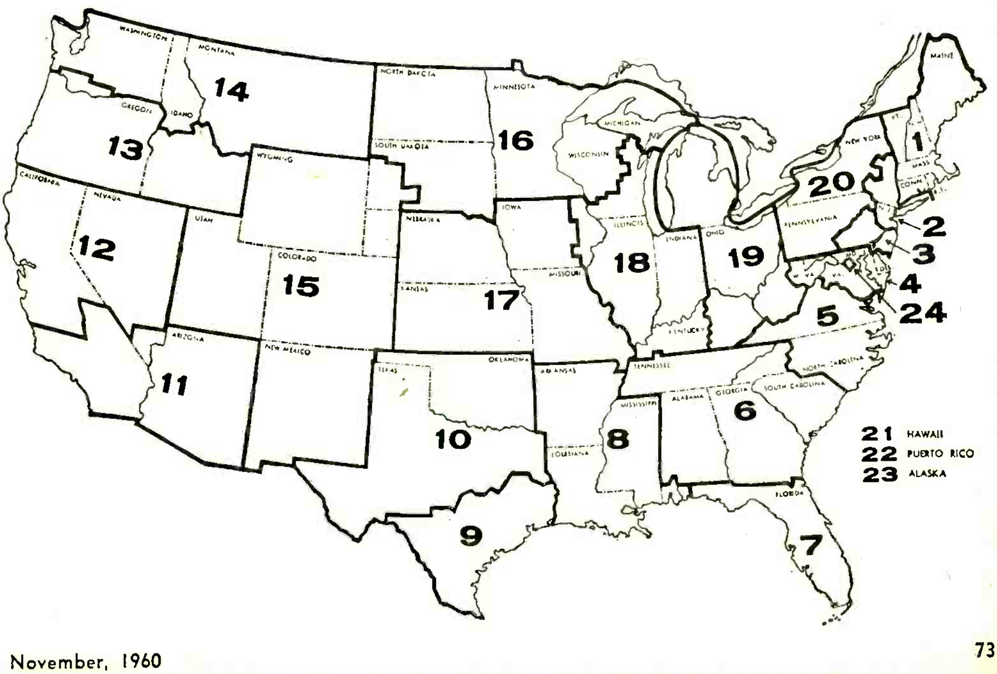
If you intend having your station licensed in the name of a corporation or an association, you will also have to fill in the appropriate questions on the reverse side of the application form.

When you are satisfied that your application is filled out correctly, take it to a Notary Public and sign it before him. Then send it to the FCC in Washington; do *not* send it to a local office of the FCC. If you enclose an airmail stamp with your application, you can speed up the receipt of your license.

Call Signs

When your license arrives, you will notice that it bears a number in the upper right-hand corner. This is your station's call sign, or serial number.

Call signs are assigned with different prefix numbers for each radio district of the country. For instance, all stations in the metropolitan New York-New Jersey area, which is the "Second Radio District," will have a "2" before the letter in the call sign (2W8833, 2W4970, etc.). There are 24



radio districts in the CB service, so when you hear a distant station you will know where the operator is from by noting his prefix number. The map on page 73 identifies each district.

Your call sign must be given regularly at specified times during your transmissions, namely at the beginning and end of all communications. However, if you are exchanging brief communications (less than three minutes per transmission) with another station, you may give your call every ten minutes (don't forget the two-minute "break" every five minutes if you're talking with another licensee).

Although anyone can listen in on CB frequencies, don't use your transmitter unless you have received your license and call letters from the FCC—it is a federal offense to do so. It is a similar offense for you to use a call sign which has not been issued to your station by the FCC.

TRANSCEIVERS

Transmitters for the Class D Radio Service must meet certain technical requirements. These include a maximum input power of five watts to the plate of the final r.f. amplifier stage and an operating frequency tolerance of 0.005%. The low power rating of the transmitter, coupled with a minimum of FCC regulation governing the design of the equipment, permits manufacturers to place low-cost transmitter-receiver units (transceivers) on the market.

The transceiver you select should be suited to your needs, both operational and financial. Your best bet is to examine the qualities of the transmitter and receiver sections separately.

There are many factors to be considered and questions to be answered when buying a transceiver, as you will see.

Transmitter Section

First, on how many different frequency channels will the unit transmit?

Does it have "push-to-talk?" Push-to-talk means that there is a button on the side of the microphone which switches the transmitter on and simultaneously puts the receiver on "standby"; this gives you "one-hand" operation, ideal for mobile use.

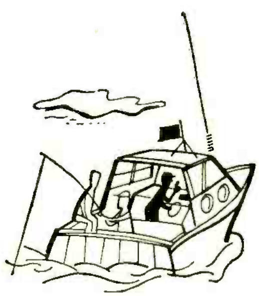
Is the transmitter rated at a full five watts power input with a maximum of 100% modulation?

Receiver Section

What type of circuit does the receiver have? The most useful receiver is one with a dual-conversion superheterodyne circuit, which will assure you of adequate selectivity (selectivity is the rejection of unwanted signals from stations which are operating on channels adjacent to yours). Superregenerative receivers, while generally less expensive than other types, have poor selectivity compared with superheterodyne types. Single-conversion receivers fall between dual-conversion and superregenerative receivers in selectivity characteristics.

Does the receiver have an r.f. amplifier stage? This is a circuit which amplifies weak signals coming into your receiver.

Is it tunable or will it receive only on the same channels to which the transmitter is tuned? You may not be interested in hearing channels on which you are not equipped to transmit; if this is the case, you should get a fixed-channel receiver. If you would like to listen in on other CB channels to hear what's going on, you'll need a tunable receiver.



Does the receiver have a "squelch" circuit? This will keep the receiver silent when the channel to which the set is tuned is not being used.

Does the receiver have a noise-limiting circuit to minimize ignition and electrical interference?

Power Supply

Taking a look at the transceiver as a whole, decide whether or not the power supply is suited to your needs. Some units will operate on all three commonly used sources—117 volts a.c., and 6 and 12 volts d.c.; others operate on only one or two of these sources. A unit to be operated only as a base station in a home, store, or office, will need 117 volts a.c.; sets to be operated in mobile units must be capable of working on 6 or 12 volts (whichever power is supplied in the vehicle's electrical system). Transceivers that will be transferred from one type of installation to another should be equipped for all three sources.

You might also look at the transceiver's construction and general appearance. Is it rugged enough for your needs? If the set is to be placed in your home or personal car, is it attractive-looking? As a final consideration, does the unit fit within the price range you have selected?

ANTENNAS

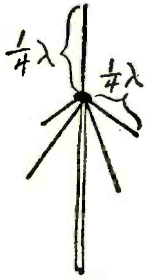
There are numerous types of antennas suitable for CB operation. Most are variations on a few basic designs, namely, the whip, the ground plane, the coaxial, and the beam. Each of these antennas will give optimum performance when put to proper use.

General Considerations

Any base station that will be talking to mobile units should have a non-directional antenna which will transmit and receive equally well in all directions. This is necessary in order to be able to communicate with mobile units which, in their travels, could be in any direction from the base station.

Another point to keep in mind is that CB communications are normally carried on utilizing vertically polarized antennas (antennas which extend "up and down") as opposed to horizontally polarized types (parallel to the ground). The reasons for this are: (1) horizontal antennas are directional and therefore not good for general CB use, and (2) on radio frequencies in the 11-meter band, ground-wave signals generally travel further when they are transmitted by a vertical antenna. (See page 78 for more on ground-wave signals.)

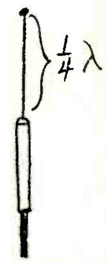
The higher the antenna, the better the range of the station. However, the FCC has a regulation which states that unless you receive FCC approval, the top of your antenna must not extend over 20 feet above the structure on which it is mounted.



GROUND PLANE

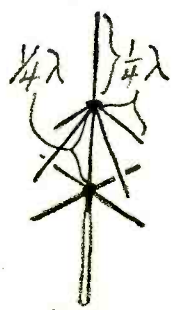
Types of Antennas

A base station can obtain excellent results with the ground-plane type of antenna. This is a non-directional antenna with a "low angle of radiation," which means that it is capable of transmitting most of your signal along ground-wave paths, letting only a small amount of the high-angle signal radiate into the ionosphere.



COAXIAL

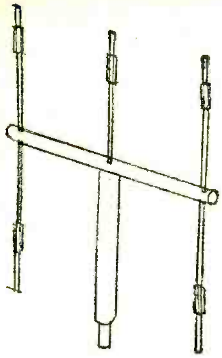
A more efficient version of this antenna is known as the "stacked" or "dual" ground plane. It possesses a significant advantage over the standard ground plane in that it has a lower angle of radiation. All types of ground planes are rather bulky and often require stabilizing guy wires to hold them rigid in gusty winds.



DUAL GROUND PLANE

Coaxial antennas, another non-directional type, are very common to CB installations where space is a consideration. These antennas, also known as "Thundersticks" in some parts of the country, take up very little room and give good results.

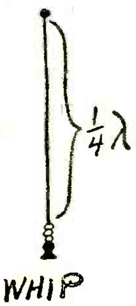
Beam antennas are directional types and are recommended only for base stations that intend to contact only other base stations. These antennas radiate primarily in one direction. In other words, if you use a beam antenna, you will send and re-



ceive very well in one direction and very poorly in all other directions.

Whip antennas, the type used by state police cars, are the simplest and most inexpensive antennas for CB'ers. Although not in common use by base stations, the "whip" is virtually the only antenna available for mobile stations. A standard CB whip is 102″ long and is held in a spring mount, usually on a rear fender or bumper. Special types of whips consisting of a helically wound coil at the base of a 48″ rod are best mounted on the vehicle's roof or in the center of the trunk cover.

Lead-In Cable



In feeding the signal from your transceiver to your antenna, you will want to be certain that the lead-in cable meets the requirements of your installation. Each type of antenna has its own characteristic "impedance" rating, and when you know this rating (it's usually given in the manufacturer's literature supplied with the antenna), you will be able to select the proper amount of lead-in.

Your lead-in should consist of coaxial cable—never of 300-ohm TV lead-in wire, which would not match the usual type of CB antenna. Keep both your lead-in and antenna clear of telephone and power lines to minimize interference and losses.

OPERATING FACTORS

The 11-meter band, so called because the characteristic wavelengths of radio frequencies in this band are 11 meters (about 37 feet) long, is capable of propagating radio signals by two distinct methods—ground wave and "skip."

Ground-wave signals are those which radiate from the transmitting antenna and go directly to the receiving antenna without the help of "skip." "Skip" signals, on the other hand, are those which leave the transmitting station's antenna and radiate upwards to the ionosphere where they are sometimes reflected back to earth by layers of ionization; these signals can actually hopscotch back and forth from earth to sky for perhaps thousands of miles.

Unfortunately, "skip" is not a reliable means of communication, and such signals are a hindrance when distant stations come in on your receiver loud enough to interfere with local communications. Furthermore, the FCC strictly forbids CB communications which rely on "skip," since CB is not intended for long-range communications.

Station Range

The range of your station will depend greatly upon several variables, and it is very difficult to make any cut-and-dried estimations as to what it will be. As we mentioned before, the higher the antennas at both the transmitting and receiving stations, the better the range—but don't forget about the 20-foot maximum height limitation.

Other factors that will affect your range are the number of stations operating on your channel at the same time you are operating, the amount of atmospheric static and other noise on the channel, the efficiency of your equipment and installation, and the manner in which the stations are operated.

CB'ers report that, on the average, they can figure on the following ranges:

Mobile to Mobile:	7 to 10 miles in the city, 12 miles in the country
Base to Mobile:	10 to 15 miles in the city, 17 miles in the country
Base to Base:	20 miles in the city, 25 to 30 miles in the country

Interference

Unless there is something drastically wrong with a standard AM broadcast receiver, it should not let any CB signals interfere with its normal functions. However, FM receivers located very close to the antenna of a CB station may experience slight interference (known as "QRM") on weak signals on the upper end of the FM band.

Television interference (CB'ers call it "TVI"), when it does occur, can usually be cleared up without much difficulty. Chances are that TV Channels 2 and 5 will be the only ones affected, and very often an adjustment of the TV receiver's fine tuning control will eliminate the interference. If all else fails, a "low-pass" filter can be placed in the CB station's antenna circuit, and a "high-pass" filter placed in the lead-in terminals of the TV receiver.

Installation and Maintenance

Although CB'ers are permitted to install and maintain equipment themselves, there are certain limitations which apply.

You may make on-the-air internal adjustments in your transmitter only if your rig has a sealed, tamper-proof oscillator circuit. The literature each manufacturer supplies with his equipment will mention whether or not the equipment meets this requirement. If your transmitter does not have a sealed oscillator, only a person holding a First or Second Class Radiotelephone or Radiotelegraph license issued by the FCC may tune it while it is in operation.

Maintenance of the equipment should present no particular problem. Citizens Band sets are generally rugged and can withstand some rough handling. You will probably have little or no reason to take your CB unit out of service for repairs other than an occasional defunct tube.

Rules of the Road

Operating procedure, surprisingly enough, will be a factor in how good your station is. Follow the *Popular Electronics* CB Courtesy Code (given below). Use CB "11" signals (see September issue of P.E.) to keep messages down to minimum transmission time and help keep the channels clear. Never use CB to "pass the time of day" with another CB'er—that's what telephones are for.

1 Do not transmit on a channel without first listening to see if it is clear. If the channel is in use, stand by until it is clear.

2 Keep calls down to a minimum ("2W4887, 2W4887, this is 2W4580" should be sufficient). If the called station doesn't reply, try again in 30 seconds. If there is still no answer, wait 10 minutes before you call again.

3 Say "over" at the end of each transmission so the operator you are contacting will know that you expect him to transmit.

4 If you hear a station being called which you know has cleared the channel, inform the calling station.

5 Always help in an emergency, even if the extent of your help is to cease transmissions and keep the channel open.

6 If a station accidentally interferes with your communications, request that the station stand by for a few moments until your communications are completed. You should then finish your contact as soon as possible.

7 Never work cross-channel unless it is the only way to send an extremely important message. If you must work cross-channel, ask the other station to give your channel a quick check to see if it is clear.

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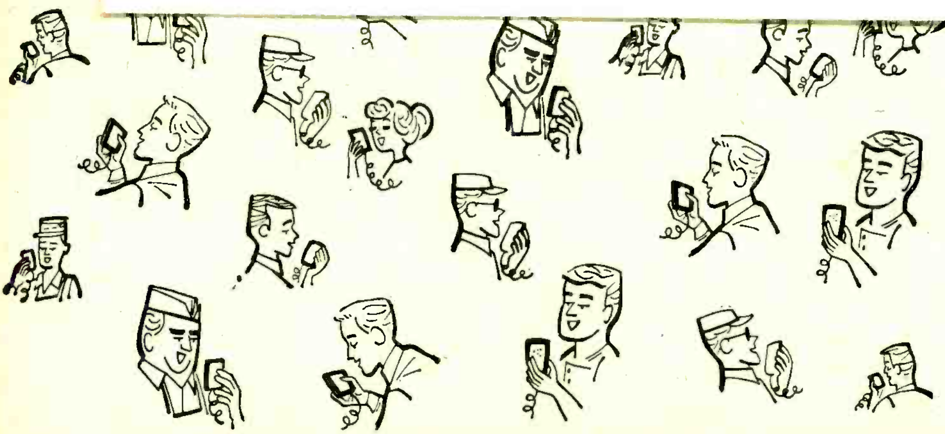

THE FUTURE

What lies ahead for Class D Citizens Radio? It's hard to say, but if CB continues to grow at its present rate, it may well be a household and office word within the next few years.

Certainly the future has much in store for Citizens Radio. Just as other radio services have changed—and will continue to change—with the years, so too will the Citizens Service. There has been talk of permitting additional types of emission on the band—such as single-sideband operation and narrow-band FM. And even the allowance of higher-powered transmitters on the band must be viewed as a distinct possibility.

While the FCC has not yet looked favorably upon the idea of revising the present rules, we predict that some changes will come into being within the next five years—probably in conjunction with the allocation of additional channels to accommodate the hundreds of thousands of new stations which will be licensed during this period.

But whatever the future holds, the important fact is this: Class D Citizens Radio offers everyone his own two-way communications system—a system as inexpensive and versatile as the old dream of the 1930's thought it would be.

Rules of the Road

Operating procedure, surprisingly enough, will be a factor in how good your station is. Follow the *Popular Electronics* CB Courtesy Code (given below). Use CB "11" signals (see September issue of P.E.) to keep messages down to minimum transmission time and help keep the channels clear. Never use CB to "pass the time of day" with another CB'er—that's what telephones are for.

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Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

SWL FIELD OPERATIONS

THIS past June, the Ransom Radio Club, a group of young SWL'ers living in and around Ransom, Kansas, set up a receiving station on the Virgil Simpson farm, 7½ miles north of Ransom. Their field operations were carried out from 2300 on June 25 to 0600 on June 26, at the same time the ARRL Field Day exercises were being held. As you may know, for 48 hours each year in June amateurs everywhere try to work as many stations as possible using only emergency power sources, such as generators, batteries, and gasoline engines. And many short-wave listeners switch from the international broadcast bands to the amateur frequencies during this period in the hope of logging new stations, areas, or countries.

The members of the Ransom Radio Club were quite successful in their recent field operations. They managed to log many amateur stations as well as a number of regular short-wave outlets, including *Radio Australia,* and some medium-wave Mexican stations. Participating operators were Rod Blocksome, WPEØUT, his brother Kent, Greg Simpson, and Eddie Zilnik.

The equipment the four boys used on their outing included a Hallicrafters S-53A, a Traveler broadcast-band receiver, a modified Airline receiver, and a Zenith three-way portable receiver—the latter unit covering both the amateur and the short-wave frequencies. Each of these receivers had its own 80′ long-wire antenna.

We think that this is a worthwhile way of operating a receiving station and suggest that other SWL groups consider a similar setup for 1961. It isn't too early to begin lining up and tuning up the receivers, determining what operators are available and what time slot they prefer, choosing a location, and generally coordinating all of the many little details that might crop up. There is good experience to be gained from setting up and operating such a station and it's bound to be a session that will be long remembered.

Operating from a hay stack, members of the Ransom (Kansas) Radio Club made the most of the recent ham field day by having a field day of their own. They logged many new stations.

American SWL Club. One of the most promising of the new clubs, the American

(*Continued on page* 137)

ADVANCED EXPERIMENTERS CORNER

Proven and suggested circuits for the electronics enthusiast who does not require construction plans

JOB TIMER

A RUNNING TIME METER is useful for indicating the a.c. "power on" time of various types of equipment; with the meter used here (Cramer 631E), you can time jobs from 0 to 9999.9 minutes. This meter is not a "plug-in" device—"as is" it's not very handy. However, if you mount it in a simple enclosure (Bud C-1854-B or equivalent) with suitable plug connectors, fuse, pilot lights, switch, and a handle, you'll have a portable instrument.

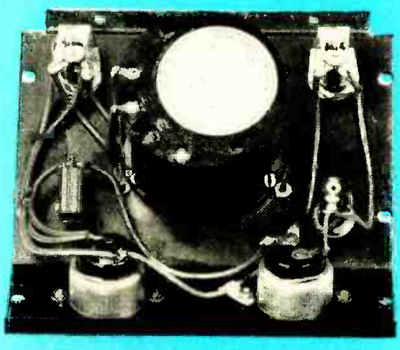
Actually, either a running time meter or an elapsed time indicator could have been used, but the author chose a running time meter. The difference between the two is the manner in which they are reset; running time meters usually have a manual reset knob on the meter face, while elapsed time indicators automatically reset to zero when the power is removed.

The circuit of the job timer is simple and straightforward. Shunted across the a.c. input is a NE-1 neon lamp which lights when the power cord is plugged into the 117-volt a.c. line. The second neon lamp and the timer operate only when panel switch *S1* is thrown to the "on" position, which also energizes the a.c. "load" receptacle. Fuse *F1* is inserted in the common (unswitched) side of the circuit to protect the equipment being timed.

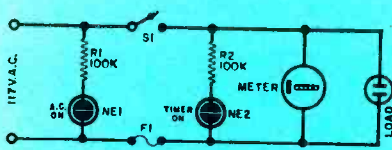
In operation, the power plug is inserted with *S1* in the "off" position; the meter is set to zero; and the load is plugged in. Both the timer and the equipment being timed start when you turn *S1* "on," and the running time is recorded by the meter until *S1* is turned "off." If your job is temporarily interrupted, you just turn *S1* off, then on again when the job is resumed. The meter indicates total "power on" time until it is reset.

