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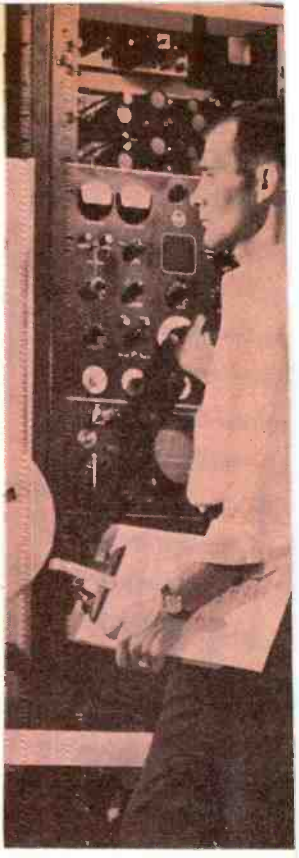

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POPULAR ELECTRONICS

VOLUME 24 JANUARY, 1966 NUMBER 1

POPULAR ELECTRONICS is indexed in the Readers' Guide to Periodical Literature

Cover photo of Owens Valley Radio Observatory by J. Eyreman

Special Feature

Electronic Construction Projects

Communications

Other Features and New Developments

Departments

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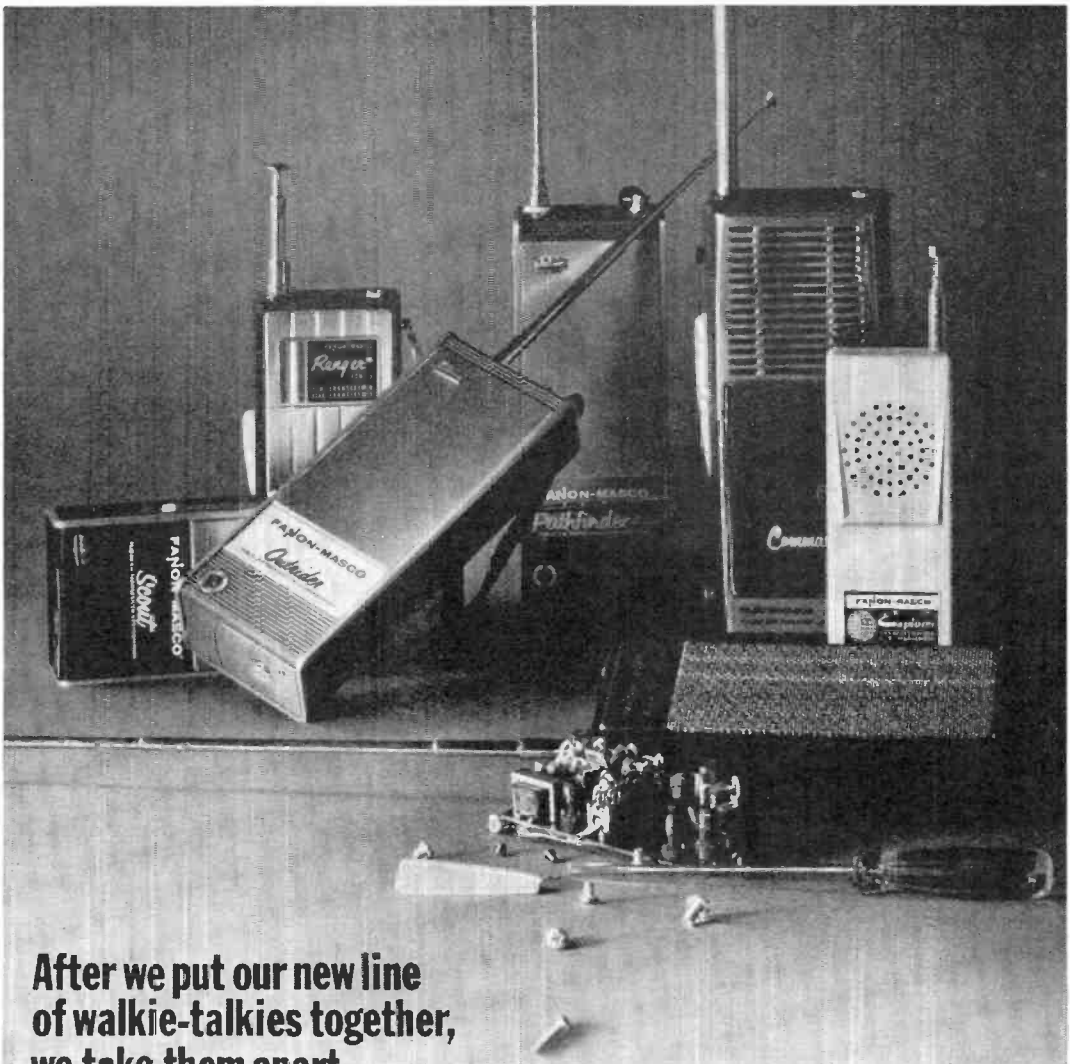

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CIRCLE NO. 7 ON READER SERVICE PAGE

LETTERS FROM OUR READERS

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EXPERIMENTER'S HANDBOOK

I have just finished reading the Fall 1965 Edition of the "ELECTRONIC EXPERIMENTER'S HANDBOOK." Due to different levels of knowledge and differing fields of interest, I feel there will be those who will send you criticisms of "The Fabulous Diodes" by Louis E. Garner, Jr., but I find this article, in light of my level of knowledge and field of interest, to be one of the most valuable presentations of the subject I have had the good fortune to read. I am a graduate (home study) of DeVry Technical Institute, and being of average ability, I find it quite difficult to grasp the

intricacies of electronic theory. I'm grateful to both you and Mr. Garner. Flowers also to you for the sketches alongside the written material and the proximity of the drawings to the reading.

GEORGE C. FERBER
Fairmount, Ill.

Is it possible to subscribe to the ELECTRONIC EXPERIMENTER'S HANDBOOKS? If so, how? The first copy I read was the Spring 1965 edition, and I thought it was wonderful. All the projects were good and right now I'm attempting the 2-Tube Superhet for 80 Meters by Charles Green, W3IKH.

DWIGHT E. MAUER
Toledo, Ohio

George, of all the simple schematic symbols, the one for diodes causes the most trouble for the most people. Dwight, you apparently missed the Fall 1965 edition. If your news dealer is sold out, you can get a copy from Mailer's Fulfillment, 589 Broadway. New York, N.Y. Send $1.40. Sorry, we don't have a subscription service for these handbooks.

PANIC ALARM FOR BURGLARS?

I recently built the "Panic Alarm" (May, 1964) and have had great fun with it. The de-

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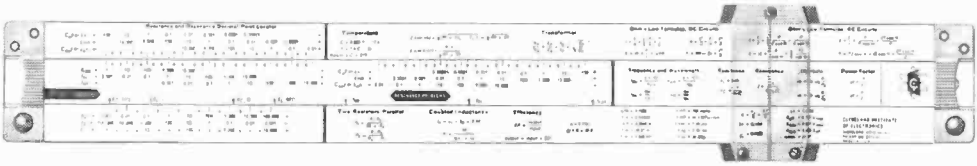

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A student, Mr. Jack Stegleman says:
"Excellent, I couldn't say more for it. I have another higher-priced rule but like the CIE rule much better because it's a lot easier to use."

The Head of the Electrical Technology Dept., New York City Community College, Mr. Joseph J. DeFrance says:
"I was very intrigued by the 'quickie' electronics problem solutions. Your slide rule is a natural."

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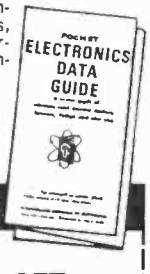

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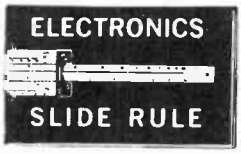

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CIRCLE NO. 5 ON READER SERVICE PAGE

LETTERS (*Continued from page 6*)

vice would make a terrific burglar alarm—it's enough to make any burglar jump out of his pants. Thanks for a fine construction article.

CHARLES ALAJAJIAN
Newton, Mass.

Charles, we're glad you had fun with the "Panic Alarm." The number of applications and variations of most projects is limited only by the builder's imagination. We have another gadget for you to build in this issue. It's bound to cause a panic, too, or at least quell the curiosity of some of your most curious friends. See "Don't Panic . . . Press The Button," on page 45.

PROJECT CHOOSE

I noted with interest the article by Ken Gilmore on "Project Choose" (September, 1965). It is the first one I have read in which the divisions of the technician's talents have been properly made and in terms that students recently graduated from high school can understand. So often I find that a student either has not heard of the fine technical institutes in the country or does not know just where he fits into the industrial picture. Your article explains all of this in a very fine manner. It shows a close liaison between Mr. Gilmore and the Technical Institute Division of the American Society for Engineering Education. Coming from a source other than the Technical Institutes themselves, this information should have more impact on students than if we send them our bulletins, etc.

E. H. FORD, Head
Technical Institute Division
Arlington State College
Arlington, Texas

I completed a two-year course in Electronic Engineering Technology at a junior college and graduated with an Associate of Arts degree in this field. I have been employed as an Engineering Technician for over two years, while attending an accredited four-year state college (California State College at Long Beach) studying nothing more than "Industrial Technology." I will graduate in a short time with the Baccalaureate Degree in Industrial Technology, and my title will be that of Industrial Technologist. After reading Mr. Gilmore's article, I feel rather ridiculous (as I imagine many of my 360 fellow industrial technology majors feel) to find out we are all wasting our time, for we could have the same title with as little as one year of training at some other schools. I feel that Mr. Gilmore's terminology is misleading and unfair to all of us.

CARL C. VAN COTT, A.A.
Long Beach, Calif.

What's in a title, Carl? The Army has a job classification book as big as your fist, and

LETTERS (Continued from page 8)

with a lot of very fine print in it. It gives everybody a number. Titles, while they are helpful, can't stand up by themselves. Who said, "Knowledge is power"? However, your argument, as is everyone's, is with semantics and not with Ken Gilmore, who did a good job of reporting. You will have another opportunity to take a crack at him when his story on Correspondence Schools breaks in the February, 1966, issue.

RADIO GHANA RESPONDS

Re Jon Puerner's letter (September, 1965) on having to wait one year for *Radio Ghana*'s QSL card, I sent a reception report to the

Ghana Broadcasting Corporation on July 24, 1965, and included six International Reply Coupons for return postage. The QSL came six weeks later.

ALLAN BACH
Allentown, Pa.

PHOTOGRAPHY, ANYONE?

The article, "Get That Beam Antenna Shot" (November, 1965), did not go far enough. While it is correct to state that conventional panchromatic black and white film does not record objects against a sky the same way that the human eye detects them, it is quite possible for the human eye to "see" what a film would—there are bluish filters on the market, and available in many camera shops, that have transmission characteristics equivalent to the response characteristics of unfiltered pan film. Photography is definitely an excellent method of making records for insurance or other purposes, and your article was good, as far as it went. However, it leaves you in the unusual position of either limiting yourself to a rather superficial discussion of the problem, or of straying rather far afield from electronics into another discipline.

STEPHEN A. KALLIS, JR.
Huntsville, Ala.

Steve, if you take electronics out of photography, you will be working with a pinhole camera and some crummy plates for film; if you take photography out of electronics, we'll be walking around with wires in our head instead of pictures in our wallets. —30—

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BASIC ELECTRONIC CIRCUITS

This recently arrived import from Britain is a most interesting variation on the theme of "self-taught electronics." Written for the Royal Air Force, this two-part volume on circuitry followed up a six-part series of manuals on basic electronics. Since the earlier series is not available in the U.S. at this time, a reader of the current book must have a fair idea of a.c. and d.c. theory and vacuum tube technology. The first part of this volume moves swiftly—but thoroughly—through pulse circuitry, pulse response, and delay line action; the presentation is extraordinarily clear-cut and readily understandable (there is little conflict between British and American terminology). The second part explains representative "families" of circuits in oscilloscopes (horizontal oscillators, phase shift circuits, sawtooth generators, etc.); many of the circuits have been built and tested and can be breadboarded for classroom demonstration. Whether or not the first six-part series on basic electronics or a follow-up series on basic radar will be distributed in the U.S. is not known at this writing. All of these books would be a welcome addition to the library of a prospective radar technician.

Published by The Technical Press (and distributed in the U.S. by The Chemical Rubber Co., 2310 Superior Ave., Cleveland, Ohio 44114). Hard cover. 250 pages. $9.50.

GE ELECTRONIC COMPONENTS HOBBY MANUAL

Expanded in size and scope over last year's 50-page "Silicon-Controlled Rectifier Hobby Manual" which concentrated on simple circuitry using SCR's, this new manual contains projects utilizing a wide range of components: transistors, vacuum tubes, reed switches, thyrectors, thermistors and photoconductors, as well as SCR's. There are step-by-step explanations of 35 projects ranging from the gimmickry of a magic lamp that turns on and off with a magnetic wand to such handy items as a one-compactron, all-band short-wave receiver. In

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LIBRARY (*Continued from page 12*)

addition, a 45-page section covers in simple language the fundamental operation of these components, including basic theory and terminology. Recommended.

Published by Electronic Components Division, General Electric Co., Owensboro, Ky. Soft cover. 200 pages. $1.50.

BEST WAYS TO USE YOUR VOM and VTVM

edited by Fred Shunaman

This clearly written and well-illustrated volume put out by Allied Radio tells how to use the VOM and VTVM. The text assumes little knowledge on the part of the reader, and tells how to connect these meters to measure voltage, resistance, and current; and how to test capacitors, coils, diodes, resistors, transistors, fuses, motors, lamps, batteries, and switches. Applications discussed cover measurements that can be made around the home on TV, radio, hi-fi, CB, and amateur radio equipment. A chapter on the care, repair, adjustment, and calibration of these instruments is also included. Recommended.

Published by Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680. Soft cover, 96 pages. 50 cents.

FREE LITERATURE

Over 250 electronic kits are illustrated in the 108-page 1966 edition of the Heathkit catalog—a kit for "every interest, every budget." Among the new kits offered are a 25" rectangular-tube color TV, a 23-channel all-transistor CB transceiver, and a low-cost transistorized FM stereo tuner which can be assembled in six hours or less. Write to Heath Company, Benton Harbor, Mich. 49023, for your free copy. . . . A new 24-page catalog from Jensen discusses inexpensive approaches to building a stereo or hi-fi monaural system, explains three ways you can convert older systems to stereo, and tells you how to get concert hall reproduction in the smallest apartment. Copies of Catalog 165-L are available from the Technical Service Department, Jensen Manufacturing Division/The Muter Company, 6601 S. Laramie Ave., Chicago, Ill. 60638. . . . . "At Home with Stereo" is the title of Scott's 1966 stereo console guide. The complete new line of Scott consoles is shown in handsome room settings specially designed by four noted interior designers. This excellent source of decorating ideas can be obtained from H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass. —30—

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VOID AFTER FEBRUARY 28, 1966 1

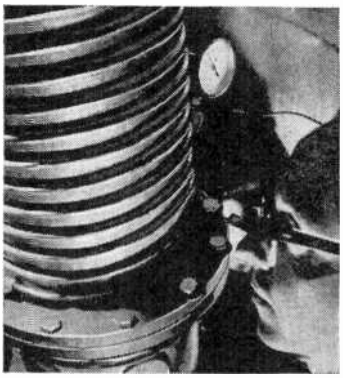
696,000 TECHNICIANS NEEDED BY 1970!

Government Report* Points Out Rapidly Growing Job Opportunities: Need for Trained Electronics Technicians An Important Factor

By Bill Gordon, RCA Institutes, Inc.

President Johnson Emphasizes Need. In his 1964 annual manpower report, President Johnson indicated that the demands for manpower are expanding most in, among other fields, service and technical (including technician) occupations. This expansion is the result of a handful of causes underlying today's big changes in the occupational picture: (1) increasing complexity of modern technology, (2) trend toward automation of industrial processes, (3) growth of new areas of work, such as in the field of atomic energy, earth satellites and other space programs, and (4) data systems analysis and data processing. Indicative also of the growing importance of the use of technicians is a recent revision of the "List of Critical Occupations" published by the U.S. Department of Labor in which technicians are listed for the first time by the U.S. Government.

Salary Levels for Trained Technicians Rising Fast. Beginning salaries for graduates of top level technician education programs have continued to go up during the past five years, at a faster rate than salaries of similar types of jobs. In fact, a U.S. Labor Department projection based on the figures shows that by 1970, technician salaries will average an all-time high.

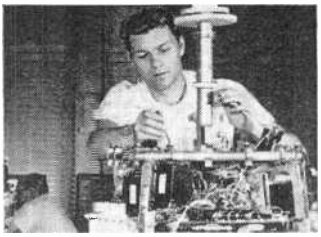


Nuclear Instrumentation

Technical Education is One of Today's Best Investments. Today, a person interested in becoming a technician can choose Home Training or Classroom Training to begin building his career. One of the nation's largest schools devoted to training electronics technicians, RCA Institutes, offers a wide variety of courses in both categories. In addition, the RCA "AUTOTEXT" Programmed Instruction Method is helping people learn faster and easier so they can get started on their careers in the shortest possible time. Dramatic proof comes from the success stories of countless graduates who find profitable positions in government, industry, or in their own businesses.

Of the total 696,000 technicians needed by 1970, it can be estimated that electronics technicians at all levels will form a vital core in today's major job picture.

*"Scientists, Engineers, and Technicians in the 1960's" U.S. Department of Labor, Bureau of Labor Statistics.



Nuclear Instrumentation

RCA DEVELOPS AN EASY WAY TO LEARN ELECTRONICS AT HOME

New "Career Programs" Help Train You For Expanding Job Opportunities. RCA "AUTOTEXT" Instruction Method Speeds Learning

Choose an RCA "Career Program" that will train you for the job you want in Electronics! No time wasted learning things you'll never get to use. "Career Programs" answer the need for today's growing job opportunities for trained Electronics Technicians. They can help you get the job you want faster and easier than you ever dreamed possible! And each "Career Program" starts with the amazing "AUTOTEXT" Programmed Instruction Method—the scientific way to learn that's almost automatic! "AUTOTEXT" helps even those who have had trouble with ordinary methods of home training in the past. This is the "Space Age" way to learn everything you need to know with the least amount of time and effort!

Choose a "Career Program" now. Each one is designed to train you for a specific, rewarding career in one of the following exciting fields:

- TELEVISION SERVICING
- FCC LICENSE PREPARATION
- AUTOMATION ELECTRONICS
- AUTOMATIC CONTROLS
- DIGITAL TECHNIQUES
- TELECOMMUNICATIONS
- INDUSTRIAL ELECTRONICS
- NUCLEAR INSTRUMENTATION
- SOLID STATE ELECTRONICS
- ELECTRONICS DRAFTING

In addition to these "Career Programs" RCA Institutes offers a wide variety of separate courses on many subjects—from Electronics Fundamentals to Computer Programming.

VALUABLE EQUIPMENT INCLUDED

And, with your RCA Training, you receive top-quality equipment to keep and use on the job. When you train with RCA Institutes, you never have to take apart one piece to build another. You'll get the new Programmed Electronics Breadboard which provides limitless experimentation... and, with which you construct a working signal generator and a superheterodyne AM Receiver.

SPECIAL BONUS — OSCILLOSCOPE and METER KITS

Valuable Oscilloscope and Multimeter Kits are yours at no additional cost when you enroll in any one of the RCA Career Programs..."must" equipment for electronics technicians in almost all jobs.

LIBERAL TUITION PLAN

Only RCA offers you this most economical way to learn. You pay for lessons only as you order them. No long term contracts. You may stop your training at any time without owing a cent.

CLASSROOM TRAINING ALSO AVAILABLE

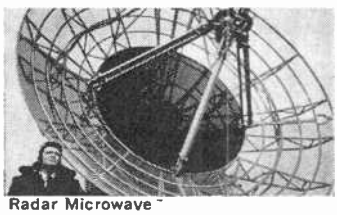
If you prefer to learn in a classroom, RCA Institutes maintains one of the largest schools of its kind where the latest classroom and laboratory training is available in day or evening sessions. You may be admitted without any previous technical training. Preparatory courses are available if you haven't completed high school. Coeducational classes start four times a year.

FREE PLACEMENT SERVICE

RCA Institutes records prove that in a recent class 9 out of 10 Resident School students who used the Free Placement Service had their jobs waiting for them when they graduated. And, many of these jobs were with top companies in the field—IBM, Bell Telephone Labs, General Electric, RCA, and radio and TV stations, and other communications systems throughout the world.

SEND THE ATTACHED POSTAGE PAID CARD FOR COMPLETE INFORMATION WITHOUT OBLIGATION. NO SALESMAN WILL CALL. VALUABLE FREE BOOK INCLUDED. CHECK HOME STUDY OR CLASSROOM TRAINING.

Computer Programming



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HAM HOBBY CLEARINGHOUSE

If you have a hobby or interest in addition to amateur radio and would like to talk about it on the air, you can contact other hams with the same hobby through this column. To be listed here, just send a legibly printed postcard to Ham Hobby Clearinghouse, POPULAR ELECTRONICS, *One Park Ave., New York, N.Y. 10016, including on it your call letters, other hobbies, the frequencies you use, mode of operation, when you operate, and your name and address.*

W2KFB—Hi-fi; primarily 40 and 75 meters SSB, occasionally 15 meters SSB; weekdays 6:15 to 7 a.m. EST, occasionally weekend afternoons. (Julian Hirsch, 53 Darling Ave., New Rochelle, N.Y.)

WB2OYE—Photography and experimenting; 80 meters, CW; early weekday mornings before school, Saturday mornings and Sunday afternoons. (Steven Llewellyn, 222 Beattie Ave., Lockport, N.Y.)

WA4UQA—Astronomy and tropical fish; CW on 80 through 10 meters; after 3:30 weekday afternoons and all weekend. (Steve Rigsby, 109 West Brentwood Rd., Greensboro, N.C.)

WN4YEY—Radio astronomy, slot racing, science fiction, and Civil Air Patrol; 7.170 mc.; 1700-1800 EST daily. (Steve Carlton, 401 W. Reynolds, Plant City, Fla. 33566)

WB6CVR—Chess and amateur rocketry; 40, 20, or 15 meters, AM or CW. (Eric Lundstrom, 200-A Byrnes, China Lake, Calif. 93556)

WB6HWR—Photography, stamp and coin collecting; 7.049 or 7.065 mc., CW; 1500 to 2200 PST, any day of week. (Ronald C. Koehler, 4924 Pacific Ave., Long Beach 5, Calif.)

WA8POS—Chess, and collecting comic books; 80 and 40 meters, CW; 1000 to 1100 and 2200 to 2300 GMT daily. (Steve Courts, Box 286, Rt. 2, Milton, W. Va. 26541)

WAØAIY—Flying, infrared photography, telephone communications; 6 meters AM, 2 meters FM, evenings and weekends. (Richard M. Jacobs, 1015 Glenside Pl., University City, Mo. 63130)

WAØKHH—Rifles and shooting; 75 meters, phone; (Darrel G. Peterson, Rt. 1, Box 136, Pocahontas, Iowa 50574)

WAØKOM/WA5EKQ—Astronomy, telescope making UFO's and the like; AM and CW on 6 meters, CW on 40 and 80 meters; Friday evening to Sunday evening. (William H. Hunkins, 714 3rd. St., Columbus Junction, Iowa 52738)

VE2SV—Astronomy and stamp collecting; 80 and 40 meters AM, sometimes 2 meters. (Maurice Dubreuil, 1740 Notre Dame, Lavaltrie, Quebec, Canada)

VE3GBW—Camping, photography, construction projects; 80 meters CW, 2 meters AM; late afternoons and evenings, all day weekends. (Bob Wood, Box 67, 6 McCleod St., St. Tilbury, Ontario, Canada) —30—

FALL OUT!

The all-new *Fall* 1965 edition of ELECTRONIC EXPERIMENTER'S HANDBOOK is *out*—available to you right now! 148 pages—30 challenging new projects—complete plans, parts lists, how-to instructions, pro tips and techniques. Scintillating entertainment, sheer fun, sure way to sharpen your skills! Clip out coupon and mail *today!*

NOTE: Electronic Experimenter's Handbook is now published twice yearly—Spring & Fall editions.

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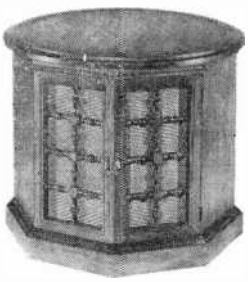
NEW PRODUCTS

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon on page 15.

THREE-WAY SPEAKER SYSTEM

Superior speaker performance is said to be combined with high-fashion furniture design in *University Sound*'s "Mediterranean" three-way speaker system. It features an all-electric, tri-sectional "sonic control" for adjusting performance to room acoustics, climinating the need for amplifier adjustment. A 12" ultralinear-response woofer handles the bass, a new integrated 8" assembly the mid-range, and a wide-angle horn coupled to a rear-loaded compression driver takes care of the treble. Power-handling capacity is 50 watts integrated program material (music power). Frequency response: 25 to 20,000 cycles. The 22½"-high cabinet is available in grained butternut with antiqued pumice brown finish, and in lacquered antique white.



Circle No. 75 on Reader Service Page 15

PROJECT CONSTRUCTION KIT

Have you used any Veroboards yet? *Vero Electronics* has announced the availability of a new project construction kit, Model PK-5. It includes five Veroboards and a detailed instruction book on how to build an impedance matching module, an engine pulse counter module, audio amplifier and r.f. probe module, multivibrator module, and an audio oscillator module. Each of these projects can be constructed in two easy steps, and without etching, wiring, or terminals of any kind.

Circle No. 76 on Reader Service Page 15

LUBRICATING KIT

The Model LK5 "Lube Kit" announced by *Workman Electronic Products* contains an aerosol can of contact cleaner for use on all electrical appliances and an aerosol can of fine oil (both with extension tubes), plus precision dispensers of oil, graphite, and grease. The handy tubes of lubricant are each fitted with a stainless steel needle to get into the smallest places and drop the right amount needed for the job.

Circle No. 77 on Reader Service Page 15

TRANSISTORIZED STEREO RECEIVER KIT

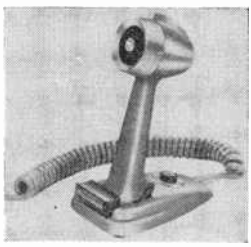
A comparatively inexpensive stereo receiver that tunes FM, FM stereo, and delivers 30 watts of IHF music power is now available from the *Heath Company*. The Model AR-14 kit can be assembled in 20 hours or less, and

can be custom-mounted in a wall or other enclosure. Features include: a 31-transistor, 11-diode circuit for cool, instant operation; power response of ± 1 db from 15 to 60,000 cycles at full power in both channels; a channel separation of 45 db or better; and a transformerless complementary output amplifier circuit for minimum phase shift and low distortion. Outputs are provided for 4-, 8-, and 16-ohm speakers.

Circle No. 78 on Reader Service Page 15

TRANSISTORIZED MICROPHONE

Adjustable output level is featured in *Turner*'s new Model +2 base station microphone. According to the manufacturer, the Model +2 makes it possible to increase the range and signal strength of any transceiver. A volume control on the microphone allows the operator to dial the output level that is best for his set, and allows changing the output to suit a big or little voice, or for working close or far away from the microphone. A simple screwdriver adjustment permits terminal wires in the base to be connected for electronic switching or relay switching.

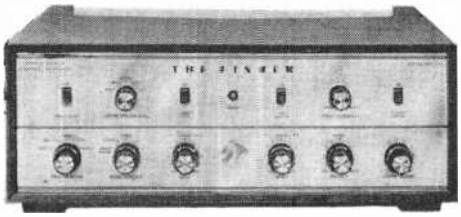


Circle No. 79 on Reader Service Page 15

EASY-TO-TUNE SHORT-WAVE RECEIVER

Everyone who can tune a regular AM broadcast receiver will be able to precisely tune in short-wave broadcasts from all over the world on the S-200 "Legionnaire" introduced by *Hallicrafters*. Four very narrow segments of the foreign broadcast spectrum, which cover about 75% of the listenable stations, have been stretched out across the entire dial width. There are only four simple controls. The audio circuit is 8 ohms, and drives a built-in speaker, but a front panel jack can

If you had started wiring yesterday, today you would own an amplifier as good as a Fisher.



If you didn't start yesterday, why not today or tomorrow? No matter when you start it, you will finish the Fisher KX-200 StrataKit faster than you thought possible. Anyone can build it—even your mother—and end up with a magnificent 80-watt stereo control-amplifier. Once built, it will be fully equal in performance and reliability to its laboratory-wired prototype.

The StrataKit method of kit construction is an exclusive Fisher development that takes the uncertainty and work out of kit building. Large, detailed diagrams and clear, nontechnical language make everybody an expert, regardless of previous experience. Assembly proceeds in simple, error-proof stages (Strata). Each stage corresponds to a *separate* fold-out page. Each stage has a separate packet of parts (StrataPack). The major components are factory-mounted on the extra-heavy-gauge steel chassis. Most of them are riveted for improved reliability. Wires are *precut* for every stage—which means every page. All work can be checked stage-by-stage and page-by-page before proceeding to the next stage.

The end result is a low-distortion 80-watt amplifier which is powerful enough for *any* music, *any* loudspeaker. The exclusive center-channel output and separate volume control eliminate the need for an additional amplifier with either a center-channel or a remote loudspeaker.

Five minutes of listening to the Fisher KX-200 *you* built will convince you that it is one of the finest control-amplifiers available, easily worth $250 or more. Yet the kit costs only $169.50. (Walnut cabinet, $24.95; metal cabinet, $15.95.)

FREE $1.50 VALUE! Send for The New Kit Builder's Manual, an illustrated guide to high fidelity kit construction, complete with detailed specifications of all Fisher StrataKits.

Fisher Radio Corporation
11-35 45th Road
Long Island City, N. Y. 11101

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Address_____

City_____ State_____

101

The Fisher

FISHER RADIO CORPORATION, INC., 11-35 45TH ROAD, LONG ISLAND CITY, N.Y. 11101. OVERSEAS AND CANADIAN RESIDENTS PLEASE WRITE TO FISHER RADIO INTERNATIONAL, INC., LONG ISLAND CITY, N.Y. 11101.

CIRCLE NO. 9 ON READER SERVICE PAGE

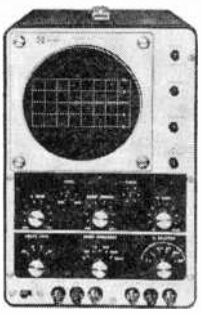
PRODUCTS *(Continued from page 22)*

be used for an external speaker, if desired. Two antennas are provided—one for standard broadcast reception and one for global short-wave reception.

Circle No. 80 on Reader Service Page 15

SOLID-STATE D.C.-TO-6 MC. OSCILLOSCOPE

Allied Electronics has announced a 3" completely solid state d.c.-to-6 mc. oscilloscope—the Knight KN-5005. It weighs only 16 pounds, uses less than 15 watts of power, and has a calibrated, compensated vertical attenuator (10 steps from X1 to X1000), as well as calibrated sweep times and triggered sweep. The vertical system has a sensitivity of 0.05 volt to 50 volts per division with 3% accuracy. Sweep speeds are 1 μsec. to 100 μsec. per division in six steps, also with 3% accuracy. Measuring only 8¾" x 6" x 14", the KN-5005 includes 25 transistors, 18 diodes, and a nuvistor.



Circle No. 81 on Reader Service Page 15

"MINIBALUN"

The "Minibalun" is an antenna-mounted, miniature, T-shaped balun designed by *CYZ Enterprises* which can handle up to 1000 watts of power throughout the 3-30 mc. range. Insertion loss is said to be less than 0.25 db. The "Minibalun" also serves as a lightning protector and as a center insulator for a dipole antenna. This matching device comes in two models: 50 ohms or 75 ohms unbalanced to 50 ohms or 75 ohms balanced; and 75 ohms unbalanced to 300 ohms balanced. Special models made to customers' specifications are also available.

Circle No. 82 on Reader Service Page 15

PORTABLE "HOBBY CENTER"

Is your work area cluttered and messy? *D.E.C. Associates* has introduced a portable "Opti-Man Hobby Center" designed to transform any table, desk, or benchtop into an efficient work center. Vertical slots and shallow trays allow you to store tools and parts for easy access without getting out of your seat. The unit is molded in one piece from durable polyethylene or styrene plastic (it comes in two models); the working surface is a mar-proof plastic laminate insert, and arranged behind it in a concave arc are two tiers containing 13 tool holders and 15 parts bins. A clear vinyl dust-cover accessory is available.

Circle No. 83 on Reader Service Page 15

"EXPERIMENTER'S KITS"

Three new "Experimenter's Kits" have been announced by *RCA* Electronic Components and Devices which will enable electronic enthusiasts to build 14 different electronic control circuits using silicon-controlled rectifiers, thermistors, and photocells. The basic kit includes one SCR, five silicon rectifiers, and two transistors; ten separate control circuits can be built with the components in this kit. The other two are "add-on" kits; one contains three thermistors, the other a photocell.

Circle No. 84 on Reader Service Page 15

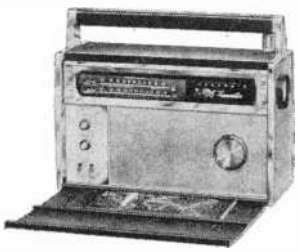
TAPE PACKAGING

Kodak sound recording tape is now available in library box packaging. Designed to harmonize with any decor, the beige-colored boxes have dark brown "bindings" and are provided with lines on the back for identification of taped selections. *Eastman Kodak* says that all 5" and 7" reels of the tape are being packaged in the new boxes at no extra cost. The tape comes in lengths ranging from 625 feet on a Durol base to 3600 feet on a polyester base.

Circle No. 85 on Reader Service Page 15

TRANSISTORIZED PORTABLE RADIO KIT

Ten bands can be tuned with the *Heathkit*® GR-43 portable radio: 150-400 kc., long wave; 88-108 mc., FM; 550-1600 kc., AM; plus seven short-wave bands from 2 to 22.5 mc. Tuning a single band is made easy by the 10-position rotating dial. The GR-43 uses 16 transistors, 6 diodes, and 44 factory-preassembled and aligned r.f. circuits. Two separate FM and AM tuners are also preassembled. Noteworthy among the many special features of the GR-43 is a battery-saver switch that cuts current drain up to 35% for normal indoor listening, or provides full power for strong, outdoor reception.

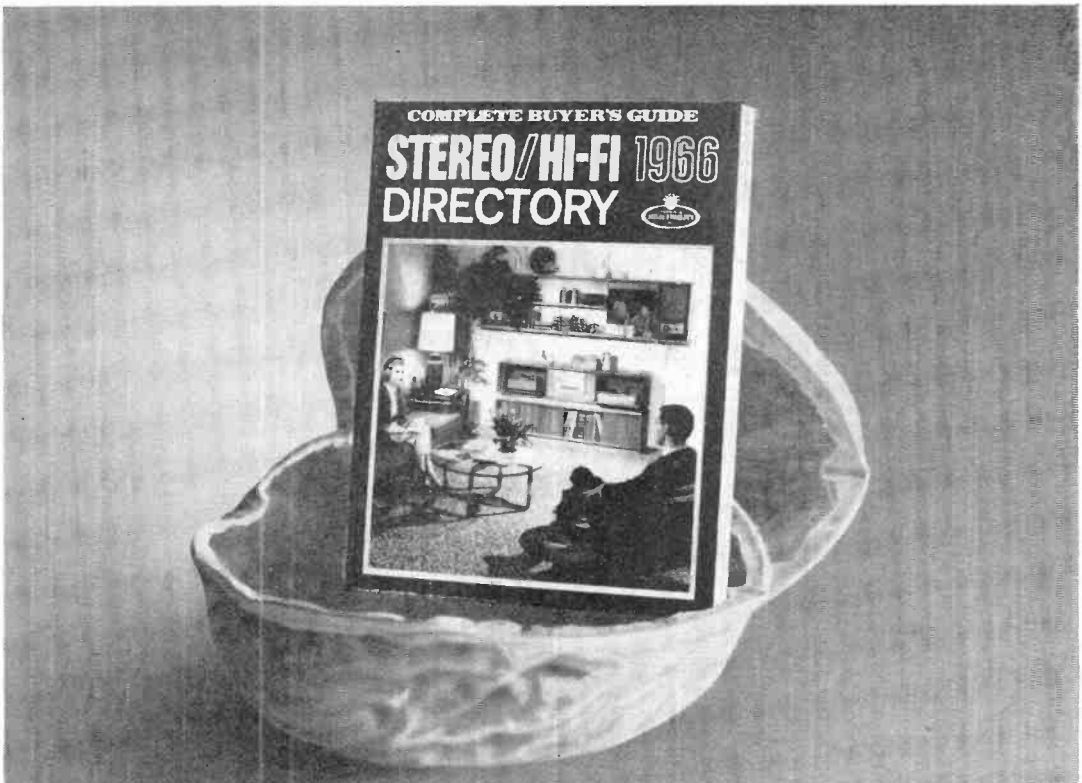


Circle No. 86 on Reader Service Page 15

SHIELDED TWIN-LEAD TV ANTENNA LEAD-IN

Specially designed for superior 82-channel color TV reception, the *Belden* 8290 shielded "Permohm" antenna lead-in provides the strong signal strength of 300-ohm encapsulated twin-lead cable, and the clean signal protection of shielded cable. According to Belden engineers, the 8290 will withstand sub-zero temperatures and hot sun without cracking, and can be installed anywhere. Standoffs are not required—the 8290 can simply be taped to the mast.

Circle No. 87 on Reader Service Page 15



How to go about selecting the best hi-fi equipment in your price range (avoiding all the nerve-racking guesswork, to say nothing of the costly disappointments)...in a nutshell.

The "meat" in this nutshell is guaranteed to whet the appetite of every audiophile and music lover who plans to buy hi-fi equipment during the next twelve months.

In over 172 fact-and-photo-filled pages, the new **1966 STEREO/HI-FI DIRECTORY** gives you all the vital statistics on amplifiers, changers and turntables, cartridges, tonearms and accessories, receivers, tuners, tape machines, speakers and cabinets—on every hi-fi component being manufactured today!

With this authoritative guidebook, you can compare similar items, feature-for-feature, dollar-for-dollar, before you buy! You'll avoid making even one costly mistake by making sure, in advance, that you get the best value for your money, on anything and everything you buy!

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This deluxe edition is a permanent, handsomely-bound collector's item that belongs in your hi-fi library! Check appropriate box on coupon.

The **1966 STEREO/HI-FI DIRECTORY** will help you select the finest equipment in your price range, so that you can derive greater pleasure than ever from your records and tapes. Now, (to ask a redundant question) where else can you get this kind of "satisfaction insurance" for a mere $1.25?

FILL IN, DETACH & MAIL COUPON TODAY!

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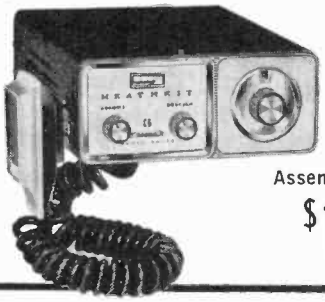
city _____ state _____ zip code

PAYMENT MUST BE ENCLOSED WITH ORDER

How To Have Fun While

New 23-Channel 5-Watt All-Transistor CB Transceiver

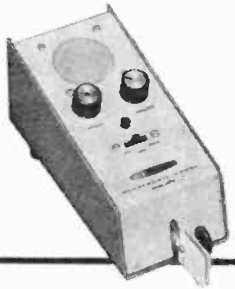


Kit GW-14
$89.95

Assembled GWW-14
$124.95

23 crystal-controlled transmit & receive channels for the utmost reliability. Low battery drain . . . only .75 A transmit, .12 A receive. Only 2⅞" H x 7" W x 10½" D . . . ideal for car, boat, any 12 v. neg. gnd. use. "S" meter, adjustable squelch, ANL, built-in speaker, PTT mike, aluminum cabinet. 8 lbs. Optional AC power supply, kit GWA-14-1, 5 lbs. . . $14.95.

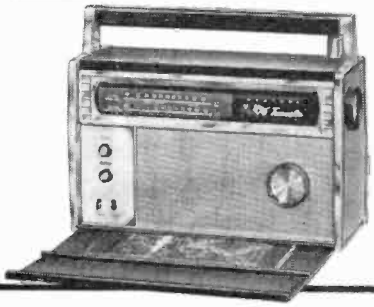
New Fully Automatic Electronic CW Keyer



Kit HD-10
$39.95

All-transistor circuitry. 15-60 words per minute. Solid-state switching—no relays to stick or clatter. Convertible to semi-automatic operation. Built-in paddle. Self-completing dashes. Variable dot-space ratio. Built-in sidetone. Keys neg. voltages only, such as grid-block keying. Transformer-operated power supply. Fused. 6 lbs.

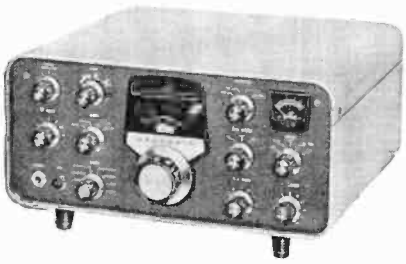
New All-Transistor, 10-Band SWL Portable



Kit GR-43
$159.95

10 bands tune longwave, broadcast, FM and 2-22.5 mc shortwave. 16 transistors, 6 diodes, 44 factory-built & aligned tuned circuits. Two separate AM & FM tuners, two built-in antennas, 4" x 6" speaker, battery-saver switch. Operates anywhere on 7 flashlight batteries or on 117 v. AC with optional charger/converter GRA-43-1 @ $6.95. Assembles in 10 hours. 17 lbs.

New Deluxe 5-Band SSB Ham Transceiver



Kit SB-100
$360.00

Full SSB-CW transceive operation on 80-10 meters. 180 watts PEP SSB—170 watts CW. Switch select for USB/LSB/CW operation. Operates PTT and VOX; VOX operated CW with built-in sidetone. Heath SB series Linear Master Oscillator (LMO) for true linear tuning. Mobile or fixed operation with appropriate power supply. 23 lbs. . . Accessory mobile mount, SBA-100-1 . . . $14.95.

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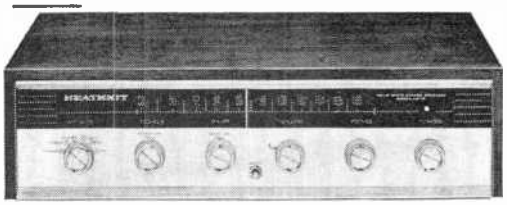
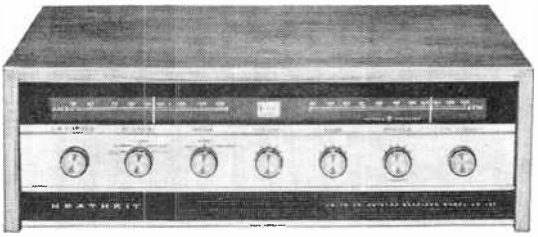
New 30-Watt Transistor FM Stereo Receiver



Kit AR-14 $99.95 (less cabinet)

31 transistors, 11 diodes for transparent transistor sound; 20 watts RMS, 30 watts IHF music power @ ±1 db, 15-60,000 cps; wideband FM/FM stereo tuner, two pre-amplifiers, & two power amplifiers; compact 3⅞" H x 15¼" W x 12" D size. Assemble in around 20 hours. Mounts in a wall, or optional Heath cabinets (walnut $9.95, beige metal $3.95). 16 lbs.

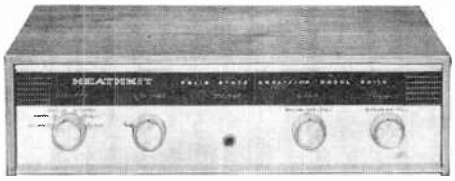
66-Watt Transistor AM/FM Stereo Receiver



Kit AR-13A Now Only $184.00

Just add 2 speakers for a complete stereo system. Boasts AM/FM/FM stereo tuning; 46-transistor, 17-diode circuit for natural transistor sound; 66 watts IHF music power (40 watts RMS) at ±1 db from 15-30,000 cps; automatic switching to stereo; preassembled & aligned "front-end" & AM-FM IF strip; walnut cab. 35 lbs.

New 30-Watt Transistor Stereo Amplifier



Kit AA-14 $59.95 (less cabinet)

17 transistors, 6 diodes; 20 watts RMS, 30 watts IHF music power @ ±1 db 15-60,00 cps. Accommodates phono, tuner, auxiliary . . . 4, 8, 16 ohm speakers. Bookshelf size: 10¼" D x 3" H x 12" W. Install in a wall, or Heath cabinet (walnut $7.95, beige metal $3.50). 10 lbs. . . . Matching FM/FM stereo tuner available @ $49.95.

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CIRCLE NO. 11 ON READER SERVICE PAGE

PARTS METHODS IDEAS GADGETS DEVICES

TIPS & TECHNIQUES

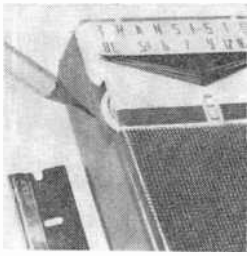
FOLLOW THE STARS FOR EASY MEASUREMENT CONVERSION

Uncertainty and mistakes in converting from one unit of measurement to another can be eliminated by using this handy strip chart. Make it out of paper, cardboard, or what have you, and mount it above your workbench or desk for easy reference. Each star between the prefixes represents three decimal places. For example, to change 3.5 kilowatts (kilo) to milliwatts (milli), jump two stars to the right. This gives you six decimal places; thus, 3.5 kilowatts becomes 3,500,000 milliwatts. To convert 120 microamperes (micro) to amperes (unit), jump two stars to the left. This gives you .00012 ampere. Try it yourself.

MEGA ★ KILO ★ UNIT ★ MILLI ★ MICRO ★ NANO ★ PICO

—Lou Wozniak

A LITTLE SHAVING GOES A LONG WAY IN MAKING TUNING EASIER



Some transistor portables are constructed in such a way that it is very difficult to adjust the flush-fitting disc-type dials without having to dig in at them with your thumb. For easier manipulation, use a sharp razor to shave away some of the plastic surrounding the dials. It's easy to do a neat job as the plastic is comparatively soft.

—Art Trauffer

ATTENUATOR PHONE PLUG CUTS TAPE RECORDER DISTORTION

To prevent a radio or amplifier from overloading your tape recorder with high level signals, you can insert a resistive attenuator network directly into the phone plug on your tape recorder's patch cord. To determine the

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- **White-noise signals to allow the stereo channels to be matched in level and in tonal characteristics.**
- **Four specially designed tests to check distortion in stereo cartridges.**
- **Open-air recording of moving snare drums to minimize reverberation when checking stereo spread.**

Why We Make the Model 211 Available Now

Although there are many stereo test records on the market today, most critical checks on existing test records have to be made with expensive test equipment.

Realizing this, HiFi/STEREO REVIEW decided to produce a record that allows you to check your stereo rig, accurately and completely, just by listening! A record that would be precise enough for technicians to use in the laboratory—and versatile enough for you to use in your home.

The result: the HiFi/STEREO REVIEW Model 211 Stereo Test Record!

Stereo Checks That Can Be Made With the Model 211

- ✓ **Frequency response — a direct check of eighteen sections of the frequency spectrum, from 20 to 20,000 cps.**
- ✓ **Pickup tracking — the most sensitive tests ever available to the amateur for checking cartridge, stylus, and tone arm.**
- ✓ **Hum and rumble — foolproof tests that help you evaluate the actual audible levels of rumble and hum in your system.**
- ✓ **Flutter—a test to check whether your turntable's flutter is low, moderate, or high.**
- ✓ **Channel balance — two white-noise signals that allow you to match your system's stereo channels for level and tonal characteristics.**
- ✓ **Separation—an ingenious means of checking the stereo separation at seven different parts of the musical spectrum—from mid-bass to high treble.**

ALSO: ✓ **Stereo Spread**
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Note to professionals: The Model 211 can be used as a highly efficient design and measurement tool. Recorded levels, frequencies, etc. have been controlled to very close tolerances — affording accurate numerical evaluation when used with test instruments.

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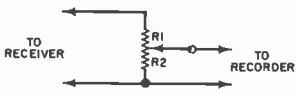
City _____ Zone _____ State _____

Sorry—No charges or C.O.D. orders! PE-16

TIPS

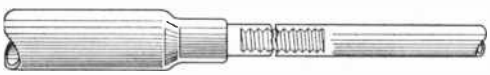
(*Continued from page 28*)

value of the two resistors needed, hook up a 50,000-ohm potentiometer as shown in the diagram and adjust it for optimum recording level. Then measure the portions labeled *R1* and *R2* and replace the potentiometer with fixed ½-watt resistors of like value. —*Marshall Lincoln*



BEHEADED BRASS SCREW COUPLES BROKEN ANTENNA ELEMENTS

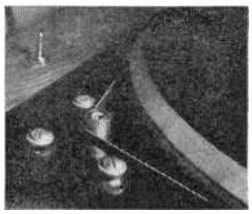
Broken auto or rabbit-ear antennas can be rapidly repaired using a decapitated brass screw about 1" long and with a diameter depending on the inside diameter of the antenna element being repaired. As shown in the diagram, you twist the screw halfway into each



of the broken ends so that the ends almost butt each other. In the small space between the ends, flow enough solder to make a strong connection and fill up the gap. Soldering will be easier if you first file or sand off the chrome plating on the surface near the broken joint. When the soldering is finished, file away excess solder from the outside of the element so it can be moved freely, especially if it's a telescoping-type antenna. —*Carl Dunant*

TAPE-MADE COLLARS CONVERT SINGLE-SPEED TURNTABLE TO THREE SPEEDS

Adding extra speeds—45 and 78 rpm—to your single-speed, belt-driven, 33-rpm turntable in an emergency is an easy task, requiring only a roll of tape and a strobe disc. Wind one turn of ½" or ¾" tape around the motor shaft, then remove the tape and dust it with talcum powder to prevent sticking (and to provide for easy removal and replacement of the finished collar). Now put the tape back on the shaft, and start adding more tape. Be sure to wind it squarely on the shaft, and in the opposite direction from shaft rotation. For 45-rpm operation the newly made collar should measure about 9/32" in diameter and for 78 rpm about ½" plus. Check for correct collar size using the strobe disc. You can add or subtract tape layers to achieve desired speed.



—*Tze-Koong Wang*

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WPE2JDF		WPE8CMK
WPE2JEL	WPE4FJT	WPE8DBX
WPE2JEU	WPE4HDX	WPE8EUJ
WPE2KBK	WPE4HUT	WPE8FFB
WPE2KOP		WPE8FSK
WPE2KXG	WPE5CNK	WPE8GCR
WPE2LNI		WPE8GQB
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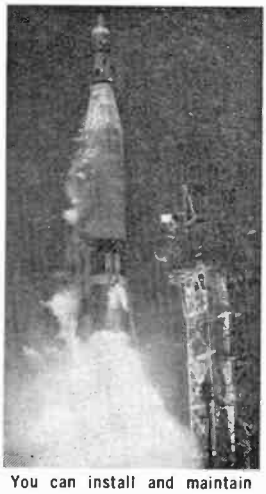

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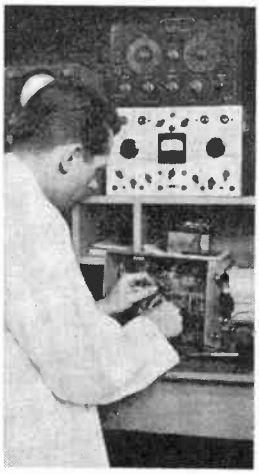

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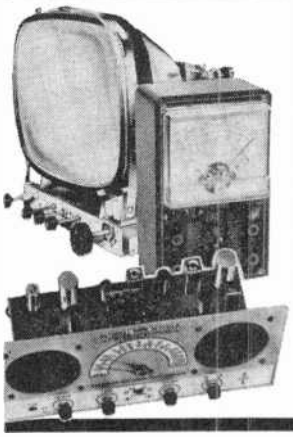

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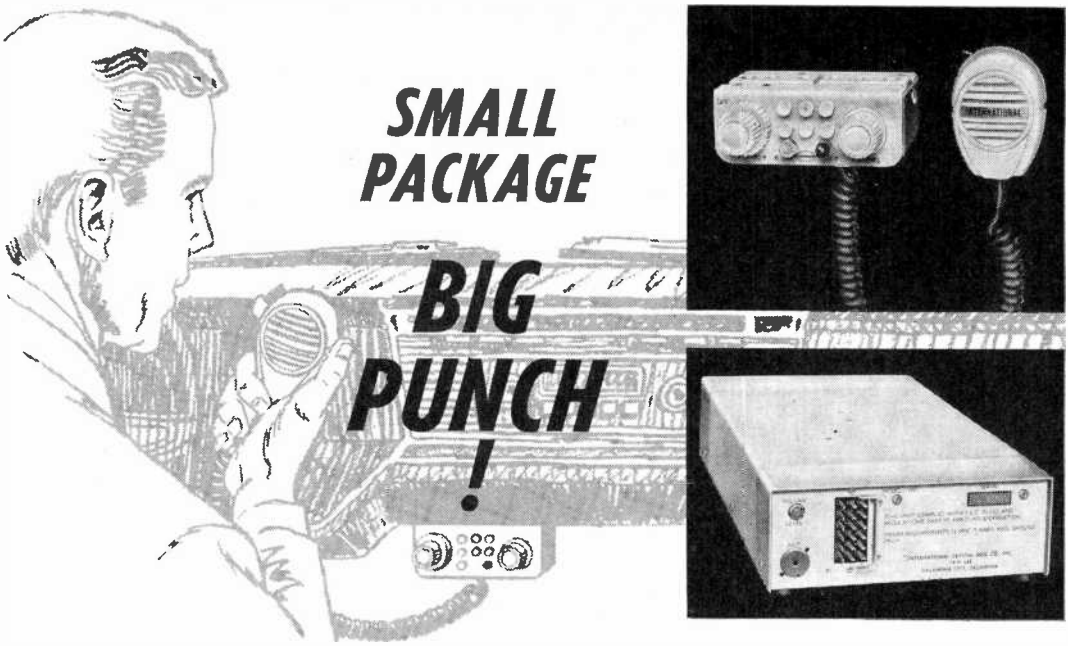

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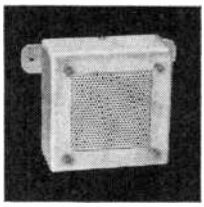

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RADIO ASTRONOMY: SURVEYING THE UNQUIET UNIVERSE

Twenty years ago, scientists scoffed at it; today radio astronomy is solving riddles of the universe that have been plaguing man since he first looked at the heavens. Here's how it all came about, how it works, and how you can become part of it.

By **CHRISTOPHER SHERIDAN**
/ Associate Editor

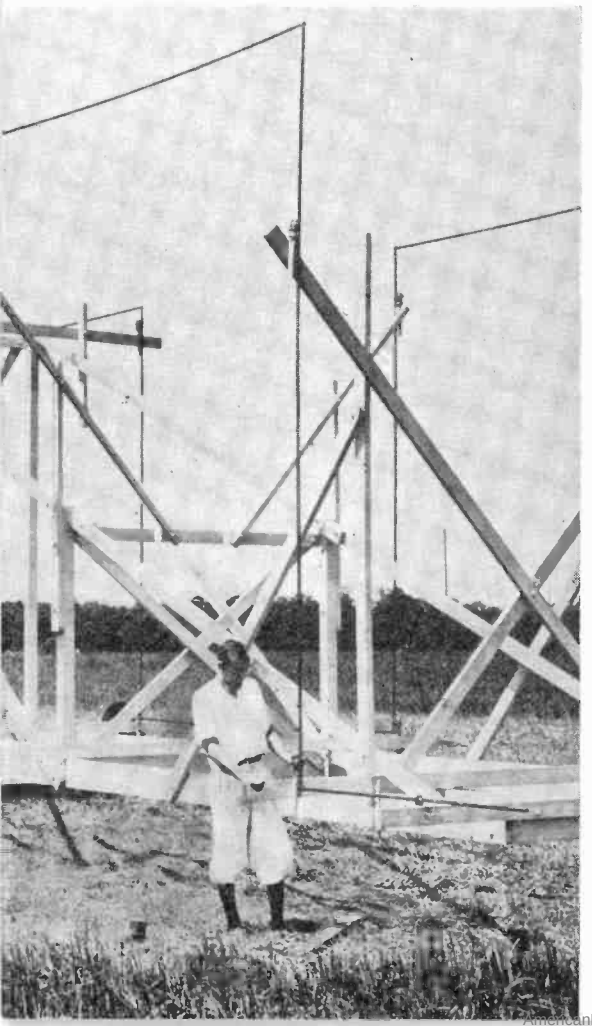
IN THE SPRING of 1933 a young engineer made front-page news with the startling announcement that he had picked up signals from outer space. But few people at the time sensed the importance of such a discovery, and the man and his work fast slipped from the public eye. No one, not even astronomers, realized that the engineer, Karl Jansky, had made contact with a new universe—a radio universe.

Like many epochal discoveries, radio astronomy resulted from a single and unexpected event. In 1930, Jansky, employed by Bell Telephone Labs, was given the problem of studying static interfering with transoceanic broadcasts. He set up a rotating 100′ antenna, mounted on wheels salvaged from a Model-T Ford, on what was once a potato farm in Holmdel, New Jersey. In his investigation of static sources around 20 mc., he became aware of a different-type signal which he described as "a hiss that can hardly be distinguished from the hiss caused by set noise. . . . The term static does not quite fit. . . . It changes direction continuously throughout the day, going completely around the compass in 24 hours."

There was really nothing peculiar about these hissing noises; radio operators had been observing them for years. But instead of dismissing them as unimportant, Jansky set out to find out where they were coming from and thereby gained immortality. It did not occur to him at first that the source could be of extraterrestrial origin, and many months of exacting observations passed before

he traced the source to the constellation Sagittarius, some 26,000 light years away, smack in the center of our galaxy, the Milky Way.

The next few years were mighty lean ones for radio astronomy; still scientifically unacceptable, Jansky's work only managed to survive through the efforts of Grote Reber, an avid radio amateur (W9GFZ) from Wheaton, Illinois. Single-handedly carrying out research with a backyard 31′ parabolic dish antenna, he not only confirmed Jansky's discovery but also compiled a complete radio map of cosmic radio sources "broadcasting" on 162 mc. in the Milky Way. Another early pioneer, G.C. Southworth of Bell Telephone Laboratories, first detected radio emissions from the sun in June, 1942, at frequencies of 3000 mc. and 10,000 mc. In England, only four months before, physicist Stanley Hey had detected radio emissions associated with sunspot activity.



The man who started it all, the late Karl Jansky, and his "merry-go-round" antenna at Holmdel. Today he's looked upon as the father of radio astronomy.

The "forgotten man" in the discovery of solar radio emissions is Dennis Heightman (G6DH). Heightman—tuning the bands between 25 and 60 mc.—had correlated the solar hiss with sunspot activity prior to 1940. Though Heightman reported his finding to Sir Edward Appleton, it was never recognized as predating the identical discovery by Hey.

Despite the efforts of these early pioneers, radio astronomy attracted very little attention until after World War II, when demobilized scientific minds and military developments in sensitive receivers and narrow beam antennas became available. And, it wasn't until 1947, when radio telescopes had some degree of resolution, that the first radio source—the Crab nebula, some 3300 light years distant—could be accurately pinpointed.

Today it's different. Radio astronomy has ripened into an exciting full-fledged science; there are now some 350 radio observatories throughout the world actively carrying out research. With this new tool, scientists can "see" vast regions of the heavens hitherto denied them, as optical study of our galaxy and of galaxies beyond is often blurred by huge clouds of interstellar dust. Radio astronomers have already pinpointed thousands of discrete radio sources, many of which have yet to be identified with optical objects.

Purely Natural in Origin. Radio signals from space are not as mysterious as you might think. Much is known about them —why they occur, and where they come from. Scientists discount the possibility that they are huge broadcasting stations manned by intelligent worlds; rather, they say, all celestial bodies, from our neighbor, the moon, to the furthermost known galaxy some 10 billion light years away, behave like giant transmitters, emitting vast amounts of electromagnetic energy.