—*Ronald L. Ives*

Job timer is mounted in sloping front cabinet; power plugs mount on front apron.

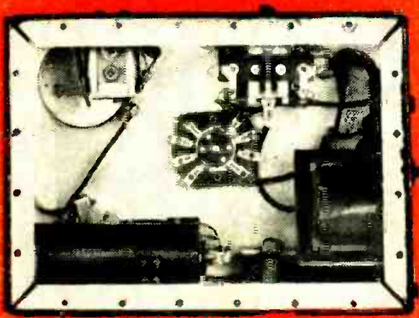


Shielded wire is used for interconnections; shields are grounded to cabinet.

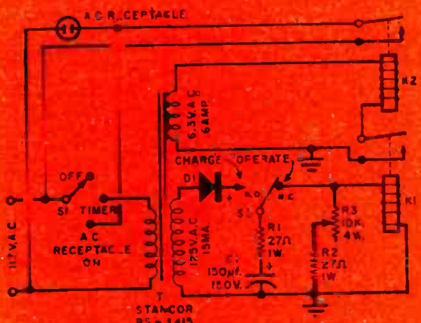


Two neon lamps are used in timer. Input is male plug; output is female receptacle.

Photo timer controls mount on top of cabinet; R3 has timing scale (white circle).



With bottom cover off, relays can be seen on upper apron; line switch is in center.



Line switch S1 is 3-position rotary switch; S2 is s.p.d.t. momentary push-button switch.

PHOTO TIMER

ACCUSTOMED AS WE ARE to using tubes and transistors in circuits these days, we're apt to overlook the fact that useful circuits can be designed which incorporate neither tubes nor transistors. Take, for example, the photo timer shown here—it was built for use with a commercial photographer's contact printer.

With switch *S1* in the "Timer" position, the unit draws no power until the "Charge" button (*S2*) is pressed; then capacitor *C1* is charged by the output of half-wave rectifier diode *D1*. Release the button, and spring action returns *S2*'s arm to the normally closed "Operate" position, allowing *C1* to discharge through the coil of relay *K1*, resistor *R2*, and potentiometer *R3*.

Due to the discharge current through *K1*'s coil, this relay is energized for a period of time determined in part by the setting of *R3* (which also consumes part of *C1*'s charge). Relay *K2* is then energized through the energized contacts of *K1*. In turn, the energized contacts of *K2* connect 117-volt a.c. power to the a.c. receptacle mounted on the rear of the unit.

When capacitor *C1's* charge falls below the energizing potential for relay *K1*, the energized contacts of both relays return to their normally open conditions and 117-volt a.c. power to the a.c. receptacle is thereby cut off.

Circuit values are not critical, but the values given are for a time interval adjustable from one-tenth of a second to one second. Larger values for storage capacitor *C1* give longer time intervals.

Relay *K1* is a Sigma 41F with a 200-ohm coil, and relay *K2* is a Potter & Brumfield MR3A with a 6.3-volt a.c. coil.

In the first position of the three-position rotary switch (*S1*), the timer is "off." In the second position, the timer is "on." The timer is again "off" in the third position, but this time the a.c. line is applied directly to the a.c. receptacle.

The photo timer is enclosed in a 5" x 7" x 3" aluminum chassis fitted with a bottom plate for safety, and rubber feet for stability. The entire unit should be sprayed with two coats of flat-black lacquer; this minimizes the possibility of light bounce and is a common precaution taken with most professional darkroom equipment.

The desired setting of *R3* can be determined by making a few test prints with the timer set at different intervals. —*Leon A. Wortman*

Modify Your Heath 6- or 10-Meter Transceiver

. . . for quicker frequency changes, easier tuning, and peak efficiency

By JAMES E. ROHEN, K8NQH

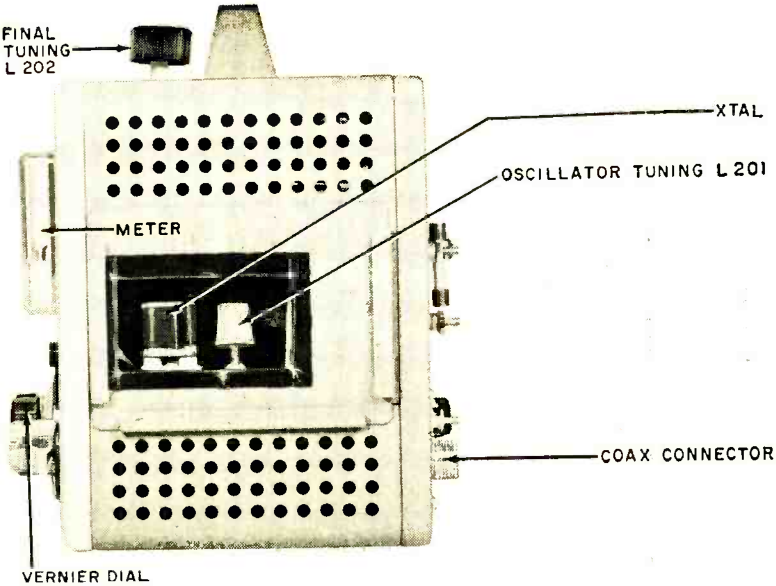
IF YOU own a Heath 6- or 10-meter transceiver, Model HW-29 or HW-19, here are a few modifications that will increase your operating pleasure. You'll be able to change transmitter frequency quickly and keep the final operating at peak efficiency. Receiver tuning will be easier, too.

The modifications include making a crystal access hole for convenient crystal replacement, and adding a plate current tuning meter to the transmitter. You also add knobs to the oscillator and final tuning slugs and attach a little vernier dial for tuning the receiver. If desired, a coaxial antenna jack can be installed to replace the RCA phono jack. Only $6 in parts are needed for all of these modifications, and you'll gain by having a more attractive rig to boot.

Tuning Meter. Before cutting a hole for the meter in the front panel, remove the front panel from the chassis and unfasten the speaker and neon bulbs. The bulbs and their leads are fragile, so be careful not to damage them. Lay the panel face up on your workbench and mark off the meter hole to the right of the speaker grille, as shown. The hole is cut with a coping saw. Make a trial fit of the meter; then remove the meter and mount it later, after the other modifications are completed.

Vernier Dial. The next step is the installation of a vernier dial for the receiver tuning capacitor. First remove the three screws holding the variable tuning capacitor (C108) to the chassis. Then, without removing any wires from the capacitor, gently push it back, as far from the front of the chassis as possible. You need just enough room to insert a ¾" chassis punch to enlarge the existing capacitor shaft hole. The punch should be centered carefully so that you don't cut into the capacitor's mounting screw holes.

Now remount the capacitor, as shown, using ¾" spacers and screws 1" long. Remount the front panel, place the vernier dial in the enlarged hole, and fit the dial onto the shaft of the capacitor. The vernier dial is used as a template; mark and drill two holes in the front panel to attach the dial. You'll find that the tuning capacitor's shaft fits the vernier dial loosely, so make



Side hole in cabinet permits rapid crystal change; oscillator and final tuning controls peak transmitter on new crystal frequency; meter indicates plate current. Vernier dial and coaxial connector jack are optional.

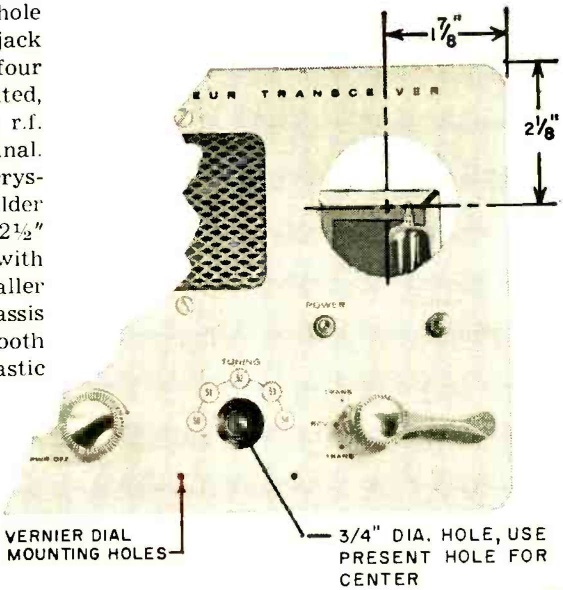
a tight fit by gluing on a wedge cut from the "half-moon" shaft of an old potentiometer. (See shaft detail.) If you wish, any other short piece of scrap metal can be used instead of the potentiometer shaft.

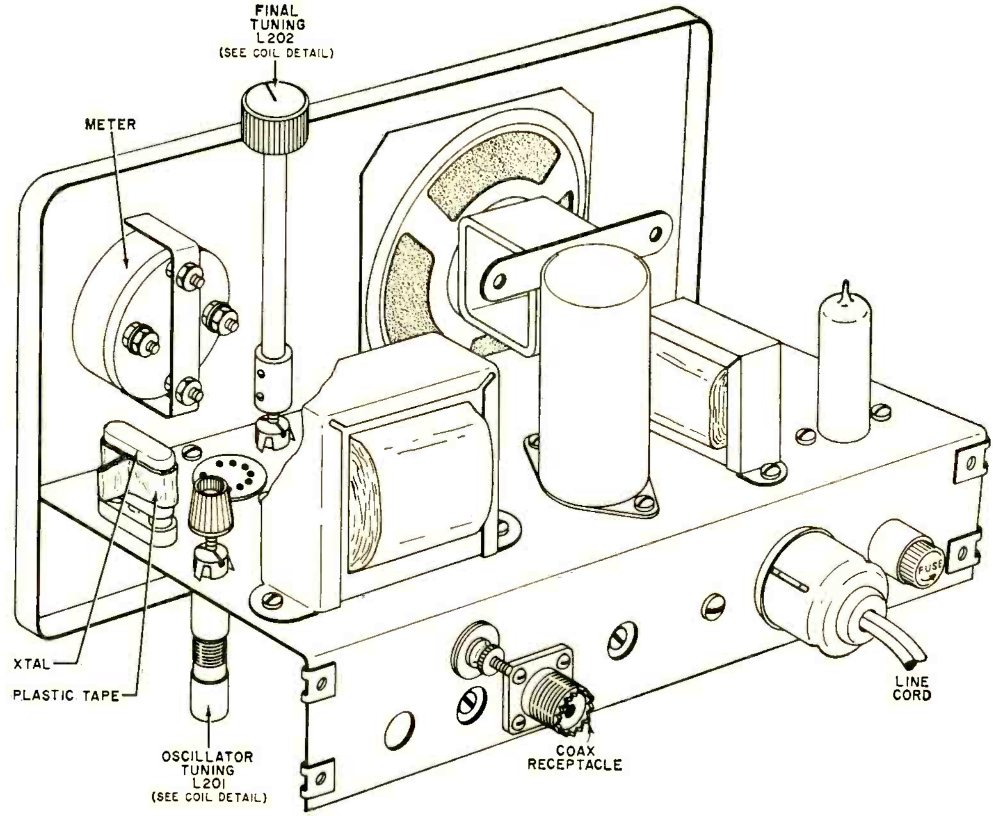
Coaxial Connector Jack. The RCA phono jack can be replaced with a standard coax connector jack if your other equipment, such as your low-pass filter or antenna, is also terminated in a coax connector. To mount the coax jack, remove the phono jack and enlarge the jack's hole with a 3/4" punch. Then use the coax jack as a template, and mark and drill four mounting holes. After the jack is mounted, using standard hardware, connect the r.f. output lead to the jack's center terminal.

Crystal Access Hole. Locate the crystal access hole behind the license holder panel, as shown. The hole should be 2 1/2" wide and 1 1/2" to 2" high; it can be cut with a coping saw or by punching several smaller overlapping holes with a square chassis punch. File the edges of the hole as smooth as possible and cover them with plastic tape.

To make crystal replacement easier, wrap a piece of plastic tape around each of your crystals, leaving a 3/8" tap protruding from their sides, as shown in the pictorial diagram. The tab is used as a handle

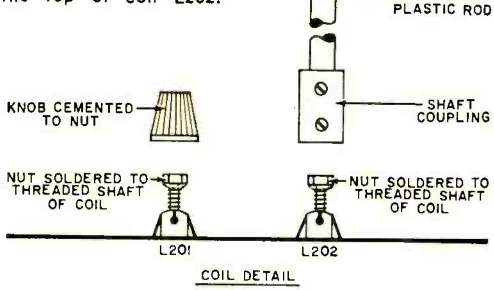
Meter hole in upper right corner of front panel is cut with a coping saw. Mounting for the vernier dial requires an enlarged center hole and two smaller holes spaced below it.





Transmitter modifications as seen from the rear of the set include tuning knobs, meter, and antenna coax receptacle. Tab of plastic tape on crystal is handle for its rapid removal through side hole.

Use very small knob on coil L201. Shaft coupling set screw tightens on the nut soldered to the top of coil L202.



when you plug in a crystal through the access hole.

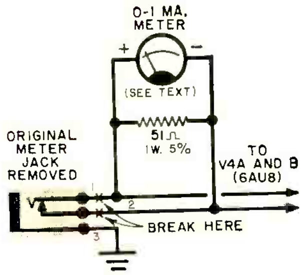
Transmitter Control Knobs. Now, tuning knobs are attached to the oscillator and final tuning slugs, L201 and L202, respectively. Start by soldering a nut to the top of the oscillator slug, L201. (See coil detail.) When the solder is cool, cement a small knob to the nut. A toothpaste tube cap makes an ideal knob for this control.

Select a second nut which will fit inside the control shaft coupling and solder this nut to the top of the final tuning slug. L202. With the nut in place, tighten the shaft coupling set screw to the nut. Next, drill a 3/8" hole in the top of the cabinet directly over the final tuning slug and pass through a 4" length of 1/4" plastic rod. The set screw at the other end of the shaft coupling is used to hold the rod in place. This set screw is accessible through the crystal access hole when the unit is reassembled. Attach a knob to the end of the rod protruding through the top of the cabinet.

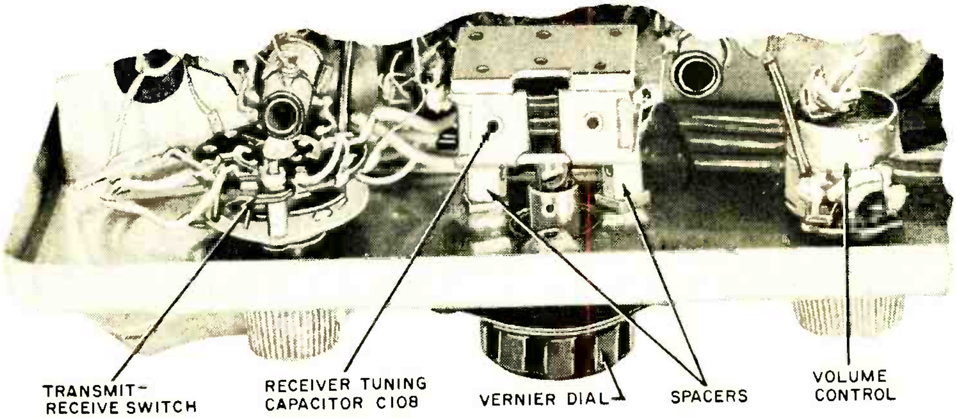
Rewiring. At this point all major mechanical modifications are complete and only some rewiring remains to be done. First, mount the meter on the front panel and unsolder the wires connected to the

PARTS LIST

1—0-1 ma. panel meter (Shurite 850 or equivalent)
1—51-ohm, 1-watt, 5% resistor
1—Vernier dial, 2" diameter (Lafayette F-347 or equivalent)
1—Coaxial jack (Amphenol 83-1R or equivalent)
1—1/4" plastic rod, 4" long (Lafayette MS-197 or equivalent)
1—Control shaft coupling connector (Lafayette MS-201 or equivalent)
Misc.—Hardware, 3/4" spacers, knobs, plastic tape, etc.



Meter jack leads are disconnected and rewired to plate current meter; jack need not be removed from set.

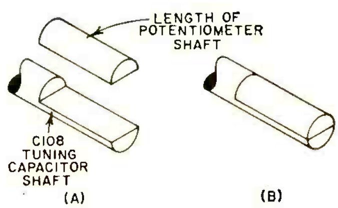


Tuning capacitor C108, above, is remounted to front panel with spacers; shaft is modified to fit vernier dial.

Shaft of C108, (A), below, is rounded with scrap of metal. Round shaft (B) is non-slip fit for vernier dial.

meter jack on the rear panel. Then, the wires from the jack are run up through the grommet located next to the crystal socket; dress them close to the chassis. Connect the wire from pin 1 of the meter jack to the positive meter terminal; the wire from pin 2 is connected to the negative meter terminal.

A 51-ohm, 1-watt, 5% resistor should be connected across the meter terminals if you use the 1-ma. meter in the parts list. If you use a different meter, compute the shunt resistance from the following formula: Shunt Resistance=Internal Meter Resistance/20. Calibration of the meter scale is not important since the meter is used only for tuning the transmitter. Now recheck all mechanical and electrical connections and reassemble the transceiver.

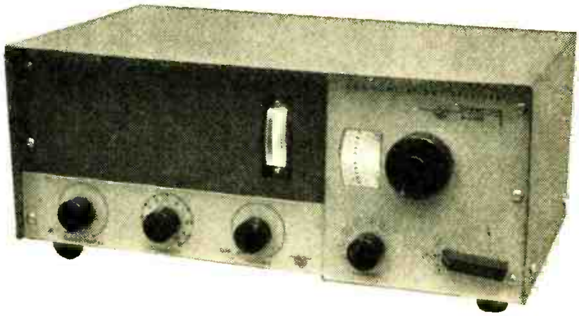


Operation. Plug in a crystal and switch the unit to "Transmit." The meter should read about 3/4 scale; the exact meter reading is not important. Adjust the knob on the oscillator slug (L201) for a maximum reading on the meter. Then adjust the knob on the final tuning slug (L202) for a "dip" (minimum meter reading); the dip will be small, so make this adjustment carefully. Now, readjust L201 for a maximum reading, and "re-dip" L202. If you repeat this procedure each time you change crystals, you'll be sure that you are getting the very most from your transceiver. —30—

CB Receiver Tunes All Channels

Browning Labs introduces bandspread receiver for fixed station use

Planetary drive dial and well-illuminated scale (above) are features of the R-2700 CB base station receiver. Vertical scale S-meter (photo at right) is mounted on speaker grille. Jacks and plugs (below) are for remote control of transmitter.



THE Model R-2700 CB receiver, manufactured by Browning Laboratories, Laconia, N. H., has been thoroughly tested by the POP'tronics staff. Designed for "base station" use, it tunes from below 26.965 mc. (channel 1) to above 27.255 mc. (channel 23). The dial is carefully marked with both frequencies and channel numbers.

In addition to its smooth planetary two-speed tuning, the R-2700 has five crystal-controlled receiver channels which can be switched from the front panel. Citizens Band operators will also appreciate the S-meter and the variable noise limiter and squelch controls.

The R-2700 is delivered to the user with a "test report" giving the sensitivity, signal-to-noise ratio, calibration of S-meter and dial, plus details on a.v.c. action and audio output. The circuit uses 10 tubes and has 40 db separation between CB channels.

The lever switch in the lower right-hand corner of the front panel is a two-position control for a companion transmitter. Antenna output from the transmitter is fed into the coax jack on the rear skirt of the R-2700, and the cable from the antenna is then connected to a second coax jack; special wires from the *"Control Socket"* turn the transmitter on and off. The instruction book carefully outlines details on how this may be accomplished with most transmitters.

Priced at $149.00, the Browning R-2700 CB receiver performed in an outstanding fashion in our editorial offices—where we are usually saturated with FM and TV signals.

—30—

Across the Ham Bands

By
HERB. S. BRIER
W9EGQ

SWEEPSTAKES

AN interesting event is about to take place in hamdom. At 5:59 p.m., EST, Saturday, November 12th, the ham bands between 3.5 and 29.7 mc. will sound practically deserted. But one minute later they will explode into life, as thousands of hams start transmitting "CQ SS" simultaneously. The 27th Annual ARRL Sections Sweepstakes Contest will have started.

When the contest ends at 3:01 a.m., EST, November 21, some 10,000 U. S. and Canadian hams will have participated in it. Many will enter just to sharpen their operating abilities or to see how well they get out in competition with other hams. But hundreds of hams will work the last few states they need to earn their WAS certificates. About eight will succeed in making over 1200 c.w. contacts, and a similar number will make over 700 phone contacts.

Whatever their reason for entering the contest, these hams will all have a good time. Why not try it yourself and find out first-hand why contest-minded hams enter the Sweepstakes year after year?

Contest Rules. You work as many amateurs as possible in any of the 73 ARRL sections, exchanging the following information with each station: number of the contact, station call letters, RST report of the station worked, section, time (24-hour

Ham of the Month

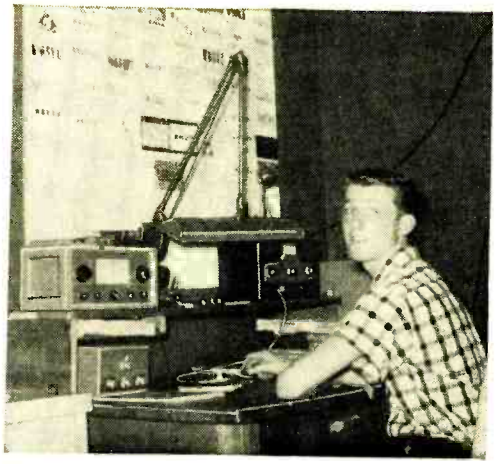
Lenore Kingston Conn, W6NAZ, is a veteran theatre, movie, and radio/TV performer. Currently she spends her days presenting her program "Purely Personal" 35 times a week over Station KFWB in Hollywood, Calif. At night she is on the ham bands observing regular schedules with Greenland, Iceland, and other arctic outposts—she keeps the men stationed in the far north in contact with their loved ones. Interestingly enough, some of the emotional family situations that develop on these schedules rival anything that ever happened in such soap operas as "Ma Perkins" and "Against the Storm," in which Lenore used to perform.

A charter member of the Young Ladies Radio League, Lenore got her first ham call letters—W9CHB—in Chicago 21 years ago. She also married a ham—Joe Kingston, W6MSC, who is a TV technical director. Her present equipment consists of a Collins KWS-1 transmitter, a 75A-4 receiver, and a tri-band beam, plus a complete sideband rig in her car.

When not keeping schedules, Lenore likes to chat with her many ham friends on phone or c.w. She sends code like a "pro" on her electronic keyer, and her 35-wpm code-proficiency certificate proves she copies it equally well. Lenore calls all the rare DX she hears but has not kept a record of how many countries she has worked.

Of the many awards and trophies Lenore has received, she is most proud of one from the men at Sondrestrom, Greenland, inscribed in gold with their "eternal gratitude for three years phone patch service." The Radio and Television Women of Southern California Merit Award of 1959 runs a close second.

Charlie Ware, Jr., KØPGC, uses his Heathkit DX-100B and Hallicrafters S-85 on 40 and 20 meters.



Ken Gilbert, WA6GCB, worked 47 states, 21 countries with a Johnson Adventurer and Heathkit AR-3.

clock system), and date. Example: Nr. 10, W9EGQ, 579, Indiana, 1810, Nov. 12.

You earn one point for sending your information and another point for copying the other station's information. Multiply your contact points by the number of sections you work and again by your power handicap. If your transmitter power does not exceed 150 watts at any time during the contest, multiply your score by 1.25 on c.w. and by 1.5 on phone. For higher power, your multiplier is one.

As previously stated, the contest starts at 6:00 p.m. (1800) EST, November 12th; it continues until 3:01 a.m. (0300) EST, November 14. The same time schedule is used again the following weekend, November 19 to 21. But although there is a total of 66 hours involved in the two weekends, you are only allowed to operate a maximum of 40 hours.

In most states and Canadian provinces, the ARRL section boundaries agree with the state and section boundaries. See page six of any issue of QST for the complete list. The League awards a certificate to the highest c.w. and the highest phone scorer in each section.

Significantly, 124 of last year's 152 certificate winners took advantage of the low-power multiplier. Twenty of them ran less than 75 watts. The fact that you do not need high power to make a good showing in the SS contest is one reason for its popularity. Nevertheless, even with the best of equipment, it takes real operating skill to become a certificate winner.

To work 1200 stations on c.w. or over 700 stations on phone in the contest requires superlative operating skill. To do so, you must average 30 stations an hour on c.w. or about 20 an hour on phone. To maintain such an average for 40 hours means that you must almost double this rate during peak hours to compensate for the periods when contacts come hard and slow.

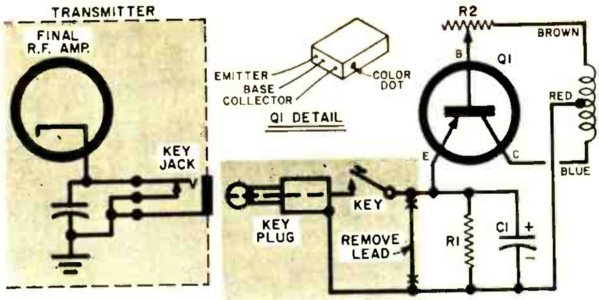
Operating Tips. While high power is not needed to run up a good score in the SS contest, operating convenience is. Full "break-in" or single-switch operation will add several contacts an hour to a good score.

To CQ or not to CQ? Experiment. If you make more contacts per hour by calling CQ, do so. If you make out better calling individual stations, concentrate on that method. Either way, keep your call short.

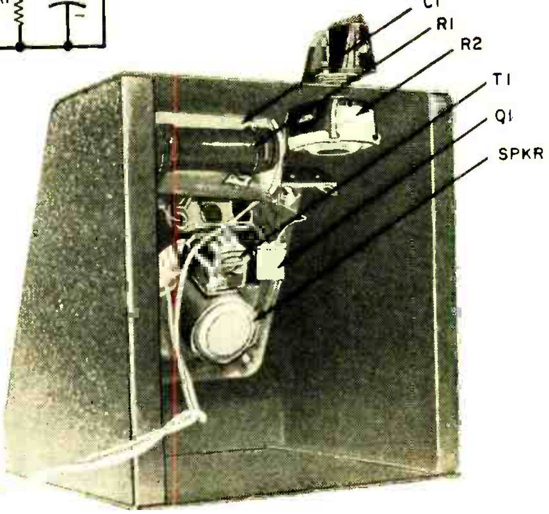
When calling another station, get right on its frequency, and send its call letters once or twice followed by your own call letters the same number of times. A longer call is seldom necessary. If you are not heard immediately, the other operator is probably already listening to someone else, has started to call CQ again, or has shifted frequency.

When calling CQ, three CQ's followed by your own call letters sent twice will usually be a long enough call, unless the band is almost deserted. Then a slightly longer CQ may be desirable.

Don't stay too long at a time on the same frequency or band. Keep moving around to



Keying monitor draws its power from the cathode circuit of the transmitter's final; setting of potentiometer R2 controls the tone of the note. The unit can also be employed as a code-practice oscillator if resistor R1 and capacitor C1 are replaced with a 1½-volt battery as described in text.



tap new pockets of unworked stations. Many successful SS'ers change bands several times an hour, especially during slack periods, to keep their contact-per-hour average up.

And don't waste your own and other contestants' time by working the same station more than once in the contest. Drop a postal card to the American Radio Relay League, 38 La Salle Road, West Hartford, Conn., and ask for Operating Aid No. 6. It will permit you to see at a glance whether or not you have worked a station before. Also ask for a supply of SS contest log sheets, so that you will be sure to submit your score in the required form.

I hope to work you in the Sweepstakes.

PARTS LIST

C1—50-µf., 10- to 25-volt electrolytic capacitor
Q1—CK768 p-n-p transistor (or equivalent, see text)
R1—15-ohm, 2-watt resistor
R2—5000-ohm potentiometer
T1—500-ohm to 16-ohm transistor output transformer with center-tapped primary (Argonne AR-118 or equivalent)
Spkr.—3" speaker, 3.2-ohm voice coil (Utah SP3A or equivalent)
1—4¼" x 4" x 4" universal meter box (Bud CM-1935 or equivalent)
Misc.—Hardware, tie points, etc.

KEYING MONITOR

Most hams know that they can send their best code when they are able to listen to their own sending. You can check your "fist" by tuning in your transmitter on your own receiver. But although this works reasonably well with some receivers, it is inconvenient at best, since you must readjust the receiver controls every time you transmit or listen. The simple, transistorized code monitor described here eliminates this inconvenience.

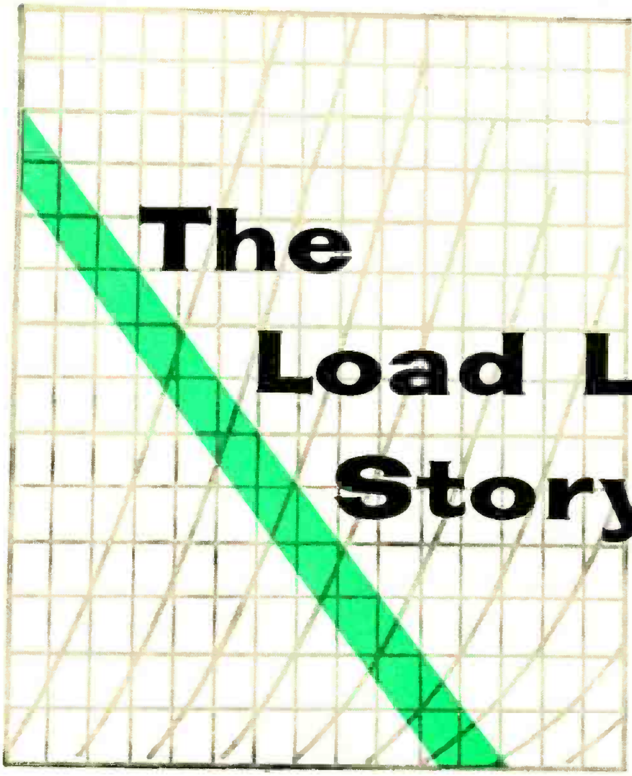
The monitor is designed for use with transmitters which have cathode-keying circuits—such well-known transmitters as Globe Chief 90A, Heathkit DX-20 and DX-40, Johnson Adventurer, and Knight T-50, for example. The unit draws all its power from the transmitter keying circuit.

With the addition of a single flashlight cell, the monitor can also be used as a code practice oscillator.

Construction. The monitor is built in a 4¼" x 4" x 4" universal meter box with a slanting front. Almost any transistor output transformer can be used for *T1;* the one specified in the parts list was selected since it resulted in a pleasant note from the speaker. Transistor *Q1* may be any general-purpose *p-n-p* unit, such as the 2N107, CK722, CK768, or experimenters' types.

First, cement *T1* to the 3" speaker and connect *T1*'s secondary leads (green and

(*Continued on page* 122)



The Load Line Story

POPULAR ELECTRONICS AFTER CLASS feature

Load lines are as fundamental to vacuum tubes as vectors are to mathematics—here's what they're all about

By SAUNDER HARRIS

LARRY was sitting at Ken's workbench watching him fill out QSL cards for the afternoon's hamming contacts.

"Do you have time for a bit of explaining, Ken?" Larry asked his older friend. "We were discussing load lines at the school radio club today and none of us really understood much about them. I told the fellows that you'd set me straight and I'd pass the dope along to them."

Ken pushed the cards aside and checked his watch. "Sure, Larry, I'll be glad to throw some light on the load-line situation. Actually, it isn't a complicated subject—if you know Ohm's law and a few basic facts about the workings of tubes."

Larry laughed, "I know about Mr. Ohm all right, but at times what you call basic looks mighty unbasic through my specs. If you're willing, though, I'd sure appreciate it."

Ken was very assuring. "I guarantee these will be *basic* basics."

He handed Larry a small book. "Here, glance through this while I do a little circuit drawing. It's a tube manual—the next time you've got an extra dollar or two in your jeans, get one—RCA, G.E., and Sylvania all publish one.

"Look up the data on the 6J5 while you're at it," Ken added. "We'll be using its plate characteristic curves in plotting our load lines."

As Larry went through the manual, Ken drew up a simple one-tube circuit.

In a few moments Ken pushed the sketch across the bench top to Larry. "Here, take a look at this circuit. What is there about it that strikes your eye after you look at it for a minute?"

Larry studied the diagram. "Well, it certainly looks simple enough. It's a triode with a fixed plate voltage and grid bias, and it also has meters to measure plate voltage and plate current." He paused for a moment, then said, "Oh, yes, I see that there's no place to feed an input into the tube—how come?"

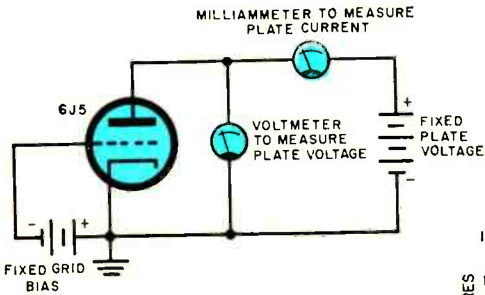
"In this circuit we just want to find out how the tube acts as we apply various bias and plate voltages. You can see that we don't take an output from the tube, either. This is the setup used to work out what are called the static characteristic curves for the tube."

He took the tube manual from Larry and pointed to the page containing the average plate characteristic curves for the 6J5. "This is the set of curves we'll use in plotting our load lines. They are called 'static' curves."

"What does 'static' mean in this case?"

"With regard to tube characteristic curves, Larry, static simply means that the voltages applied to the circuit during the tests were steady—or static—voltages.

"Well, if there's no useful work being done by the circuit," Larry said, "what good are these static curves?"



Circuit for determining tube characteristics under static operating conditions. See text.

Average plate characteristic curves for 6J5 tube, with grid voltages from 0 to −24 volts.

Ken smiled. "Don't make them sound useless, Larry. Actually these static curves tell us a great deal about the relation between grid bias voltage, plate voltage, and plate current within the tube. Take a close look at the 6J5 curves and see what you can make of them."

Larry peered intently at the family of curves. "I can see quite a few things, Ken. For one thing, I see that each curve stands for a different negative grid bias voltage. The more negative this voltage, the less the current seems to flow through the tube, even though the plate voltage remains the same."

"Be specific, Larry," Ken replied. "Let's see if you really understand this point."

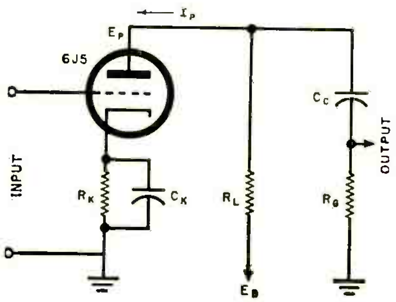
"Sure thing. Take the −4 volt grid bias curve. With a plate voltage of 160 volts and this bias, the tube has a plate current of 8 milliamperes." Larry then pointed to the −6 volt grid bias curve. "When the bias is increased to −6 volts, less than 4 ma. flows for the same plate voltage."

He paused a moment, then burst out, "Say, look here, Ken! When we increase the grid bias to −10 volts and over, we can't get any plate current to flow unless we increase the plate voltage to more than 170 volts!"

"Right you are, Larry. Do you begin to see now how we can get valuable information from static characteristic curves?"

"Yes, I do, but where do the load lines come in? Are they static curves, too?"

"No, Larry, the plotting of a load line gives us information about the tube under operating conditions. What we do is use the static curves to develop the load line. Now we'll see how that works. First look at this circuit." Ken passed another diagram across to Larry. "Tell me what you make of it."



"This looks more like the real thing, Ken. It's an amplifier and it has a resistor in the plate circuit, and . . ."

"Hold on a sec, Larry. That's more than just a resistor in the plate circuit. It's a resistor that does a very special job."

"What do you mean?"

"That's the load resistor, buddy, and it's just about the most important element in our whole discussion." Larry's face was still blank, so Ken smiled and continued, "Without that load resistor in the circuit, the tube couldn't do any useful work. When we put the load resistor in the plate circuit and the plate current flows through it, a voltage drop is developed across the load resistor."

Larry's face lit up. "I get it now! As the plate current varies because of the input signal, the voltage drop across the load resistor varies—and that's the output of the tube." He looked pleased with himself. "Sure thing! That voltage drop is the amplified signal and it can be passed on to another circuit or used to do work just as it is. But what has that got to do with figuring the load line?"

"Hold your horses. That's the next step, but I did want you to see how important a job the load resistor did. Here's where we use the family of curves you looked up."

KEN took some scratch paper and a pencil, then continued.

"As soon as we put that load resistor into the circuit, the one I marked R_L, all the dope given by the static curves is changed. When a signal is fed into the tube, it varies the voltage on the grid. This causes the flow of current through the tube to vary, and as this current passes through R_L it causes an IR drop . . . you'll remember this from Ohm's law . . . which varies the plate voltage.

"Now, Larry, when this happens, the current flowing through the tube varies and everything changes again. With all these things jumping around, we have what is known as a dynamic, or changing situation; the curve that describes it is called a dynamic curve. That's what a load line is—a dynamic curve."

"Wow!" Larry exclaimed, "There sure are a mess of things going on all at once. How do we keep track of them?"

"With a load line, my friend, with a load line."

Ken grinned at Larry's puzzled expression and went on. "For the sake of illustration let's assume that the plate supply voltage, E_b, equals 240 volts and that the value of the load resistor, R_L, is 22,000 ohms. Okay?"

When Larry nodded in agreement, Ken went on, "The actual voltage at the plate of the tube, E_P, must then be the difference between the plate supply voltage and the voltage drop across the load resistor. Since we know that the more current—I_P—flowing through the tube, the greater this voltage drop, we can see that the plate voltage goes down as the plate current goes up.

"Can you write a simple equation to express what I just described, Larry?"

Larry took the pencil, paused thoughtfully for a moment, and then wrote:

$$E_P = E_b - I_P R_P$$

"I can see where Ohm's law comes in," he said. "The more plate current flowing, the greater the IR drop across the load, and the less plate voltage. I've got it so far."

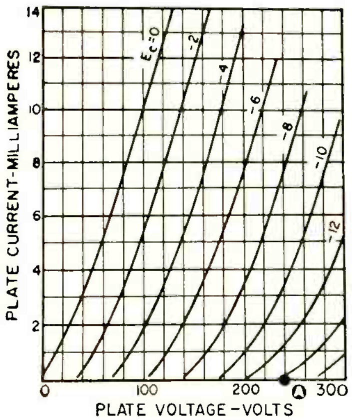
"Good," said Ken. "That's just the fact we'll use to establish the first point for drawing the load line in on the tube characteristic chart. Let me ask you this, Larry—at what point would the full 240 volts be on the plate of the 6J5?"

Larry hesitated a moment and Ken dropped a hint. "Look back at the equation you wrote out a moment ago."

"I have it!" Larry shouted. "When there is no current flowing through the tube, there would be no IR drop across the load resistor, and the full 240 volts would be on the plate."

"Right," said Ken. "Now, take the tube characteristic chart and find the point on the graph where the plate voltage scale reads 240 volts and the plate current scale reads 0 ma. That will be one of the end points for the load line we're drawing. Mark this point *A*."

Larry took up the chart and ran his finger along the bottom scale until he came to the 240-volt marking. He noticed that the bottom line of the chart was also the line for 0 milliamperes of plate current, so he marked the 240-volt point on the bottom line with an *A*.



"Good enough, Larry. You have one of the points for the load line we're drawing. I should mention that a resistive load line is linear, which simply means that it's a straight line and not curved. So, if we can find one other point and mark it on the chart, we can connect the two points and have a load line. Do you follow me?"

When Larry nodded agreement, Ken asked, "Now, do you have any suggestion as to how we can find a second point?"

Larry didn't snap back with an answer, so Ken hinted again, "Remember how we found the first point? Consider what we're looking for and let old man Ohm help you."

After a moment's thought, Larry said slowly, "To get the first point we assumed that there was no current flowing and that the full plate voltage was applied to the tube. I'd figure that to get the second point we should find the point where enough current is flowing through the load resistor so that the IR drop cancels out the plate supply voltage. What we're looking for is the theoretical point where the plate voltage becomes zero."

"Right again," Ken replied. "Now let's see how you'd go about finding this point."

Larry spoke half to himself and half to Ken. "If the plate voltage is 240 volts and the load resistor is 22,000 ohms, I want to find out what current would have to flow through 22,000 ohms to give an IR drop equal to 240 volts." He took the pencil, wrote out the Ohm's law equation for this situation, and used some simple algebra.