Part of this energy lies in the visible portion of the spectrum, but a much greater part lies in the radio range, invisible to the eye but every bit as real as the visible wavelengths. Radio waves offer astronomers a range of wavelengths

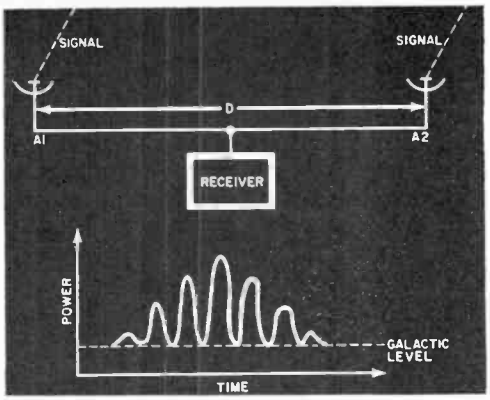
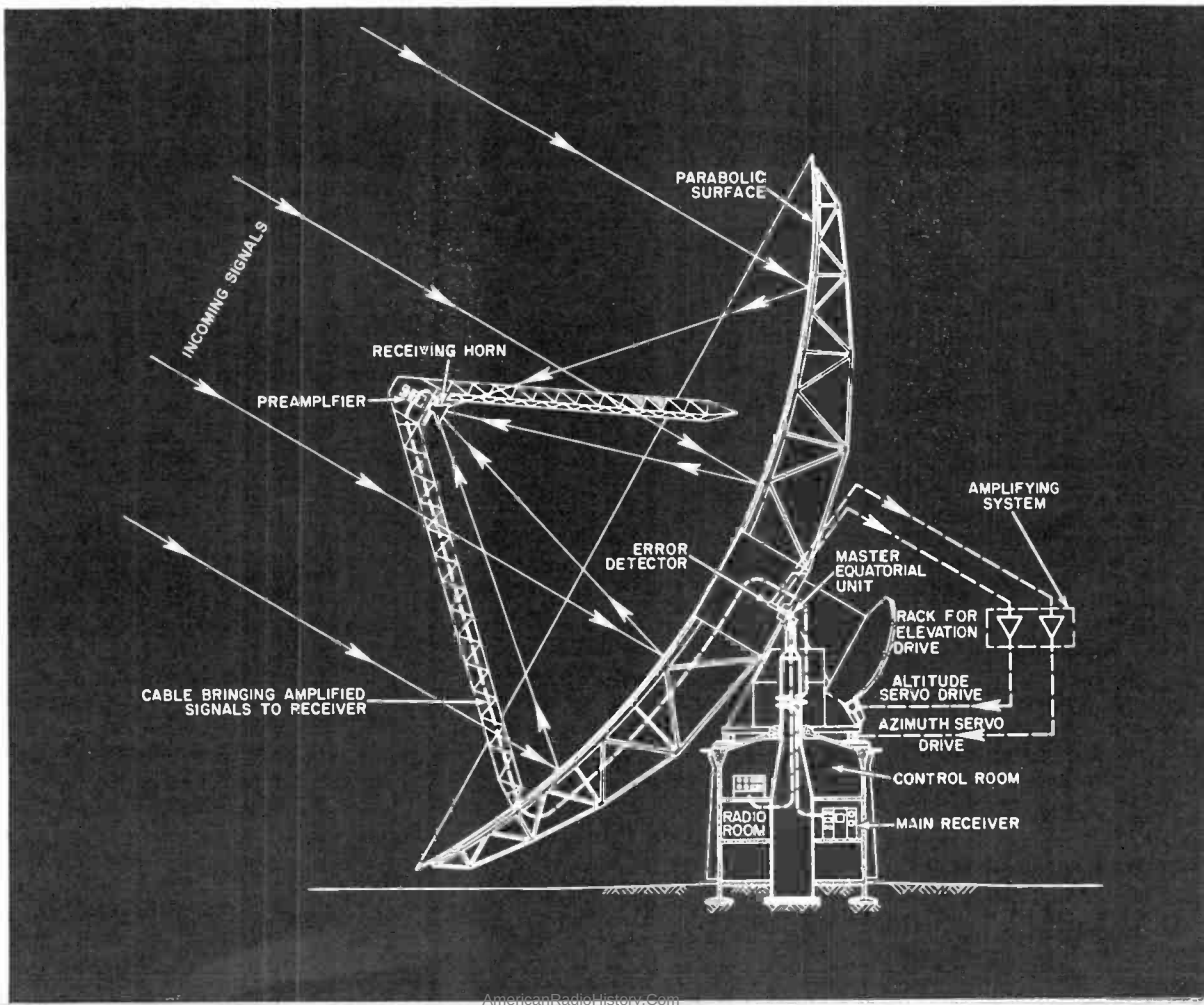


Illustration below shows a basic radiometer employing a single-aperature dish antenna. The signals are fed into a preamplifier and receiver, and the output is coupled to a recorder. Scientists in their quest for radio telescopes of greater resolution have turned from making larger and larger dishes to using an interferometer, a simplified diagram of which is shown above. The high-resolution interferometer picks up the signal on two widely-spaced antennas connected to the same receiver. The signals at each antenna either add to or subtract from each other, depending upon their phase, resulting in the response curve shown. A small source shows closer spaced lobes than a large one.

with which to "view" the universe some 10,000 times greater than the available range of optical wavelengths. With this broad spectrum available for analysis, it's easy to see why astronomers feel that the radio telescope has opened a new "window" to the universe.

All radio sources fall into two categories: thermal and non-thermal. Thermal radiation sources are called so because the intensity of radiation depends on the temperature of the source. Generally visible to the optical astronomer as well as to the radio astronomer, these sources include the solar corona, moon, planets, and galactic nebulae.

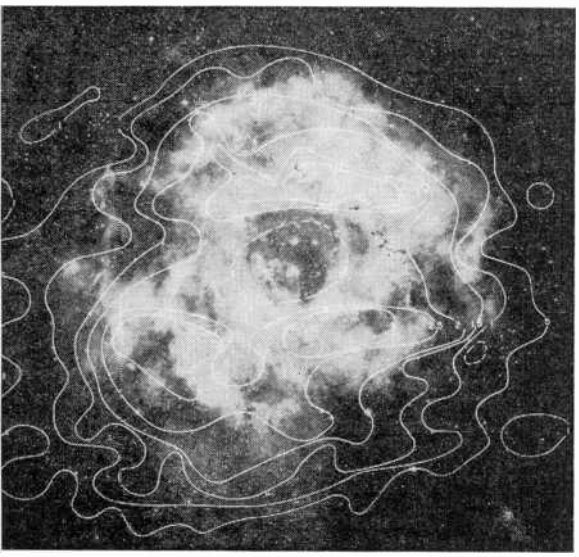
Most thermal radiation is said to be of the continuum type; one important source of thermal radiation, however, occurs on a monochromatic wavelength of 21 centimeters (1420 mc.). Called the "Hydrogen Line," it originates from clouds of cold hydrogen gas which make up a significant portion of the universe. Discovery of this important phenomenon has enabled scientists to chart the mo-



tions of huge clouds of hydrogen gas.

Unlike thermal sources, non-thermal sources do not depend on source temperature. Often referred to as synchrotron radiation, non-thermal radiation is generated by the interaction of free electrons with various magnetic fields of our galaxy. Some well known non-thermal sources include: the Crab nebula, Cassiopeia, and Cygnus A—the three most powerful radio sources yet discovered. All three emit signals on many frequencies below 10 mc. to way above 10,000 mc. Cygnus A, a half billion light years away, is the strongest source—the energy emitted by this one source alone in just one millionth of a second could supply all the world's electrical power requirements a million times over for the next 10 million years.

Most radio sources "broadcast" with



An isophote or contour map of the Rosette nebula super-imposed on an optical picture. Note similarity. Lines of isophote join points of equal temperature.

tremendous energies, often as much as 10^{35} watts or more (10^{6} watts is 1,000,000 watts). Because these sources are so distant from the earth, however, the power dwindles to around 10^{-7} of a watt or less by the time it reaches us. Most extragalactic radio sources are galaxies and are classified as "normal" or "radio" galaxies. Although both types look the same through a telescope, radio galaxies (e.g., Cygnus A) emit radio signals at energies more than one million times that of normal galaxies (e.g., Andromeda).

Most recently, radio astronomers have discovered a number of mysterious star-like sources of fantastic radio energy billions of light years away. Called quasi-stellar or quasars, their erratic behavior may eventually give answers to the origin of the universe.

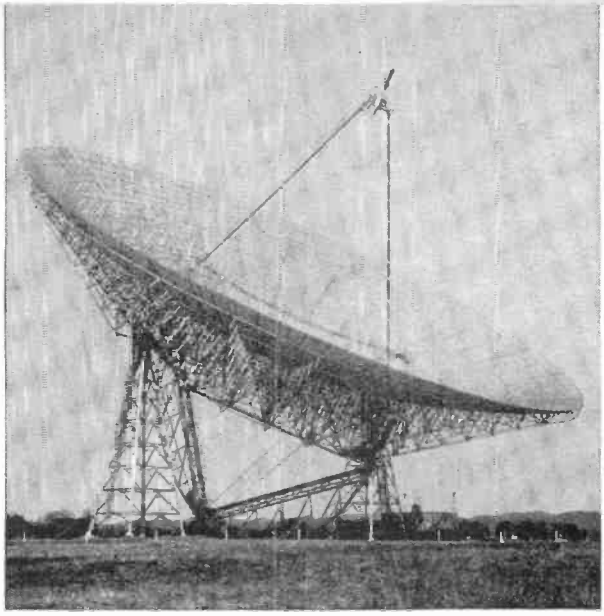
Tuning in the Solar System. The sun, only eight minutes away from earth by the speed of light or radio waves, is the most studied radio source. Radio emissions from it, characterized by a background of radiation (quiet sun) upon which are imposed bursts caused by sunspots and noise storms, occur at frequencies between 20 and 30,000 mc. Sunspot emissions can be picked up between 50 and 1000 mc. and are usually 100 times as intense as quiet sun emissions; noise storms broadcast at tremendous intensities, sometimes as high as 10,000 times quiet sun emissions, and can be picked up at frequencies between 20 and 300 mc.

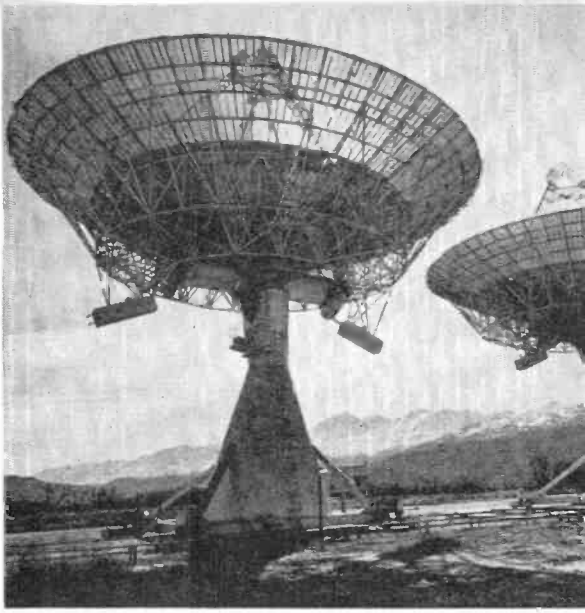
Other "broadcasting stations" in our solar system include the moon and most planets; frequencies most used in planetary radio astronomy range from 5 mc. to 75,000 mc. Interpolation of radio data from these close-to-home sources has led to many unexpected and valuable discoveries. Scientists can tell much about the surfaces, temperatures, and atmospheres of these sources.

Lunar signals were first detected on 24,000 mc. by American scientists Dicke and Beringer in 1945. These signals, which occur on many frequencies between 20 mc. and 25,000 mc., are a combination of second-hand waves emitted by the sun and bouncing off the moon, and true lunar signals generated beneath the moon's surface. Peak intensity of these signals occurs at least three or four days after full moon.

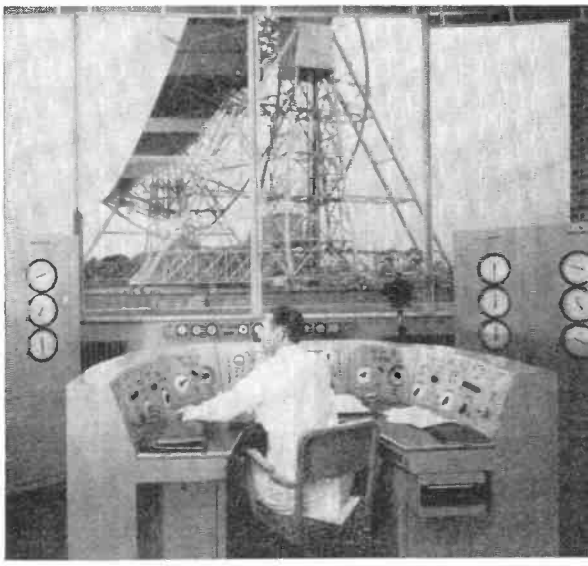
Signals were first detected from Venus, Mars, and Jupiter in 1956. Radio observations of Venus, usually made on frequencies between 400 and 10,000 mc., have shown the planet to have an extensive atmosphere and high surface tension. Signals from Mars are usually picked up at frequencies above 2500 mc.

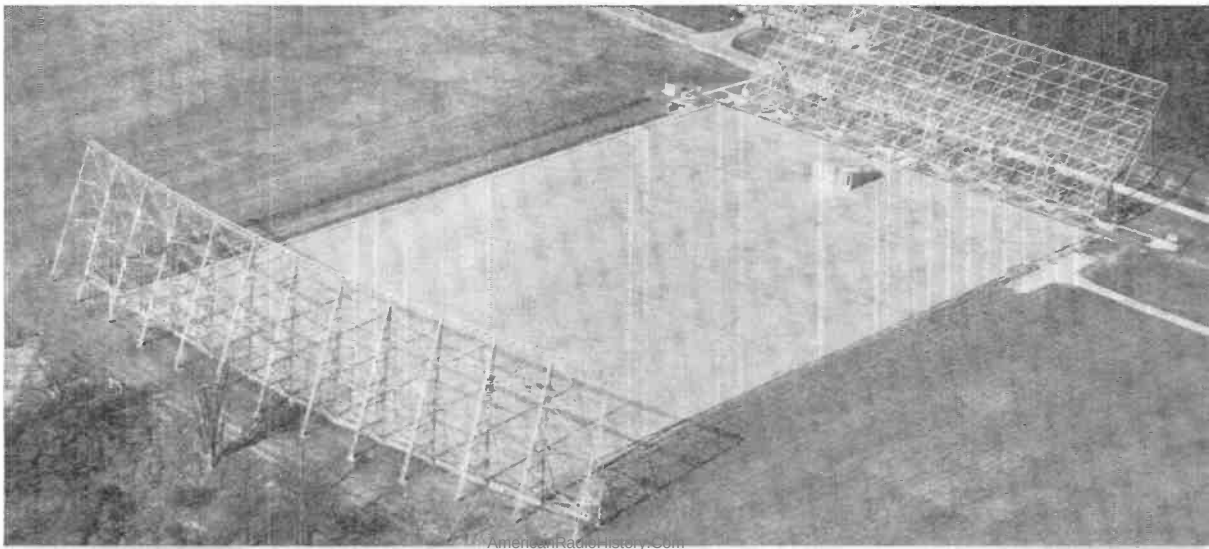
Jupiter, one of the strongest radio sources ever found, has three types of emissions: very high frequency radiation





The photos on this page, left to right, clockwise, show installations at the National Radio Astronomy Observatory, Green Bank, West Virginia; the Owens Valley Observatory, California Institute of Technology, Pasadena, California; the control console at Jodrell Bank, England; and the Ohio State University telescope. The 300′ radio telescope at the National Radio Astronomy Observatory, the largest partially movable unit in the world, is currently measuring hydrogen in this and other nearby galaxies. Twin 90′ dishes operate together as an interferometer at Owens Valley. Rails move them up to 1600′ apart, or they may work independently. Operating at 960 mc., this installation is currently being used to chart the distribution of radio noises in our galaxy. The largest fully steerable unit in the world, the 250′-diameter dish at Jodrell Bank, can receive and transmit wavelengths from a few centimeters to 20 meters. All telescope motions are controlled from a console located some 200 yards from the main telescope. The Ohio State tiltable reflector uses a 260′ by 100′ flat reflector to reflect energy onto a 360′ by 70′ fixed parabolic section. A feed horn located on the ground plane near the base of the flat reflector receives radio signals from the parabolic section.

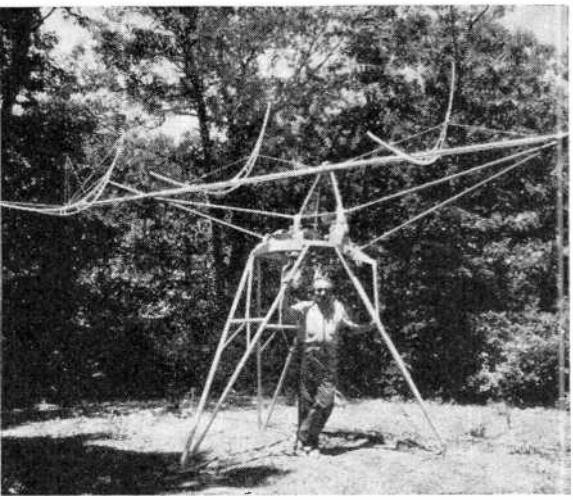




from the visible disc; linearly polarized radiation at frequencies between 30 and 3000 mc.; and very intense bursts of radiation between 5 and 30 mc. The microwave emission originates in an invisible halo—a Jovian Van Allen belt, so to speak—extending over a much wider area than the visible planet. Recent investigation of the Jovian bursts indicates that they occur only when a particular side of the planet is facing the earth and that they originate from an area about one-tenth the size of the planet.

Mercury was added to the roster of radio sources in 1960 when signals were first picked up from it at 1000 mc. Most signals originating from this planet occur above 5000 mc. Of the planets beyond Jupiter, Saturn is presently the only known "broadcasting station"; signals have been detected from this planet at frequencies around 100 mc. and 1000 mc. Undoubtedly, the other planets will in time join this fast-growing "broadcaster's club."

Types of Telescopes. The radio telescope is not as complex as you might at first imagine; in fact, it functions a lot like your small pocket radio. Basically, the radio telescope consists of an antenna, a receiver, and some sort of recording system. The antenna collects and focuses the radio waves much in the same manner as the optical telescope focuses light waves. The focused waves are amplified and detected through a sensitive receiver and then recorded by a recorder or computer. Receivers used in radio astronomy are usually specially-designed types and feature extremely low noise circuits such as the parametric amplifier and maser. Computers are also being integrated into radio telescope setups. Most amateur setups, however, use a superheterodyne-type receiver, an explanation of which can be found in any radio textbook.



An example of what the amateur can do. This antenna was built by Zvi Gazari, a member of the New York Astronomers Association, using surplus parts.

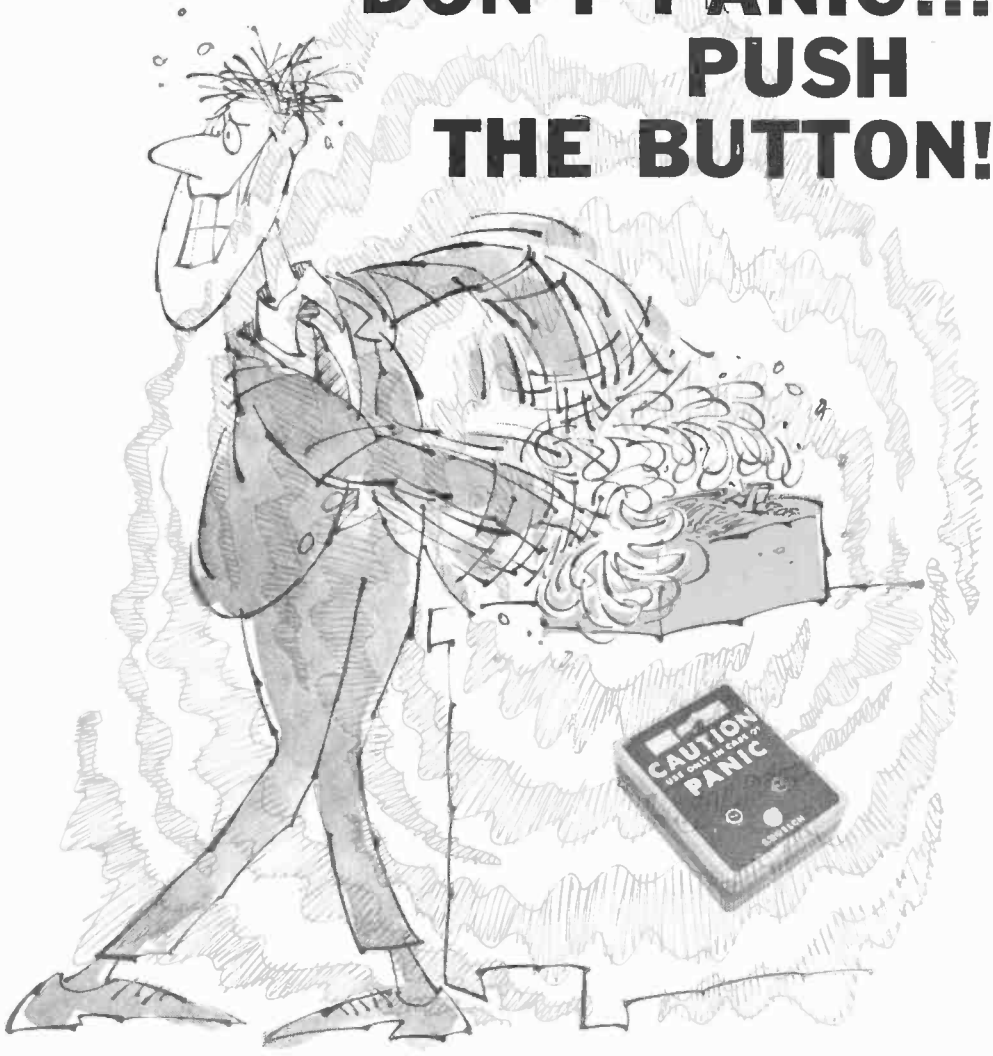
When you consider that radio astronomers detect almost inconceivably faint signals against galactic background noise many times greater than the "brightest" radio source, the need for massive-sized antennas and super-sensitive receivers is readily apparent. Some radio telescopes use a single antenna, others employ many. They may be fully steerable, or fixed. Fully steerable units can be steered in any two coordinates to any point in the sky; partially steerable units can be turned in one direction, usually declination; and fixed antennas can be steered by electrical means.

The most popular design now in use is the fully steerable paraboloid or "dish," a schematic of which is shown on page 41. The world's largest fully steerable dish is the 250′-diameter Jodrell Bank installation in Manchester, England; and the world's biggest partially steerable telescope is the 300′-diameter dish at the National Radio Astronomy Observatory in Green Bank, West Virginia. Other big dish antennas include the 210′-diameter telescope of the Australian National Radio Observatory near Sydney, the new 150′-diameter telescope at Stanford University, California, and the 84′-diameter telescope of the Navy Research Laboratory in Maryland. The record holder for a non-movable radio telescope is the 1000′-diameter spherical reflector at Arecibo, Puerto Rico; nestled in a 450′-deep crater, this colossus functions as a radar telescope as well as a radio telescope.

But the "dish" is by no means the only single aperture-type antenna used by radio astronomers; indeed, there are about as many varieties in use as there are radio telescopes. At Ohio State University, for example, radio astronomers use a tiltable reflector type anten-

(*Continued on page* 89)

DON'T PANIC... PUSH THE BUTTON!



Don't you dare build this box .... unless you want to create pandemonium

By BRUNO M. LARSEN

THIS PANIC siren is guaranteed to set the most blasé individual or "stuffed shirt" on his ear, and cause the unwitting "victim" who sets it off a moment or two of embarrassed concern. For it is a certainty that if this box is left alone some venturous soul will be tempted to throw that switch. And when he does, you are sure to see a panic in the making.

Once the main switch is thrown, and after a one- or two-second delay, the box lets out a wailing sound akin to that of a fire engine, ambulance, or police siren. Lights go on and, within a second or two, start to blink like mad. The "victim" will snap the switch back to OFF, only to find, to his chagrin, that the switch has no effect whatsoever on the rising siren wail, or on the lights.

If the switch thrower can keep a cool head, he'll "push the panic button"—the one innocently labeled *SQUELCH*—and

sigh with relief as the siren starts on its downward wail. If he releases the button while the siren is dying down, as he probably will, the siren immediately starts up again, whereupon the "victim" quickly presses the panic (*SQUELCH*) button again. But this time he isn't taking any chances—he's going to keep his fingers on that button until the sound ceases completely. As it does, he smiles triumphantly. (All this time the lights are still blinking—the squelch button has no effect on the lights.) Once again he releases the button—and once again the siren starts.

What the "victim" doesn't know is that the contraption will go off by itself once the main switch is thrown to *OFF* and a preset time has elapsed. Every time he throws the switch he recycles the panic box, and when he presses the button he only interrupts the sound, without affecting the cycle.

How It Works. The secret of the panic box is a delay incorporated in the *ON-OFF* switch that causes the siren and light circuits to remain activated for from 60 to 90 seconds after the switch is turned off. Pressing the SQUELCH button is the only "known" action that can be taken to start the siren on its downward wail.

The heart of the panic box is a siren module (Fig. 1) connected to a speaker and a battery. The module contains a relaxation oscillator (*Q1*) and a direct-coupled output stage (*Q2*). The oscillator creates a tone which rises from 5 to 3000 cycles within 30 seconds, and creates a downward wail after the delay switch shuts itself off.

Switch *S1* is a concealed slide switch that is normally left *ON*. It is used only by those in the know to shut the works down. You can have fun in another way—leave the switch off and your "victim" won't be able to victimize someone else.

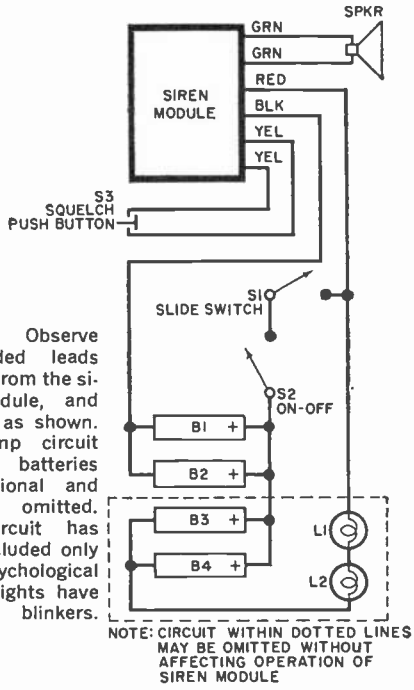


Fig. 2. Observe color-coded leads coming from the siren module, and connect as shown. The lamp circuit and its batteries are optional and can be omitted. This circuit has been included only for psychological effect. Lights have built-in blinkers.

An 8-ohm, 2½" PM speaker serves as the siren horn, and the entire unit is powered by two or four 9-volt batteries, as shown in Fig. 2. Two of these batteries—in parallel—provide power for the siren, and the other two—also in parallel—provide power for the lights.

Construction. The box, a 6 15/16" x 5 9/32" x 2 5/16" plastic meter case, houses all the components, including the speaker and the batteries. The box also functions as

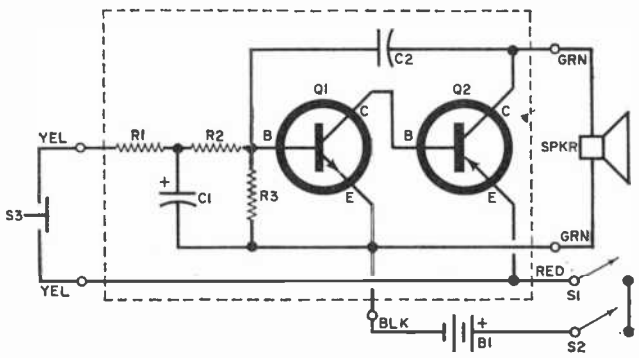
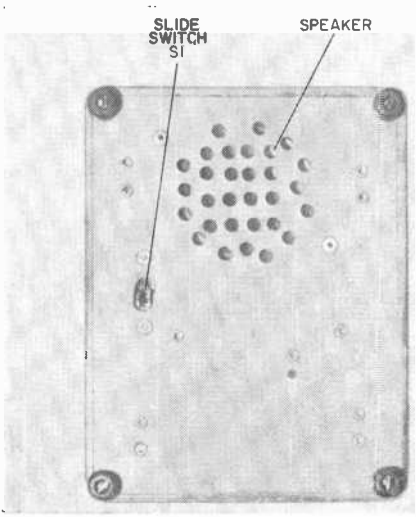


Fig. 1. Secret of continuous panic-making noise output is the built-in delay in switch S2; outwardly it seems to be an ordinary on-and-off toggle switch. Switch S1 is concealed and normally left on. Only you know where to find it and shut the thing off in case of panic. Panic button S3 has no effect on the delay action of S2 and opens the siren circuit only as long as it is held down. If the victim's patience runs out before the delay cycle is completed, he is most likely to recycle the unit so that it will not cut out by itself.

a resonant cavity and greatly amplifies the siren sound. What's more, the same loudness is maintained during the upward and downward wails of the siren.

Other types of enclosures can be used, provided care is taken to select a box that will resonate properly. Metal boxes are generally poor resonators, while



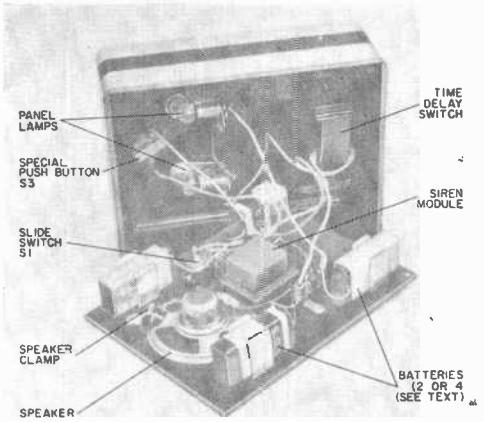
Speaker and "hidden switch" are mounted on back of box. Better chain the box in place lest your victim heave it out the window when the alarm sounds off.

wooden boxes make ideal resonators. The arrangement of the components is left to the discretion of the builder.

The slide switch (*S1*) can be wired so that it opens only the siren cycle, or

PARTS LIST

B1, B2, B3, B4—9-volt transistor radio battery (Eveready 216, or equivalent)
L1, L2—4.9-volt, 0.3-amp. flasher bulb (GE-407 or equivalent)
S1—S.p.s.t. slide switch
S2—60-second delayed action light switch (Lafayette Radio 34 R 3805, or equivalent)
S3—Normally-closed momentary push-button switch
SPKR—2½", 8-ohm speaker (Philmore TS-25, or equivalent)
1—Siren module (Lafayette Radio 19-0105, Olson Radio TR 71, or Saxton Hi-tron Model HS available at parts distributors)
1—6-15/16" x 5-9/32" x 2-5/16" plastic meter case (Allied Radio 87 P 886 or equivalent)
1—Matching panel (cover) for above case (Allied Radio 87 P 888 or equivalent)
2—Bulb sockets with red-faceted jewel lenses (DIALCO 510M or equivalent)
4—Type 5D battery clips (Cinch-Jones, or equivalent)
4—Battery brackets (Keystone No. 95, or equivalent)
Misc.—Rubber feet, wire, solder, hardware and terminal strips



Parts layout and box dimensions are not critical. Paint the outside fireman's red and use large bold letters. Battery mounting brackets are optional.