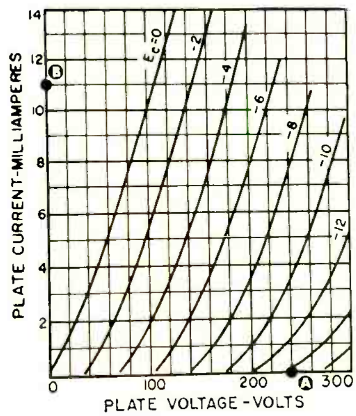
$I \times 22{,}000 = 240$ volts

$I = 240 \div 22{,}000$

$I = .0109$ amperes $= 10.9$ ma.

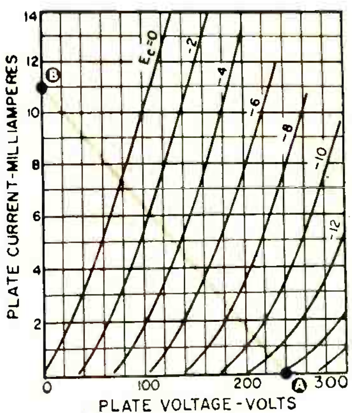
$I = 11$ milliamperes (approx.)

"When 11 ma. flows through the tube," Larry said, "the IR drop across the load resistor, R_L, equals the plate supply voltage. Under these conditions, the plate voltage is zero. Here, Ken, I'll mark this as point *B* on the characteristic chart."



"You've got it, sonny boy." Ken looked pleased. "Now what do you think you do to complete the load line?"

"Connect points *A* and *B*, I guess," replied Larry. He did this using a ruler.



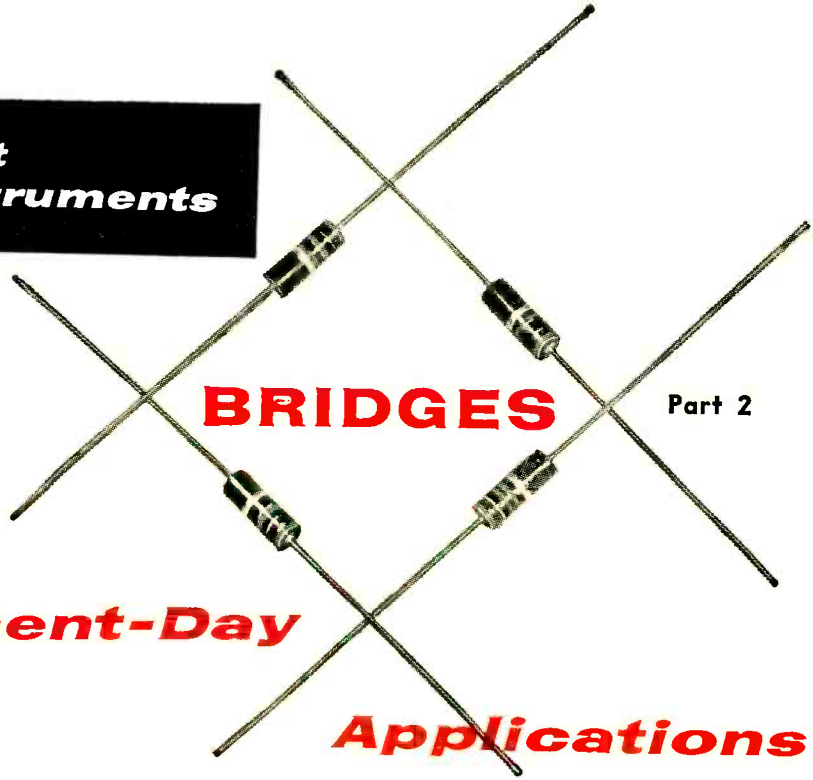
"Good, but remember this, Larry. The load line you just drew is only good for a 6J5 with a load resistor of 22,000 ohms and a plate supply voltage of 240 volts. There's

(*Continued on page* 128)

Test Instruments

BRIDGES Part 2

Present-Day Applications



By G. H. HARRISON

BRIDGES, as we saw last month, are frequently used to measure resistances in applications where the readings of an ordinary ohmmeter are not accurate enough. Similarly, bridges are also put to work measuring inductance and capacitance where values must be checked out to the last possible decimal place.

Since anyone needing extreme accuracy in resistors would probably want capacitors and coils of a comparably close tolerance, bridge designers frequently combine several types of bridges in one package. Such compact, self-contained instruments are usually capable of making many different kinds of measurements. The various bridges are set up simply by flipping the switches and twirling the knobs on the unit's front panel.

Multi-Purpose Bridges. The Heath IB-2A impedance bridge is a good example of a general-purpose test instrument of this type. Set the panel knobs one way, and you will obtain a straightforward Wheatstone bridge, as in Fig. 1(A). Change the controls and a capacitance bridge, as in Fig. 1(B), is connected to the test terminals. Adjust once more and you can have either a Maxwell bridge, as in Fig. 1(C), for measuring the inductance of coils with low Q, or a Hay bridge, as in Fig. 1(D), for measuring high-Q coils. (For a more complete description of the various types of bridges, see "Bridges," Part 1, appearing in the October issue of POPULAR ELECTRONICS.)

The IB-2A has a built-in 1000-cps oscillator, whose output is used as a signal voltage for the a.c. bridges. It also has a vacuum-tube-voltmeter detector circuit—more sensitive than a simple galvanometer—for a null indicator. To add to its versatility, the IB-2A incorporates terminals to which an external generator can be connected for making a.c. bridge measurements at frequencies other than 1000 cps. It also has provisions for using an external null detector, such as an oscilloscope, headphones, or a radio receiver.

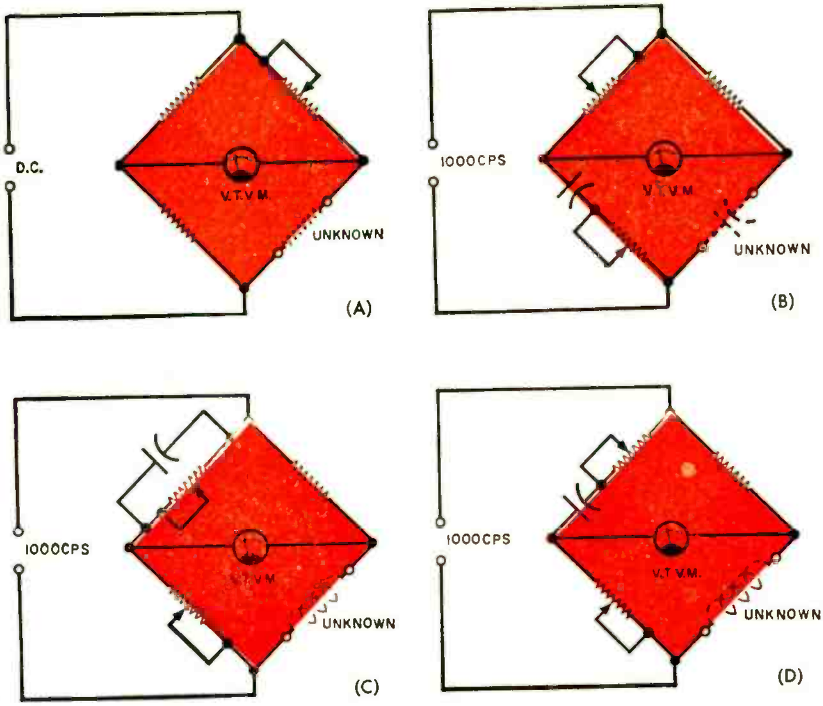


Fig. 1.

Instruments of this type are usually designed to measure an extremely wide range of values. The Heath bridge, for example, can measure resistance from 0.1 ohm to 10 megohms; capacitance from 100 μμf. to 100 μf.; and inductance from 0.1 mh. to 100 henrys. Such bridges are easy to use. You simply set up the proper bridge for the measurement you want to make—the instruction book tells you where to set the various knobs—then tune for a null on the meter. When the meter nulls, the value of resistance, capacitance, or inductance can be read on the panel dials.

Heath IB-2A

All of the bridges we have talked about so far rely for their operation on being balanced. Another type of widely used bridge, in contrast to the previous ones, starts out in a balanced condition, but ends up unbalanced. Let's see how it works.

Vacuum-Tube Voltmeters. Probably the most common circuit of this type is found in the vacuum-tube voltmeter. Figure 2 shows the basic circuit used in the Knight-Kit VTVM and other similar instruments. As long as the currents through both tubes are identical, the drops across *R2* and *R3* will be identical, so no current will flow through the meter. (Potentiometer *R4* serves as an adjustment to compensate for differences in tube characteristics or variations in the values of *R2* and *R3*.) To see how the VTVM operates, let's touch the test probes across the terminals of a battery. The battery voltage will appear across *R1*, changing the bias of *V1*. The grid becomes more positive, and *V1* begins to conduct more current. The voltage drop across *R2* increases, the bridge is unbalanced, and the meter needle is deflected.

A vacuum-tube voltmeter has a number of advantages over its non-vacuum tube cousin; most important, perhaps, is its very high input impedance. In the grid circuit of *V1*, the *R1* network determines input impedance, which can be 10 or 20 megohms, or more. To change the range of the VTVM, the grid of *V1* is simply switched to the proper tap on voltage divider *R1*. However, the input impedance remains the same for all ranges since the input signal is always applied across all of *R1*.

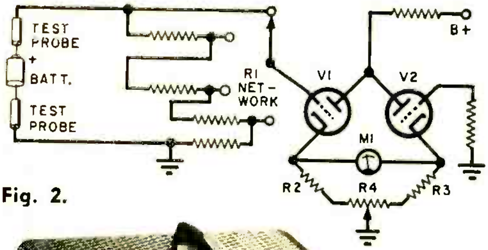


Fig. 2.


Knight-Kit VTVM

Standard voltmeters frequently have impedances of only a few thousand ohms in low ranges. Connecting such a low-impedance meter across, for example, a high-impedance grid circuit, can so completely upset the operation of this circuit that its operating conditions cannot be measured. The VTVM can measure such circuits easily.

A second big advantage of the VTVM is that its vacuum tubes amplify the signals applied, thus making the basic meter movement more sensitive.

Generators. The bridges we have talked about so far have been used in measuring instruments. But the versatile bridge has a lot of other tricks up its sleeve. Take the EICO Model 377 sine and square wave generator, for example. Here, and in many other audio oscillators, a bridge is responsible for setting the instrument's operating frequency. In this case, a member of the Wien bridge family is involved. Figure 3 shows the simplified diagram of the frequency-determining network. It may not look much like a bridge at first glance, but there is one there.

When the circuit is turned on, current begins to flow from the cathodes to the plates of the two tubes. Somewhere along the line, thermal noise—a tiny signal caused by random movement of electrons along the circuit's conducting pathways—joins in with the current flow, and gets itself amplified. This minute signal—perhaps only a millionth of a volt—is amplified in the plate circuit of *V1* and applied to the *V2* grid. Here it is amplified again, then applied back to the grid of *V1* through *R1* and *C1*. Tube *V1* amplifies the signal again,

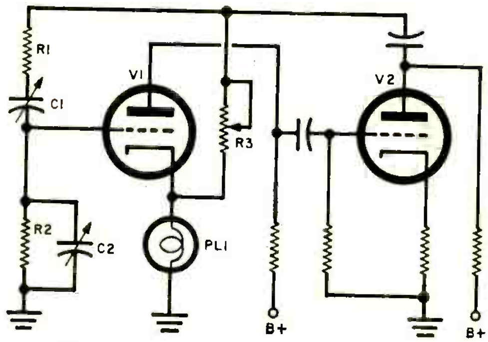
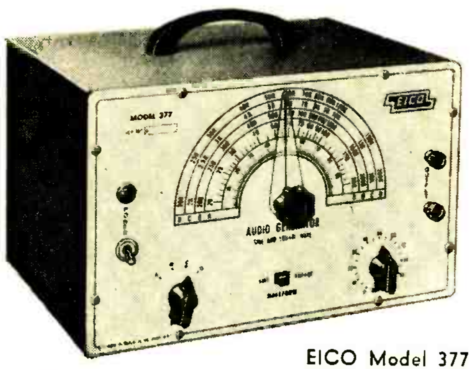
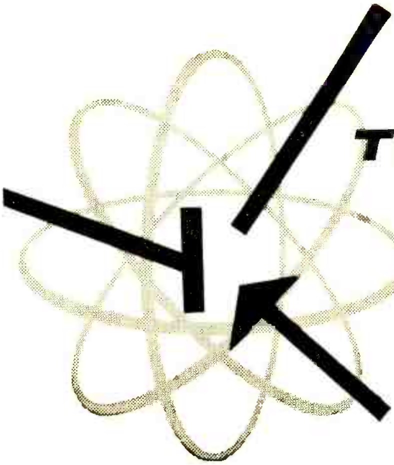


Fig. 3.


EICO Model 377

(*Continued on page* 135)



Transistor Topics

By LOU GARNER

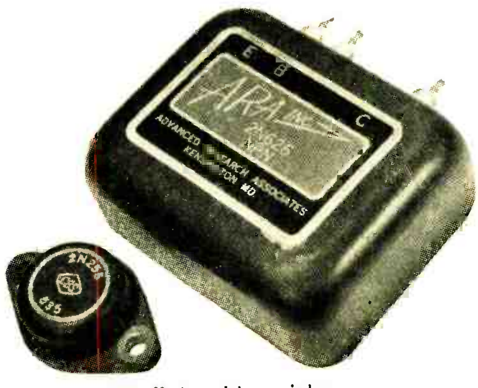
SOME astounding improvements have been made recently in the *beta* of transistors. As you may know, a transistor's *beta* is its current gain in the common-emitter arrangement under specified conditions. If a unit has a *beta* of, say, 10, this means that a current change of 1 ma. in the base circuit will bring about a current change of 10 ma. in the collector circuit. *Beta,* then, is indicative of the gain that can be obtained when a transistor is used as an amplifier.

The majority of commercially available transistors have *betas* of less than 100, the lower-priced experimental types ranging from about 5 to 30. Up to the present time, a *beta* of about 500 has been the highest that could be obtained in standard transistors, and such units have been specially selected and premium-priced.

But now all these figures for the value of *beta* have been smashed. Advanced Research Associates, Inc. (Box 68, Kensington, Md.), a relatively new firm, is currently producing a line of "Composite" transistors with *betas* of up to—hold your breath—30,000!

In these "super" units, a current change of only 100 *microamperes* in the base circuit can bring about a change of 3 *amperes* in collector current. A single transistor, then, can take the place of a four-stage amplifier in which each stage has a *beta* of over 13.

The ARA "Composite" transistor is a multi-element semiconductor device which has the input characteristics of a small-signal transistor and the output characteristics of a power unit. Five types are in current production. Four of these are germanium transistors with *betas* between 15,000 and 30,000, maximum collector voltage and current ratings of 30 volts and 3 amperes, and maximum power dissipation of 10 watts. A single silicon type is available; with a *beta* of 10,000, its maximum collector voltage and current rating are 40 volts and 3 amperes, its power dissipation about 40 watts at 25°C.



"Composite" transistors, introduced by Advanced Research Associates, have extremely high gain. Note size of unit at left compared with a conventional power transistor.

Extremely high gain is not the only feature of the ARA transistors. In addition to conventional *p-n-p* and *n-p-n* units, ARA's manufacturing technique has resulted in the development of *p-n-n* and *n-p-p* types. The *p-n-n* transistor behaves like a *p-n-p* type as far as input characteristics are concerned, but as an *n-p-n* type in its output circuit. Similarly, the *n-p-p* transistor has the input characteristics of a *n-p-n* unit and the output characteristics of a *p-n-p* unit. They permit assembly of push-pull power amplifiers requiring a single-ended drive, thus eliminating the need for a phase inverter or center-tapped input transformer. In a practical circuit, for example, *p-n-p* and *n-p-p* transistors can be used together, with their base circuits in *parallel* and their collectors connected to a center-tapped load.

Practical applications for the ARA transistors include servo systems, audio amplifiers, power supplies, industrial controls, and a variety of relay and switching circuits. Selling for something over $40.00 under 50 cents each in moderate quantities.

Reader Richard Bond, 814 10th Ave., SE, Jamestown, N. D., has been intrigued by these low-cost units but a little unhappy with the lack of published circuits showing practical applications for them. Accordingly, he undertook to develop a few basic circuits on his own. (See Fig. 1.) He has found these low-cost units to be fully the equal of more expensive "experimenters' " transistors when used within their maximum ratings. All three circuits shown here utilize low-cost *p-n-p* types, but *n-p-n* units will work as well if d.c. polarities are

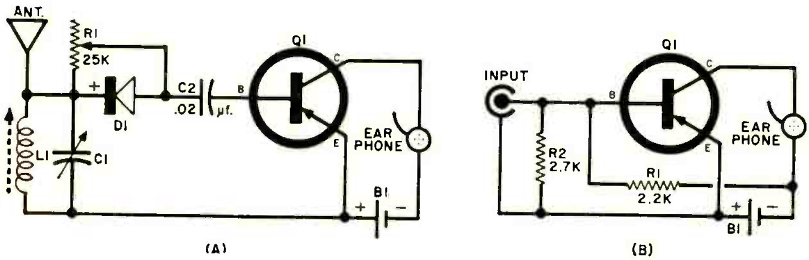
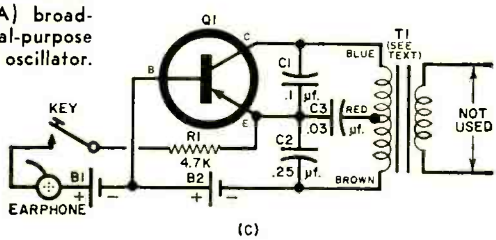


Fig. 1. Simple circuits evolved by reader Richard Bond using low-cost "experimenters' " transistors: (A) broadcast-band receiver; (B) general-purpose amplifier; (C) code practice oscillator.



each in small quantities, the units are somewhat more costly than conventional power transistors. However, the cost is offset by the fact that *a single unit* can replace a multi-stage cascaded amplifier, eliminating the need for several transistors, resistors, capacitors, and interstage transformers. In addition, its ability to handle relatively large output currents often permits expensive relays to be replaced, thus effecting further savings in control circuit design.

Reader's Circuits. Low-cost transistors offer interesting possibilities in experimental circuits. Several of the larger mail order distributors, including Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) and Olson Radio (260 S. Forge St., Akron 8, Ohio), have a variety of private-brand transistors available at extremely low prices. Some of these sell for well reversed. Moderate-impedance (1000- to 3000-ohm) magnetic headphones are employed in each case.

In Fig. 1(A) is a simple broadcast-band receiver circuit. Antenna coil *L1* is a Superex Type VLT-950 loopstick or equivalent, and *C1* is a standard 365-µµf. tuning capacitor. Diode *D1* may be any general-purpose unit, such as a 1N34, 1N48—or what have you. Potentiometer *R1* is a 25,000-ohm unit, and *C2* is a paper, mica, or ceramic 0.02-µf. capacitor. Richard indicates that he gets good results with a single 1.5-volt penlight cell for *B1*, but slightly more volume can be obtained with two in series. For best performance, the receiver should be used with a short external antenna. In operation, r.f. signals picked up by the antenna are selected by tuned circuit *L1-C1* and detected by *D1*. Potentiometer *R1*, shunted across *D1*, serves as a

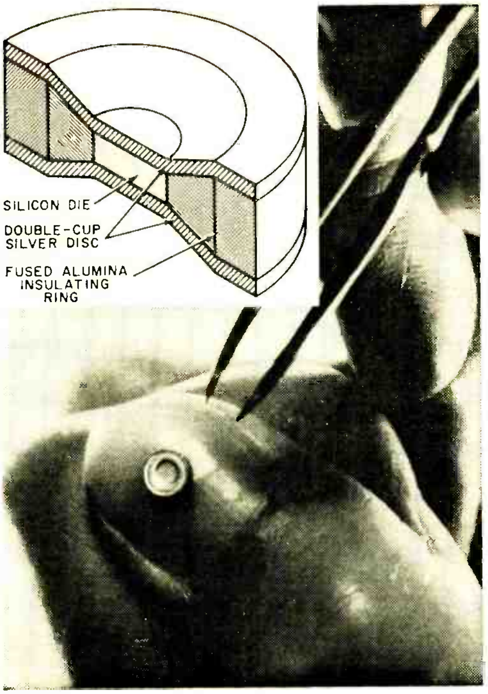


Fig. 2. Cross-sectional view of the "Sildisc" diode developed by Controls Company of America. It features a new type of construction that provides maximum heat dissipation. Photo shows a typical unit.

variable load and hence as a volume control. Transistor *Q1* is used as an unbiased common-emitter amplifier, with *C2* blocking the d.c. component of the detected signal from *Q1*'s base.