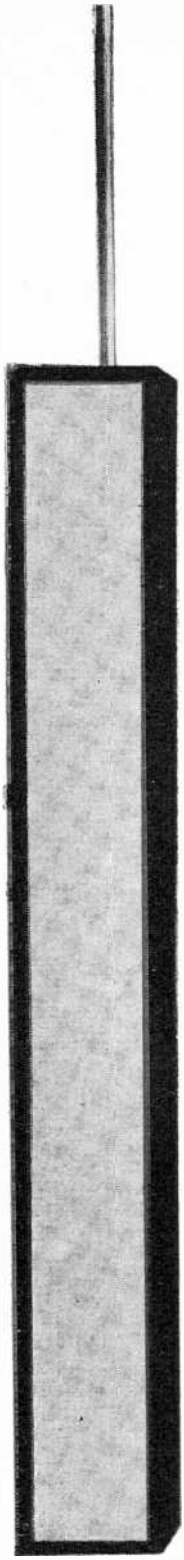
both the lights and the siren. To make this switch less conspicuous, the protruding stem can be cut off flush with the plastic box. You can use *6-32* hardware to mount the components, or you can fasten them permanently to the box cover with pop rivets.

The small speaker has no mounting holes or flanges (actually, there are a number of speakers available *with* mounting holes), but you can use a couple of mounting clips with washers to secure the speaker to the back cover of the meter case. Scribe a 2"-diameter circle before mounting the speaker. Also, to make certain that the batteries clear the main *ON-OFF* switch and the light sockets, install battery mounting brackets near the edge of the box cover.

There is nothing critical in the wiring. Nor is there anything functional about the blinking lights, which are included purely for psychological purposes —you can omit this circuit if you'd rather.

The outside of the box can be finished and stenciled in any manner you wish. For example, the *SQUELCH* button can be labeled *PRESS HERE*, or *PANIC BUTTON*. Or *WARNING, DANGER*, etc., can be substituted for *CAUTION*.

Setting the Trap. Make sure that the concealed slide switch is in *ON* position, and the master *ON-OFF* switch is set to *OFF*. Then lay the box in a conspicuous place, and be ready when the fun starts. Happy panic! -30-



TOTEM POLES FOR STEREO

Go the "Sweet Sixteen" one better with a column speaker system and a separate bass speaker enclosure

By DAVID B. WEEMS

MOST stereo speaker systems are simply two mono speakers connected to a stereo amplifier. Any good system, when duplicated, can be expected to perform well in stereo. But good stereo presents unique requirements.

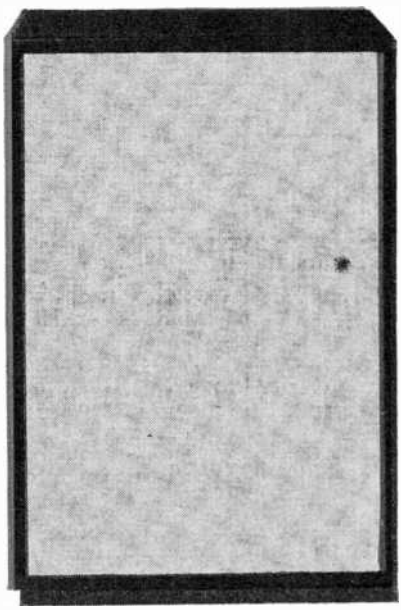
The first requirement is that the system be able to provide perspective, or give direction to the sound of individual voices or instruments. Some of the early stereo recordings seemed engineered for this purpose alone, with the result that we got a "ping-pong" effect. It was probably exaggerated effects such as this one that caused some audiophiles to condemn stereo hi-fi as inferior to mono hi-fi. Regardless of the misuse of directionality, however, without it there would be little reason for stereo recording and reproduction.

There are a number of factors which influence the ability to locate sound sources, such as the difference between sound intensity, waveform, and arrival time at each ear. Another factor, and one which influences the others, is the ratio of arrival times of direct to reflected sound. If this ratio is made very high, the sound source can be easily located. In an extreme case, the ping-pong effect is the result, with the music coming from two widely spaced "holes in the wall."

A second important requirement for good stereo sound is an apparent enlargement of the source. One way to accomplish this is to simply enlarge the source itself, i.e., use a large multiple speaker system. Another way is to utilize reflected sound (reverberation) to augment the direct sound from the speakers. Properly utilized, reverberation can give the effect of a sound source even larger than the room itself.

Other requirements for stereo include the suitability of room acoustics of course, as well as the usual high-fidelity characteristics of wide and smooth frequency response, low distortion, good transient response, and wide dynamic range.

Control of Reflections. It would appear, in looking back over the above requirements, that there is a conflict. For directionality, we need a high ratio of direct sound to reflected sound, but for enlargement, we need a mixture of re-



flected sound with the direct sound. The trick, then, is to control the reflections.

One way of controlling reflections is to limit the dispersion of sound to one plane, either horizontal or vertical. The choice of which to use is an easy one since horizontal dispersion gives good distribution of sound over the listening area, whereas vertical distribution does little except bounce the sound waves off the floor and ceiling. If we can limit dispersion in the vertical plane and increase it in the horizontal plane, we can achieve two benefits; more efficient use of sound energy and an opportunity to control the ratio of direct sound to reflected sound simply by positioning the speakers properly.

Excellent horizontal dispersion of sound can be obtained from a vertical line source. A single loudspeaker acts like a point source, radiating sound in the form of a spherical wave, which spreads out in all directions at once. The sound wave propagated from a line source, however, travels outward in a cylindrical pattern. If we use several speakers to produce the sound and mount them in a straight line, we can approximate a line source. By making the line a vertical one, we can concentrate the sound into horizontal dispersion and conserve some of the energy that a point source squirts out in the vertical direction. Reflections from ceilings and floors are minimized.

A vertical column, of course, is not a new idea in sound reproduction; column speakers have been known and appreciated for years by the manufacturers of public address systems and by the sound engineers who install them. Perhaps one reason for the acceptance of column speakers by public address people was the fact that their p.a. systems had to be used in such impossible acoustic environments as half-empty gymnasiums with their hard reflective surfaces.

"Sweet Sixteen" Concept. The benefits of using multiple small speakers for low distortion are well argued by the popularity of such systems as the "Sweet Sixteen" (POPULAR ELECTRONICS, January and April, 1961). Critics of these multiple speaker systems insist that they produce no measurable low frequency bass or extreme highs. However, pro-

For awhile, when the "totem poles" were being developed, the workshop looked like a hi-fi supply house. The single woofer gave way to separate woofers.

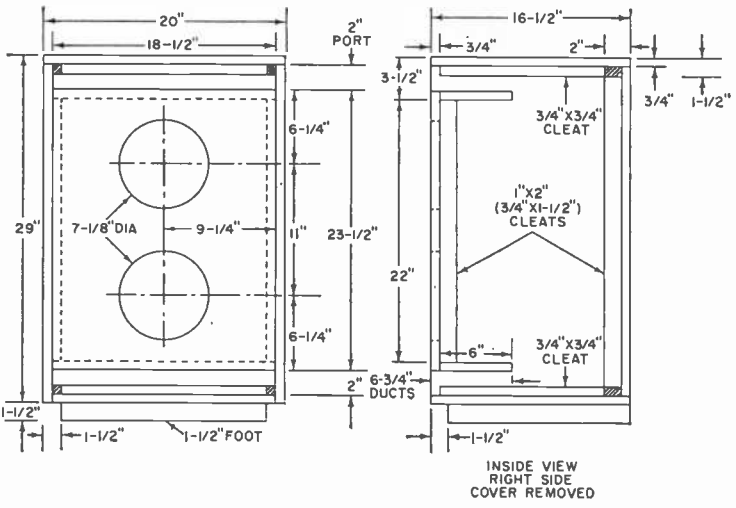
ponents go right on building Sweet Sixteens, indicating that there are benefits that can't be measured. One reason, perhaps, is the apparent enlargement of the sound source. Those who have heard a multiple system usually admit that the speaker arrangement does have something to offer.

One deficiency multiple speaker systems have is that the speakers must be mounted in a concentrated pattern, such as a square. This results in identical distances between identical speakers, which causes certain points in their frequency range to be boosted or cut, and peaks or valleys appear in the response curve. These variations are measurable and have contributed to the criticism of the whole idea of multiple speakers.

An obvious answer to this deficiency is to use the Sweet Sixteen concept where it is strongest and to eliminate its weaknesses. The prescription for changing the Sweet Sixteen into something really great is to install a crossover network, add woofers and tweeters, and string the mid-range speakers to create a line source of sound.

Speaker Selection. If you already have a Sweet Sixteen system that you want to update, you can split the speakers into two groups of eight each. Ten speakers were used in the system shown here to obtain an 8-ohm impedance, but omitting one pair would not appreciably affect performance.

Either 4- or 5-inch speakers can be used with the design shown. If you are buying new speakers, choose them by magnet weight rather than size. Avoid consideration of arbitrary phrases such as "heavy duty," "heavy magnet," etc. Magnet weight should be about 1 ounce or more. Actually, magnet weight by itself is not a foolproof way of determining magnet size. Look for the gauss rating —the larger it is, the better.



These drawings show all the necessary woodworking details. A Bill of Materials is given on page 52. Width and depth of the ports in the combined bass speaker enclosure are somewhat critical as the ports are cut for the Electro-Voice speakers. The author attached poles to his column speakers so the systems could be rotated and aimed at the audience. Sound radiation from column speakers is mostly horizontal with little vertical dispersion.

The small speakers can all be of a single brand and model, but a slight improvement will be gained by using two different brands. If you do, pair off the unlike speakers and connect them in parallel, then connect these pairs in series. Ten speakers, each having a 3.2-ohm voice coil, provide a final impedance of 8 ohms when wired in this manner.

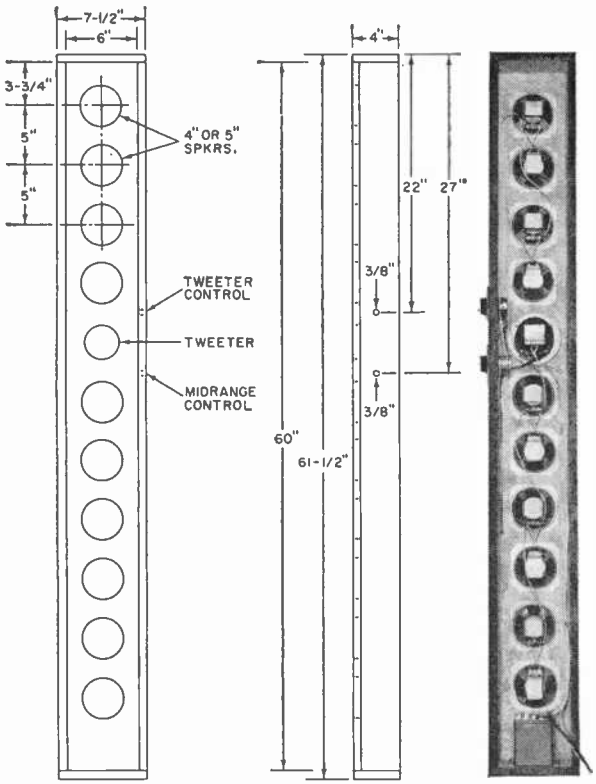
There are small foreign-made speakers available with 8-ohm voice coils. If you want to use some of these, you'll need a different wiring arrangement. To obtain an impedance of 8 ohms, you can parallel three speakers in one set, and wire three sets in series for a total of nine speakers to handle the mid-range instead of ten. For a 16-ohm hookup, use eight 8-ohm speakers—four parallel pairs in series. Don't try to use speakers of mixed impedance ratings in the same system unless you are sure you can design a circuit that will provide equal power to each speaker. You might end up with one or two speakers doing all the work.

While you can substitute other woofers with good results, the Electro-Voice SP8B specified in the Bill of Materials is highly recommended. It was the final choice over the other 8-inch woofers that were tested for this particular application. Of course, you can use separate woofer systems, or other quality brands of woofers in the manufacturer's enclosures, if you don't mind having two woofer cabinets plus two columns in your living room. The compelling reason to put the two 8-inch woofers in a single enclosure is to keep the cabinet population within acceptable limits. You also gain the advantage of mutual coupling between the two woofers with improved low-frequency performance.

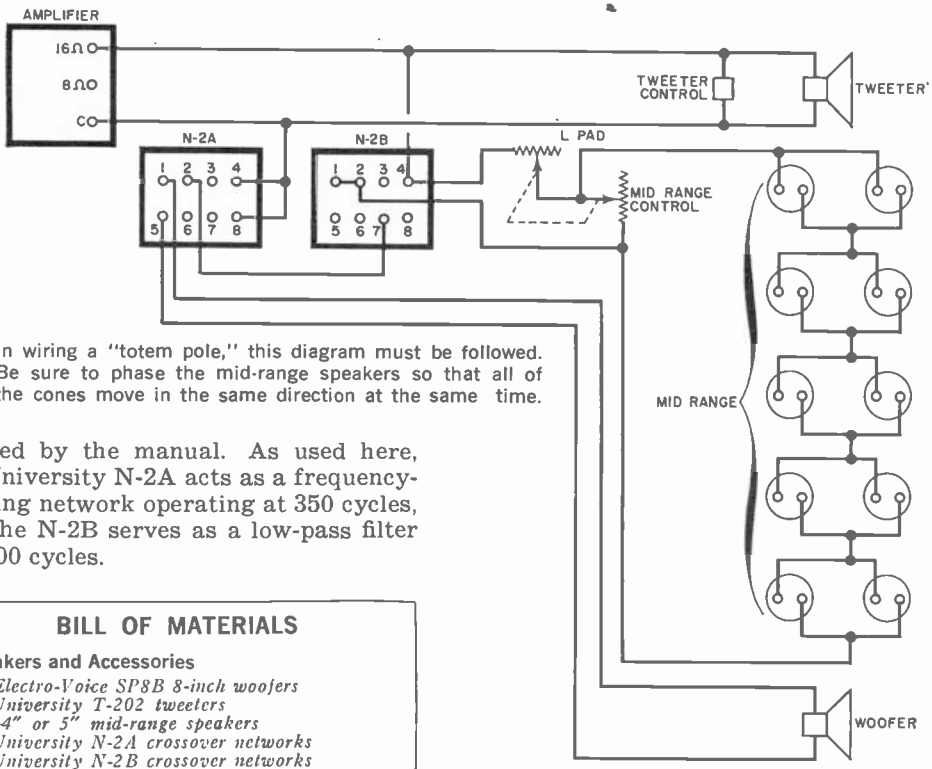
There is an alternative, though, particularly if you have an amplifier that will tolerate mixing of the two stereo channels (some transistor amplifiers won't). The alternative is to use one woofer for both channels, but the woofer should have either a dual voice coil or an added mixer transformer to which the bass from each channel is fed. For the latter method, a possible choice is the Electro-Voice XT-1 transformer with an E-V SP12B either in the manufacturer's enclosure or in the enclosure described in "Mr. Thuras' Magic Box" (POPULAR ELECTRONICS, April, 1965).

It is also possible to substitute other tweeters for the University T-202 specified, but you must check for similar wide-angle dispersion characteristics first. (Note that the totem pole control of dispersion angle is essentially for mid-range sound.) The T-202 has its own built-in filter network and is hooked directly across the output of the amplifier. If you substitute a tweeter without a high-pass filter or with a filter operating at a different crossover frequency (other than 3000 cycles), then you'll have to change the wiring or the crossover network to obtain the required crossover frequency.

Some of you may note that the wiring of the crossover network is unusual and somewhat different than any shown in University's instruction book. The changes were made necessary by the use of a 16-ohm woofer and a tweeter with a high-pass filter set at a frequency not



DIAMETER OF SPEAKER HOLES IS 3-1/2" FOR 4" SPKRS.
4" FOR 5" SPKRS.
TWEETER HOLE IS 2-15/16"



In wiring a "totem pole," this diagram must be followed. Be sure to phase the mid-range speakers so that all of the cones move in the same direction at the same time.

covered by the manual. As used here, the University N-2A acts as a frequency-dividing network operating at 350 cycles, and the N-2B serves as a low-pass filter at 3000 cycles.

BILL OF MATERIALS

Speakers and Accessories

2—Electro-Voice SP8B 8-inch woofers
2—University T-202 tweeters
20—4" or 5" mid-range speakers
2—University N-2A crossover networks
2—University N-2B crossover networks
2—University AP-8 controls for mid-range speakers

Lumber for Two Columns

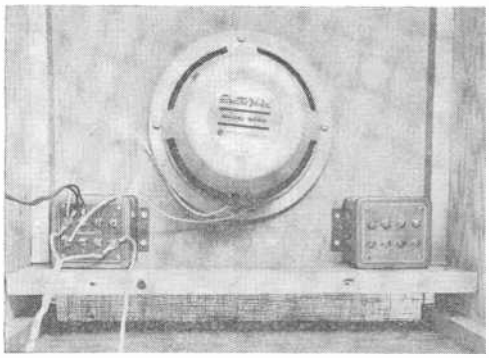
2—6" x 60" pieces of ¾" fir plywood (for speaker panels)
4—4" x 60" pieces of ¾" fir plywood (for sides)
4—4" x 7½" pieces of ¾" fir plywood (for tops and bottoms)
2—7½" x 61½" pieces of ¾" fir plywood (for backs—optional)

Lumber for Woofer Enclosure

1—18½" x 23½" piece of ¾" fir plywood (for speaker panel)
1—18½" x 27½" piece of fir plywood (for back)
2—16½" x 28¼" pieces of ¾" fir plywood (for sides)
1—16½" x 18½" piece of ¾" fir plywood (for bottom)
1—16½" x 20" piece of ¾" fir plywood (for top)
2—6" x 18½" pieces of ¾" fir plywood (for duct panels)
2—1½" x 22" pieces of ¾" pine (for cleats on speaker panel)
2—1½" x 26" pieces of ¾" pine (for back cleats)
2—1½" x 18½" pieces of ¾" pine (for back cleats)
4—¾" x 14¼" pieces of ¾" pine (for corner cleats)

Miscellaneous

104—#8 x ½" sheet metal screws (for small speakers and crossover networks)
84—#8 x 1¼" wood screws (for woofer enclosure)
2—Tool or "gripper" clips (to fit lamp poles, if used)
Grille cloth, plastic veneer, glue, finishing nails, fiberglass



A peek inside of an unfinished bass reflex cabinet shows the two University N-2A crossovers attached to the front panel. See the wiring diagram above.

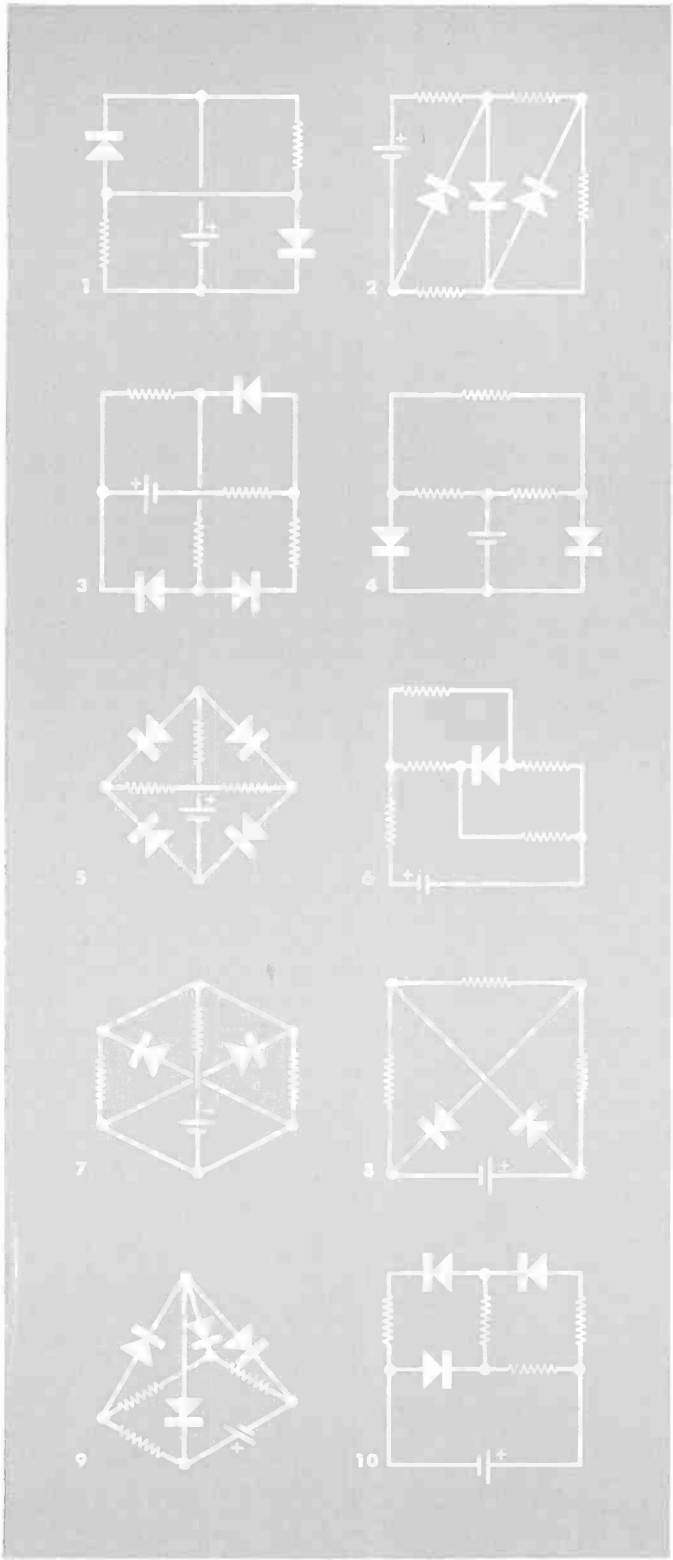
Construction. The speaker enclosures, both the woofer box and the columns, are constructed from ¾-inch plywood. The columns are quite simple in design, and should cause no difficulty, but you should wait until you decide whether you need a back or not before putting on the plastic veneer covering (see Speaker Placement section of this article).

(*Continued on page 91*)

RECTIFIER QUIZ

By ROBERT P. BALIN

The ideal rectifier permits current to flow in one direction only. For electron flow, this direction is against the arrow in the rectifier symbol. Although ideal rectifiers do not exist, consider the rectifiers in problems 1-10 to have zero forward resistance, and infinite reverse resistance, and see if you can determine the total effective resistance that the battery "sees" in each circuit. Assume that each resistor measures 6 ohms.



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(*Answers on page* 113)

THE FIRST LICENSE —AND BEFORE

By HENRY E. CHURCH

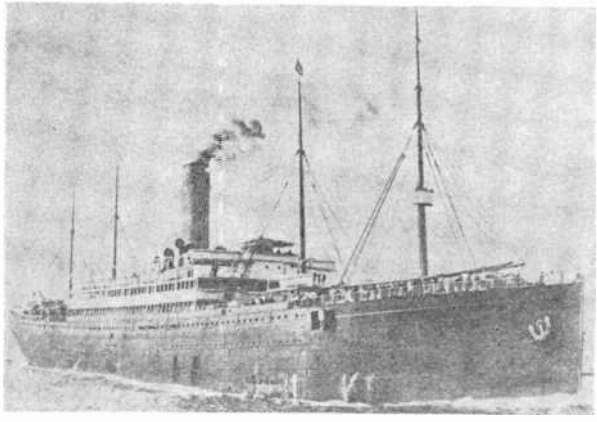
WIRELESS was in swaddling cloth in 1905 when James Baskerville stepped into the three-room combination office and laboratory of the De Forest Wireless Company and asked for a job. Although six years had elapsed since Marconi established wireless communication between two British cruisers, and the Atlantic Ocean had been bridged by that historic "S," it was still just the beginning.

As a boy, in Charlotte, N.C., James Baskerville had loafed around the Seaboard dispatcher's office and had picked up a bit of Morse code. Several times he had been allowed to key a message up the railroad line. This was the extent of his experience. But his tremendous interest in wireless outweighed his lack of knowledge about it. He got the job—at $15 a week—and proceeded to learn how the De Forest "detector box" and transmitter worked.

This detector box contained an electrolytic detector, a refined version of the electrolytic rectifier. It was a great improvement over the earlier coherer, but soon to be outmoded by the galena crystal. The detector rectified the output from a slide tuner that fed as much wire as the station could afford to hang from its hundred foot tower. On damp days it took strong fingers to slide the three contacts on the slide tuner. Some effort as well as skill was required to tease the signal through these indelicate devices and into the headphones.

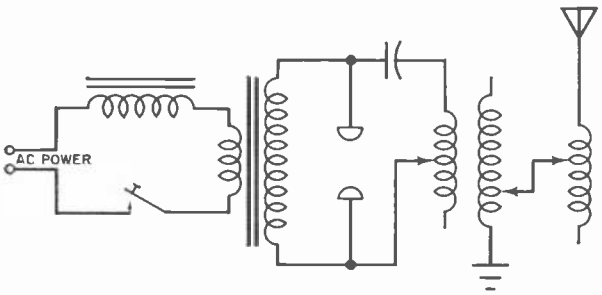
The transmitter was a raucous behemoth when its 2-kw. spark was fired up by keying 60-cycle power to the transformer primary. The secondary was coupled to the spark gap and a "helix." The helix was a massive tank coil which was brought into a degree of resonance by moving clips about on it. Thus, damped waves were produced to climb the antenna lead and swim through the ether as best they could. James Baskerville said, "A steam siren, two fire engines, a fog horn, and a couple of factory whistles, all exploding at once, will give you a shock similar to that which I got when that crashing open spark was let loose almost on top of my ear." (For many years, the cognomen for a wireless operator was "sparks.")

After completing a couple of ship installations, James and a small crew were

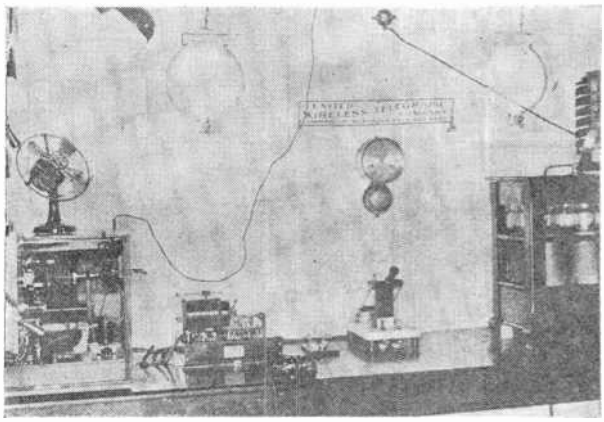


The sinking of the "Republic" off Nantucket Island in 1909 brought the use of wireless by ships to the attention of the public and the government.

sent to the beach at Galilee, N.J., to build a station there. When it was finished, there was no regular operator on hand. Baskerville heard opportunity knock and christened the station with its first message in an exchange with chief operator Birchard back at the De Forest headquarters in New York City. It wasn't difficult for him to make the transition from the clicks of the telegraph sounder he heard as a boy to the new buzzings in his earphones at the wireless station. James stayed on as operator.



Schematic of early spark transmitter. Loud and startling things happened when the key was closed.



There were no standard operating procedures for ship wireless installations in the years before the licensing of operators, then known as aerographers.

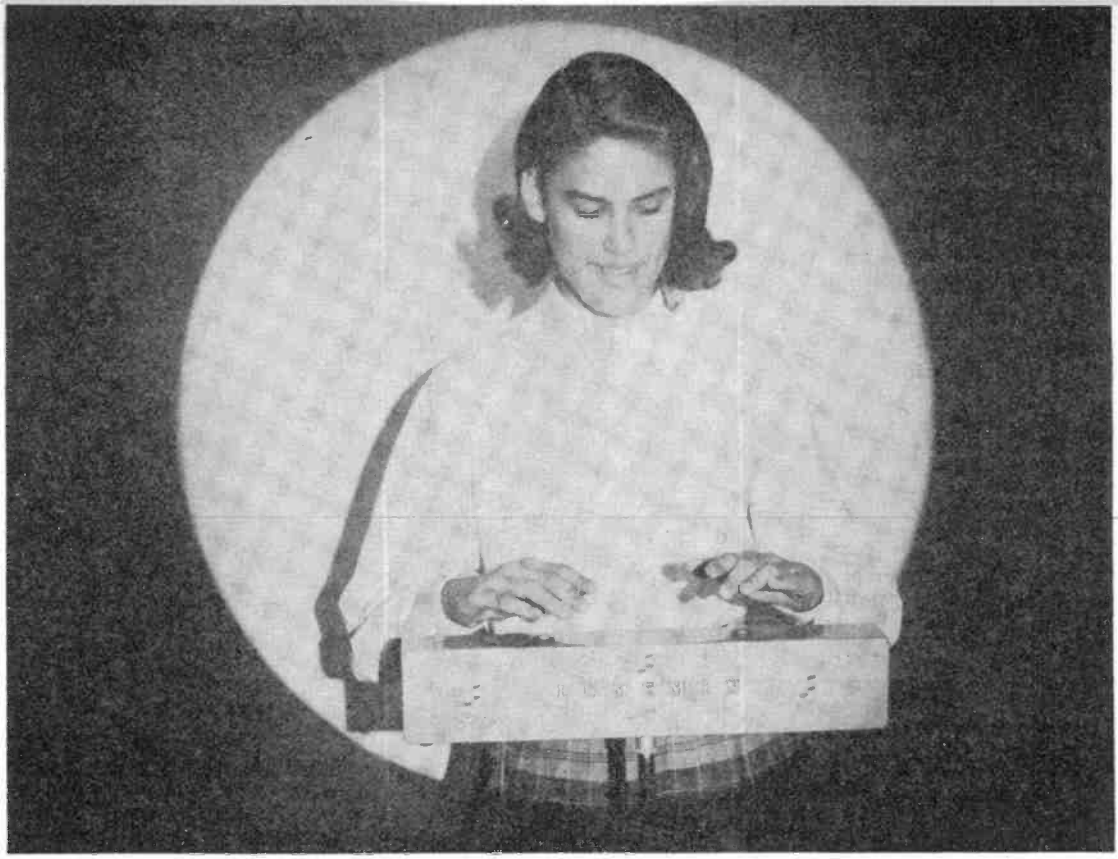
Pioneering in commercial wireless communication must have demanded the resources of an inventive mind. There were no legal directives, no international Q signals, and no standard operating practices. Call letters were bestowed by whim. The Galilee station, for example, was known as "G." Operators used their own initials for identification and the figure 3 was the sign-off signal. In formal terms, operators were known as aerographers. The word "radio" had not yet been coined.

James Baskerville was later to be in charge of some of the most important Atlantic coast land stations at Charleston, S.C., Savannah, Ga., and Atlanta, Ga., and the main office of the United Wireless Telegraph Company in New York. He also served as radio operator on more than a score of ships, including the Panama liner, the *S.S. Finance*.

The American Line's *Philadelphia* was the first American ship to carry a radio installation. Other ships were quick to follow, but the attention of the public and the legislature was not caught until 1909—by the dramatic rescue of 1500 people from the *Republic* of the White Star Line. The *Republic* was sinking off Nantucket after a collision with the Italian ship *Florida* when Jack Binns, her radio operator, summoned aid with the first QRD, the distress signal used before SOS.

As a result, on June 24, 1910, the Congress passed an Act to Regulate Radio Communications. This act required ships carrying 50 passengers or more to have radio installations, and provided for the

(*Continued on page* 95)



THE CURTAIN RISES and the spotlight falls on the slender girlish figure of the performer as she strolls gracefully towards the center of the stage. She stops behind a thin narrow box perched atop a microphone stand and turns to face the audience. Like a symphony conductor, she raises her hands . . . and on the downbeat rich musical tones, changing in pitch and intensity with each wave of the hand, fill the auditorium. She plays marches, polkas, and operatic themes—without once ever touching the music box.

Magic? No. "Lumemin" is the word. Using a pair of sensitive photocell "eyes," the Lumemin "sees" our performer as she moves her hands up and down, causing varying amounts of light and shadows to fall on its "eyes." In operation, one photocell controls loudness while the other controls the musical tones which are rich in harmonics and sound somewhat like conventional brass, woodwind, and string instruments.

The UJTO Circuit. The heart of the Lumemin is a versatile UJTO (Unijunction Transistor Oscillator) module (Fig. 1), driven by a power supply and its photoconducting circuit. The UJTO pro-

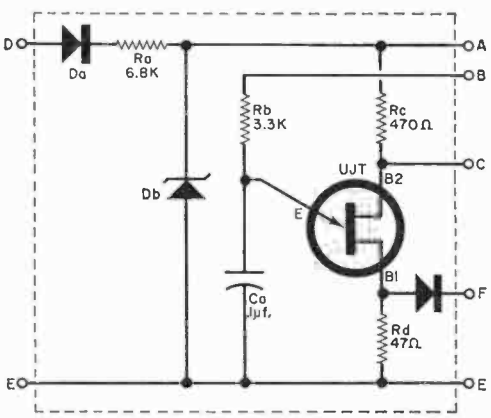


Fig. 1. Modified sawtooth signal across points B and E is fed to an external amplifier and speaker.

LUMEMIN STEALS THE SHOW

This easy-to-build musical instrument reads your hands like a Gypsy

By LOU GARNER

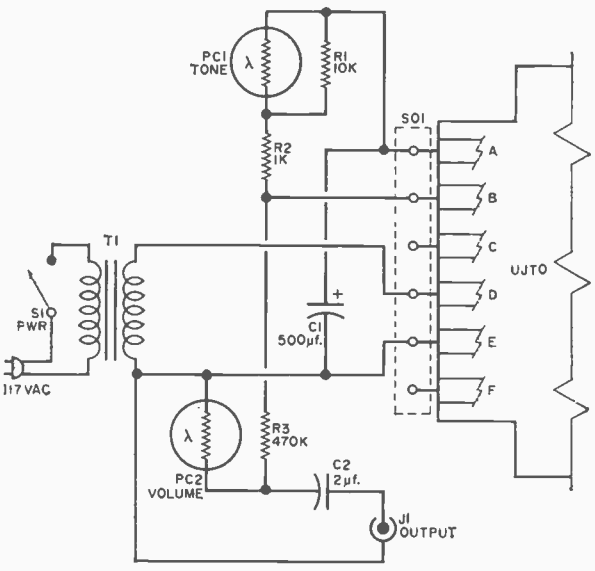


Fig. 2. Diagram of power supply and timing network shows wiring connections to UJTO plug-in module.

duces square-wave pulses as well as a modified sawtooth signal rich in harmonics. The latter is fed to an external audio amplifier and speaker.

Referring to Fig. 1, an a.c. input applied across *D* and *E* is rectified by diode *Da* and smoothed out by *Ra* and a 500-μf. capacitor (*Ca*) in the power supply circuit. Zener diode *Db* limits any voltage surges from the power supply to maintain a constant potential at the unijunction transistor (UJT) base electrodes through *Rc* and *Rd*.

Without emitter bias, the UJT is in a nonconducting (high-resistance) state. Capacitor *Ca* charges up through *Rb* and a resistor in the power supply circuit that appears effectively across *A* and *B*. As *Ca* begins to charge, the emitter voltage increases gradually until its point of conduction is reached. At this time, the UJT is triggered and switches from its nonconducting to a conducting state.

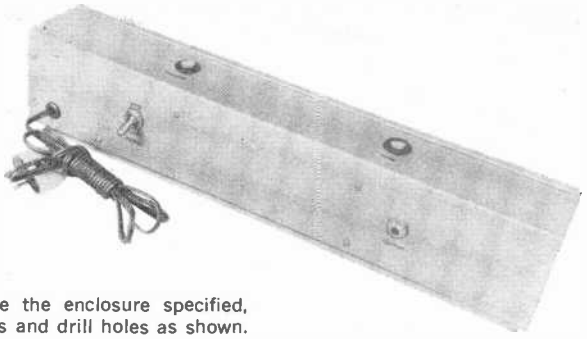
As the UJT conducts, *Ca* discharges rapidly through the UJT and *Rd*, developing a positive-going pulse at *B1* across *Rd*, and a negative-going pulse at *B2* across *Rc*. At the same time, a modified sawtooth waveform appears between terminals *B* and *E*. With *Ca* discharged, the UJT reverts to its high-resistance (nonconducting) state and the entire cycle is repeated.

The frequency (or repetition rate) of the circuit is dependent on the *RC* time constant of the components in the UJT emitter circuit. Basically, this boils down to the values of *Ca*, *Rb*, and the external resistance between *A* and *B*, as mentioned earlier. The output appears across points *B* and *E*.

The Other Components. Now, let's look at the rest of the Lumemin's circuit (Fig. 2). The major components are an isolating transformer (*T1*) and photocells *PC1* and *PC2*. Photocell *PC1* is part of the UJTO's timing network. It is shunted by *R1*, and this shunt combination is in series with *R2*. Therefore, *PC1* serves as the external frequency control resistor. As *PC1*'s resistance changes with different light intensities, corresponding changes take place in the UJTO's frequency. Thus, the instrument's *tone* is controlled essentially by *PC1*.

Recall from Fig. 1 that a modified

Fig. 3. Rear view of box used by author shows attractive slide cover design finished in gray aluminum. However, the builder can select practically any size or shape enclosure consistent with good appearance.



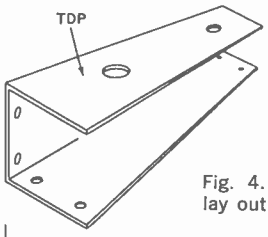
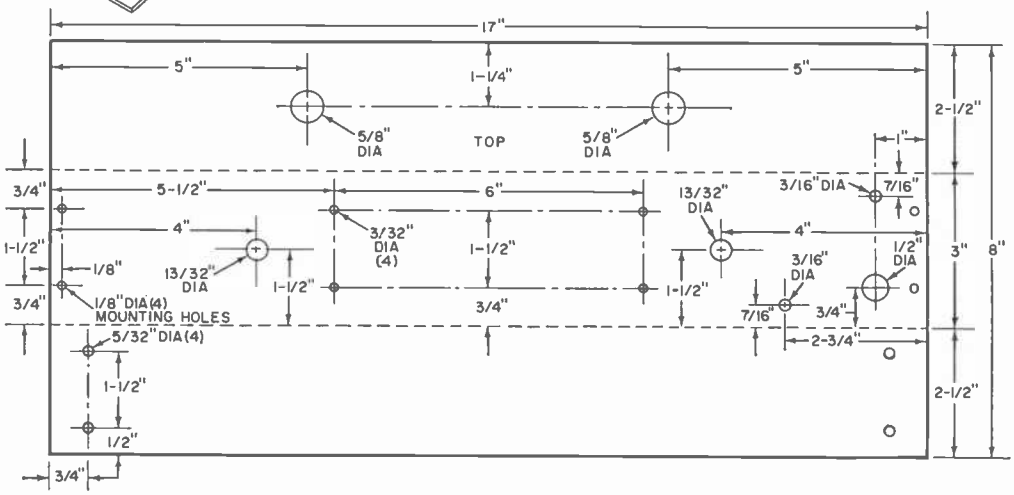


Fig. 4. If you use the enclosure specified, lay out the chassis and drill holes as shown.



sawtooth signal appears between terminals *B* and *E*. It can be seen from Fig. 2 that this signal appears across *R3* and *PC2* which are in series. The signal across *PC2* is coupled through *C2* to output jack *J1* which feeds an audio amplifier. Operation of *PC2* is such that its resistance decreases with the intensity of the light shining on it. Therefore, the amplitude of the output signal is directly proportional to *PC2*'s instantaneous resistance, and thus inversely proportional to the light falling on the device. Accordingly, maximum *volume* is obtained with reduced lighting, while a strong light produces little or no output.

Although the UJTO can be powered directly by the a.c. line, isolation transformer *T1* is used to insure greater safety and shock-free operation. Terminals *C* and *F* on the UJTO's circuit board (Fig. 1) are not used in this application.

Construction. Although the model shown in Fig. 3 has been designed around an attractive slide cover gray aluminum box, and all layout and construction details are centered around this design, the instrument can be housed in practically any type of enclosure, including a wooden cabinet or plastic box.

Remove the cover and drill the holes in the box following the layout and hole dimensions given in Fig. 4. Mount *J1*, *S1*, *T1*, *PC1* and *PC2* on the chassis as

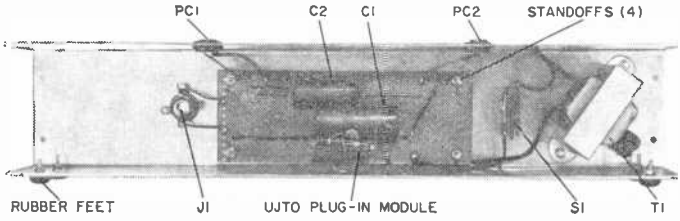


Fig. 5. Electrical components are first mounted on the perforated phenolic board which is then mounted on the chassis with four standoff spacers. Orientation must be as shown in diagram.

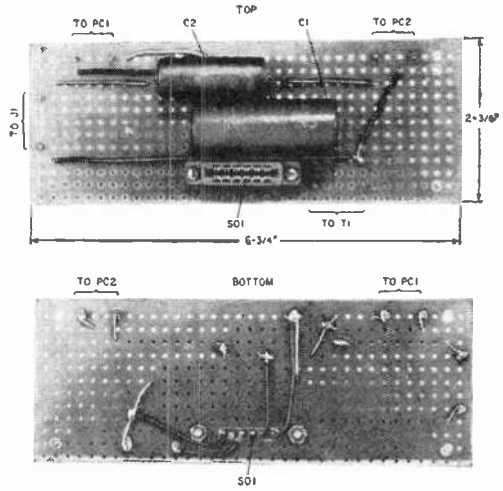


Fig. 6. Phenolic board showing components mounted on one side (top) and wiring details on other side.

PARTS LIST

C1—500-μf., 15-volt electrolytic capacitor
C2—2-μf., 200-volt paper capacitor
J1—Open circuit phone jack
PC1, PC2—CdS photocell (GE Type X6)
R1—10,000-ohm, ½-watt resistor—see text
R2—1000-ohm, ½-watt resistor—see text
R3—470,000-ohm, ½-watt resistor—see text
S1—S.p.s.t. toggle switch
SO1—Cinch-Jones bifurcated-contact edge connector, Series 250, Type 50-6A-20 (Newark Electronics Stock No. 29F952 or Allied Electronics Stock No. 40 H 319)
T1—115-volt isolation transformer (Lafayette Stock No. 33 G 7502)
UJTO—Unijunction transistor oscillator module (MS Type 5100-4.1—available for $5 from Midland Standard, 161 E. Chicago St., Elgin, Ill. 60120)
1—3⅛" x 2⅝" x 17" slide cover utility box (LMB No. 19)
1—6¾" x 2⅜" perforated phenolic board
Misc.—Line cord and plug, rubber feet (4), standoff spacers (4), push-in terminals, rubber grommets (3), machine screws, nuts, wire, solder, etc.

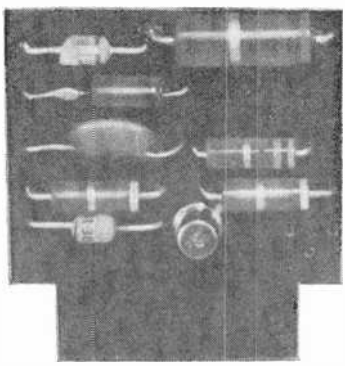


Fig. 7. When installing the UJTO module in the Cinch-Jones connector (SO1), make sure it is positioned with foil side of the board facing the chassis rim as shown in Fig. 5, or circuit will not work.

shown in Fig. 5. The photocells are mounted in tight-fitting rubber grommets, and the rubber feet can be put on at this time. Use No. 6 self-tapping screws, or if you prefer, machine screws with nuts and flat washers. Transformer *T1* can be mounted with the same size hardware. Then put the chassis aside, temporarily.

You can now begin to assemble the electronic components on the phenolic board as shown in Fig. 6. On one side of the board, mount the Cinch-Jones socket (*SO1*), and capacitors *C1* and *C2*, as shown in the top view. Wire the other side of the board as shown in the lower view. Refer to Fig. 2 for detailed wiring information.

The only thing left for you to do is to plug the UJTO module (Fig. 7) into socket *SO1* (Fig. 6), and mount the electronic component board on the chassis using four standoff spacers (Fig. 5). Be sure to insert the module with the foil side facing the chassis rim. Then complete the interconnection wiring.

As a final touch, you can use decals to label the controls and thus give the instrument a commercially built appearance. After the decals are put on, they should be protected with two or three coats of clear lacquer or acrylic plastic.

Using the Instrument. For personal use or individual practice, a pair of high-impedance magnetic or crystal headphones can be plugged into *J1*. For parties, or audience entertainment, you will need a suitable audio amplifier/loudspeaker system such as a guitar amplifier, a public address system, or a standard hi-fi system. Simply connect a suitable cable between *J1* and the amplifier's high-impedance *microphone* jack.

The Lumemin should be placed in an area where a moderately strong light will fall on its photocells. The light source can be an overhead lamp or a sharply focused spotlight, as you prefer. Since no warm-up is required (except for the reproduction equipment used), the moment you turn the instrument on you can play individual notes by using your hands to cast appropriate shadows on the photocells. The lowest frequency note is obtained when the *tone* photocell (*PC1*) is in complete darkness, and the

(*Continued on page* 93)

BUILD THE ELECTROLOCK

By MURRAY E. COULTES

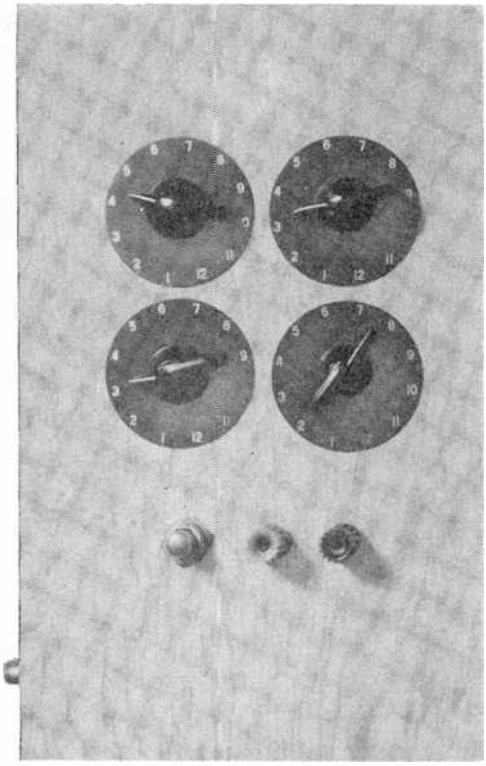
A keyless wonder—
you just dial
the secret combination
to open it

THEY SAY daisies don't tell. Perhaps the same can be said of the "Electrolock." Unlike conventional locks which give tell-tale sounds when the right combination registers or which can be easily jimmied, the Electrolock is electronic and can't be opened by anyone but yourself. It uses no key; instead, you dial the four correct digits, and presto—it opens.

As seen in Fig. 1, the Electrolock is a series circuit consisting of a battery, a solenoid, a push-button switch, and four rotary switches. The plunger of the solenoid is connected to a small barrel bolt, and a small spring holds the bolt closed when the solenoid is not activated. But when you dial the right four numbers and depress the push button, you complete the circuit, current flows through the solenoid, and the plunger pulls back the barrel bolt. When the push button is released, the spring pulls the bolt into the closed position again.

There are many ways in which you can construct the Electrolock. The combination that will open the lock depends on the switch connections you use. Usually, a 4.5-volt battery suffices, but for more snap you could try a 6- or 9-volt battery.

Drill a hole through the barrel bolt the same size as the hole through the plunger of the solenoid, and fasten them together as shown in Fig. 2. Be sure to drill the hole parallel to the knob so that the bolt will not be turned down when the plunger is connected to the bolt. The spring is fastened between the screw connecting the solenoid plunger and barrel together to another screw mounted on the barrel lock frame. If you can't find a suitable spring, use two or three smaller ones tied together.



External battery can be connected to the banana jacks to overcome a weak internal battery. However, the lock cannot be opened without the combination.

To operate the Electrolock, dial the correct combination and depress the push-button switch. The bolt should

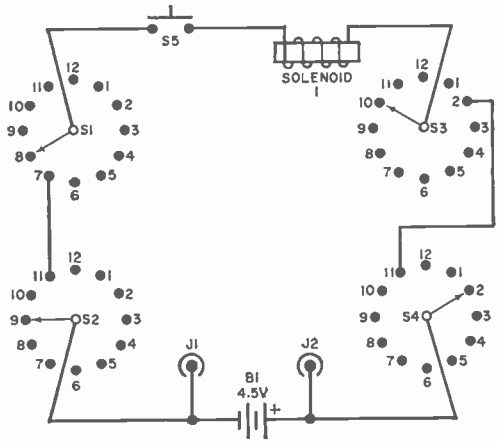


Fig. 1. Any combination can be made by selecting different switch positions. As there are more than 20,000 possible combinations, chances of "picking" the lock are discouraging. Furthermore, if you add a fifth switch, you can get 248,832 combinations.

PARTS LIST

B1—4.5-volt battery
J1, J2—Banana jack
S1, S2, S3, S4—12-position rotary switch
S5—Push-button switch, normally open
1—6-volt d.c. type solenoid (Guardian Model 11 or equivalent)
Misc.—Barrel bolt, aluminum strip battery mount, machine screws, hookup wire, solder

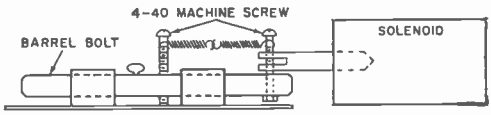


Fig. 2. Spring holds barrel bolt in closed position. Solenoid retracts the bolt when the proper combination is dialed and the push button is depressed.

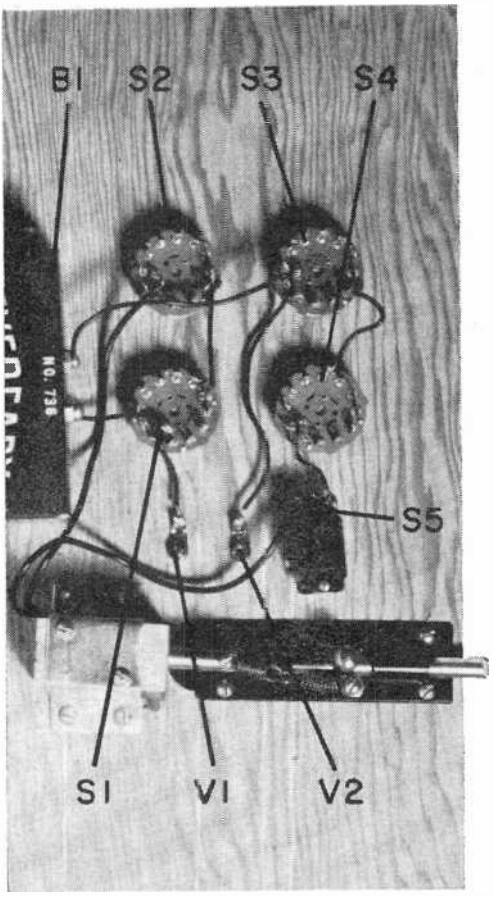
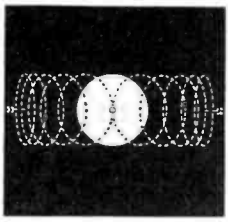


Fig. 3. Align barrel bolt with solenoid to obtain smooth action without bolt rotation. Battery and switches can be mounted in any convenient position.

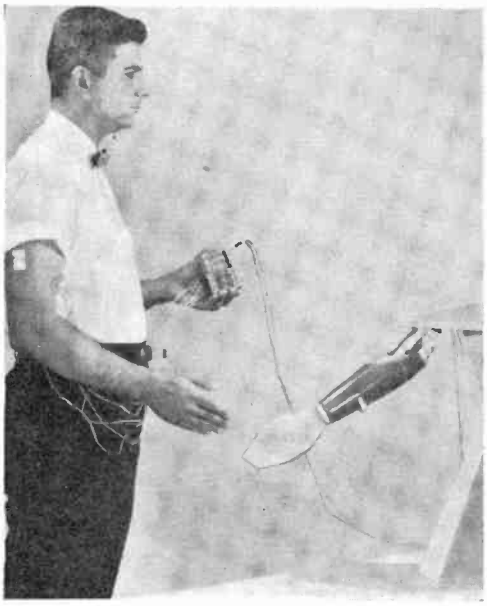
snap open. If it doesn't, check your wiring, particularly the switches. You may have to adjust alignment and spring tension to get smooth, positive action.

You've probably guessed the reason for putting the two banana jacks on the front panel. In case the battery inside the unit hasn't the energy left to open the lock, you just connect a fresh battery across the terminals and dial the combination. Remember, you can't open the lock if you forget the combination. —30—

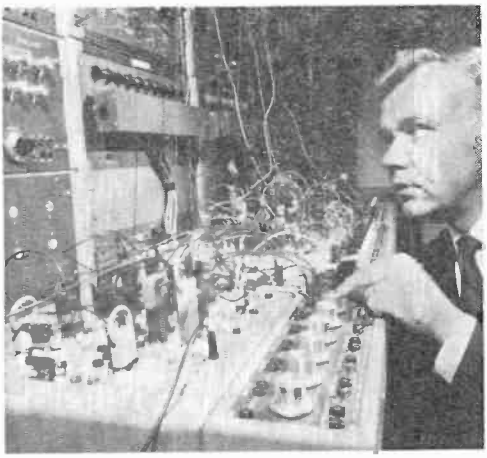


ZERO-BEATING THE NEWS

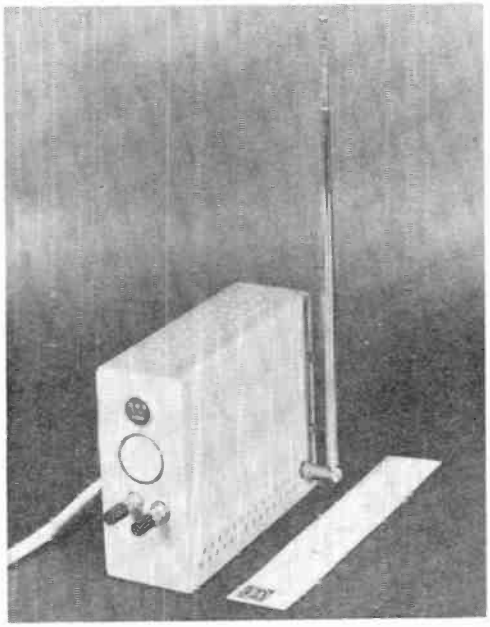
25-YEAR-OLD INVENTION BRINGS AN AWARD—A major communications invention that made possible pictures from Mars has won the coveted Stuart Ballantine Medal of the Franklin Institute for its inventor, Alec Harley Reeves, a scientist at ITT's Standard Telephones and Cables Ltd., London. The invention, a highly efficient method of sending information called Pulse Code Modulation (PCM), was used by "Mariner IV" to transmit television signals from Mars to Earth. The award was presented to Mr. Reeves, who originated the concept 25 years ago, at the Institute's Medal Day ceremonies on October 20 in Philadelphia by Institute president Dr. Wynn Laurence LePage. When asked about the future impact of PCM on communications, Mr. Reeves said he believed that by the turn of the century the major portion of our communications will be by pictures—television—transmitted in a still-to-be-developed system of light beams sent through pipes, the light carrying the message in the form of his pulse code modulation. PCM is already widely used commercially, and eventually most telephone calls may be sent by this method. It enables a telephone call or TV picture to be chopped into "bits" or pieces, thus permitting many messages to be sent instantaneously over a single line on a time-sharing basis. These bits can be sent extremely long distances over wires or radio, with little distortion, and be reconstructed into the original message or picture at the receiving end.



REHABILITATION—Philco has developed a working model of an artificial arm which bends at the elbow and turns its hand, all by remote electric signals from living muscles (see photo at left). It is hoped that in the near future such an electronic control package will help people who have lost the use of an arm. In another area of rehabilitation, at Stanford Medical Center, a 61-year-old deaf man (below) "heard" two out of several tunes during an experiment in which doctors stimulated his hearing nerve via electrodes implanted in his auditory nerve. Results indicated that speech communication via direct nerve stimulation might be possible.



HOW TIME FLIES—A 24-hour day shrinks to only 14 seconds on this analog computer developed by Honeywell Inc. The computer electronically simulates temperature, humidity, wind, sunshine—even hills and trees—to help researchers like Lorne Nelson (above) design building control systems for the future. In 24 hours' actual time, the computer can give a building control system the equivalent of 17 years' use. "Function generators" electronically duplicate changing weather conditions; and other components simulate windows, construction, etc.

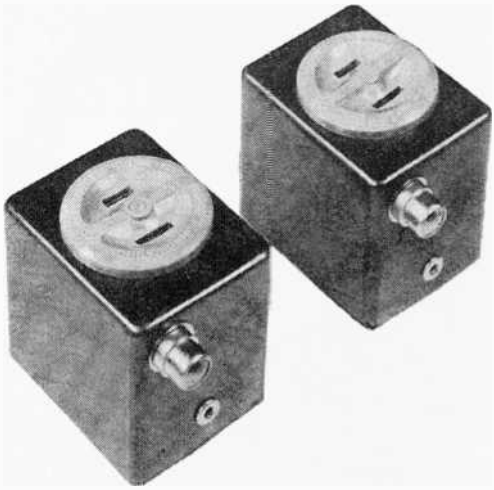


WORLD'S TINIEST TV—What surely must be the smallest TV set ever made, this unit measures only 3½"x4½"x1½" and uses a picture tube which is less than 1" in diameter. Built by engineers at the Westinghouse Defense and Space Center in Baltimore to demonstrate capability in the use of microminiature circuitry and components for military and space equipment, the television set is the only one of its kind and is not commercially available.

NEW TANK KILLER—TOW, a new anti-tank missile system, is examined by troops at Hughes Aircraft Company, Culver City, Calif., where it is being developed for the U.S. Army. In tests, the TOW (for Tube-launched, Optically-tracked, Wire-guided) missile scored bull's-eye hits on tank-sized targets over a mile away. With TOW, the gunner does not have to estimate the distance or speed of his target; he simply aligns the cross hairs on his telescopic sight, then launches the missile. In flight, TOW unreels two tiny wires so that, if the gunner should change his aim to track a moving target, the missile can receive corrective commands.

ION ENGINE SUCCESSFULLY TESTED—An electron bombardment ion engine, having recently operated for more than 2600 hours non-stop without failure under space-simulated conditions, is now a step closer to being the space propulsion system of the future. Developed by Electro-Optical Systems, Inc., Pasadena, Calif., it is small enough to be hand-carried, yet provides a thrust of 10 millipounds at a power-to-thrust ratio of 182 kw. per pound. It weighs about 10 pounds, including the loaded 5-lb. fuel feed system. The engine generates ions by electron bombardment of vaporized cesium. The ions are then accelerated electrostatically at high velocities to produce thrust. Lifetimes in excess of 10,000 hours can now be extrapolated for the cesium thruster, according to an EOS physicist.

HI-FI À GO-GO LAMPS



Add a new dimension to your hi-fi . . . in color

By DON LANCASTER

WHY BE SATISFIED with just listening to hi-fi programs when for a sawbuck you can have the added enjoyment of seeing what you're hearing, and intriguing all your friends. A pair of ten dollar bills will get you two sets of audio controlled lights to let your stereo system really brighten up the place. For those who want something different, it's quite a conversation piece.

With the *À Go-Go* circuit, the brightness of one or more incandescent lamps is controlled by an audio signal. Its full-range proportional control is capable of bringing the lights from full darkness to full brilliance; the louder the sound, the brighter the lamps. You can use it to control up to 200 watts of light, and with modification and a few dollars more, up to 2000 watts. The unit is about the size of two ice cubes.

How It Works. Sounds fed into *J1* are stepped up by *T1,* rectified by *D1* and filtered by *C2* only to become a control voltage for trigger diode *D3*. (See Fig. 1.) It takes 15 volts to make *D3* conduct. The time required to build up 15 volts on *C3* depends upon the amplitude of the sound and the values of *C3* and *R2*. The louder the sound, the quicker the voltage buildup; the larger the resistor or capacitor, the longer it takes to build up the voltage.