The general-purpose amplifier circuit in Fig. 1(B) can be used in assembling an audio stage for a crystal receiver, as a headphone amplifier, or as a test amplifier for checking phono cartridges and similar devices. Both *R1* and *R2* are ½-watt resistors. As in the receiver in Fig. 1(A), a 1.5- to 3-volt battery (*B1*) is employed. If a low-impedance source is connected to the amplifier's input, a 0.5- to 6.0-μf. coupling capacitor should be inserted in series with one of the amplifier's input leads to prevent a short of base bias.

An interesting code-practice-oscillator circuit is shown in Fig. 1(C). Using the common-base arrangement, the circuit is a modified Colpitts-type oscillator. Transformer *T1* is a standard transistor audio unit with a 500-ohm center-tapped primary (Argonne AR-119 or equivalent); the secondary winding is not used. Resistor *R1* is a half-watt unit, and *C1*, *C2* and *C3* are paper, mica, or ceramic capacitors—working voltages are not critical. Batteries *B1* and *B2* are penlight or flashlight cells.

Although neither lead dress nor parts layout is at all critical in any of these three circuits, a few tips on working with low-cost transistors may be helpful. First, *don't exceed* the transistor's maximum voltage ratings, although you can use higher voltages than those given above. Secondly, don't hesitate to experiment with bias-resistor values to obtain optimum circuit performances—remember that low-cost transistors, as a general rule, are not held to as close tolerances as are more expensive types. Third, double-check all d.c. polarities in the circuit if you use *n-p-n* types in place of *p-n-p* types.

New Diode Design. A new type of construction is used in a line of diodes recently introduced by the Electron Division of Controls Company of America (845 W. Broadway Rd., Tempe, Arizona). Called "Sildisc" types, these units feature a double-cup construction which provides maximum heat dissipation and is easily adapted to a variety of mounting methods in printed-circuit boards. A cross-sectional view of a typical "Sildisc" diode is shown in Fig. 2.

With this design, no separate "heat sink" between the diode and terminal connections is needed, since the cupped silver discs on each side serve both as contact points and heat sinks. Heat dissipation is increased, permitting ratings of up to 500 milliwatts in units measuring only 3/16" in diameter by 1/16" thick. These units make possible solder-in, clip-in, plug-in, or press-fit insertions in standard circuit boards. One of them can even be inserted in a lamp socket as a blocking diode between the socket and bulb.

A variety of the new diodes are now in production, including general-purpose units, rectifiers, Zener diodes, and double anode types.

Product News. The General Electric Company (Syracuse, N. Y.) has announced a 93% price reduction on its line of gallium arsenide tunnel diodes! The two original diode types have been cut from \$55.00 and \$85.00 each to \$4.50 and \$6.00. In addition, five new types have been announced, rang-

(*Continued on page* 121)

By
JOHN T. FRYE
W9EGV

Carl and Jerry

The Hand of Selene

IT WAS almost five o'clock in the afternoon when Carl and his parents returned from a Sunday visit with an uncle and aunt in a neighboring town. The boy shed his tie and coat as he passed through the house, and then he headed straight out the back door and across the lawn to the entrance of the electronic laboratory he and his chum, Jerry, had fixed up in the basement of Jerry's house.

As Carl clattered down the outside basement steps, he could hear the murmur of voices through an open casement window; and when he opened the door, he saw Jerry and Norma busy at the workbench. Norma was a very pretty neighbor girl in her early twenties. Because of her "advanced" age and the fact she was what the boys called "a good Jill," she escaped the suspicion and disdain Carl and Jerry affected toward girls their own age.

"Come on in," Jerry called to Carl, who had paused in the doorway.

"Yes," Norma seconded, "but what's the idea of goofing off visiting relatives when we need your brains and brawn?"

"It's nice to feel wanted," Carl said with a grin as he looked down at the object she was holding in her hands. "What have you two been up to? Grave robbing?"

"In a matter of speaking, yes," Jerry answered, taking what looked like a wrinkled, mummified, feminine human hand from Norma and placing it on the bench. "Here's the scoop: tomorrow night, which is Halloween, as you know, Norma's going to entertain her sorority with a party at her house, and—"

"And," Norma interrupted, "after you boys fixed me up with that talking skull at last year's party, I attained quite a local reputation as a witch. In fact, some of my cattier friends say it's perfect casting. Anyway, the girls are expecting something pretty special tomorrow night, and unless I give them goose-bumps the size of ant hills, they're going to be disappointed."

"We decided to put on a séance in which a severed human hand raps out answers to questions," Jerry resumed quickly when Norma stopped to catch her breath. "A couple of weeks ago, after that windstorm that blew in several store-front windows, I was passing through a downtown alley and saw the remains of a damaged dress dummy in an ash can. The right forearm was intact; so I brought it home with me. I've had an idea about this rapping-hand thing for some time, and the dummy's arm was just what I needed. It's made of light, tough plastic; and the fingers are curled just right for my purpose.

"First, I ground out the end of the middle finger and imbedded a piece of soft iron in

it. I used plastic wood to anchor the iron in place and to conceal the operation. Notice that as the hand rests on the table this middle finger clears the surface by only a quarter of an inch. The wrist has been carefully cut off to act as a counterbalance so that the hand stays in that position normally; but a slight downward pull on the metal in the finger causes the hand to rock forward and down so that the fingers strike the supporting surface smartly."

"I get it!" Carl exclaimed. "You're going to put an electromagnet under the hand and send pulses of current through its windings to make the hand rap. But one thing bugs me: you say that hand is from a dress dummy. That's hard to believe. All the dress dummies I ever saw were plenty good-looking; but if the appearance of that hand is any guide, the dummy it came from must have looked like Dracula's kid sister."

"That's a compliment to my art work!" Norma explained, with a giggle. "I intend to say the hand is from the mummy of Selene, an Egyptian moon goddess. To give it the shrunken, wrinkled look, I painted it with latex and allowed the liquid rubber to dry in the rough, seamed form you notice. Then I sprayed it with a dark stain. Now it looks so real I'm almost afraid to touch it."

"It's plenty grisly looking," Carl agreed; "but was I right about how you intend to work the hand?"

"Only in a general way," Jerry answered. "We have to use something considerably more sophisticated than concealed wires running up table legs, and so on. The guests that will be at the party are pretty smart cookies—for girls, that is."

"Thanks loads!" Norma said sarcastically, making a face at him.

"This little table is the key to the whole operation," Jerry said as he placed his hand on the glass top of a small table with chrome-plated tubular legs. "The top part under the glass looks as though it were made of a solid two-inch-thick piece of walnut, but actually it's made of two one-inch-thick pieces fastened together. This metal trim around the edge conceals the joint. The concealed sides of both pieces of wood are hollowed out to form a cavity in the table top. In this cavity are mounted a powerful but compact electromagnet, a transistorized remote-control receiver, and a relay that closes the power circuit of the magnet when a signal is picked up by the receiver.

"Power for the receiver and for the magnet comes from flashlight batteries loaded into these tubular legs. There's a coiled spring in the bottom of each leg to hold the batteries in firm contact. The top ends of the legs are let into the bottom of the table top so that the wires coming out the tops of the legs can pass through grooves between the two pieces of walnut into the cavity."

"Why the glass top?" Carl wanted to know.

"In order for the magnet to be as close as possible to the metal in the hand, the layer of wood between the magnet pole pieces and the top of the table is very thin. The single-strength sheet of glass affords protection to this thin membrane of wood and prevents anyone from rapping on it and noticing that it sounds hollow."

"You boys will be sitting at a darkened window here in Jerry's house looking

across into the room where I'll hold the seance," Norma explained. "A concealed mike will let you hear the questions the girls ask. Then you can use the transmitter to make the hand rap once for 'yes' and twice for 'no.' I'll give you a secret signal so you'll know which way to answer. Before I forget it, though, there's one more thing. You'll have to put a switch on that mike so I can keep it turned off until just before the seance begins."

"Why?" Jerry asked in round-eyed wonder. "Why not let it run all evening?"

"Because I think it's best that you boys keep your illusions as long as you can," Norma said with an enigmatic smile. "You're far too young to know what girls talk about when they think men aren't listening. But let's see how the gadget works. Then I have to scamper home, put up my hair, make up some party favors, and read those books on Egyptian magic I got from the library. I want my part in this thing to do justice to the technical excellence I know I can expect from you two."

"Okay," Jerry said, "but you can lay off

(*Continued on page* 112)

On the Citizens Band

By TOM KNEITEL, 2W1965

WE'VE NEVER ADVOCATED replacing parts in a CB transmitter to increase its output for pretty obvious reasons. We haven't changed our minds on the subject, but we have come across a nifty way of coupling one receiver to another which can make all the difference in the world to some single-conversion rigs.

The rig we used was a Lafayette HE-15A, but the idea can be applied to any CB set having a 1750-kc. intermediate frequency. The object is to combine two receivers and effectively add another conversion stage to the set. Here's how you go about it:

(1) Remove the noise limiter tube from the CB rig (in the HE-15A, it's the 6AL5).

(2) Run a wire from the cathode connection of the empty socket (pin "1" in the HE-15A) to the antenna post of any communications receiver.

(3) Ground the chassis of the CB set to the "ground" post on the rear of the communications receiver.

(4) Turn both sets on and tune the communications receiver to 1750 kc.

(5) Turn the volume control of the CB rig all the way counterclockwise.

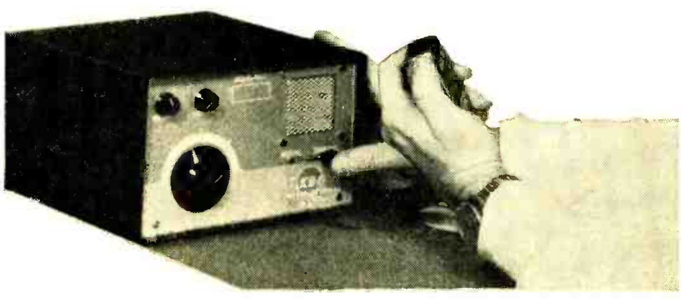
You should now have a highly selective dual-conversion receiver. When you tune the CB rig across the band, you will hear the sound coming from the other set's speaker and you can use the other set's volume control to adjust the level.

Just a reminder—"skip" season is here, so please resist the temptation to work those "jokers" who disregard the law and insist on calling you from across the country when the band "opens up."

A handy new test set has recently been brought out by Seco Mfg. Co. This hand-sized wonder checks crystal activity and accuracy, helps you tune your final am-

plifier, and lets you know how you are getting out. For a spec sheet on this new unit, drop Seco a card at 5015 Penn Ave. S., Minneapolis 19, Minn.

The rig shown below is the International KB-1, the final result of a few hours of very enjoyable kit building. It's not really a "kit," as we ordinarily think of one, but a few prewired subchassis which can be hooked up very easily. It can save you considerable loot when compared to a factory-wired job with similar features (squelch, tunable dual-conversion superhet receiver, etc.). —30—



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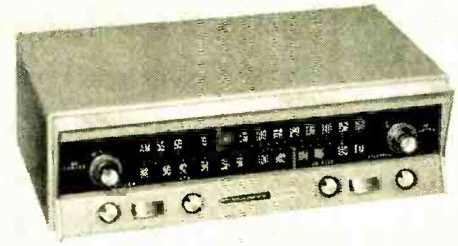
Exciting new styling and advance-design features rocket this Heathkit to the top of the Christmas value list. Featured in this outstanding tuner are: complete AM, FM, Stereo reception, plus multiplex adapter output; individual flywheel tuning; individual tuning meters on each band; FM automatic frequency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

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



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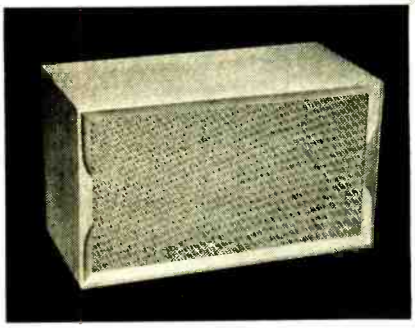
In the inimitable style of the Heathkit AJ-30 Tuner above, this complete stereo amplifier offers you the ultimate in stereo conveniences. Jam-packed with extra features, including: mixed-channel center speaker output; "function selector" for any mode of mono or stereo operation; "stereo reverse"; "balance" and "separation" controls; ganged volume controls; and separate concentric bass and treble tone controls. 30 lbs.

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



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Its "bookshelf" size belying its gigantic capabilities, this amazing unit outperforms speakers 4-times its size. A 10" acoustic suspension woofer and two "dispersed-array" cone tweeters deliver high-fidelity tone with fantastic brilliance over the entire range of 30-15,000 cps, ± 5 db. Preassembled cabinet in choice of finishes or unfinished woods. Measures 24" L x 11½" D x 13½" H. 28 lbs.

Model AS-10M or **W** (mag. or wal.) ... $6.50 dn. **$64.95**
Model AS-10U (unfinished) ... $6.00 dn. **$59.95**

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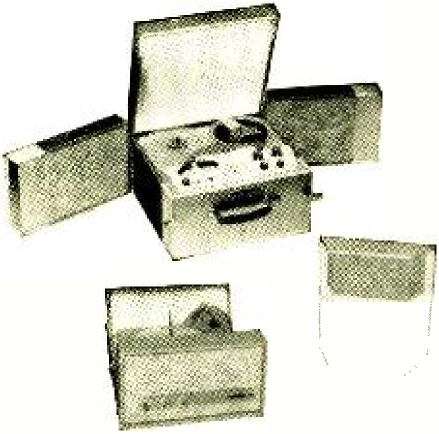
Now, just in time for Christmas, Heathkit introduces new factory-assembled, ready-to-use equipment and speaker cabinets designed to house complete monophonic or stereophonic systems. The cabinets, resplendently styled in a timeless and universally compatible motif, are available in rich hand-rubbed walnut or mahogany finishes ... or unfinished if desired. ¾" stock is used for all exterior panels and supports; solids for edgings, furniture grade veneers for front and side panels and shelves. Versatile in accommodations, the center cabinet has room for all components of a complete stereo or mono hi-fi system except speakers. The changer compartment will accept any Heathkit record changer or most tape recorders. The storage compartment holds records and tapes or using an accessory slide-out drawer may be used for a tape recorder. Two shelf compartments accept tuners and amplifiers. The power amplifier compartment will hold any Heathkit stereo power amplifier, a pair of UA-2 mono amplifiers or any single mono amplifier. The handsome speaker-wing cabinets in two models for 12" and 15" speakers are designed to blend into the flowing lines of the center cabinet and are perfectly acceptable as single console speaker enclosures. Adapter rings are provided for using other size speakers, while a special port is provided for installation of a horn-type tweeter.

Complete ensemble as low as $133.50. Send for details in FREE HEATHKIT CATALOG.



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What better gift than this? . . . a compact portable tape recorder just waiting to record the caroling, frolicking family joys of the holiday season! You'll thrill to the natural stereophonic sound of this new unit that also serves as a hi-fi, power center for your tuner and record player. Tape deck and cabinet are preassembled.

Model AD-40...$18.00 dn., $16.00 mo. **$179.95**

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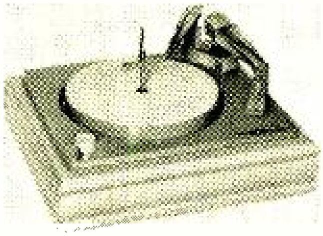
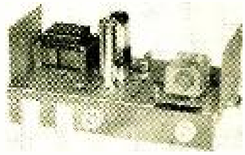
Thrill to your favorite Christmas recordings in life-like stereo! This GD-10 offers you complete stereo and mono operation *plus* portable convenience. Handsome aqua and white two-tone vinyl clad cabinet and four-speed automatic changer come preassembled—you build only the amplifier in just a few enjoyable hours. Changer has turnover diamond and sapphire stereo cartridge. Complete tone controls. Measures 15½" W x 18" D x 8⅝" H. 28 lbs.

Model GD-10...$7.00 dn., $7.00 mo. **$69.95**





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Model AJ-20 .... **$29.95**

AUTOMATIC RECORD CHANGER KIT

Jam-proof mechanism . . . quick-change cartridge holder . . . "muting" switch . . . and "size-selector" for intermixing 7", 10" and 12" records of the same speed! Holds up to 10 records, for hours of delightful stereo or mono listening enjoyment.

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Model EK-2A...8 lbs. **$19.95**

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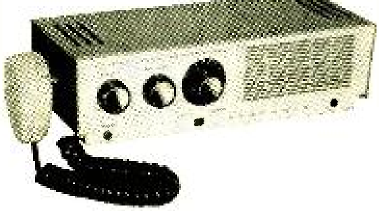
Model GW-30 (kit) .... **$32.95** (64.95 a pair)
Model GWW-30 (wired) .... **$50.95** (99.95 a pair)



DELUXE 2-WAY CITIZENS BAND TRANSCEIVER

This Christmas, give the best that money can buy in a Citizens Band Transceiver. The efficient superheterodyne receiver has an automatic "noise limiter" and adjustable "squelch" control, single channel "crystal" or continuous tuning. The transmitter has press-to-talk microphone and can be switched to any of the three crystal controlled channels. Choose the "under-dash" DC mobile model or "fixed" station AC unit. 11 lbs.

Model GW-10 (kit) $6.30 dn., $6.00 mo. **$62.95**
Model GWW-10 (wired) $10.00 dn., $9.00 mo. **$99.95**

(specify 117 v AC or 6 or 12 v DC model)

Carl and Jerry

(*Continued from page* 105)

the butter, Norm. Save that poor-dumb-little-me and big-strong-smart-you stuff for your boy friends. This is Carl and Jerry; remember?"

"I'm sorry, fellows; I had that coming," Norma said quickly. "I know better than to try and feed you two a line, but I really don't want to mess things up."

"You won't," Jerry said with a reassuring smile. He placed the hand on the glass-topped table and picked up the radio-control transmitter. Every time he pushed a button on the latter, the hand rapped smartly against the glass. This was true even when he went outside and crossed the street with the transmitter. By the time they had assured themselves that the apparatus was working to perfection, both Carl's and Norma's respective mothers were calling them for supper; so the three friends parted company for the evening.

THE FOLLOWING EVENING the TV weather map revealed a rapidly approaching low, and there was a warning of accompanying strong winds and heavy rain. As Carl and Jerry went downtown after supper to watch the Halloween parade, a warm wind from the south was already picking up. By the time they came home, around eleven, it was whistling through the bare branches of the trees and shaking Jerry's tribander beam which was mounted on a tower between his house and Norma's.

Norma was saving her seance for the witching hour of midnight; so the boys settled down in the darkened room where they could look across at the curtained window of Norma's house and keep an ear cocked at the mute intercom speaker in the corner. At ten minutes before midnight, Norma's voice suddenly burst from the speaker, and the window curtains parted.

"All right, girls; it's time to invoke the spirits," she was saying as she stood between the open curtains looking up at the storm clouds moving swiftly across the face of the nearly full moon. A dozen girls could be seen crowding behind her and following her upward gaze.

"I can't reveal how," Norma continued, "but I've managed to obtain, just for tonight, the mummified hand of a person said to be an incarnation of the Egyptian moon goddess, Selene. Think on the questions you

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The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 20 Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $26.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are twenty Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE EXTRAS

• SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

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wish to ask while I bring the hand of the moon goddess from its resting place."

Carl and Jerry could hear the girls whispering and giggling nervously while Norma was gone. Then they heard the girls gasp as Norma came back into the room with a measured tread, carrying before her on a white satin pillow the gruesome Hand of Selene. Each girl was required to touch the hand as Norma knelt in front of her.

"It's so cold and clammy!" the first girl quavered as she recoiled from the contact. Inasmuch as the hand had been reposing in

Norma's deep-freeze for the past thirty-six hours, she was probably right!