When *D3* fires, it triggers the SCR into conduction only if the SCR anode also has a positive voltage on it. Once the SCR fires, it continues to conduct until the anode voltage drops down to about 0. This happens each time the line voltage waveform goes through zero. The SCR will remain off until another pulse is applied to its gate. The sooner the gate pulse occurs when anode voltage is present determines the amount

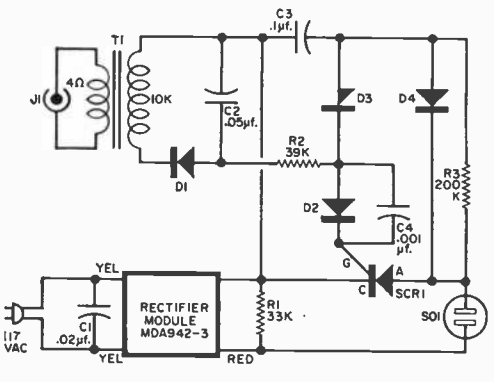


Fig. 1. Ratio of "on time" to "off time" of SCR1 changes in step with music levels, and brightens or darkens different colored bulbs plugged into SO1.

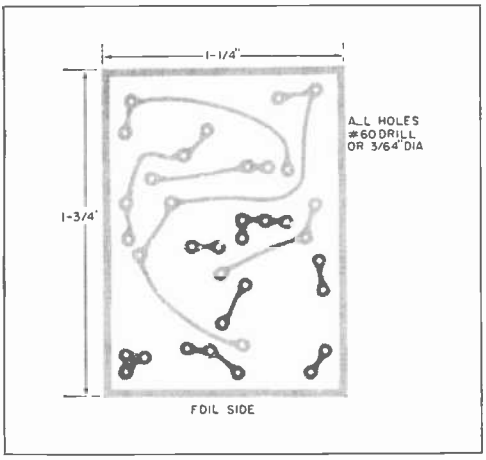


Fig. 2. Printed circuit board is shown actual size to help you make your own. However, almost any suitable chassis or breadboard arrangement can be used.

PARTS LIST

C1—0.02-μf., 200-volt Mylar capacitor
C2—0.05-μf., 200-volt Mylar capacitor
C3—0.1-μf., 200-volt Mylar capacitor
C4—0.001-μf., 600-volt disc capacitor
D1, D2, D4—1N4003 diode
D3—Trigger diode (Texas Instruments T1-42 or equivalent)
J1—Phono jack
R1—33,000-ohm, ½-watt resistor
R2—39,000-ohm, ¼-watt resistor
R3—200,000-ohm, ¼-watt resistor
SCR1—2N3528 silicon-controlled rectifier
SO1—Chassis-mounted a.c. socket (Amphenol 61-F or equivalent)
T1—Output transformer, 4 ohms primary to 10,000 ohms secondary (Thordarson TR-203 or equivalent)
1—Full-wave bridge rectifier module, 1.5 amp., 200 volts (Motorola MDA942-3)
1—Chassis-mounting a.c. plug (Amphenol 61-M or equivalent)
1—Case (Millen 74400 or equivalent)
1—2" square of 1/16" single-sided circuit board
Misc.—Silicon potting compound, hookup wire, solder, pop rivets or screws

of time during each half-wave that current can flow through the lamps plugged into *SO1*.

Neither the eye nor the lamps can follow the 120-cycle unfiltered pulsating voltage out of the rectifier module, but the lamps do respond in a proportional manner. The brilliance of the lamps is a function of the ratio of "on" time to "off" time; or the louder the music, the brighter the lights.

Capacitor *C1* serves as a filter to prevent the switching transients in the *À Go-Go* from getting back into the power line and causing AM-type radio interference. The other components optimize the circuit to prevent premature turn-on of the SCR and allow more accurate proportional control by discharging *C3* before a new "on" cycle begins.

As the audio is used for bias only, little audio power is consumed. The *À Go-Go* has high sensitivity and very little volume is needed to drive it.

Construction. Start construction by laying out and etching the printed circuit board shown in Fig. 2. Drill holes and mount components as shown in Fig. 3. Watch the polarity—one wrong connection can destroy all the semiconductors.

After you've finished the wiring, connect an a.c. socket and plug to the board and test the *À Go-Go* with a 25-watt bulb. The bulb should glow slightly with no audio. A fairly low level audio signal should drive the lamp to full brilliance. If this test checks out okay, test the board using the lamps and audio source

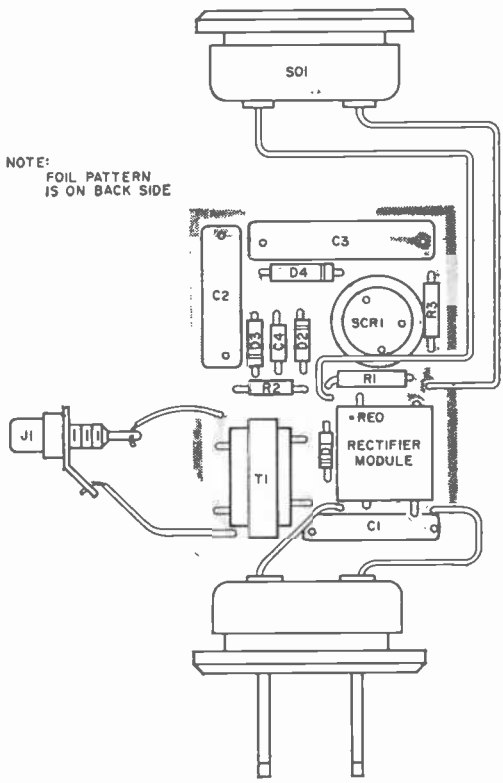


Fig. 3. Mount the jack and sockets in the case before connecting them to the circuit. If space is not a factor you can add more features. See text.

you plan to have in the permanent installation.

For best appearance and greatest sensitivity, the display lamps should barely light with no audio input. A different background level can be obtained by changing the value of *R2*; increasing its value will decrease the background light level. You might also experiment with *C2*—use too small a value, and you'll have a choppy response; too large, and the response will become mushy.

The components are mounted inside a modified Millen octal base and shield. Cut the shield to about 1¾" long (see Fig. 4), and drill or punch 1 9/64" keyed or 1 5/32" round holes in both top and bottom for the plug and socket. Drill a 17/64" hole in one side for the audio jack. Screws or rivets can be used to fasten the two parts of the case.

Once you've wired the board, socket, and audio jack, you can pot the circuit in silicon rubber. To do this, turn the *A Go-Go* upside down and place small bits of tape over the inside openings of *J1* and *S1*. Then pour in about half an inch of rubber and let it set. The printed circuit board is then positioned in place and another half inch of rubber added. Complete the assembly by connecting the plug.

Modifications. The *A Go-Go* operates on 117-volt, 60-cycle lines and utilizes incandescent lamps only. For the unmodified unit, you can use a total of 200 watts maximum, but for cooler operation and longer life, 100 watts or less is advisable.

If you plan to use a bigger package than the modified Millen shield, you might add a 250-ohm potentiometer in the input circuit as a sensitivity control, and replace *R2* with a 250,000-ohm potentiometer to serve as a variable background control. A selector switch with several capacitors (0.02 μf., 0.05 μf. and 0.1 μf.) to replace *C2* will give you control over lamp response.

More power is a snap, but it will cost extra and you'll probably need a bigger

(*Continued on page* 88)

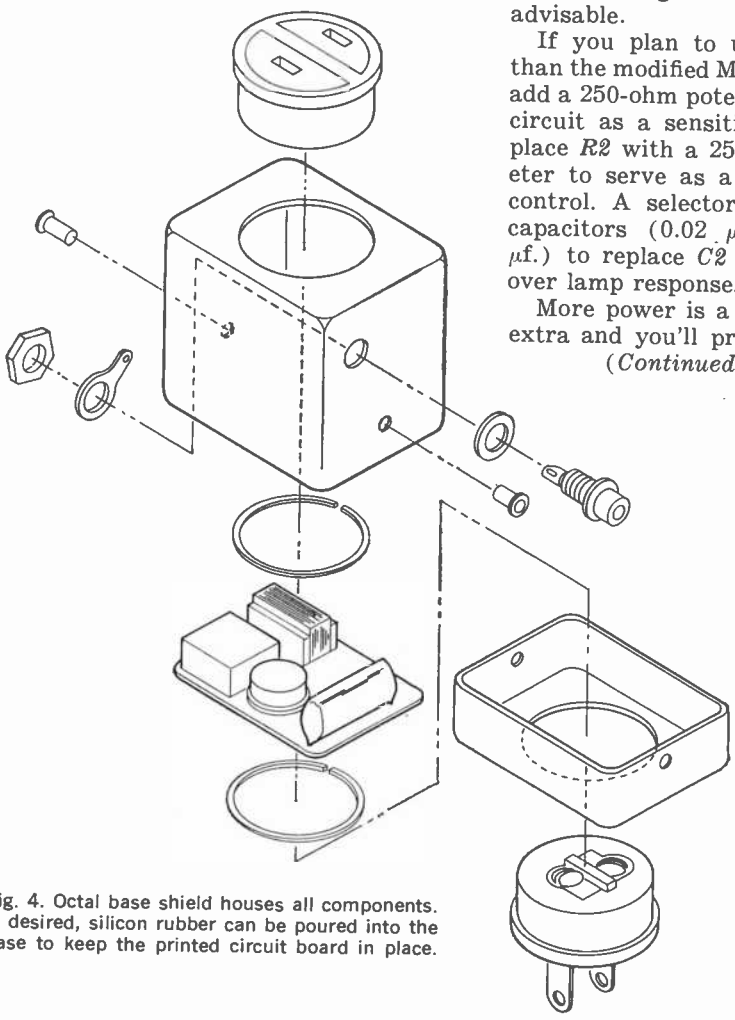


Fig. 4. Octal base shield houses all components. If desired, silicon rubber can be poured into the case to keep the printed circuit board in place.

DUAL-SENSITIVITY FIELD STRENGTH AND ABSORPTION METER

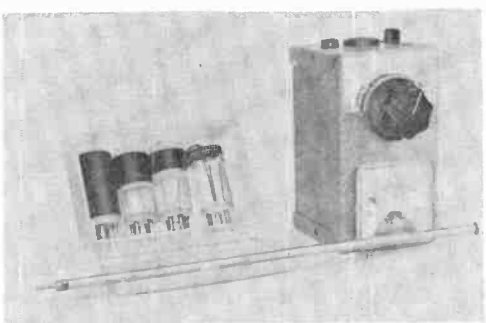
By ROBERT N. TELLEFSON
W7SMC/6

PERHAPS the simplest yet most underestimated item of test equipment found in the ham shack is the absorption meter. It's impossible to calculate the number of hams who have been spared FCC pink tickets for being on the wrong band because they took care to monitor their own frequency. But this is just one of many applications of the field strength and absorption meter, or "wavemeter." It can be used as a neutralization indicator or as a null indicator for adjusting balanced modulators in SSB transmitters. It can also be used to determine if an oscillator circuit is working, and to compare transmitter signal output before and after adjustments are made.

Easy to build, the absorption meter consists of a variable-tuned single transistor amplifier powered by a 1½-volt penlight battery. (It works with and without the battery; with the battery in the circuit, sensitivity increases by a factor of 10.) Resonance is indicated by a front-panel-mounted 0-1 ma. meter. Four plug-in coils are used to cover the 160-meter to 6-meter bands.

Parts cost is less than $8 and it shouldn't take you more than an evening to put the whole thing together.

How It Works. A small amount of r.f. energy is absorbed by tuned circuit *C1, L1* when the coil or antenna is placed in the vicinity of an r.f. field. The amount of energy absorbed depends upon the strength of the r.f. field, the extent of coupling of the meter to the field, and the resonant condition of the meter's tuned circuit.



Only four coils are needed to cover the 160- to 6-meter amateur bands. Whip antenna extends effective range of the field strength and absorption meter.

COIL TABLE

160 Meters
L1 = 140 turns of #32 enameled wire
L2 = 13 turns of #32 enameled wire

80 and 40 Meters
L1 = 44 turns of #26 enameled wire
L2 = 6 turns of #26 enameled wire

20 and 15 Meters
L1 = 17½ turns of #22 enameled wire
L2 = 3 turns of #22 enameled wire

10 and 6 Meters
L1 = 4½ turns of #18 enameled wire
L2 = 1 turn of #22 enameled wire

The r.f. energy in the tuned circuit is coupled to the base of *Q1* by *L2,* and is detected in the base-emitter circuit, as shown in Fig. 1. The greater the signal strength, the higher the meter reading.

Detection and current flow take place even when *S1* is off. By switching *S1* on, the battery is placed into the circuit and permits *Q1* to function as a transistor amplifier instead of just as a diode. Sensitivity goes up because of the transistor's gain characteristic. It takes only 1/10 as much signal to obtain full-scale deflection when the battery is in the circuit.

Construction. A 2¼" x 2¼" x 4" aluminum box (Fig. 2) houses all the components except the plug-in coils and a whip antenna. Parts can be located as shown, or in any other convenient arrangement. However, it is necessary to observe polarity of the meter and battery. A 1½"-diameter plastic clamp and a right angle bracket serve as a battery holder. The battery ends should be taped to prevent electrical contact with the sides of the box.

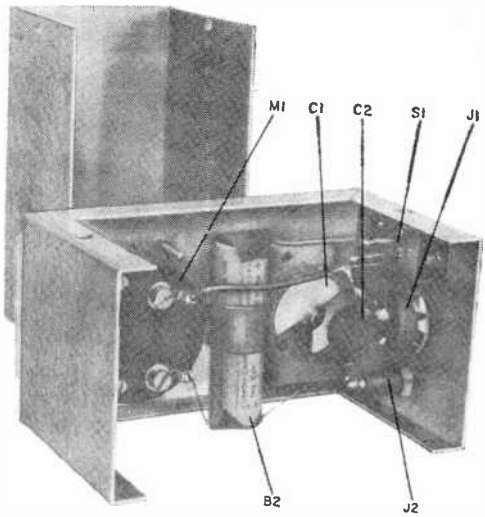


Fig. 2. When mounting components, consider clearance space required for the variable capacitor. Tape battery ends to prevent contact with metal case.

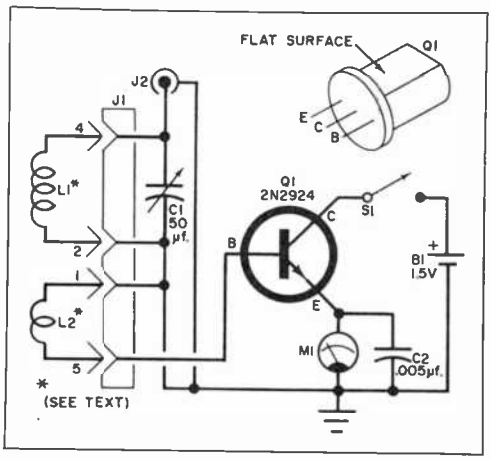


Fig. 1. Base-emitter circuit of Q1 functions as a simple diode detector when battery is not connected; with battery, sensitivity increases tenfold.

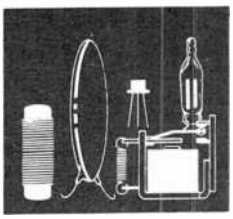
PARTS LIST

B1—1.5-volt penlight battery
C1—50-pf. variable capacitor (Hammarlund HF-50 or equivalent)
C2—0.005-μf. disc ceramic capacitor
J1—5-pin miniature socket (Amphenol 78-S5S or equivalent)
J2—Phono tip jack
L1, L2—Plug-in coils (see Coil Table)
M1—0-1 ma. meter
Q1—2N2924 transistor, or equivalent
S1—S.p.s.t. slide switch
1—2¼" x 2¼" x 4" aluminum box (Bud CU-2103A or equivalent)
Misc.—5-prong polystyrene plug-in coil forms (4), knob, solder, etc.

Since the transistor leads are soldered into place, be sure to heat-sink the leads when soldering. Wind the four coils on ¾"-diameter polystyrene plug-in coil forms using the data in the coil table. Avoid overheating the coil pins, as the plastic melts easily.

Calibration and Use. Calibrate the absorption meter with a signal generator or grid dip oscillator. Plug in the appropriate coil, loosely couple the absorption meter to the signal source and rotate the variable capacitor to obtain a maximum meter reading. Then mark the dial scale. By selecting frequencies at the top and bottom ends of the band, you will be able to determine quickly if your transmitter is within legal limits. The purpose of the absorption meter, in this case, is to spot the band rather than an exact frequency within the band.

You can make a dial by cementing a small piece of white paper to the box as shown, and marking it with an ink pen. Low meter readings can be raised by switching in the battery, or by increasing the coupling, or both. Signal pickup can be through the plug-in coil, or from the whip antenna when it is plugged in. -30-



PARTS PROFILES

By DON LANCASTER

THE COMPONENT OF THE MONTH

"PARTS PROFILES" IS INTENDED TO PROVIDE YOU WITH EXCITING INFORMATION ABOUT UNUSUAL OR LITTLE KNOWN ELECTRONIC COMPONENTS AND DEVICES THAT ARE INEXPENSIVE, INTERESTING, AND USEFUL. THESE PRODUCTS WILL USUALLY ENABLE YOU TO BUILD MORE INTERESTING PROJECTS AT LESS COST, IN LESS TIME, AND WITH IMPROVED PERFORMANCE. ITEMS COVERED ARE AVAILABLE NATIONALLY OR FROM AT LEAST ONE RELIABLE SOURCE OF SUPPLY.

OPTICAL RELAY HAS NO MOVING PARTS

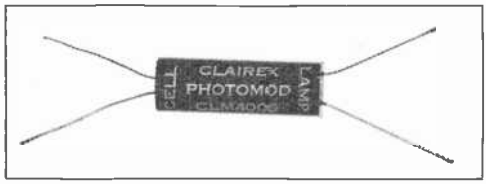
Do you want a device that will let you control a large signal with a small a.c. or d.c. voltage? A new series of photocell-lamp modules by Clairex fits this application, nicely. At least one other manufacturer (Raytheon) has a similar device, but the Clairex prices hurt the pocketbook the least.

The basic photocell-lamp module is a four-terminal device containing a light source at one end, and a photoresistor at the other end. Dubbed "Photomod," the unit provides complete isolation between the *control* and *signal* circuits. The control signal is applied to the light bulb, and the light shines directly on the light-sensitive resistor. Resistance goes down in proportion to the amount of light, and thus the output current follows the input voltage.

Slow response is achieved because of the time required to heat or cool the filament in the light bulb. It takes a few milliseconds for the output to change smoothly from a high resistance to a low resistance or from a low resistance to a high resistance. This slow action promptly "absorbs" any transient, noise, or key click.

Each model offered by the manufacturer is only $\frac{3}{8}$" in diameter by $1\frac{1}{8}$" long. You have a choice of bulbs from a 6-volt to a 120-volt, 40-ma. incandescent lamp, to two models of a 3-mil neon lamp (externally current limited). The incandescent lamps are slower, easier to drive, and produce lower values of *on* resistance, while the neons are more linear, faster, and require less current. The photoresistor is rated at 50 milliwatts dissipation, and typically has an *off* resistance of 100 megohms, and an *on* resistance of less than 40 ohms.

The Photomod serves either as a switch or as a linear, electrically variable resistor. As



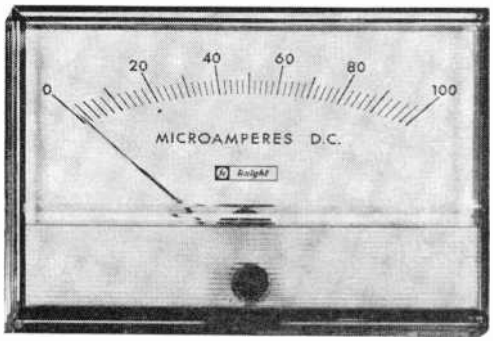
a switch, it is suitable for musical instruments, VFO's, and inductive loads where noise, key clicks, and transients are intolerable. A Photomod can also be employed to remote-control a power SCR, using a 6-volt battery and bell wire. Or it can replace or shunt the brightness pot in a dimmer, and thus automatically provide more or less lighting as needed. Drive it with a few milliwatts of music and you can make hundreds of watts of light "paint" a picture.

For linear applications, Photomods make dandy a.v.c. and a.g.c. systems and remote voltage controls. For frequency control applications, you can use Photomods to replace the resistors in the timing circuits of multivibrators and oscillators.

Made by Clairex Corp., 8 W. 30th St., New York, N.Y. 10001, "Photomod" Photocell-Lamp Modules CLM3006 through CLM4120 can be purchased from distributors at $3.25 each. Data sheets are available.

LOW-COST CLEAR-VIEW PANEL METERS

If you combine the best styling you can get in a panel meter with prices that are from $1 to $3 below current prices of "cheap" meters, you'll come up with an item that offers tremendous appeal to the engineer, hobbyist, and experimenter. But when you go on to add such extras as clip-on, noncritical mounting, good legibility, accurate readings ($\pm$ 2% on d.c. and $\pm$ 3%



on a.c.) without need for recalibration whether the instrument is mounted on a ferrous or nonferrous panel, Mister, you've got yourself a meter. These are but some of the features offered by Allied Radio's Knight clear-view panel meters.

The rectangular meter types measure 4½" or 6" across, and come in a variety of ranges. You have your choice of *current* ranges from 0-50 μa. to 0-15 amperes, and *voltage* ranges starting from 0-50 volts and going up to 0-300 volts, a.c. or d.c. A sister line of square-face meters measuring 3½" or 4½" across is also available from the same manufacturer. These are a few dollars cheaper, but are also somewhat less stylish. The quality (accuracy) and movements are identical. An optical bezel that provides further sharpness, and gives added protection to the plastic meter face, is also available.

You wouldn't use any of these meters on battery chargers, or on power supply monitors—there are lots of $2 meters which are tops for this sort of thing. You'd use them wherever accuracy, good legibility, and sharp appearance are required.

Applications? Build yourself one of those new FET voltmeters (FET prices are down to around $5 now). This will give you a "VTVM" with extra-high input impedance, long battery life, and no line cord to plug in. Or how about a frequency meter, or a quality transistor tester that measures *beta* (gain) directly? Need more ideas? A capacitance tester, an inductance bridge, a miles-per-gallon meter, or a receiver "S" meter? Hams should consider VSWR meters and field strength meters; so should technical-minded CB'ers. These clear-view panel meters can also be used to make dandy exposure and light level meters, as well as sound level meters.

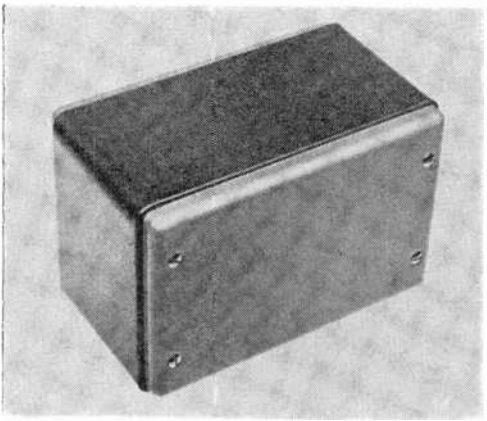
A mounting template included with each meter movement makes layout a snap. When mounting one of these meters, the best way to cut the 2¾" mounting hole is with a nibbling tool or a flycutter; but a number of closely spaced ¼" drill holes, combined with the use of a file, and some patience, are all that is really needed. Unlike when working with most meter movements, you don't have to be too precise over the exact size or shape of the hole. By the way, if you want to change the scale markings to suit your own application, there's a real professional low-cost way to do it—just refer back to our February, 1965, issue and read the article on professional-looking meter faces.

The Knight "Clear-View Panel Meters" are available from Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680, and are described in their current catalogs. Prices start at $8.95 (for the 3½" square-face meter).

CUSTOM UTILITY CABINETS AT $5.50

Here's a metal utility cabinet that'll add the finished, custom appearance to that special project you want to display. Finished in two-tone grey hammertone, this Bud cabinet features smooth, rounded edges, and four "no-skid" rubber feet. Also featured are removable front and rear panels, each secured with four heavily chromed oval-head screws. The rear panel has ventilation slots.

The cabinet comes in six sizes, the smallest being 4" x 4" x 6". This size is a natural for small projects. For example, it can house a phototimer and still have room to accommodate two timing knobs and a control



switch on its front panel. If you want to be real fancy, you can use oversized pointer knobs on the timer to allow you to read them in the dark, by touch. And you can mount the timer's *start* and *bypass* push buttons right on the top of the cabinet where you can get at them easily.

Still on the subject of photography, you can also build yourself a *double* timer. This

(*Continued on page* 106)

SOLID STATE

By **LOU GARNER,** Semiconductor Editor

OUR brand-new calendar on the wall tells us it's time once again for our annual crystal ball game with the electronics industry. Before placing our bets for 1966, however, let's look at our 1965 score. In January, 1965, we predicted:

● *Development of a completely new type of semiconductor device.* Home run—not just one but several devices were developed during 1965, including a new class of transistor with a built-in tuning fork that provides high-*Q* frequency discrimination and a solid-state *neuristor* based on tunnel-diode principles.

● *Progress in the development of organic semiconductors.* Home run—reports of progress in this field have been coming thick and fast, with the Johns Hopkins Applied Physics Laboratory and the Fort Monmouth Electronics Laboratories both announcing significant breakthroughs.

● *Production of line-operated transistorized radio receivers* to compete in a market which has, in the past, been dominated by vacuum-tube circuits. Home run—in the latest Sears catalog, the majority of line-operated sets offered utilize transistorized circuits. An important sales feature of such sets is that they offer "instant play," since no warm-up is required.

● *Introduction of consumer thermoelectric-operated products.* Home run—at least two manufacturers are offering across-the-counter thermoelectric generators. while another is producing a hot/cold serving trivet with the cold area provided by a thermoelectric module. Still other firms are producing TE-operated refrigerators for use in automobiles and on small boats.

● *Production of UHF Field Effect Transistors (FET).* Home run—several firms are now manufacturing these devices. Texas Instruments' 2N3823, typical of the new breed, is an N-channel FET capable of low-noise performance from 10 cycles to over 500 mc.

● *Development and production of a sensitive solid-state oscilloscope with a 50-mc. bandwidth.* Home run—an English firm has developed and produced such an instrument, and introduced it on the market early in 1965. At least two U.S. instrument manufacturers have also come up with similar units. As might be expected, prices are high, but not out of line when compared with tube-operated instruments having similar performance characteristics.

● *Expanding use of transistorized circuits in toys.* Home run—for details, check our December, 1965, column, and your local toy stores.

● *A new production technique for semiconductor manufacturing.* Home run—a number of new techniques were introduced during 1965. General Electric is producing low-cost SCR's for consumer applications, Motorola has a process for producing silicon transistors with practically zero input and output capacitances, and IBM has a technique for manufacturing integrated circuits with improved high-frequency characteristics.

Things to Come. Having achieved—at long last—a perfect score, your columnist is naturally reluctant to climb out on a limb again. But, here goes. For 1966 we predict: production of transistorized color TV receivers by at least one major U.S. manufacturer; introduction of a transistorized B/W TV receiver for under $100 retail; use of integrated circuits in automobile electronic systems; use of monolithic integrated circuits in TV, r.f., i.f., and video amplifier circuits, incorporating the latest diffusion and construction techniques, resulting in increased reliability and cost reduction; development of SHF transistors to compete with klystrons and other "exotic" tubes; expanded use of SCR's and related solid-state devices in consumer products other than receivers and amplifiers; relatively inexpensive thermoelectric (TE) modules for hobbyist and experimenter applications; and an appreciable drop in the prices of solid-state light emitters or semiconductor lasers.

Reader's Circuit. Students, Science Fair contestants, and advanced experimenters alike should be interested in the circuit in Fig. 1. Submitted by reader Charles D. Rakes (Oak Grove, Mo.), this two-transistor pulse shaper is capable of converting sine-wave input signals into variable-width rectangular pulses. According to Charles, the unit can be employed at frequencies from

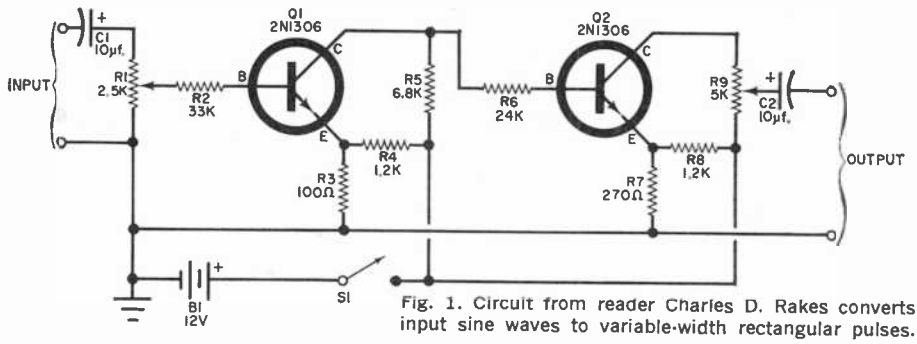


Fig. 1. Circuit from reader Charles D. Rakes converts input sine waves to variable-width rectangular pulses.

10 cycles to over 10 kc., to produce an output pulse waveform whose width can be adjusted from 5% to 50% of the period of one input cycle.

A pair of *npn* transistors are used as cascaded clippers. In operation, the input signal is applied through d.c. blocking capacitor *C1* to pulse width control *R1*. A portion of this signal, depending on *R1*'s setting, is applied through base resistor *R2* to *Q1*'s base-emitter circuit. Transistor *Q1* is operated with a small reverse bias, established by emitter resistor *R3* in conjunction with resistor *R4* which forms a voltage divider. Resistors *R1* and *R2* are also part of the bias circuit.

Clipped and amplified by *Q1*, the signal appearing across collector load *R5* is applied through series resistor *R6* to the second stage (*Q2*). As with *Q1*, *Q2* is operated with a small reverse bias, developed, in this case, by emitter resistor *R7* in conjunction with *R8*. The final output signal is developed across collector load *R9* which also serves as the instrument's output level control. Capacitor *C2* couples the output from *R9*. Operating power is furnished by battery *B1*, through switch *S1*.

Transistors *Q1* and *Q2* are 2N1306's or equivalent *npn* types. Potentiometers *R1* and *R9* are standard linear types, while all resistors are half-watters. Capacitors *C1* and *C2* are 25-volt electrolytics. Switch *S1* can be any s.p.s.t. type. The power supply, *B1*, can be any 12-volt battery, or a combination of batteries to make up 12 volts.

In practice, the pulse shaper is used in conjunction with a conventional audio signal generator connected to its *input* terminals. Its *output* terminals can be connected to an oscilloscope, a test amplifier, or similar equipment. Since the exact point at which clipping occurs—and hence the width of the output pulse signal—depends on the relative amplitude of the applied sine-wave drive signal, potentiometer *R1*, then, serves as the unit's *pulse-width* control. Also, because the pulse shaper must be overdriven for clipping to occur, the signal generator output must be turned up sufficiently or the unit will not operate as described.

Manufacturer's Circuit. If you're interested in working with the new four-layer (*pnpn*) bistable switches now being offered by several manufacturers, the free-running sawtooth generator shown in Fig. 2 should provide a good starting point for your experiments. The circuit is one of several described in a "PNPN Switch Specifications and Applications" bulletin recently published by Sylvania Electric Products Inc. The bulletin is available without charge through franchised Sylvania semiconductor distributors.

A type 2N3254 *pnpn* switch is used in conjunction with a conventional *RC* circuit. In operation, the switch is normally in a high-resistance (nonconducting) state. With *S1* closed, *C1* is charged slowly by *B1* through *R1* and *R4*. As *C1* charges, a portion of the d.c. voltage developed is applied to the *pnpn* switch control electrode (gate) through voltage divider *R2-R3*. As the gate current increases, the 2N3254 switches suddenly to a low-resistance (conducting) state, discharging *C1* through *R4* and its anode-cathode circuit. When the discharge current drops below the 2N3254's "holding" current, the device switches back to its high resistance state, and *C1* starts to charge again. The action is repeated as long as power is applied to the circuit at a rate determined by the *RC* circuit time constant and by the supply voltage.

Except for the 2N3254, the components are standard. All resistors are half-watt types. Capacitor *C1* is a 0.1-μf., 100-volt ceramic or tubular paper type. Switch *S1* is a s.p.s.t. toggle or slide switch. The power source, *B1*, may be series-connected batteries or a conventional line-operated d.c. power supply.

The Sylvania circuit can be used in the form shown for breadboard tests and educational experiments or, if preferred, modified

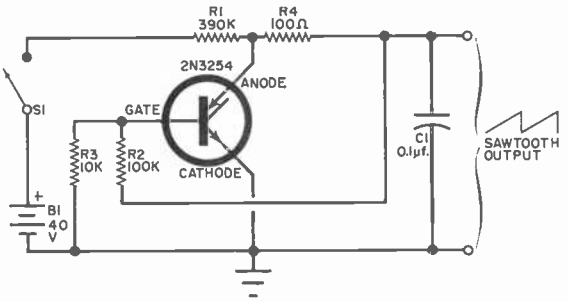


Fig. 2. This free-running sawtooth generator is one of several circuits described in a bulletin recently published by Sylvania Electric Products.

to serve as a linear sweep for an oscilloscope or CRT monitor. According to Sylvania, the specified component values will deliver a sawtooth output with an amplitude of 5.5 volts, a 10.5-millisecond period, and a 24-microsecond fall time. The amplitude and time factors can be varied by appropriate variation of the supply voltage, capacitor *C1*, or the resistors. The value of *R1* must be such that the current available through it is less than the 2N3254's holding current.

New Guide Booklet. A new "Semiconductor Replacement and Interchangeability Guide" has been published by Semitronics Corporation (265 Canal St., New York, N.Y. 10013). Priced at 25 cents per copy, the eight-page booklet lists standard foreign and domestic transistors by type number, together with recommended Semitron replacement types. Similar listings are provided for germanium diodes and silicon power rectifiers. Standard transistor base diagrams are illustrated. The booklet should be of value to service technicians and experimenters.

Transitips. Chances are that nearly every electronics hobbyist, at one time or another, has assembled a single-transistor receiver. In a sense, it is one of the most popular beginning hobby projects. Chances are equally good that a majority of those who have assembled such circuits were disappointed with the results and, subsequently, tried a variety of modified circuits, always hoping for better performance. Let's examine the single-transistor receiver in detail.

A basic receiver circuit is shown in Fig. 3. It consists of an antenna, a tuned circuit (*C1-L1*), a transistor (*Q1*), a headphone, and a power source (*B1*). In operation, *Q1*'s base-emitter circuit serves as a simple diode detector, while amplification is provided by transistor action.

Transistor *Q1*, then, serves both to detect the r.f. signal selected by tuned circuit *C1-L1* and to amplify the resulting audio signal. Unfortunately, it cannot do both jobs efficiently, because the best detector action is obtained when the base-emitter circuit is operated without bias; and maximum gain is obtained when the transistor has a small forward bias. At the same time, the moderate input impedance of the transistor acts to load the tuned circuit, reducing its *Q* and selectivity. In general, this type of circuit has only slightly more gain than an

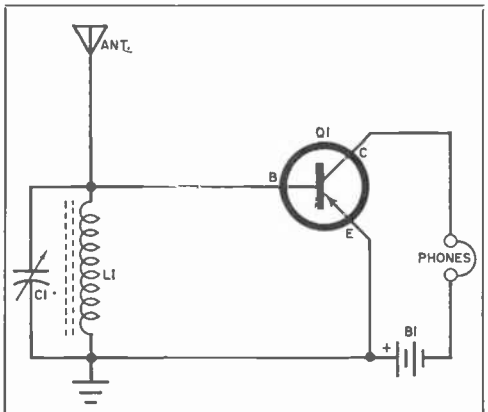


Fig. 3. Circuit of a basic one-transistor TRF receiver consisting only of antenna, tuned circuit (C1-L1), transistor (Q1), headphone, and battery.

old-fashioned crystal receiver with high-impedance headphone, and may have much less selectivity.

Two modifications can be made to the basic circuit to improve performance. First, a small capacitor (generally, 0.01 μf.) can be connected in series with the base lead. This serves to block the d.c. action of *L1* and permits *Q1* to develop a small internal base bias due to leakage. Although detector action may suffer, the resulting improvement in audio gain may be enough to offset this, with the net result being that overall

(*Continued on page* 96)

DX AWARDS

The third in our series of DX Awards is an all-Canada award and is based upon having at least one verification from each of Canada's provinces. (For the purpose of this award, the Yukon Territory and the Northwest Territories are considered as provinces.) The rules and regulations are basically the same as for the previous contests, but you should read them carefully to make sure you follow the correct procedure.

1 Each applicant must be a registered WPE Short-Wave Monitor, and must enter his identification sign on the application form (or facsimile).

2 Each applicant must submit a list of stations (any frequency or service) for which he has received verifications, one for each heard and verified. The list should contain 6, 8, 10, or 12 provinces, depending on which DX award is being applied for. The following information must be furnished in tabular form and in alphabetical order by province for each verification:

(a) Province heard
(b) Call-sign of station verified and location
(c) Frequency
(d) Date station was heard
(e) Date of vertification (postmark dates acceptable)

All the above information should be copied from the station's verification. Do not list any verification you cannot supply for authentication on demand. The provinces of Canada deemed acceptable are: Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, Yukon Territory, and the Northwest Territories.

3 All pertinent verifications, whether QSL cards or letters, should be carefully packaged and stored by the applicant until such time as instructions are received to send in some or all of them for checking purposes. Instructions on how and to whom to send the verifications will be given at that time. Failure to comply with these instructions will disqualify the application.

4 A fee of 50 cents (U. S. coin or stamps) must accompany the list of verifications to cover the costs of printing, handling, and mailing. This fee will be returned in the event an applicant is found to be ineligible for an award. Applicants outside of the United States may send 60 cents (U.S.) in coins of their country if they so desire. Please do not send International Reply Coupons (IRC's).

5 Apply for the highest DX award for which you are eligible. If, at a later date, you become eligible for a higher award, then apply for that award, following these rules and regulations exactly as before.

6 Mail your verification list, fee, and the application form to: Hank Bennett, Short-Wave Editor, POPULAR ELECTRONICS DX AWARDS, P. O. Box 333, Cherry Hill, N.J., 08034. Include in the envelope only those items which are directly related to your entry for the award. Do not include an application for a Short-Wave Monitor Certificate (you are not eligible for any of the awards until you have a Monitor Certificate). If you want to supply news items, reports, etc., please use another envelope.

POPULAR ELECTRONICS' DX AWARD APPLICATION FORM

(please print)

WPE Identification _____ Name _____

Address _____ City _____ State _____ Zip Code _____

Please enter my application for the following POPULAR ELECTRONICS' DX AWARD:

(check one) 6 ☐ 8 ☐ 10 ☐ 12 ☐

☐ I have enclosed a list of the required number of provinces, and I hereby certify that I hold a verification from at least one station (any frequency or service) in each of the provinces listed

☐ I have enclosed 50 cents to help cover the costs of processing and mailing my DX Award

Signature _____ Date _____ 1966

Mail to Hank Bennett, POPULAR ELECTRONICS DX AWARDS, P. O. Box 333, Cherry Hill, N. J.

SHORT-WAVE LISTENING

By **HANK BENNETT,** W2PNA/WPE2FT
Short-Wave Editor

A NEW CANADIAN BROADCASTING AUTHORITY?

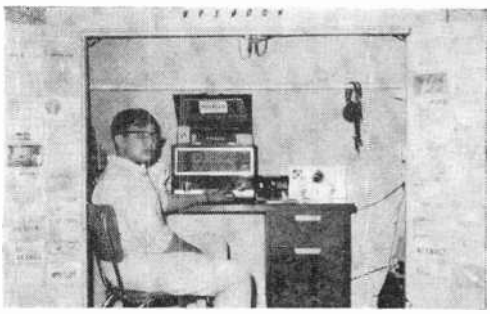
IN May, 1964, the Canadian government set up an advisory committee headed by Robert N. Fowler, an industrialist who formerly had headed a Royal Commission on Broadcasting in 1957. Recently the committee completed its investigations and handed down a 140,000-word document called the Fowler report. In it the committee recommended that the Board of Broadcast Governors be abolished and replaced by a new body called the Canadian Broadcasting Authority, that the new 15-member Authority approve licenses instead of the Federal cabinet, and that the Authority supervise the CBC (Canadian Broadcasting Corporation) instead of the CBC's present 11-man board.

The report also recommended that the national headquarters of the CBC, now in Ottawa, be moved to Montreal, and that the new $2 million-plus national administrative headquarters in Ottawa be sold. Construction has been suspended on the new *Radio Canada* building in the east end of Montreal until further notice due to the uncertain future of the CBC.

A brief was presented to the committee by the CBC proposing that (a) three new 100-kw. transmitters be purchased and installed at Sackville, New Brunswick, for the International Service, (b) that the antenna systems at Sackville be modified, (c) that the CBC develop further cooperation with foreign broadcasters in the relaying of CBC programs over their domestic stations, and (d) that there be "maximum integration" of the CBC Domestic and International Services in both radio and television. No reaction by the Fowler committee to the CBC's proposals has been heard here yet.

News Items. In last month's column we listed a station identifying as *The Voice of the Blue Eagle*, and reported that a letter from the FCC mentioned that the station had been located and the operator warned but that the station continued to broadcast. A subsequent report from a high FCC official now states that the station *is* authorized by the FCC, and is being operated as part of a government test of broadcast operations and related facilities for world-

(*Continued on page* 108)



The main receiver of Neely Kountze, WPEØDOW, Omaha, Nebr., is a Hallicrafters TW-1000, but he has three smaller units. He also has a homemade VHF "broadspanner" and a Sony 111 recorder.

One of our long-time monitors on the West Coast is Stewart Mac Kenzie, Jr., WPE6AA, of Huntington Beach, Calif. Stewart's equipment includes BC453 and R45A557 receivers, a Webcor two-track tape recorder, and a BC306B tuning unit for his antenna.

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA

Prepared by ROBERT LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

COUNTRY	CITY	TIME—EST	TIME—GMT	FREQUENCIES (MC.)
ALBANIA	Tirana	7-7:30 p.m.	0000-0030	7.265
ARGENTINA	Buenos Aires	10-11 p.m. (Mon.-Fri.)	0300-0400 (Tues.-Sat.)	9.69
AUSTRALIA	Melbourne	7:15-7:45 a.m.	1215-1315	11.84 or 9.58
BULGARIA	Sofia	7-8 p.m.	0000-0100	6.07
CANADA	Montreal	7:15-8:15 a.m.	1215-1315	5.97, 15.32
CHINA	Peking	7-8 p.m.	0000-0100	11.82, 15.06
	"	8-10 p.m.	0100-0300	9.48, 11.945
CUBA	Havana	10-11:30 p.m.	0300-0430	6.135
CZECHOSLOVAKIA	Prague	10-11 a.m. (Sun.)	1500-1600 (Sun.)	15.20, 15.285, 17.825
	"	8-9 p.m.	0100-0200	5.93, 7.115, 7.345
DENMARK	Copenhagen	7:30-8 a.m.	1230-1300	15.165
	"	9-9:30 p.m.	0200-0230	9.52 or 6.065
ECUADOR	Quito (HCJB)	9-10 a.m.	1400-1500	15.115, 17.89
	"	9-11:30 p.m.	0200-0430	9.745, 11.915
FINLAND	Helsinki	7:15-7:45 a.m. (Tues., Sat.)	1215-1245 (Tues., Sat.)	15.185
GERMANY	Cologne	8:30-9:50 p.m.	0130-0250	6.075, 9.64
	Berlin	8-9 p.m.	0100-0200	5.97, 6.16
GHANA	Accra	8-9 p.m.	0100-0200	9.76
GREAT BRITAIN	London	10:30 a.m.-12:30 p.m.	1530-1730	15.30, 11.84
	"	4:15-9:45 p.m.	2115-0245	6.195, 7.13, 9.51
HUNGARY	Budapest	7:30-8 p.m.	0030-0100	7.305, 9.833
	"	8:30-9:30 p.m.	0130-0230	7.305, 9.833
ITALY	Rome	8-8:20 p.m.	0100-0120	5.96, 6.01, 9.63
JAPAN	Tokyo	7-8 p.m.	0000-0100	11.78, 15.135
JORDAN	Amman	8:15-8:45 p.m.	0115-0145	9.557
LEBANON	Beirut	8:30-9 p.m.	0130-0200	9.575
NETHERLANDS	Hilversum	4-4:50 p.m.	2100-2150	6.085, 9.59
	Bonaire relay	8:30-9:20 p.m.	0130-0220	6.085 or 9.59
NETH. ANTILLES	Bonaire	7-8 a.m.	1200-1300	11.82
	"	7:35-8 p.m.	0035-0100	11.82 or 9.605
NORWAY	Oslo	9-9:30 a.m. (Sun.)	1400-1430 (Sun.)	15.175, 17.825
	"	7-7:30 p.m. (Sun.)	0000-0030 (Mon.)	6.185, 9.61
PORTUGAL	Lisbon	9-9:45 p.m.	0200-0245	6.025, 6.185
RUMANIA	Bucharest	8:30-9:30 p.m.	0130-0230	5.98, 9.57
	"	10-10:30 p.m.	0300-0330	5.98, 9.57
SPAIN	Madrid	8-8:45 p.m.	0100-0145	6.13, 9.615
	"	9-9:45 p.m.	0200-0245	6.13, 9.615
SWEDEN	Stockholm	8-8:30 a.m.	1300-1330	15.195
	"	8:45-9:15 p.m.	0145-0215	5.99
SWITZERLAND	Berne	8:15-9:15 p.m.	0115-0215	6.08, 6.12, 9.535
U.S.S.R.	Kiev	7:30-8 p.m. (Mon., Thurs.)	0030-0100 (Tues., Fri.)	7.175, 9.685
	Moscow	5-5:30 p.m. & hourly until 12-1 a.m.	2200-2230 & hourly until 0500-0600	7.15, 7.31, 9.685
VATICAN	Vatican City	7:50-8:10 p.m.	0050-0110	5.985, 7.25, 9.64

TO WESTERN NORTH AMERICA

ARGENTINA	Buenos Aires	10-11 p.m. (Mon.-Fri.)	0600-0700 (Tues.-Sat.)	9.69
AUSTRALIA	Melbourne	5-7:45 p.m.	0100-0345	15.22, 17.84
BULGARIA	Sofia	8-8:30 p.m.	0400-0430	6.07
CHINA	Taipei	6:50-7:50 p.m.	0250-0350	9.72, 11.825, 15.345
	Peking	7-9 p.m.	0300-0500	7.08, 9.457
CUBA	Havana	9-10 p.m.	0500-0600	6.135
CZECHOSLOVAKIA	Prague	7:30-8 p.m.	0330-0400	5.93, 7.115, 7.345
GERMANY	Cologne	7:10-7:50 a.m.	1510-1550	9.735, 11.795
	"	9-9:40 p.m.	0500-0540	6.145, 9.735
	Berlin	7:45-8:15 p.m.	0345-0515	5.97, 6.16
GHANA	Accra	7:30-8:30 p.m.	0330-0430	6.11
HUNGARY	Budapest	8:30-9 p.m.	0430-0500	7.305, 9.833
JAPAN	Tokyo	7-8 p.m.	0300-0400	11.78, 15.135
KOREA	Seoul	7-7:30 p.m.	0300-0330	11.925
NORWAY	Oslo	8-8:30 a.m. (Sun.)	1600-1630 (Sun.)	11.85, 15.175
PORTUGAL	Lisbon	7:45-8:30 p.m.	0345-0430	6.025, 6.185
SPAIN	Madrid	7-7:45 p.m.	0300-0345	6.13, 9.615
SWEDEN	Stockholm	7:15-7:45 p.m.	0315-0345	5.99
SWITZERLAND	Berne	7:15-8:15 a.m.	1515-1615	11.715
	"	8:15-9:15 p.m.	0415-0515	6.12
THAILAND	Bangkok	8:15--9:15 p.m.	0415-0515	11.91
U.S.S.R.	Moscow (via Khabarovsk)	7-10:30 p.m.	0300-0730	7.20, 9.64, 11.75

ON THE CITIZENS BAND

By **MATT P. SPINELLO,** KHC2060, CB Editor

LAST SUMMER, at a fairly quiet Jamboree, a disgruntled dealer informed us that "CB is dead. Since the new Rules hit, the service is all washed up!" At the time, we felt that a better choice of words would have been "all cleaned up."

Upon questioning the dealer, we found his judgment to be a little off-balance, and his statistics more opinionated than factual.

CB YEAR IN RETROSPECT

In friendly courtroom style, we managed to get him to admit that his primary intention was to make a "fast buck" in the CB business on a part-time basis. He had been selling gear for six months and as summer arrived, "all of a sudden the bottom dropped out."

We informed him that CB activity in some areas almost comes to a halt during the summer months (except for emergencies), and that many clubs discontinue printing their monthly newspapers and take a hiatus on monthly meetings until early fall. He was much relieved to learn that CB'ers take vacations, too, and that *all* CB interest hadn't fallen away simply because the FCC changed the Rules and goofed up his "easy money" plans.

The fact of the matter is: from the standpoint of the Citizens Radio Service as it was primarily intended to serve, CB never had a better year! Our resolution-type predictions in this column two years ago have moved into an admirable position of acceptance that cannot be denied. Rule changes *have* minimized verbal shenanigans to a large degree; and 1965 appears to have been *the* year for uniting ham and CB operators through the use of CB/ham communications during some of the worst tornadoes, hurricanes, and floods ever known to many areas of the United States.

Many police and civil defense groups formerly dead-set against the use of CB communications as an aid to emergency search and rescue handling did a complete reversal in 1965. One area reports no less than ten counties linked through CB base stations in police and sheriff departments, with teams of CB volunteer mobiles on stand-by in almost every city within the network.

The Part 95 rule changes had a noticeable effect on the CB hobbyist in 1965, but special police teams, rescue units, and club activities along the lines of first-aid training, CD meetings and affiliations continued to grow. REACT's national operation now boasts more than 850 teams, and the recently initiated Highway Emergency Locating Plan (H.E.L.P.) has drawn upwards of 1000 teams. Hundreds of local and area-wide CB clubs continued to man emergency teams within their organizations. And at least a dozen state-wide CB clubs are working towards the unification of a National CB Congress.

Citizens Band radio appears to have settled down to more serious business than was expected. With a record new high in usefulness, it beckons the personal user who can now find assistance as close as his microphone anywhere in the country, in addi-

When tornadoes struck portions of the midwest and western states during 1965, CB'ers and their equipment took over—for weeks in some cases—until regular communication facilities could be restored.

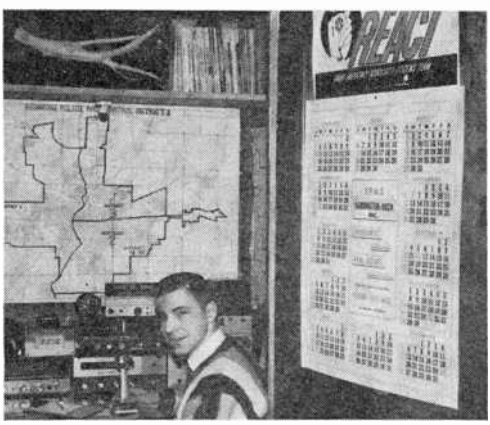
Police, civil defense, and sheriff's agencies have become more dependent on the assistance of CB'ers. The group shown here is preparing a divisional plan to cover an entire county during Halloween week.

tion to 16 "cleared channels" from which he may work his units. The business user can likewise find aid, as needed, as well as inexpensive long-range communications as far as his service vehicles travel, through the use of specialized gear and antenna systems.

Too many lives were saved in 1965 through CB communications on land, from water, and—no doubt—from the air, to be overlooked. Authorities have seen the dawn; city-wide and state-wide nets are growing—and someday there will be nation-wide nets. The CB growth has occurred despite verbal wars between services and the juvenile attitudes of a few junior G-men. The picture is painted; it looks brighter!

Emergency CB Assists. When the Richmond, Ind., telephone company was gutted by a disastrous fire, cutting Richmond residents off from the rest of the world, the local REACT team of the Eastern Indiana Emergency Communications Net went into action. Mike Chambers, president of the group, was called out of school by CD officials and got only 12 hours' sleep during the next 82 while performing his job in the emergency communications net. Communications services were provided by the group for hospitals, schools, city offices, newspapers and various businesses whose services and products were essential to community well-being. Mobile units were stationed throughout the area, and on each fire alarm box in the city was posted the address of the nearest CB or ham station in operation. Accident reports, ambulance service, emergency communications involving births, deaths, and heart attacks were all part of the service provided by Mike and his area REACT'ers.

Two Washington State youths, aged 11 and 12, were reported missing after failing to return home one evening. They had been last seen during the day heading for a densely wooded area on the outskirts of Ashford, near Mount Rainier. At 5:30 a.m. the next morning, teams were made up of sheriff's department deputies, the Tacoma Citizens Band Radio Association Search & Rescue team, Department of the Interior employees, Webfoot Jeep Club members, and other volunteers. By 10:30 a.m. the boys had been located and returned to base camp. They had spent the night in an abandoned car in the woods; the only ill effects of their escapade involved a few "hunger pangs." The boys' parents saw to it that the rescue team members enjoyed a homemade spaghetti dinner with all the trimmings.



Mike Chambers and his REACT team provided varied emergency communication services when the Richmond, Ind., phone company was disabled by a fire.

The *CB Squelch*, monthly publication of the Broward Citizens Band Radio Club, recently saluted Ken Nordine and his hurricane team for their assistance during Florida's hurricane lashing last fall. Seventeen club members manned shelters, handled communications, ran a taxi service, served coffee, and even baby-sat! One CB mobile, a small foreign sports car, carried a poodle through the operation. He was not too happy with the ride or cramped quarters, but evidently accepted the situation when he learned that four-legged animals were not allowed in the shelters. Kudos were also bestowed on the 11 Meter Club whose members participated during the crisis under the direction of L. Hart. All members of both organizations have been asked to prepare a critique on their operations during the hurricane in order that CB control personnel may evaluate them to improve their methods of operation in future assists.

Richard Steimel, KNJ9876, Madison, Wis., editor of the *Lakeland CR Net Newsletter*, was involved in an emergency assist while returning home from Oshkosh, Wisconsin. Traveling on U.S. Highway 41, at about 1 a.m., Richard and two companions came upon a vehicle that appeared to have something burning beneath it. On their approach, the vehicle burst into flames. Attempts to extinguish the blaze with Rich's fire extinguisher were futile since the fire had too much of a head start. A general emergency call was placed on channel 9, and immediately answered by Marv Niemuth, KLK6814, Oshkosh. Rich and his passengers directed traffic until authorities arrived.

The above assist can be considered typical of the emergencies that prompted the organization of H.E.L.P. In this case assistance was too late in arriving, through no fault of Richard Steimel. But the driver's earlier attempts to stop passing motor-

(*Continued on page 101*)

AMATEUR RADIO

By **HERB S. BRIER,** W9EGQ
Amateur Radio Editor

SIGNAL REPORTS, ANTENNAS, AND GETTING OUT

WHY IS IT that sometimes every station you call answers you, but at other times you call and call without success, yet, when you finally do make a contact, you get an excellent signal report? Unfortunately, there is no single answer to this question. In fact, no amateur, no matter how elaborate his station is, thinks that he always gets out as well as he should. For instance, a certain W6 didn't think that a hand-picked dream location and a 1000-watt transmitter driving a huge rotary beam antenna was quite enough. When the FCC dropped in to see him, he was operating with a transmitter power of 10,000 watts. He no longer has an amateur license.

Even if your transmitter isn't very powerful, it may be putting out a good signal which is swamped by other signals from stations closer to the distant station that you are trying to contact. Or your receiver may be at fault—the distant station may have heard your transmission and be returning your call but is being knocked out of the box by a few strong signals that seem to fill up the entire amateur band.

If you have a low-power transmitter and a non-selective receiver, you are bound to be in a real bind during the popular operating hours. Obviously, you are not going to get many calls from the powerhouse stations—they are working each other, or calling exotic DX. Worse, you can't hear the weaker signals that you might work through them. About all you can do is concentrate most of your operating during the less-crowded hours of the day until you get better equipment.

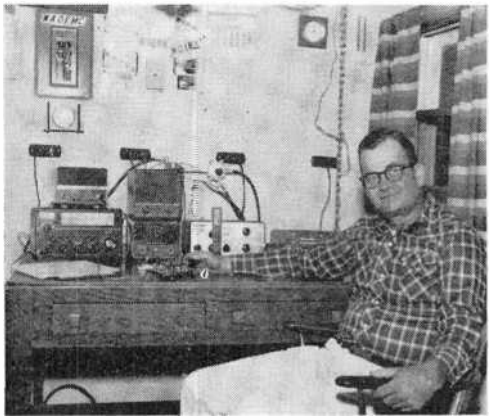
But suppose you have a fairly high power transmitter and a good receiver, and are a good operator, and *still* find it difficult to make contacts at certain times of the day—often in the late afternoon and evening hours—even when competition doesn't appear too great. You may be the victim of the radiating characteristics of your antenna.

To give a capsule review of antenna characteristics, at frequencies up to 30 mc. a low horizontal antenna (say less than 30 feet high) radiates most of the energy at high angles above the horizon, but signals radi-

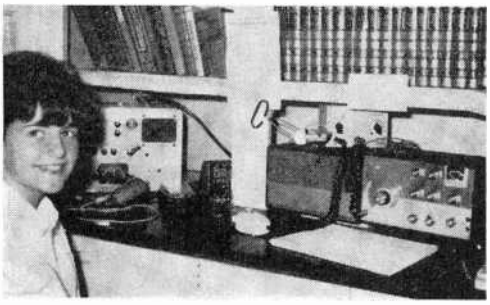
AMATEUR STATION OF THE MONTH

Charles Stokes, K5ROB, Midland, Texas, neglects neither the public service nor the hobby side of amateur radio. He has earned three public service awards from the ARRL, and is a member of RACES, AREC, Navy MARS, and U.S. Coast Guard auxiliary. K5ROB has worked all states both as a fixed station and as a mobile station. His equipment includes a Swan-240 transceiver, a home-built amplifier, and a tri-band beam on a 50′ steel tower. Charles will receive a one-year subscription for submitting this winning photo for January in our Amateur Station of the Month contest. If you would like to enter the contest, send us a clear picture of your station, preferably showing you at the controls, accompanied by some details on your equipment and your ham career. Mail your entry to Amateur Photo Contest, c/o Herb S. Brier, P.O. Box 678, Gary, Ind. 46401.

With a power output never exceeding 75 watts, Bill McGrew, WAØEMC, managed to work 50 states on 80-meter CW. Bill's equipment includes a WRL "Meteor-175" transmitter, a Hallicrafters HA-5 VFO, a Drake 2-B receiver, and an electronic keyer.



At the age of ten, Donna Lane, now WB6AUB, got her Novice license. When she became a General, her Gonset "Gooney Box" was superseded by a Galaxy-III transceiver feeding a Hy-Gain 14-AVS antenna. She is pretty close to 50 states—only 3 more to go.



ated at a low angle are more readily reflected from the ionosphere to earth. It is this reflection that makes high-frequency DX communications possible. Above a certain critical frequency, high-angle signals pass through the ionosphere into outer space, never to return.

Normally, around mid-day even signals radiated straight up at frequencies below 4000 kc. are reflected by the ionosphere back to the earth. But this is not the complete story; the sun's rays that create the ionosphere also bombard the upper regions of the lower atmosphere so strongly that low-angle, low-frequency signals are absorbed in the atmosphere before they can reach the ionosphere. Thus, the normal mid-day range of signals below 4000 kc. (75 meters) seldom exceeds a few hundred miles, and a low antenna works about as well as a high one.

Then, as the sun begins to set, the signal absorption in the lower atmosphere decreases much more rapidly than the layers of the ionosphere. Consequently, for an hour or two around sunset, 80-meter signals become very strong, even from low antennas, but in the later evening hours the higher antennas take over.

With a low horizontal antenna, daytime conditions on 40 meters (and to some extent on 15 and 20 meters at distances up to 900 miles or so) are similar to the conditions on 80 meters, the main difference being that daytime losses in the lower atmosphere are much less for 40 meters than for 80 meters. On the other hand, the difference between day and night conditions is normally much more pronounced on 40 meters than on 80 meters.

Undoubtedly you have already found out that it's a pretty good trick to work distant 40-meter stations at night with a low horizontal antenna. After dark, 15 and 20 meters are usually completely dead, except for local signals.

If you are stuck with a low horizontal antenna and have trouble getting out, you can: (1) wait until summer, when conditions will change; (2) raise your antenna; (3) drop down to a lower frequency band at night—your average DX may not be quite as great as before, but you probably won't be talking to yourself as much either; or (4) try a vertical antenna. Compared to a low horizontal antenna, a vertical antenna may not be quite as good over the shorter distances on 80 and 40 meters, but it should do better over the longer distances.

Louisiana QSO Party. You are invited to participate in the First Annual Louisiana QSO Party sponsored by the Lafayette Radio Club between 1400 GMT (8 a.m., CST), Saturday, January 29, and 2200 GMT (4 p.m., CST), Sunday, January 30. You may use phone and CW and all amateur bands.