After each girl had forced herself to touch the hand, Norma placed it carefully on the glass-topped table in front of the window so the moon could shine down on it intermittently between patches of clouds. All the lights in the room were turned out except for a dim spotlight shining on the hand. Slowly she intoned:

"I, Norma, conjure you, spirit of Selene, Goddess of the Moon, in the name of The Feather, sacred symbol of Truth, to return into your hand and to answer truly the questions put to you!"

She paused, and the hand in the dim little circle of light twitched rapidly and beat a devil's tattoo on the table top as Jerry worked the button on the transmitter. A murmur of fear came from the girls.

"Selene awaits your questions," Norma announced in a sepulchral voice. "Let them be cast so that she may answer them with one rap for 'yes' and two for 'no.' "

"Wi-wi- will Ted ask me to the Military Ball?" a faltering voice finally piped up

(*Continued on page* 120)

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C	Radio & TV Servicing (V-3)	2 yrs. High School	Day 9 mos. Eve. 2¼ yrs.
D	Transistors*	V-3 or equivalent	Eve. 3 mos.
E	Electronic Drafting (V-9)*	2 yrs. High School, with Algebra, Physics or Science	Eve. 3 yrs.
F	Color TV	V-3 or equivalent	Day 3 mos. Eve. 3 mos.
G	Audio-Hi Fidelity*	V-3 or equivalent	Eve. 3 mos.
H	Video Tape*	V-3 or equivalent	Eve. 3 mos.
I	Technical Writing (V-10)	V-3 or equivalent	Eve. 3-18 mos.
J	Radio Telegraph Operating (V-5)*	2 yrs. High School, with Algebra, Physics or Science	Day 9 mos. Eve. 2¼ yrs.
K	Radio Code (V-4)*	8th Grade	Eve. as desired
L	Preparatory Math & Physics (P-0)	1 yr. High School	Day 3 mos.
M	Preparatory Mathematics (P-OA)	1 yr. High School	Eve. 3 mos.

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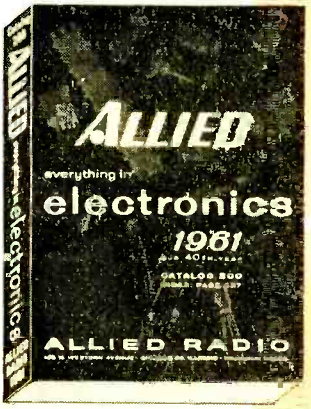

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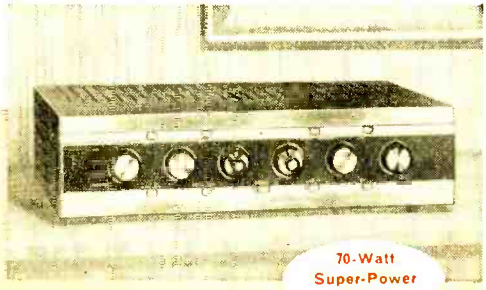

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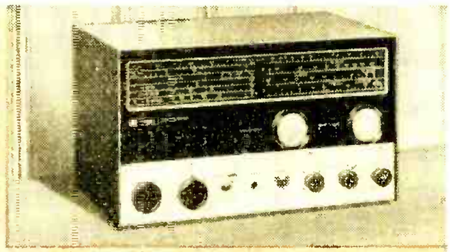

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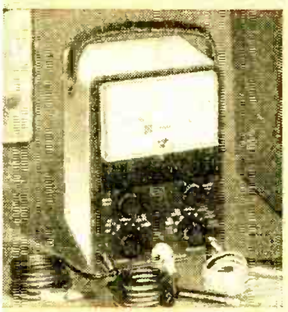

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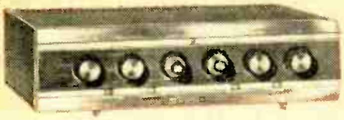

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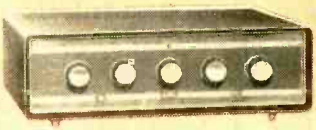

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Carl and Jerry

(*Continued from page* 114)

from the intercom speaker in Jerry's house.

The hand waited for a suspenseful few seconds and then rapped once. Emboldened by this good news, the other girls threw questions thick and fast, and the answers were tapped out quickly and decisively.

"How do you know whether to make the hand say 'yes' or 'no'?" Carl whispered.

"If Norma turns her head a little to the right, that means 'yes'; to the left means 'no,'" Jerry whispered back, although there was no reason for whispering.

Finally there was a lull in the questions, and a tall, black-haired girl stood up in the flickering light of the candle and said, "This

is lots of fun, Norma; but you're not fooling me. Someone's moving that hand with threads."

"Let the unbeliever see for herself," Norma answered, raising her voice as a blast of wind made the house shudder.

The tall brunette approached the table a little nervously and waved her long arms all around the hand in search of threads. Then she grabbed the table and raised it a couple of feet off the floor. As she did this, the hand began to tap on the table top.

Abruptly she set the table back on the floor and grabbed at the hand. But as she touched it, she shrieked and stumbled backward. "It *is* alive!" she cried; "I could feel it writhing in my hand!"

THIS EXPERIENCE, coupled with the gathering storm, broke up the party. Fifteen minutes later the girls were all gone.

The boys threw their raincoats over their heads and dashed through the beginning rain to Norma's back door. She let them in, and the three went into the living room. They ate ice cream pumpkins and witch-shaped cookies while they laughed about the events of the evening.

"I'd say Selene was a pretty successful spirit," Jerry remarked as he looked fondly at the hand still resting on the table. "Maybe I should try a question. Selene, old girl, will my beam stay up in this storm?"

The indulgent smile froze on his face as the hand deliberately rapped twice, and at that instant there was a loud crash outside the window. The three of them dashed outside to discover the wreckage of Jerry's beam antenna lying between the two houses.

"I don't get it," Jerry said dazedly as they huddled there in the cold pelting rain. "Of course, someone *could* have swished an oscillating Citizens Band transmitter across the receiver frequency a couple of times and jerked the hand—"

"Or it could have been just the Hand of Selene," Norma interrupted. "You get that thing this minute and take it home with you. I wouldn't be able to sleep a wink with it in the house!" —30—

Transistor Topics

(*Continued from page* 103)

ing from \$7.50 to \$18.00 each when sold in large quantities.

Three new high-speed mesa switching transistors have been introduced by the Semiconductor Division of RCA (Somerville, N. J.). Included are two *n-p-n* silicon units, Types 2N706 and 2N706A, and a *p-n-p* germanium transistor, Type 2N1683.

From Nippon Victor (Tokyo, Japan) comes news of a low-cost transistorized telephone recorder. Priced at only \$100.00, the unit records on a paper roll holding up to two hours' conversation.

Barker Sales Company (339 Broad Ave., Ridgefield, N. J.) is now offering a British-made, 45-rpm battery-operated record player. Designed for operation on a nominal 6-volt battery, the unit will maintain turntable speed with supply voltages between 6.2 and 4.5 volts, and requires an average current of only 32 ma. Furnished complete with a ceramic element pickup, it is ideal for transistorized phonographs.

That does it for now. Next month we'll discuss some new Christmas items.

—*Lou*

Across the Ham Bands

(Continued from page 93)

black) to the speaker voice coil terminals. Then mount the speaker to the box, inserting a piece of grille cloth across the box's grille hole to protect the speaker's cone. Mount a pair of terminal strips under the upper two speaker mounting screws. Pitch control *R2* mounts in one of the holes already punched in the top of the box.

To wire the monitor, connect resistor *R1* and capacitor *C1* in parallel between two of the tie point terminals. Solder the center tap (red) of *T1*'s primary to the tie point connected to the negative side of *C1*. Then connect a few feet of insulated wire to the same point.

No socket is needed for *Q1;* leave its leads full length and solder it rapidly to avoid possible damage from heat. Connect the base of *Q1* to the center terminal of *R2*. One end of the primary (brown lead) of *T1* is connected to either end terminal of *R2;* the other end terminal of *R2* is not used. Now connect the collector of *Q1* and *T1*'s remaining lead (blue) to a tie point. Finally, connect the emitter of *Q1* and another few feet of insulated wire to the junction of *R1* and the positive end of capacitor *C1*.

Operation. To place the monitor in operation, disconnect the wire from the grounded side of your transmitter key. Connect this wire to the lead from the negative side of *C1*. Then connect the lead from the positive side of *C1* to the terminal of the key from which the wire was disconnected. Press the key, tune up the transmitter, and adjust *R2* for the desired tone from the loudspeaker.

To use the monitor as a code practice oscillator, replace *R1* and *C1* with a 1½-volt flashlight cell and connect the key in series with the battery. When wiring the flashlight cell, observe the same polarity as that shown for capacitor *C1*.

News and Views

Bill Kosek, WV2KXY, 105 Saratoga Ave., Waterford, N. Y., receives on a Zenith "all-wave" receiver with the help of a Q-Multiplier; he transmits with a Heathkit DX-20 tied to a dipole antenna. Three months on the air and 48 contacts have brought him 20 QSL cards. . . . If you need a Montana contact, check with **Doug Heimstead, KN7LEL,** 13th F.I.S., Glasgow A.F.B., Montana. His Heathkit DX-40 transmitter and Heathkit SX-100 receiver are at your command. He can nominate you for the Rag Chewer's Club, too. . . . **Patrick "Mike" O'Brien, K8LEN,** 1179 Sunset Blvd., Mansfield, Ohio, is looking for skeds with other teen-agers on 2 and 6 meters in Ohio and Pennsylvania. Mike runs 80 watts to a home-brew transmitter feeding a Finco 2- and 6-meter beam. He receives on a National NC-109 receiver, plus International Crystal FCV-1 and FCV-2 converters. Mike has worked two states on 2 meters and six states on 6 meters. I wonder how many states he would work on 75 meters.

Tom Narad, KNØYIZ, Box 395, Kimball, Nebr., has worked 43 states, including Hawaii and Alaska, in four months on the air. A Globe Chief 90 transmitter, a Hallicrafters SX-100 receiver, and a "long-wire" antenna help. His DX list includes VE3, VE4, WP4, ZM6, and DU7! Many Generals would like to have those last two on their lists. . . . **Rick Felisko, K4BHK,** 389 Euclid Ave., Daytona Beach, Fla., started as a Novice two years ago when he was 13. Going up through Technician and Conditional licenses, he now has his General. Rick uses a Globe Chief 90 transmitter aided by a Heathkit VF-1 VFO, and he receives on a Hallicrafters S-85. He has 40 states, including Hawaii, confirmed and 10 countries worked. His single-element beam put up in January gets credit for half of the states and all the DX worked. Rick is wondering if Vermont, New Hampshire, and Delaware still exist. . . . **Bruce J. Smith, WV6LJP,** 2947 Kelton Ave., Los Angeles 64, Calif., built the "Nifty Novice" transmitter in the April, 1959, POPULAR ELECTRONICS, with slight modifications to fit his junk box. In 46 days, its 20 watts have accounted for 27 states—21 confirmed. A 3-element, 15-meter beam gets him S8 and S9 reports, but, so far, his DX score is zero. Bruce receives on a Hallicrafters SX-24.

Dan Lewis, K4MQT, 1860 Audobon Dr., N.E., Atlanta 6, Ga., has had both good luck and bad since his write-up in the June column, in which we called him "Don." He broke all his 40-meter crystals, and the 40-meter antenna would not get out on 15; so he put up a temporary 15-meter antenna and worked HR1NX. He found out that the new antenna really was "temporary" when a windstorm blew it down. On the credit side, Dan now has his General and a 15-wpm code certificate. Also, his school

"ZED" IS OKAY ON PHONE

It has been claimed that the FCC monitoring stations have been issuing "discrepancy reports" to phone hams who use "zed" for "Z" in their call letters to differentiate it from letters which sound similar, such as "B," and "C." Here is the official word on this point from Ben F. Waple, Acting Secretary, Federal Communications Commission.

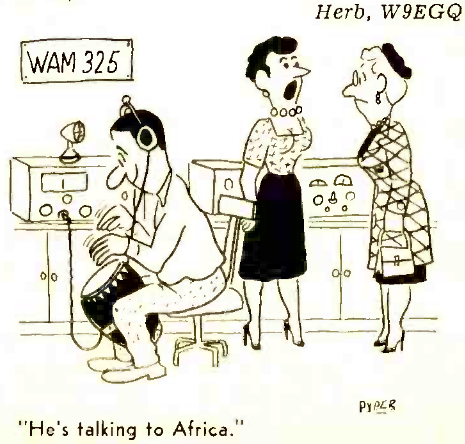
"Section 12.82(d) of the Amateur Radio Service Rules provides for the use of phonetic aids to identify the call signs of amateur stations using telephony. If the operator of W9NZZ announces his call letters as "W9N zed zed" on phone, this would be considered to be in accordance with Section 12.82(d)."

grades went up. He is taking part in organizing a radio club in his high school and would appreciate suggestions on writing the club constitution. . . . **Richard Cobb, KN5CGI,** 5118 Pershing, Houston 33, Texas, first became interested in ham radio five years ago via our column. He uses a Heathkit DX-40 and a Hallicrafters SX-110. His antenna has been a 40-meter dipole, which must work well if 34 states, including Alaska on 40 meters, and Puerto Rico, Dutch West Indies, and Cuba, is any evidence. But he now has a 50′ self-supporting tower and is building a 4-element, 15-meter beam. . . . **John W. Black, K3JOI/4,** 1708 Ellis St., Brunswick, Ga., is operating "portable" because he is a radioman in the Navy, which makes his location subject to change. John transmits on a surplus ARC-5 transmitter, running 20 watts on 40-meter c.w., and he receives on a Hammarlund HQ-100 receiver. With this combination, plus a 20′-high doublet, he has worked 23 states and Canada.

Ken Gilbert, WA6GCB, 704 Kingsford St., Monterey Park, Calif., has worked 47 states and 21 countries on all continents in 10 months; he has been a General for the last two months. Ken's transmitter is a Johnson Adventurer, and his receiver is a Heathkit AR-3. He has two antennas, a 40-meter dipole, and a home-built, 3-element, 15-meter beam. . . . The Novice license of **Neil Mayes, KN7IPP,** expired the day he graduated from high school. With no school work to interfere, Neil started a crash study program for his General license; so you'll be hearing him without the "N" in his call any day now. His QSL's go to Route 1, Box 23-HP, Gig Harbor, Wash. Neil's record as a Novice was 37 states worked with a 40-meter dipole fed by a Globe Chief 90. He receives with a Hallicrafters S-38D. . . . **Paul W. Roehrenbeck, WA2HAY,** 181 Ege Ave., Jersey City 4, N. J., likes 20 and 40 meters. He has separate folded-dipole antennas for these bands, which he drives with a Johnson Adventurer assisted by a Knight-Kit VFO. He receives with a National NC-109 and has 20 states and Canada worked.

Until next month, keep your letters, suggestions, and pictures headed this way. Send them to: Herb S. Brier, W9EGQ, % POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. 73,

Herb, W9EGQ



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	1G3	.73
	1J3	.73
	1K3	.73
	1L6	1.05
	1LN5	.59
	1R5	.62
	1S5	.51
	1T4	.58
	1U4	.57
	1U5	.50
	1X2B	.82
	2AF4	.96
	3AL5	.42
	3AU6	.51
	3AV6	.41
	3BA6	.51
	3BC5	.54
	3BE6	.52
	3BN6	.76
	3BU8	.78
	3BY6	.55
	3BZ6	.55
	3CB6	.54
	3CF6	.60
	3CS6	.52
	3CY5	.71
	3DK6	.60
	3DT6	.50
	3Q5	.80
	3S4	.61
	3V4	.58
	4BC5	.56
	4BC8	.96
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	4BU8	.71
	4BZ6	.58

Qty.	Type	Price
	4BZ7	.96
	4CS6	.61
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	5AQ5	.52
	5AT8	.80
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	5BR8	.79
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	5CL8	.76
	5EA8	.80
	5EU8	.80
	5J6	.68
	5T8	.81
	5U4	.60
	5U8	.81
	5V6	.56
	5X8	.78
	5Y3	.46
	6AB4	.46
	6AC7	.96
	6AF3	.73
	6AF4	.97
	6AG5	.65
	6AH6	.99
	6AK5	.95
	6AL5	.47
	6AM8	.78
	6AN4	.95
	6AN8	.85
	6AQ5	.50
	6AR5	.55
	6AS5	.60
	6AT6	.43
	6AT8	.79
	6AU4	.82
	6AU6	.50
	6AU7	.61
	6AU8	.87

Qty.	Type	Price
	6AV6	.40
	6AW8	.89
	6AX4	.65
	6AX7	.64
	6BA6	.49
	6BC5	.54
	6BC7	.94
	6BC8	.97
	6BD6	.58
	6BE6	.55
	6BF6	.44
	6BG6	1.66
	6BH6	.65
	6BH8	.87
	6BJ6	.62
	6BK7	.85
	6BL7	1.00
	6BN4	.57
	6BN6	.74
	6BQ5	.65
	6BQ6GT	1.05
	6BQ7	.95
	6BR8	.78
	6BU8	.70
	6BY6	.54
	6BZ6	.54
	6BZ7	.97
	6C4	.43
	6CB6	.54
	6CD6	1.42
	6CF6	.64
	6CG7	.60
	6CG8	.77
	6CM7	.66
	6CN7	.65
	6CR6	.51
	6CS6	.57
	6CU5	.58
	6CU6	1.08
	6CY5	.70
	6CY7	.71
	6DA4	.68
	6DB5	.69

Qty.	Type	Price
	6DE6	.58
	6DG6	.59
	6DQ6	1.10
	6DT5	.66
	6DT6	.53
	6EU8	.79
	6EA8	.79
	6H6GT	.58
	6J5GT	.51
	6J6	.67
	6K6	.63
	6S4	.48
	6SA7GT	.76
	6SK7	.74
	6SL7	.80
	6SN7	.65
	6SQ7	.73
	6T4	.99
	6U8	.78
	6V6GT	.54
	6W4	.57
	6W6	.69
	6X4	.39
	6X5GT	.53
	6X8	.77
	7AU7	.61
	7A8	.68
	7B6	.69
	7Y4	.69
	8AU8	.83
	8AW8	.93
	8BQ5	.60
	8CG7	.62
	8CM7	.68
	8CN7	.97
	8CX8	.93
	8EB8	.94
	10DA7	.71
	11CY7	.75
	12A4	.60
	12AB5	.55
	12AC6	.49
	12AD6	.57

Qty.	Type	Price
	12AE6	.43
	12AF3	.73
	12AF6	.49
	12AJ6	.46
	12AL5	.45
	12AL8	.95
	12AQ5	.52
	12AT6	.43
	12AT7	.76
	12AU6	.50
	12AU7	.60
	12AV5	.97
	12AV6	.41
	12AV7	.75
	12AX4	.67
	12AX7	.63
	12AZ7	.86
	12B4	.63
	12BA6	.50
	12BD6	.50
	12BE6	.53
	12BF6	.44
	12BH7	.73
	12BL6	.56
	12BQ6	1.06
	12BY7	.74
	12BZ7	.75
	12C5	.56
	12CA5	.59
	12CN5	.56

Qty.	Type	Price
	12CR6	.54
	12CU5	.58
	12CU6	1.06
	12CX6	.54
	12DB5	.69
	12DE8	.75
	12DL8	.85
	12DM7	.67
	12DQ6	1.04
	12DS7	.79
	12DZ6	.56
	12EL6	.50
	12EG6	.54
	12EZ6	.53
	12F5	.66
	12F8	.66
	12FM6	.45
	12K5	.65
	12SA7M	.86
	12SK7GT	.74
	12SN7	.67
	12SQ7M	.73
	12U7	.62
	12V6GT	.53
	12W6	.69
	12X4	.38
	17AX4	.67
	17BQ6	1.09
	17C5	.58
	17CA5	.62

Qty.	Type	Price
	17D4	.69
	17DQ6	1.06
	17L6	.58
	17W6	.70
	19AU4	.83
	19BG6	1.39
	19T8	.80
	21EX6	1.49
	25BQ6	1.11
	25C5	.53
	25CA5	.59
	25CD6	1.44
	25CU6	1.11
	25DN6	1.42
	25EH5	.55
	25L6	.57
	25W4	.68
	25Z6	.66
	35C5	.51
	35L6	.57
	35W4	.52
	35Z5GT	.60
	50B5	.60
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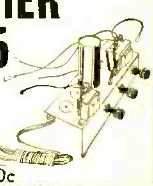

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Make .... Model ....

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

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Dual-Meter Power Supply

(*Continued from page* 50)

The current should increase from 14 to 26.5 ma. without appreciably affecting the voltage. Note that the current does not double when the load resistance is halved—this apparent discrepancy is caused by the extra current drawn by the voltmeter which is always in parallel with the load.

To check the operation of the guard circuit, remove both 470-ohm resistors from the output terminals. Set *S2* to "in" and advance the voltage control (*R4*) fully clockwise. Short the output terminals together and note the value of the short-circuit current. It should not exceed about 75 ma. If the milliammeter reads more than 100 ma., the trouble is probably due to a higher than normal voltage drop across the stabistors or the emitter-base junction of *Q2*. Increasing the value of *R5* slightly should correct this condition.

HOW IT WORKS

A standard rectifier-filter circuit is used, consisting of transformer *T1*, diode *D1*, resistor *R1* and capacitors *C1a/C1b*. Transistor *Q1* operates as a series regulator with its base voltage determined by the collector voltage on control transistor *Q2*. The combined current gain of the transistors determines the output voltage stability.

Potentiometer *R4* is the output voltage control: moving its center arm up or down changes the power supply's output voltage. Transistor *Q2* reacts to changes in the position of *R4*'s arm by raising or lowering the voltage at the emitter of *Q1*, which varies the output voltage accordingly.

A guard circuit, consisting of resistor *R5* and stabistor *D3*, limits the output current whenever an overload occurs e.g., if the supply's output terminals are shorted together, the output voltage begins to build up across *R5*. When the potential across *R5* reaches about 1.7 volts, *D3* conducts and duplicates the effect of a counterclockwise rotation of *R4*. This results in a decrease in the output current of the supply.

Using the Supply. Simply connect the load to the output terminals, set the voltage to the desired level, and you're ready to go. In the case of transistor radios, a set of leads terminated in suitable snap-on battery plugs will facilitate connections. Make sure, however, that the leads are properly polarized.

Always use the guard circuit and advance the voltage control slowly when using the supply on equipment with suspected faults. Both of the power supply's meters will sometimes give a good indication of the type of trouble to look for in faulty equipment and can be a valuable aid in servicing the equipment. —30—

The Load Line Story

(*Continued from page* 97)

nothing in the rule book that says you have to stick to these conditions. In fact, you would want your plate load resistor to be as high as possible to get the most gain out of the tube with the least distortion in the output signal.

"The limiting factor in the value of the plate load resistor is the plate supply voltage available; as the load resistor gets larger in value, a small current flow passing through it can provide a large enough IR drop to make the tube inoperative."

"Just when I thought I had it made, Ken, you complicate things. How would I know the best plate resistor value to use?"

"That's another place where most tube manuals prove they're worth the money." Ken replied. He flipped through the little book to the section labeled "Resistance-Coupled Amplifiers" and showed it to Larry. "This section lists all the amplifier tubes and gives you the dope on typical plate voltage supplies and plate resistances to use."

LOAD lines come in handy when you want to find operating conditions for load resistances and supply voltages not shown in the standard tables, Larry," Ken continued. "The important thing to get out of our discussion is the method we used to find two points for the load line.

"Remember, any point along the load line is an operating point for the tube under the voltage and resistance conditions you set up. By means of the load line you can read off current, voltage, and bias conditions without any further calculations."

"I can see that, Ken," said Larry. "Now I know something about a topic that has been a real puzzler to me."

Ken laughed, "It's only the start, son, only the start. I suggest you do a little homework on your own. Why not take the same circuit we used, throw a 47,000-ohm load resistor in, and see what the load line looks like. It'll be good practice for you."

"I'll do that, Ken. And thanks again for the time and info." —30—

TO OUR READERS: Why not figure the 47,000-ohm load line along with Larry? Trace the 6J5 curve from the illustrations in this article and see how you come out. The calculations and completed load line diagram will be given next month.

Electronic Teaching Machines

(*Continued from page* 63)

ing would keep him 100% occupied and attentive.

For and Against. In spite of their many advantages, teaching machines can't teach everything. They are tools to be used by the teacher, not substitutes for the teacher. They perform spectacularly in drilling students on the thousands upon thousands of basic, incontrovertible *facts* which must be learned—including everything from multiplication tables to irregular French verbs.

But, as one teacher puts it, "You can't argue with a machine." Therefore, whenever an exchange of ideas between teacher and pupil is part of the learning process—whenever interpretation, controversy, opinion, and discussion are involved, as in history or philosophy, for example—there is no substitute for the classroom teacher.

Mr. Komosky, perhaps one of the most enthusiastic backers of teaching machines, observes, "I cringe at the thought of pupils taking their lessons day after day from machines, just as I abhor the idea of learning only from books. You can't learn to write or think imaginatively from a machine, nor can it develop critical judgment. Its role in the school of the future will be to impart basic information and manual skills, leaving the instructor free for creative teaching."

Of course, like all new ideas, the concept of the machine teacher has its opponents. "It is dehumanizing," is one of the favorite complaints. "No vacuum tube will ever understand a child."

While this latter statement is undoubtedly true, it is also somewhat beside the point. Since the teaching machine is only a tool of the new educational method, it is no different in principle, and certainly no more sinister, than those other technological aids which have been appearing more and more regularly in the nation's classrooms: the tape recorder and the motion picture projector.

Actually, the machine is not even central to the new method. There is no reason why these new learning techniques must always be applied by machine since some material can be presented in so-called programed tests. The student merely follows instructions, and is quizzed at each step. He writes his answer, and then is instructed where to look to see if he is right.

Although opposition to teaching machines exists, manufacturers are betting on their widespread acceptance. Over a dozen firms have either begun actual production, or have prototype models under development.

The Rheem Manufacturing Company's Califone Division, for example, has built several models, distributed them for testing and evaluation during the past several years, and now has them on sale. The Western Design Division of U. S. Industries has sold 18 of its Autotutors to the Air Force where they are being used to teach basic electronics to airmen. The same machine is being tested by the Prudential Life Insurance Company as a means of shortening the training time of insurance agents.

Programing. Although the business of machine development and manufacture is booming, even greater activity is evident in the field of programing—writing the specially organized material without which the machines are just so much expensive but useless hardware.

Writing programs for the machines is a complex business. The skills of the psychologist, the educator, and the specialist in the subject to be programed must all be blended into the final product. Then, since the technique is still new and still largely experimental, the final product must be tested on students, then evaluated, altered where tests reveal weakness, re-tested, and re-written until everybody is satisfied.

Since universities are generally best equipped with the talents needed, they have so far done most of the work. Harvard, Hamilton College (New York), Earlham College (Indiana), Oberlin College (Ohio), and Hollins College (Virginia) have been leaders. New York's Collegiate School has also been a pioneer in programing and testing. In addition, at least a score of universities, from Arizona to Wisconsin, are involved in less ambitious projects.

Among the subjects programed so far are statistics, computer arithmetic, algebra, trigonometry, modern mathematics, logic, psychology, beginning English, spelling, remedial reading, critical reading, junior high English, French, German, Russian, Hebrew, Latin, elementary school science, engineering, Latin, electronics, biology, physics, chemistry, and music.

On the Market. Several completely programed subjects are already available on the commercial market. U. S. Industries, which now has some 20 members of its projected 40-man programing staff assembled and producing, offers a course in computer arithmetic; Teaching Machines, Inc. of Albuquerque, New Mexico, offers courses in statistics and spelling. Both machine-makers and text-book publishers have been hiring programmers, or entering into agreements with universities in the field, and courses will soon be available in dozens of subjects.

This fall, Harcourt Brace will bring out courses in algebra, trigonometry, electronics, and, for the home market, bridge. TMI will introduce algebra, Russian, Hebrew, and fundamentals of music. The Encyclopedia Britannica recently incorporated its new programing subsidiary, and will, in conjunction with Hollins College, offer complete high school mathematics and language courses by fall, 1961. The New York Institute of Technology is programing electronics, math, and physics. And there are many others.

When will teaching machines come into wide use? Proponents say it must come soon. They feel that the widespread tests this year—now going on in the public school systems of Denver, Colorado; Evanston, Illinois; Westport, Connecticut; Manhasset, New York; and Newton, Massachusetts; in addition to college-sponsored programs elsewhere—will bring about quick and enthusiastic recognition of the value of these devices.

Pointing the Way. And what of the future? Electronics will play a more and more important role in the world of education as newer and better machines are developed.

Perhaps pointing the way to the future is a design under development by the Systems Development Corporation, which will be built around a Bendix G-15 digital computer. Fifteen or twenty students will use it simultaneously, each one following his own individual course. The computer flashes a series of questions to each student, receives his answers by push button, and notifies him if he is right or wrong. At the same time, it makes a record of his response for future analysis.

Such a machine would also be programed to analyze the pattern of a student's answers, and present a condensed, rapid course for the bright, fast learner, while giving the slower pupil the extra detail and explanation he needs. —30—

Electric Power

(*Continued from page* 55)

spotted at key points automatically emit signals. These signals go through leased telephone lines to selected generating stations, where they cause the turbines to speed up.

Each power system has a central control station. Operators at this station decide which of their generators will get the control signals from the frequency-measuring devices. Switches are set hourly in accordance with charts that show the anticipated power demand and the generating units available. In some power systems that have considerable mileage between generating stations, the selection of generators is made by electronic computers.

It has become a growing practice for neighboring power companies to design their systems jointly and to tie into one another. This is particularly helpful when their peak loads fall at different times of day or in different seasons. For instance, New York's peak loads generally come in the summer, while those of its neighbors usually occur during the winter. Thanks to tie-ins with its neighbors, New York now buys extra summer power and sells its excess winter capacity.

Tomorrow's Transmission System. An ever-increasing demand for power is a prime fact of life for the entire nation. Until recently, this demand approximately doubled every 10 years. But the pace has quickened—70 million kilowatts were consumed in 1948, and the 1958 consumption was on the order of 160 million. Planners see national power demand up to at least 300 million kilowatts come 1968.

There are two ways to meet this need: double the number of power lines—generally conceded to be impractical—or beef up the transmission voltage. The second approach calls for taller transmission towers to keep the tremendous energy from jumping around, bigger transformers to do the gigantic step-up, step-down job; king-size circuit breakers to protect the high-potential system.

Extra-high-voltage transmission will make possible a cherished dream of the power planners. That dream is to interconnect all the systems in the nation with extra-high-voltage cross-country lines. New York, for example, would be able to draw extra current from California as well as from Connecticut. All the nation's power companies could pool their generating resources for the most economical use of their equipment. In short, a supersystem of limitless flexibility would be created.

This extra-high-voltage scheme will soon get its first practical test when a 4½-mile experimental line is put into operation between Pittsfield and Lee, Massachusetts. The line, a joint project of the General Electric Co. and the Western Massachusetts Electric Co., will carry a staggering 460,000 volts. This compares with the 138,000 volts in a standard high-tension line. About a year after it's energized, some 750,000 volts will be fed into the pilot system.

Tomorrow's Generators. But new transmission systems are only part of the story of tomorrow's power. More efficient generating systems are also dear to the hearts of planners. One of the more exciting ideas is a magnetohydrodynamic generator. This jawbreaker does away with the wire coils and turbine of a conventional generator. The idea is to superheat gas until it becomes ionized and changes into a gaseous electrical conductor known as plasma. When the plasma cuts across a magnetic field at high speed, current is generated in it. This current is then drawn off by electrodes.

So far, only experimental magnetohydrodynamic generators have been built; much closer to practical application is power generation by atomic energy. An atomic power plant uses conventional generators and near-conventional steam turbines. But the turbines are powered by a nuclear reactor coupled to a complex heat-exchange system.

Atomic power is far from a dream. A government reactor is already at work in Shippingport, Pa. In Chicago, the Commonwealth Edison Co. is now loading its reactor with nuclear fuel. In New York, the Consolidated Edison Co. is building an atomic power plant at Indian Point that should be in operation early next year. Other atomic plants are either under actual construction or are being blueprinted by private power companies in Boston, Detroit, and Philadelphia, in the Carolinas, and in Virginia.

—30—

Test Instruments

(*Continued from page* 100)

and within a few millionths of a second, it has made several thousand trips around its circular race track, through *V1* and *V2*, getting bigger on each trip. What we have of course, is simply an ordinary oscillator; the feedback circuit *R1-C1* will keep it oscillating indefinitely.

But this is an oscillator with a different twist. In addition to the series *R1-C1* network, there is also the parallel network *R2-C2*. To see what effect this second circuit has, let's go back for a minute to the point where oscillations are just beginning to build up around the *V1-V2* path. Since random noise is made up of signals of many different frequencies, all at first are amplified and sent around through the feedback loop. But since the capacitive reactance of the *R1-C1* network decreases as frequency increases, the higher frequencies fed to the network have a much easier time getting through to the grid of *V1* than do the low frequencies.

If only the *R1-C1* network were in the circuit, the frequency of the oscillator would thus tend to get higher and higher. But *R2* and *C2* put a stop to that. This network has an effect exactly opposite to that of *R1* and *C1*. It tends to short the high frequencies to ground, while allowing the low frequencies to build up in the tube's grid circuit. The final frequency at which the circuit oscillates is, therefore, a "happy compromise" between the two networks.

Distortion Analyzers. If you're a hi-fi fan, you may have used another version of the Wien bridge without knowing it. Most harmonic distortion analyzers use the frequency-discriminating characteristics of this bridge to check amplifier operation. Let's follow the operation of an analyzer and see what part the Wien bridge plays in insuring that your fi will be of the highest.

First, set your audio signal generator to, say, 1000 cps, and feed this signal into the amplifier. Now, if there is any harmonic distortion induced by the amplifier, it will appear at the amplifier's output as signals of other frequencies mixed with the 1000-cps tone.

What we want to know is how much signal voltage at these new frequencies is generated by the amplifier when we apply a 1000-cps tone. To find out, we feed the amplifier output containing the fundamental—1000 cps—and all the harmonics, into the analyzer. There, a Wien bridge tuned to 1000 cps cancels out the 1000 cps tone, leaving only the harmonics.

If we checked the amplitude of the output signal—including the 1000-cps tone before we shorted it out with the Wien bridge—we can easily measure what percentage is represented by the harmonic distortion that remains. A typical amplifier, for example, might be rated as having 2% harmonic distortion. This means that at a given power and frequency, distortion accounts for 2% of the output signal.

Figure 4 shows in simplified form the frequency-*cancelling* network in the Heath harmonic distortion analyzer. As you can

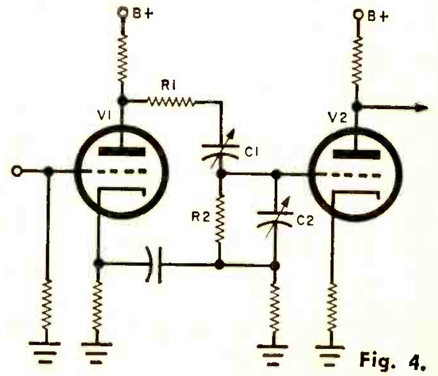

Fig. 4.

see, it is very similar to the frequency-*determining* network in the EICO 377 signal generator. Tube *V1* is a phase splitter. It takes the incoming signal, slices it into two parts 180° out of phase, and applies both parts to the grid of *V2*. But one part is applied to the grid through series network *R1-C1*, the other through parallel network *R2-C2*.

If these networks are set at the proper compromise frequency—as explained in the section about the signal generator—the two sections of the signal exactly cancel out each other. If the bridge is balanced at 1000 cps, for example, it will cancel out the signal at that frequency. But signals of all other frequencies—such as the distortion signals we want to detect—will not be cancelled. The bridge will not be balanced for them, and they will pass through one network or the other—depending on whether they are higher or lower in frequency than the compromise frequency—and be amplified by *V2*. These amplified signals can then be read on the meter. —30—

Short-Wave Report

(*Continued from page 83*)

SWL Club is now in its second year of operation and has over 100 members. Ken MacNeilage, 46C Parkway Village, Cranford, N. J., is Chief Editor; his assistants include Drayton Cooper (medium waves, FM and TV), Maxey Irwin (short waves), and James Howard (card swappers).

The dues for the American SWL Club are $2.00 yearly in the United States and Canada, $3.00 elsewhere. You can obtain a sample copy of their bulletin by writing to Mr. MacNeilage at the address given above and enclosing 15 cents in stamps or in coin.

Ham Turns SWL. Bailey Dickinson, K4YTS, was an amateur operator for over three years. During that time he never realized that there were any short-wave stations other than amateur stations because his receiver tuned only the ham bands.

While listening on a friend's S-85 one day, however, he found that there *were* other stations and that some of them had good programs. So he promptly traded in his receiver *and transmitter* and purchased a new Hallicrafters SX-110. He's been having the time of his life ever since.

Bailey, your report forms have been mailed to you, and we will look forward to receiving your reports.

Current Station Reports

The following is a resume of current reports. At time of compilation, all reports are as correct as possible. Stations may change frequency and/or schedule with little or no advance notice. Please send all reports to me at P. O. Box 254, Haddonfield, N. J. Requests for monitor call letters should be sent to Monitor Registration, POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. (See form on page 126.)

Aden—According to a new schedule, the *Aden B/C Service* operates on Saturdays, Mondays, Tuesdays, Wednesdays, and Thursdays at 2300-0000; on Fridays and Sundays at 0130-0500; daily at 0700-1600 (relay in Arabic from London at 1300-1600); all on 7170 kc. (*WPE1BM*)

Australia—According to the latest program guide, *R. Australia*, Melbourne, transmits to Eastern N.A. at 0710-0815 on 11,810 kc. with home news at 0745, a mailbag on Sundays at 0730-0745, and a DX program on Sundays at 0800-0812. The West Coast segment is aired at 1014-1115 on the same frequency. (*WPE4BTY*)

Austria—*Osterreichischer Rundfunk* is testing on 9775 kc. with classical music at 1845 and an ID in Eng., French, and German at 1900 followed by a prompt s/off. The best day to hear it is Thursday, when 4VEH, Haiti, is off. Exact location not certain. (*WPE1BM*)

Brazil—A new outlet is believed to be *R. Excelsior,* 15.265 kc., Sao Paulo. Noted around 2000, it features music, ads, and news—all Portuguese. (*WPE9KM*)

The schedule for *R. Gazeta,* Sao Paulo, reads: 0530-1600 on 15,325 kc.; 1000-2300 on 9685 kc.; and 0600-1200 and 1600-2300 on 5955 kc. (*WPE1BY*)

A rarely noted station is PRI8, Aracatuba, 2450 kc. Tuned at 2040 with L.A. music, there was considerable marine and shipping QRM. (*WPE3NF*)

Burma—Rangoon is noted on 9540 kc. at 0200 with Eng. news and from 0220 to 0240 s/off with classical music. (*WPE6CJ*)

Cape Verde Islands—*R. Barlavento,* 3960 kc., is audible around 1830 with Portuguese home news and commercials. (*GP*)

China—English xmsns from *R. Peking* are as follows: to England and Western Europe on 9457, 11,650, and 15,060 kc. at 1400-1500 and 1530-1630; to Eastern N.A. on 11,945, 15,430, and 17,720 kc. at 2000-2100 and 2100-2200; to Western N.A. on 11,975, 15,060, and 17,745 kc. at 2200-2300 and 2300-0000; to Australia and New Zealand on 15,060 and 17,835 kc. at 0330-0430 and 0430-0530; to S. E. Asia on 11,885 and 15,417 kc. at 0600-0700 and on 11,820 and 15,095 kc. at 0700-0800; to India, Pakistan, and Ceylon on 11,965, 15,140, and 17,810 kc. at 0900-1000 and on 12,010, 15,060, and 17,675 kc. at 1100-1200; to Africa on 9775, 11,740, and 15,095 kc. at 1000-1100 and 1200-1400 and on 9500, 11,740, 11,980, and 15,520 kc. at 1630-1730. Language broadcasts include French to France at 1330-1430, 1430-1530, and 1630-1730 on 9480, 11,885, and 15,430 kc. (also on 11,740 kc. at 1430-1530 only); German at 1300-1330 and 1500-1530 on 9457, 11,650, and 15,060 kc.; Spanish to Latin America at 1700-1800 and 1930-2030 on 15,060, 11,650, and 9457 kc., and at 2100-2200 on 17,745, 15,060, and 11,975 kc.; and Spanish to Spain at 1530-1630 on 9480, 11,885, and 15,430 kc. (*WPE8HF, WPE8MS, WPE8WT*)

Costa Rica—TIDCR, *La Voz de la Victor,* San Jose, is heard well on 9615 kc. from 0143 to 0203 s/off with L.A. music and talks in Spanish; IS of chimes at 0200. (*VE7PE1R*)

Denmark—Copenhagen broadcasts to N.A. at 2030-2130 and 2200-2300 on 9520 kc. in Eng. with a DX program on Tuesdays. They broadcast to South America in Spanish and Danish at 1730-1830; to the Far East, Australia, and New Zealand at 0400-0500 in Eng. and Danish; to South Asia at 0930-1030 in Eng. and Danish; and to Africa and the Middle East at

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	N.A.—North America
B/C—Broadcasting	QRM—Interference
Eng.—English	QSL—Verification
ID—Identification	R.—Radio
IS—Interval signal	s/off—Sign-off
kc.—Kilocycles	s/on—Sign-on
kw.—Kilowatts	xmsn—Transmission
L.A.—Latin America	xmtr—Transmitter

1140-1240 in Eng. and Danish, all on 15,165 kc. In addition, Danish programs to ships are broadcast at 0130-0200, 0900-0930, 1100-1130, and 1700-1730 on 15,165 kc., and at 2000-2030 on 9520 kc. Reports go to *Danmarks Radio*, Radiohuset-Rosenorns Alle 22, Kobenhavn V, Denmark. (*WPE1AXK, WPE1BM, WPE1II, WPE2BDK, WPE2FK, WPE3AJC, WPE8OF, VE2PE3W, VE3PE5S*)

Dominican Republic—A new and widely heard station is *R. Caribe:* HI2U, 6090 kc., and HI3U, 9505 kc. It is heard well from 0530 s/on to 0200 s/off with music and Spanish announcements, numerous brief talks in Eng., Spanish, Dutch, French, and Italian. A letter from the station claims that *R. Caribe* is a private enterprise using private capital, that the equipment is completely new, and that the station has had no connection with any other station. (*WPE1BM, WPE1BY, WPE2AXS, WPE2CVU, WPE4AOJ, WPE4HJ, WPE8FV, VE3PE1S, VE4PE2L, VE7PE1R, AA, SH*)

(Many DX'ers have thought that *R. Caribe* was an outgrowth of the former *R. Liberacion* which operated on 6088 and 9505 kc.—*Ed.*)

Ecuador—HCHC2, *R. Emisora Central,*

SHORT-WAVE CONTRIBUTORS

Stanley Schwartz *(WPE1AAC)*, Bridgeport, Conn.
Jim Silk *(WPE1AGM)*, Madison, Conn.
Maurizio Giordano-Lanza *(WPE1AXK)*, Waterbury, Conn.
Jerry Berg *(WPE1BM)*, W. Hartford, Conn.
Alan Roth *(WPE1BY)*, Bridgeport, Conn.
Gregory Killam *(WPE1II)*, Reading, Mass.
H. E. Rothwell *(WPE1QF)*, Fall River, Mass.
Richard Lawrence *(WPE1QY)*, Fall River, Mass.
Riley Sundstrom *(WPE2AJ)*, Stockton, N. J.
Robert Newhart *(WPE2AXS)*, Merchantville, N. J.
P. J. Scognamilio *(WPE2BDK)*, Brooklyn, N. Y.
Paul Staffin *(WPE2CVU)*, Cooperstown, N. Y.
Steven Meltzer *(WPE2FK)*, New York, N. Y.
Ed MacDonald *(WPE3AJC)*, Malvern, Pa.
Donald Campbell *(WPE3BCE)*, Washington D. C.
Steve Breitenbach *(WPE3BJL)*, Philadelphia, Pa.
George Cox *(WPE3NF)*, New Castle, Del.
Bruce Wrinkle *(WPE3UZ)*, Baltimore, Md.
Stewart Drake *(WPE3WN)*, Philadelphia, Pa.
Gene Pearson *(WPE4AIX)*, Birmingham, Ala.
Charles Sapp, Jr. *(WPE4AOJ)*, Jacksonville, Fla.
Johnny Smith *(WPE4BTY)*, Milledgeville, Ga.
Gary Yarus *(WPE4EC)*, Pikeville, Ky.
Alan Knapp *(WPE4HJ)*, Roanoke, Va.
Lewis Tucker *(WPE4NA)*, Eagle Rock, Va.
William Bing *(WPE5AG)*, New Orleans, La.
Garlord Carlock *(WPE5ART)*, Joshua, Texas
David Penney *(WPE5SH)*, New Orleans, La.
D. L. Carl *(WPE6APD)*, Los Angeles, Calif.
Bill Lund *(WPE6CJ)*, Manhattan Beach, Calif.
J. Art Russell *(WPE6EZ)*, San Diego, Calif.
James Saindon *(WPE6UD)*, Coronado, Calif.
Richard England *(WPE8FV)*, Columbus, Ohio
Dan Wilt *(WPE8HF)*, Akron, Ohio
Mike Kander *(WPE8MS)*, Dayton, Ohio
Steve Lohbauer *(WPE8OF)*, Norwalk, Ohio
Mark Lewis *(WPE8WT)*, Avon Lake, Ohio
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
Ken Smolik *(WPE9NB)*, Franklin Park, Ill.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Dick Schreiber *(WPEØEH)*, Wheat Ridge, Colo.
Burton Lang *(VE2PE3W)*, Howick, Quebec
Russ Smith *(VE3PE1BC)*, North Bay, Ont.
Cyril Gilmour *(VE3PE1S)*, St. Catharines, Ont.
David Digweed *(VE3PE5S)*, St. Catharines, Ont.
Edmund Wanless *(VE4PE2L)*, Winnipeg, Man.
David Bennett *(VE7PE1R)*, Richmond, B. C.
Angel Arzola *(AA)*, Chicago, Ill.
Martin Cummings *(MC)*, St. Louis, Mo.
M. D. Herr, Jr. *(MH)*, Fort Sheridan, Ill.
Shaler Hanisch *(SH)*, Pasadena, Calif.
Giacomo Perolo *(GP)*, Bauru, Brazil
Edward Tilbury *(ET)*, Anchorage, Alaska

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Vinces, 4500 kc., is noted at 1900-1935 in Spanish with varied musical shows. Check at 1925 for a tone signal of several ascending and descending notes. Frequency varies to as low as 4490 kc. (*WPEØAE*)

French Guiana—Cayenne is heard well on 6170 kc. from 1730 to 1800 s/off, mostly in French. (*WPE6CJ*)

Greece—*R. Athens, The Voice of Greece,* operates on 17,778 kc. at 1220-1235 in French and English. A flute is used for the IS. (*WPE8MS*)

Guatemala—A QSL from *R. Nacional de Quezaltenango* lists outlets as TGQ, 1310 kc., TGQB, 11,700 kc., both 1 kw., and TGQA, 6110 kc., 500 watts. (*WPE1BM*)

Jordan—The new 100-kw. xmtr in Amman is testing on 9530 kc. around 1700 with pop Eng. records but all Arabic anmts. S/off at 1720. (*WPE1BM*)

Liberia—ELBC, Monrovia, is breaking through on 3255 kc. around 1800 and is heard to 1845 s/off with all American pop records and Eng. anmts. This is a 10-kw. outlet. (*WPE1BM*)

Mali Federation—*R. Mali*, Dakar, 15,385 kc., is heard well with Eng. news at 1530-1540 and in French at 1023, from 1730 to 1845 s/off with pop records, and from 0130 s/on to 0300 s/off. French news is given at 0255. This station outlet is often better than the parallel outlets on 7210 and 11,895 kc. (*WPE1BM, WPE3NF, WPE4AIX, WPE8HF, WPE9KM*)

Monaco—*R. Monte Carlo,* 7140 kc., is noted with French news at 0300; talk in French to 0310; European light music to 0330. (*WPEØAE*)

Morocco—Rabat has Eng. news at 1300 and 0700 on 7225 and 11,735 kc. (*WPE1BY, WPE8HF*)

Another Rabat outlet, previously unidentified, is on 9700 kc. from 1400 to 1700 s/off with all Arabic news, music, and talks. (*WPE1BM*)

New Zealand—Wellington carries the Home Service relay at 1200-1345 on 11,780 kc. and at 1400-0045 on 15,280 kc. There is a xmsn to the Pacific Islands at 0100-0345 and to Australia at 0400-0645 on 6080 and 9540 kc. The mailbag is given Fridays at 0200 and 0500, the DX program on the first Wednesday of each month at 0315 and 0530. (*WPE3AJC, WPE5ART, WPE8HF, WPE9NB, VE3PE1BC, MC, MH, ET*)

North Korea—*R. Pyongyang* operates as follows: at 1800-1830 and 0830-0900 in Eng., at 0600-0630 (Wednesdays only) in Esperanto, at 1630-1700 and 0730-0800 in Japanese, all on 6250 kc.; at 1430-0930 on 2850 and 6195 kc. and 1430-1130 on 6250 kc. in Korean. Reports go to Won Oo Heum, Dep't. of Broadcasts for Foreign Countries, Korean Central B/C Committee, Pyongyang, North Korea. (*WPE1BM, WPE8MS*)

Portugal—Lisbon operates on 15,150 kc. at 0700-1000 (Sundays at 0600-1345; Saturdays at 0700-1340) and on 6373 kc. at 1300-1900 (Saturdays and Sundays at 1400-1900) with 10 kw. English programs are at 0845-0930 on 21,495 and 17,880 kc. and at 1215-1300 on 17,895 kc. (*WPE8HF, WPE8MS*)

South Africa—Paradys is noted at 2300-2345 in the Eng. Service on 3316 and 4810 kc., and in the Commercial Service on 4945 kc. The

POPULAR ELECTRONICS

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Selsyns, Husky type II-4, C56701, 115 v/60 cyc. ..	15 lbs.	7.95
Differential relay, one mil operates. 9000 ohm x 2.	1 lb.	3.39
Pwr xfmr for LM freq meter, 510/25, 12.6/0.9 6.3/0.5.	5 lbs.	2.19
Choke, 5 hy/105 mils, 100 ohm, double shell vert.	3 lbs.	.95
Pwr xfmr, 115/220/60 cyc. 600 ct/350 & 12.6 ct/11.	18 lbs.	4.29
Oil cond., 4 mfd/1650 dc, HV terminals	3 lbs.	2.29
6SN7GT vacuum tubes, a dozen for	3 lbs.	5.95
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rms/piv 560/800 $1.05	rms/piv 630/900 $1.25	rms/piv 700/1000 $1.70	rms/piv 770/1100 $2.00

Use in F.W.Bridge or F.W.C.T. up to 1A DC or mtg 2" sq Fins for 1.5Amp. *(Orders $5 or more we pay postage 48 states.)*
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WALKIE TALKIE RADIO SENDING SET

YOUR OWN POCKET SIZE RADIO STATION

Talk to any house or car radio without wires or hookups of any kind! Wt. only ½ lb. Size 1½" x 2½" x 4½". Built-in antenna. "Break-In" on regular radio broadcasts with "Dial Setter" and "Push-to-Talk" switch. Self-contained flashlight batteries—**Power transistor! Talk to radios in the same building and to cars or between cars** up to one block or more away—depending on local conditions. **No license or permit needed!** Practical and real fun in a million ways. **Guaranteed to work—1 year service guaranteed. SEND ONLY $3.00**—(cash, ck, mo) and pay postman only $9.95 plus COD postage or send $12.99 for postpd. delivery. Shipped complete ready to operate with instructions for all kinds of operation. New 1961 Model Radio Talkie is now **Super-powered!** Order yours now—Today! Available only from:

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Buy One At Our Regular Low Price And Get The Second For Only 1¢ More

CITIZENS BAND TRANSMITTER (27 MC) 5 watt chassis, complete with crystal $14.99 each, two for $15.00

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We're closing out our large stock of Citizen Band Transceiver Kits. These were nationally advertised at $39.95. All Kits complete with cabinet, tubes, parts, crystal, FCC form, Instructions, less mike. All sales final.

110 VOLT TRANSCEIVER KITS $19.95
12 VOLT TRANSCEIVER KITS $22.95
6 VOLT TRANSCEIVER KITS $22.95
FAMOUS MAKE CITIZEN BAND XMTG CRYSTALS $1.99

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The Post Office has divided 106 cities into postal delivery zones to speed mail delivery. Be sure to include zone number when writing to these cities; be sure to include **your** zone number in **your** return address—after the city, before the state.

3316-kc. channel is also noted in Brazil at 0215 with Eng. news, apparently repeating the program which is broadcast at 0000 on 4810 kc. (*VE3PE1BC, GP*)

South Korea—Seoul operates to N.A. at 0030-0130 on 15,125 and 17,890 kc. and at 0930-1030 on 11,925 kc., both in Eng. and Korean. The Hawaiian Service in the same languages is broadcast at 0230-0330 on 17,890 kc. and at 1100-1200 on 11,925 kc. (*WPE3BJL, WPE6APD, WPE6UD, ET*)

Swan Island—Another station being widely heard and reported is the new *R. Swan*, on 6000 kc., dual to 1160 kc. Try for the short-wave outlet at 2200-2300 in Eng., from 2300 to 0000 s/off in Spanish. During the Eng. segment there are many pop programs, including horse- and soap-operas. A newscast is usually given at the end of each segment. Reports go to *Radio Swan*, G.P.O. Box 1247, New York 1, N. Y. (*WPE1AAC, WPE1AGM, WPE1BM, WPE1BY, WPE1QF, WPE1QY, WPE2AJ, WPE2AXS, WPE3UZ, WPE3WN, WPE4EC, WPE4HJ, WPE5AG, WPE5SH, WPE8FV, WPEØEH, VE3PE1BC*)

(We are in receipt of a letter from Mr. Richard S. Greenlee, an officer of the Gibralter Steamship Co., operator of *Radio Swan*. Mr. Greenlee would like to have reception reports of *R. Swan*, especially reports that have been published in various club bulletins. Please write directly to him at 29 Broadway, New York 6, N. Y.—*Ed.*)

United Arab Republic—Damascus operates as follows: to local target areas at 2300-0300, 0630-0900, and 1000-1800 on 5675 and 11,750 kc., at 0300-0600 and 0900-1000 on 7398 kc. in Arabic, and at 0600-0630 on 5675 kc. in Turkish; to Europe in French and Eng. at 1430-1530 and to N. Africa in Arabic at 1600-1700, both on 15,165 kc.; to South and Central America in Arabic and Spanish at 1900-2100 on 15,165 and 17,865 kc. The power is 20 kw. on all frequencies, except for 7398 kc. on which it is 7 kw. (*WPE3BCE, WPE6CJ, WPE8MS, WPE9KM*)

United States—Watch 15,180 kc. for KFRN, Forney, Texas, expected to start operations very shortly if it is not already on the air. It is tentatively scheduled at 2200-2300 in Eng. and at 2300-0200 in Spanish. The power is 50 kw. (*WPE4NA*)

The new *Voice of America* facility at Greenville, N. C., is expected to be completed late in 1962. This facility will provide a stronger signal to Europe, Africa, the Middle East, and South America. Obsolete transmitters at Bound Brook and Wayne, N. J., and Brentwood and Schenectady, N. Y., will be replaced by Greenville's six 500-kw., six 250-kw., and six 50-kw. units. In additional, there will be smaller transmitters and a modern receiving station. (*WPE6EZ*)

Venezuela—YVMI, *La Voz de la Fe*, Maracaibo, 3375 kc., is noted at 1930-1955 with religious music and talks in Spanish. S/off is abrupt at 1955; the station was immediately replaced by ZYK78, *R. Olinda de Pernambuco* (Brazil). (*WPEØAE*) —30—

POPULAR ELECTRONICS
Advertisers' Index
November 1960

ELECTRONICS MARKET PLACE

RATE: 50¢ per word. Minimum 10 words prepaid. January issue closes November 7th. Send order and remittance to Martin Lincoln, POPULAR ELECTRONICS, 1 Park Ave., New York 16, N. Y.

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TELEVISION Sets $11.95 plus Shipping. Jones TV, Sanatoga, Pa.

WPE-SWL-CB-QSL Cards—Samples 10¢—"Brownie" W3CJi, 3110A Lehigh, Allentown, Penna.

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JUNK Your Distributor and Voltage Regulator. Improve automobile mileage and performance. Construction details for transistorized distributor and voltage regulator. No moving parts. $4.75. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

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10 Distance Crystal Set plans—25¢; 20 different 50¢, with Transistor experiments, catalog. Laboratories, 1131-L Valota, Redwood City, California.

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CASH paid for short-wave ham receivers and transmitters. Treger W9IVJ-2023B N. Harlem Ave., Chicago 35, TUxedo 9-6429.

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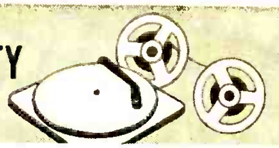

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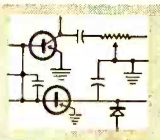

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EXAMINE ANY OF THESE TESTERS BEFORE YOU BUY!!

Yes, we offer to ship *at our risk* one or more of the testers described on these pages.

The Model 88.... A New Combination

TRANSISTOR RADIO TESTER and DYNAMIC TRANSISTOR TESTER

The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no adequate provision for servicing this ever increasing output.

The Model 88 was designed specifically to test all transistors, transistor radios, transistor recorders, and other transistor devices *under dynamic conditions*.

Model 88 TRANSISTOR RADIO TESTER & TRANSISTOR TESTER . . . Total Price . . . $38.50

Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors including NPN and PNP, silicon, germanium and the new gallium arsinide types, *without referring to characteristic data sheets*. The time-saving advantage of this technique is self evident. A further benefit of this service is that it will enable you to test new transistors as they are released!

The Model 88 will measure the two most important transistor characteristics needed for transistor servicing; leakage and gain (beta).

The leakage test measures the collector-emitter current with the base connection open circuited. A range from 50 ohms to 100,000 ohms covers all the leakage values usually found in both high and low power transistor types.

The gain test (beta) translates the change in collector current divided by the base current. Inasmuch as the base current is held to a fixed value of 50 microamperes, the collector current calibrated in relative gain (beta), is read directly on the meter scale.

AS A TRANSISTOR RADIO TESTER

We feel sure all servicemen will agree that the instruments and methods previously employed for servicing conventional tube radios and TV have proven to be impractical and time consuming when used for transistor radio servicing. The Model 88 provides a new simplified rapid procedure — a technique developed specifically for radios and other transistor devices.

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble whether it be a transistor, some other component or even a break in the printed circuit is located and pin-pointed. The injected signal is heard on the front panel speaker as it is followed through the various stages. Provision has also been made on the front panel for plugging in a V.O.M. for quantitative measurement of signal strength.

The Signal Tracing section may also be used less the signal injector for listening to the "quality" of the broadcast signal in the various stages.

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-On Cables for Transistor Testing, an R.F. Diode Probe for R.F. and I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete — nothing else to buy! Only

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Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

Model TV50-A—Genameter
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 TV-50A **GENOMETER**

7 Signal Generators in One!

- R.F. Signal Generator for A.M.
- R.F. Signal Generator for F.M.
- Audio Frequency Generator
- Marker Generator
- Bar Generator
- Color Dot Pattern Generator
- Cross Hatch Generator

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.

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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 pric

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.

• 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 th measuring circuit by a balanced push-pu amplifier. • Uses selected 1% zero tempera ture coefficient resistors as multipliers. Thi assures unchanging accurate readings on al 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

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL-VIEW METER

A Combination **VOLT-OHM MILLIAMMETER**
Plus **CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENT**
Also Tests **SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIU DIODES**

Model 79—Super Meter
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes — components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

● **D.C. VOLTS:** 0 to 7.5/15/75/150/750/1,500. ● **A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000 ● **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes ● **RESISTANCE:** 0 to 1,000/100,000 Ohms. 0 to 10 Megohms. ● **CAPACITY:** .001 to 1 Mfd., 1 to 50 Mfd. ● **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. ● **INDUCTANCE:** .15 to 7 Henries, 7 to 7,000 Henries. ● **DECIBELS:** −6 to +18, +14 to +38. +34 to +58. The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings. All **Electrolytic Condensers** from 1 MFD to 1000 MFD. **All Germanium Diodes. All Selenium Rectifiers. All Silicon Diodes. All Silicon Rectifiers.**

Model 79 comes complete with operating instructions, test leads, and streamlined carrying case. Use it on the bench—use it on calls. Only $38.50

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