Amateurs outside of Louisiana are to work stations in the different Louisiana parishes; Louisiana amateurs are to work stations in the different states (including Louisiana), Canadian provinces, and countries. You exchange number of contact, RST report, and location (parish, state, province, or country) with each station worked. The same station may be worked once per band and mode. Your total score is the number of contacts multiplied by the number of parishes, or states, provinces, and countries worked. Suggested frequencies are 3600, 3910, 7100, 7230, 14,100, 14,300, 21,100, 21,400, 28,100 and 28,800 kc.

Send your contest logs and claimed scores

(*Continued on page* 98)

HEADLIGHTS-ON ALARM

Alarm sounds if the lights are left on after the ignition is switched off

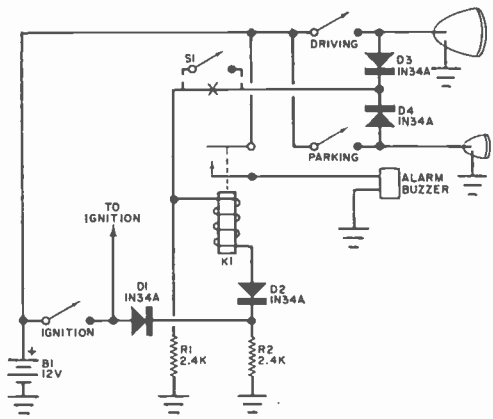
By THOMAS R. YOCOM

HOW MANY TIMES have you jumped into your car, turned on the ignition switch, ready to go somewhere, only to have nothing happen—a dead battery! Why? Because the lights were left on after the car was parked; during the winter months the chance of this happening is greatly increased. You can put this annoying situation behind you for good by installing a "Headlights-On Alarm." It is small enough to be tucked under the dashboard, and it will sound an alarm if you leave your lights on when you turn off the ignition switch.

How It Works. A warning bell or buzzer goes on when current runs through relay *K1*. When the ignition switch is turned on, a small current on the order of 5 ma. will flow through *R2*. No current can flow through *K1* because *D2* is reverse-biased at essentially full battery voltage. The ignition system and any other electrical devices connected through the ignition switch operate in a normal manner.

When the parking or driving lights are turned on, current runs through the lights as usual, and also goes through *R1*. Current cannot go through *K1* because of the reverse-biased condition of *D2*. However, if the ignition switch is turned off, the bias on *D2* is removed, and if the headlight switch is still on, current will run through *K1*, *D2*, and *R2*, and energize the relay to turn on the alarm.

Diodes *D3* and *D4* prevent interaction between the parking and driving lights; otherwise both lights would go on when either light switch was closed.



Should you forget to turn off your lights when you turn off the ignition switch, the alarm will sound—unless you install a disabling switch (S1).

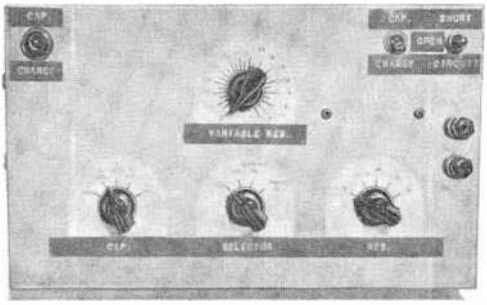
PARTS LIST

D1, D2, D3, D4—1N34A diode or equivalent
K1—5000-ohm remote-control relay, s.p.s.t., pull in at 1.4 ma., drop out at 1.2 ma. (Lafayette 99 R 6091 or equivalent)
R1, R2—2400-ohm, ½-watt resistor
S1—S.p.s.t. switch (optional—see text)
1—12-volt buzzer

Installation. Parts can be mounted on a small chassis or clustered around the relay. The alarm circuit shown in the schematic is for cars having a negative ground electrical system. For positive ground systems, reverse the polarity of all the diodes.

Should you want to operate the lights without having the alarm sound off and without having to turn on the ignition switch, break the line at point *X* in the diagram and add *S1*.

Another innovation is to use the taillight circuit instead of the headlights and parking lights. Since the taillights go on when either the parking or driving lights are on, you only need to monitor the taillights. In this case, eliminate *D4* and connect the anode of *D3* to the taillight bus instead of to the driving lights circuit. —30—



COMBINATION RC SUBSTITUTION BOX

By CARLETON A. PHILLIPS

Just flip the switch to substitute heavy-duty resistors or capacitors individually or in series or in parallel networks in your construction projects

HERE'S AN ITEM that's a must for shack or shop—an *RC* substitution box which provides substitute resistors and capacitors individually, or in series or parallel *RC* combinations. You can use it to bridge suspected defective components, or to rapidly switch in different values of resistance and capacitance to

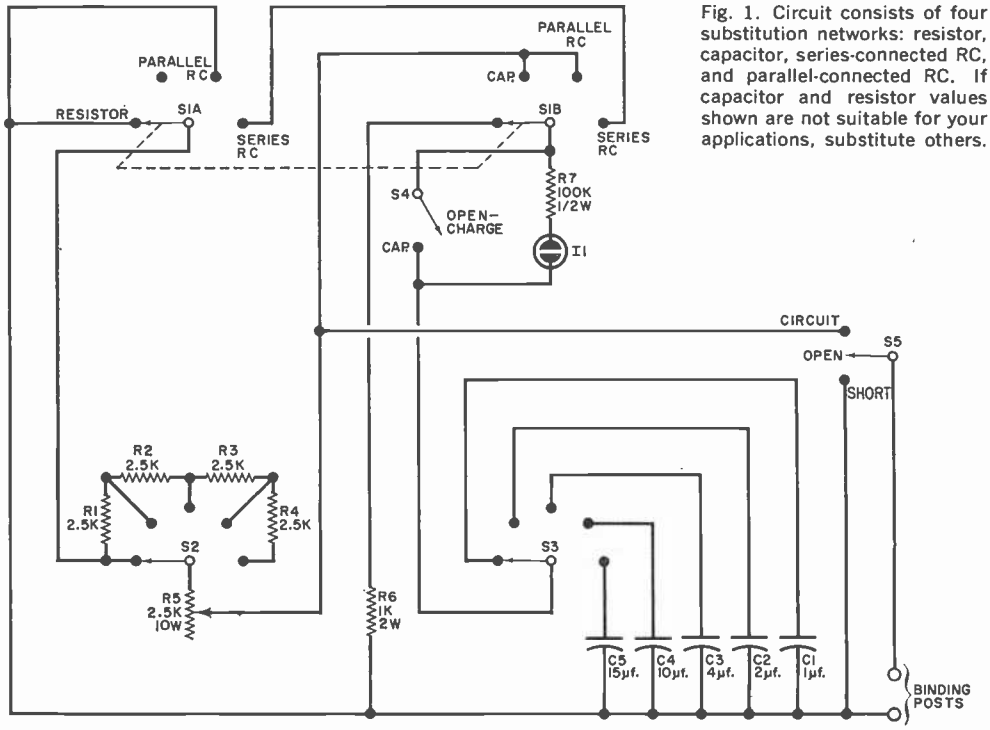


Fig. 1. Circuit consists of four substitution networks: resistor, capacitor, series-connected RC, and parallel-connected RC. If capacitor and resistor values shown are not suitable for your applications, substitute others.

check transistor characteristics and circuits, and to perform various electronic experiments. Simple to build, it can be fashioned from ordinary parts.

How It Operates. Essentially, the substitution box is composed of a bank of capacitors and a bank of resistors which can be switched in by front panel controls to obtain desired values. See Fig. 1.

To use the box as a substitute resistor, place the *SELECTOR* switch in the *RES* position, and rotate either the *RES* switch (*S2*) or the *VARIABLE RES* control (*R5*) for the value you want. The *RES* control, which switches in one or more resistors (*R1* through *R5*), provides a resistance value of from 0 to 12,500 ohms in increments of 2500 ohms. The *VARIABLE RES* control fills in all the values between each 2500-ohm step.

To use the box as a substitute capacitor, place *S1* in the *CAP* position, and rotate the *CAP* switch (*S3*) to select the capacitance you want.

When bridging a suspected defective capacitor, especially in a transistor circuit, throw the *CHARGE* switch (*S4*) to the *OPEN* position to allow the substitute capacitor to charge slowly through *R7* and *CAP CHARGE* lamp *I1*. When the capacitor is charged, the lamp will go out. Now you can throw *S4* into the *CAP* position. This procedure prevents temporary healing of the bridged capacitor, if it is defective, and current surge. By rotating the *SELECTOR* switch back to the *RES* position, charges built up on the capacitors used in the substitution box will be dissipated through *R6*.

To obtain a parallel-connected resistor and capacitor network, rotate the *SELECTOR* switch to the *PARALLEL RC* position. Capacitance value is selected by *S3* and resistance value by *R5* and *S2*. To obtain a series-connected resistor and capacitor, place the *SELECTOR* switch in the *SERIES RC* position.

PARTS LIST

C1—1 μf.
C2—2 μf. } *600-volt*
C3—4 μf. } *paper*
C4—10 μf. } *capacitors*
C5—15 μf.
I1—NE-51 neon lamp
R1, R2, R3, R4—2500-ohm, 10-watt resistor
R5—2500-ohm, 10-watt potentiometer
R6—1000-ohm, 2-watt resistor
R7—100,000-ohm, ½-watt resistor
S1—Two-gang, four-position rotary switch
S2, S3—Five-position rotary switch
S4—S.p.s.t. toggle switch
S5—S.p.s.t. toggle switch with center-off position
2—Binding posts
1—7" x 12" x 4" box (Bud CU-2111A or equivalent)
Misc.—Knobs, hardware, etc.

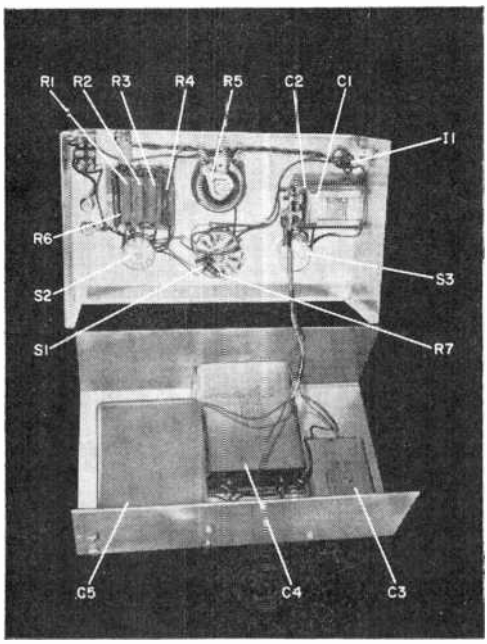


Fig. 2. Use of heavy-duty components puts this substitution box in a class all by itself. You need have no fear of burning out the 10-watt resistors.

Construction. All components are mounted in a 3" x 5" x 7" box as shown in Fig. 2. You can select any assortment of resistors and capacitors to put into the substitution box should you desire a different range of values from that shown. If electrolytic capacitors are used, polarity should be observed and indicated at the *BINDING POSTS*. Paper capacitors were used here to avoid polarity problems.

All components, except for the three large capacitors, are fastened to the cover of the box. The resistors can be mounted on a small phenolic board. The board can be fastened to the cover, but kept in the clear by a pair of standoff bushings. -30-

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DATE AND TIME OF EXPIRATION SEPTEMBER 11, 1968 AT THREE O'CLOCK A. M. EASTERN STANDARD TIME.

SPECIAL ENDORSEMENTS SHIP RADAR ENDORSEMENT - SEPTEMBER 11, 1963 - BUFFALO, NEW YORK

ISSUING OFFICER

Federal Communications Commission.

Tommy Willis Duffy (Licensee)

(Issuing Officer)

Ben F. Waple (Secretary)

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SPECIMEN

Employers are paying good money for men holding FCC tickets. Read how to get yours:

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These CIE men have good jobs
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Matt Stuczynski, Senior Transmitter Operator, Radio Station WBOE. "I give Cleveland Institute credit for my First Class Commercial FCC License. Even though I had only 6 weeks of high school algebra, CIE's AUTO-PROGRAMMING teaching method makes electronics theory and fundamentals easy. After completing the CIE course, I took and passed the 1st Class Exam. I now have a good job in studio operation, transmitting, proof of performance, equipment servicing. Believe me, CIE lives up to its promises!"

Ted Barger, Electronic Technician, Smith Electronics Co. "I've been interested in electronics ever since I started operating my own Ham rig (K8ANF). But now I've turned a hobby into a real interesting career. Cleveland Institute of Electronics prepared me for my Commercial FCC License exam . . . and I passed it on the first try. I'm now designing, building and testing all kinds of electronic equipment . . . do a lot of traveling, too. It's a great job . . . and thanks to CIE and my FCC License, I'm on my way up."

Chuck Hawkins, Chief Radio Technician, Division 12, Ohio Dept. of Highways. "Cleveland Institute Training enabled me to pass *both* the 2nd and 1st Class License Exams on my *first* attempt . . . even though I'd had no other electronics training. (Many of the others who took the exam with me were trying to pass for the eighth or ninth time!) I'm now in charge of Division Communications and we service 119 mobile units and six base stations. It's an interesting, challenging and extremely rewarding job. And incidentally, I got it through CIE's Job Placement Service . . . a free lifetime service for CIE graduates."

Glenn Horning, Local Equipment Supervisor, Western Reserve Telephone Company (subsidiary of Mid-Continent Telephone Company). "There's no doubt about it. I owe my 2nd Class FCC License to Cleveland Institute. Their FCC License Program really teaches you theory and fundamentals and is particularly strong on transistors, mobile radio, troubleshooting and math. Do I use this knowledge? You bet. We're installing more sophisticated electronic gear all the time and what I learned from CIE sure helps. Our Company has 10 other men enrolled with CIE and take my word for it, it's going to help every one of them just like it helped me."

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HI-FI À GO-GO LAMPS

(*Continued from page* 66)

container. All you have to do is replace the rectifier module and SCR with models rated to handle the increased wattage. The accompanying table lists components needed for 200, 600, 1000, and 2000 watts. Parts cost for 200 and 400 watts runs a little over four bucks. But for 1000 watts it jumps up to about $7, and for 2000 watts, $8.50.

MODIFICATION TABLE FOR MORE POWER

Power Level (watts)	Rectifier Module	Heat Sink?	SCR1	Heat Sink?
200	1.5 amp. Motorola MDA942-3	No	2.0 amp. RCA 2N3528	No
600	6.0 amp. Motorola MR1032B (4 req'd.)	No	5.0 amp. RCA 2N3228	Yes
1000	10 amp. Motorola MDA962-3	No	8.0 amp. Motorola MCR1305-4	Yes
2000	18 amp. Varo Inc. 1N4436	Yes	18 amp. Motorola MCR808-4	Yes

How To Use It. There are many ways in which you might use the *À Go-Go* lamps. For instance to make stereo listening fun to watch, you can install an *À Go-Go* in each channel. In the right channel use four red and two green 25-watt bulbs; in the left channel use four yellow and two green ones. Arrange all the lamps in a row in a reflective enclosure (crumbled aluminum foil will do) or behind a translucent screen. The green lamps should be in the middle, the red on the right, and the green on the left.

Audio signals for the *À Go-Go* can be taken directly from the speaker leads. If the sound is too loud for the amount of light you want, try a lower impedance tap on the amplifier or add a few ohms resistance between the amplifier and the speaker. -30-

RADIO ASTRONOMY

(*Continued from page 44*)

na, whose physical aperture is equivalent to a 152′-diameter dish. Another large radio telescope is the 600′ parabolic cylinder, spread out on an area bigger than four football fields, at the University of Illinois.

In an effort to increase the resolution of the radio telescope, scientists have turned to using multiple-aperture devices instead of building larger and larger single-aperture ones. The resolving power of a radio telescope can be defined as the minimum separation between two radio sources at which the radio telescope can still distinguish that two sources are present.

One such multiple-aperture device now widely in use is the interferometer, the operation of which can be understood by referring to the illustration on page 41. Basically, the interferometer converts the broad antenna beam of a single-aperture device into a large number of fan-shaped beams. Thus it's able to pinpoint many faint sources in small areas of the sky. With the largest dish antennas, the minimum angle of resolution is greater than 1/10°; but with the interferometer, resolutions on the order of 30 seconds of arc or less are common.

Many observatories, notably the Radio-physics Laboratory in Australia, and the California Institute of Technology's Owens Valley Observatory, use variable-spacing interferometers. By varying the distance between the two antennas, varied interference patterns are obtained from which radio astronomers can deduce the positions, sizes, and shapes of very distant sources.

Another widely used variation of the interferometer is the Mills cross or cross-type interferometer. Consisting of an array of antennas arranged in the shape of a cross, it's actually a combination of two interferometers. The great length of these arms of electrically linked antennas results in a very accurate pinpointing of radio sources without the excessive cost of a parabolic

dish with a diameter equal to its length. The world's largest Mills cross installation is nearing completion in Australia; it has two mile-long rows of antennas. Other cross-type interferometers can be found at Stanford University, California, Oka Radio Astronomical Station, Moscow, and University of Bologna, Italy.

Another method of achieving high resolution is through the use of an array of half-wave dipoles connected in phase and located above a reflecting screen. One installation, at the U.S. National Bureau of Standards Observatory near Lima, Peru, uses an array of 9000 half-wave dipoles. And, as for future radio telescopes, radio astronomers are talking about telescopes with pinpoint resolution, as well as orbiting and lunar-based units.

Amateurs and The Stars. Each year finds more and more hobbyists joining the ranks of amateur radio astronomers, as radio astronomy is one field where the amateur can really dig in and do some responsible research. Some of these people build their own radio telescopes and work alone out of backyard or rooftop observatories, but the majority belong to amateur astronomy groups.

Actually, you need very little equipment to get started. Some radio sources, notably the sun and planet Jupiter, can be picked up with a standard communications receiver and simple directional antenna. (See August, 1964, POPULAR ELECTRONICS.) You can even substitute an inexpensive voltmeter for a pen recorder. But to get any real degree of resolution, you need a big antenna and more sophisticated instruments, and that usually means joining a club where such units are available.

One amateur reported making a simple high frequency radio telescope using little more than a beach umbrella, a modified UHF converter, and a standard communications receiver. He converted the umbrella to a dish antenna by spraying the inside of it with aluminum paint and then finding the focal point by moving up the umbrella handle with a flashlight. When the area inside the umbrella lit up, he had a pretty good idea where the focal point was. Since this particular amateur was interested in picking up 21-cm. hydrogen "broadcasts," he modified the UHF converter so it would tune as high as 1400 mc. instead of the normal 890 mc., and by using it as a "front end," he was able to employ a communications receiver tuned to 20 mc. There are also many types of surplus equipment, particularly high frequency receivers, which can be adapted for the purpose.

But before you start hoisting a massive dish antenna up to the roof of your house or go about filling up your backyard with dipoles, why not read up on the subject? Many good books are available from your local library or bookshop, some of which are slanted toward the amateur telescope builder. For example: *Radio Astronomy* by J. H. Piddington (Harper & Brothers—now out of print but available at libraries); *Radio Exploration of the Planetary System* by Alex G. Smith and Thomas D. Carr (D. Van Nostrand Co., 24 W. 40th St., New York 18, N.Y., $1.50); *Radio Astronomy And How to Build Your Own Telescope* by John Heywood (Arco Books, 219 Park Ave. South, New York, N.Y., $2.50 cloth, 95 cents paperback); and *Radio Astronomy For Amateurs* by Frank W. Hyde (W. W. Norton & Co., 55 Fifth Ave., New York, N.Y., $5.00).

As interest in amateur radio astronomy is world-wide, so are the amateur societies serving these people. For instance, in England, where radio astronomy is very popular, the British Astronomical Association is a highly respected organization and its members sometimes work with radio astronomers from Cambridge and Jodrell Bank on various experiments. In the United States, the Astronomical League, the parent organization to some 170 clubs, can guide you in selecting a nearby astronomy club. For more information, write to the Executive Secretary, Astronomical League, 4 Klopfer St., Millvale, Pittsburgh, Pa. Westerners and Hawaiian residents can also write to the Western Amateur Astronomers, 4636 Vineta St., La Canada, Calif.

Many of these local clubs have active radio astronomy programs. In the New York City area, for example, the Amateur Astronomers Association, which meets regularly at the Hayden Planetarium, operates a radio telescope in Rocky Point, Long Island; for information on

joining this club, write to Amateur Astronomers Association, 212 W. 79th St., New York, N. Y. The Brooklyn Children's Museum, Brooklyn Ave. and Park Place, Brooklyn, N. Y., also has a radio astronomy program.

Where Do We Go From Here? As mentioned earlier, radio astronomy has already told us much about the universe. In less than 20 years, it has enlarged our knowledge not only by discovering radio sources millions of light years away, but also by investigating heavenly bodies closer to us. But even more important, it's providing answers to the origin and perhaps evolution of the universe and the laws inherent in its existence. The farther out we are able to "peer," the farther back in time we go. In this way, scientists are able to analyze age-old signals to determine if physical laws are changing.

Where we go from here depends on man's ingenuity. Since we are discovering new things about the universe every day, the simple radio telescope and its applications may pave the way to even greater feats, perhaps lying just around the corner. And perhaps there will be other Janskys, dedicated men that take time out to analyze what's right in front of their eyes. -30-

TOTEM POLES FOR STEREO

(*Continued from page* 52)

The woofer enclosure is somewhat unorthodox, but very easy to build, particularly if you plan to cover it with a plastic veneer. First cut out all the parts, and before joining the major components, glue and screw the cleats to their proper places on the sides; this will eliminate the need to struggle with them later inside the cabinet. Attach the cross cleats to the rear of the top and bottom pieces, and you are ready to glue and screw together the top, bottom, and sides. Next, make the speaker cutouts in the proper locations in the front, then glue and screw the duct panels to each end of the front panel. Slip the front panel into the enclosure and secure it in place. If you are covering the sides of the en-

closure, you can fasten the duct panels more securely by driving some finishing nails through the sides directly into the edges of the duct panels; this will greatly increase the rigidity of the enclosure.

Grille cloth and molding can be selected to fit in with your decor, and you can add feet or legs to the basic enclosure as desired. Both crossover networks are mounted just above the lower duct as shown in the photo. After you mount and wire the speakers, the enclosure should be padded with "kimsul," felt, cotton batting, or fiberglass wrapped in cheesecloth. Don't pad within the duct area, but other exposed surfaces of the back, sides, top, or bottom can be covered as desired, leaving no two opposing surfaces uncovered. If you wish, the totem poles can be attached to decorative pole lights or other room dividers.

Wiring Considerations. Wire the nine or ten mid-range units first, so that they can be handled as a unit. They must be checked first for proper phasing, and a single flashlight battery will do for this job. Connect it in series with the speaker, reversing the leads if necessary, until the speaker cone moves forward when the circuit is completed and to the rear when broken. Now mark the speaker terminal to which the positive battery terminal is connected. This marked terminal will correspond to the red coding or "+" sign on the other speakers.

Follow the wiring diagrams, and make a final phasing check between the units in a channel and between the two channels. For an excellent method of phasing a complex system such as this one, see "Phasing Speaker Systems" by John Dewar (POPULAR ELECTRONICS, September, 1965). If you don't have an audio generator available, any good recording will do. First, check the phasing in each channel, reversing the leads of either the woofer or mid-range unit, then the tweeter. If you use a dummy load in the other channel, as suggested by Dewar, be sure that its switch is turned on to avoid having an open circuit. For the final phasing of the two channels, a mono record is probably more useful than a stereo record.

Speaker Placement. Now you have to make a decision on speaker placement

and whether to enclose the backs of the columns or not. For maximum dispersion of sound the back panel should be eliminated, but placement is somewhat more important in that case due to sound reflections from the rear. By experimenting with various locations for the columns as well as by aiming them at various angles, you will appreciate the enormous range of possibilities, some of which should solve any acoustic problems your living room can present.

When the columns are aimed outward, toward the side walls of the room, maximum reverberation is obtained in the listening area. If the sound is consistently too "big," or too reverberant and nondirectional, a back should be used. Also, if it is necessary to place the columns very close to a wall with the front parallel to the wall, it is advisable to cover the back with a 1-inch layer of fiberglass or other open acoustic damping material. (This material is always necessary when a back is added.) The more experiments you perform, the closer the final system will match your special acoustical situation and tastes.

The totem pole system offers superb stereo from any good stereo source, but for a final test put on a good stereo record of a large orchestra or chorus. It is in reproducing massed instruments or voices that this system excels. And for such program material it has few peers. -30-

LUMEMIN STEALS THE SHOW

(*Continued from page* 59)

highest pitched note when it is fully illuminated. Similarly, maximum volume is obtained when the *volume* photocell (*PC2*) is completely in the dark, and minimum volume when it is exposed to the brightest light.

If you happen to be a skilled musician, you should be able to play a recognizable tune with as little as a half-hour's practice. Generally speaking, however, considerable practice, skill, and patience are required to play the Lumemin, as with other musical instruments. Trem-

olo, vibrato, sliding tone, and similar special effects can be obtained.

Possible Circuit Variations. After using the Lumemin for a while, you may find it desirable to change certain component values to meet your individual playing techniques. As you can see from Fig. 2, the lowest pitched note that can be produced depends on the value of *R1*, while the highest pitched note for a given light intensity depends on the value of *R2*. Therefore, the ratio of these two resistors establishes the basic tonal range of the instrument. With the presently assigned values, the instrument's range is about three octaves, the lowest frequency being about 800 cycles (this will vary with component tolerances).

If you want to drop the lower frequency limit, use a larger value resistor for *R2*. The exact value will have to be determined experimentally. One way to do this is to put a potentiometer in place of the resistor, and adjust it for different effects. Later you can either leave the potentiometer in the circuit at the desired setting, or you can measure the resistance at the desired setting, and substitute an appropriate resistor.

In some cases, it may be necessary to change the value of *R3*. Here a larger value resistor will reduce the output volume, while a smaller value will increase the loudness for a given light level on *PC2*. Values as high as one megohm and as low as 250,000 ohms can be tried.

There seems to be no end to the number of circuit changes you can make. For example, you can arrange a bank of different value resistors for both *R1* and *R2*, and, by means of an appropriate switching circuit, select the best combination for the piece to be played. One other possibility is to combine the Lumemin's circuit with a modular audio amplifier and loudspeaker in a single cabinet as a self-contained instrument. Finally, for more precise performance, you can incorporate a built-in light source by mounting a suitable lamp over the photocells.

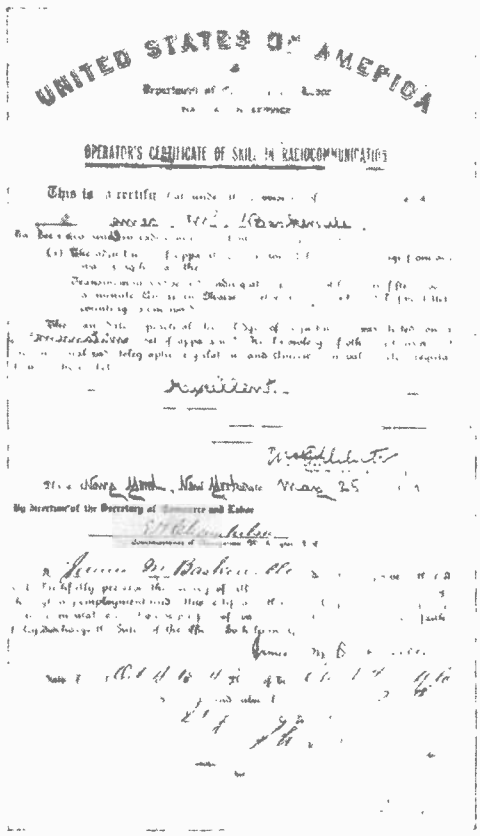
Regardless of the final modifications you may wish to make, or even if you use the design as is, the Lumemin can provide you with many exciting hours of music and sheer pleasure. —30—

THE FIRST LICENSE

(Continued from page 55)

licensing of operators for two years "subject to suspension or revocation by the Secretary of Commerce and Labor for cause. It should be kept where it can be shown to officers of the customs or other officers of the Government just before the ship leaves port."

On May 25, 1911, James M. Baskerville was examined at the New York Navy Yard for "(a) the adjustment of apparatus, correction faults, and change from one wavelength to another; (b) transmission and sound-reading at a speed of not less than 15 words a minute American Morse, 12 words Continental, five letters counting as one word." His performance was judged to be "Excellent" on a "Combination" set of apparatus. He received the first radio operator's license issued—#1. -30-



UNITED STATES OF AMERICA

OPERATOR'S CERTIFICATE OF SKILL IN RADIOCOMMUNICATION

This is a certificate that ... James M. Baskerville ...

... May 25, 1911 ...

By Direction of the Secretary of Commerce and Labor

... James M. Baskerville ...

SOLID STATE

(*Continued from page 73*)

performance improves. A second technique is to use a conventional diode in series with the base lead (see Fig. 4). Again, if the diode's polarity is correct, it can serve to block *L1*'s d.c. shorting action, permitting a bias to develop and—at the same time—improve detector action.

Unfortunately, neither of these modifications will improve selectivity appreciably. Furthermore, circuit performance will vary considerably with the characteristics of the individual transistor. Quite often a high-quality, low-leakage transistor will not perform as well as a slightly leaky unit, for it cannot provide its own internal base bias.

Circuit selectivity can be improved at a sacrifice of signal strength by *tapping* down on the coil to match *Q1*'s input impedance. This modification is illustrated in Fig. 4. From a technical viewpoint, the resulting circuit represents a definite improvement over the basic design even though, in practice, it may not seem as sensitive as the previous arrangement. However, its performance is still dependent, to a major extent, upon the individual characteristics of the transistor used.

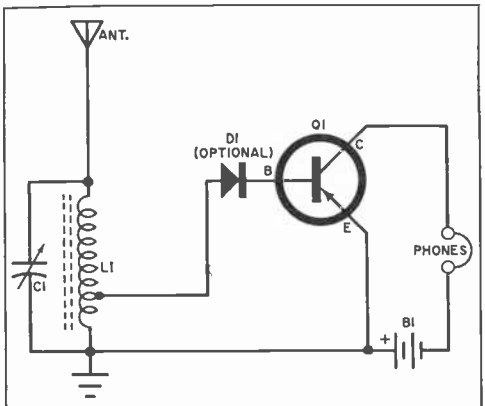


Fig. 4. One technique used to improve performance of the basic circuit of Fig. 3 is to insert a conventional diode in series with the base lead of the transistor, permitting a base bias to be developed. Further improvement can be made by tapping down on the coil to match Q1's impedance.

Circuit performance can be improved further by providing a fixed base bias, as shown in Fig. 5. Here, *C2* serves to block *L1*'s d.c. shorting action, while *R1* applies a forward base bias. With this arrangement,

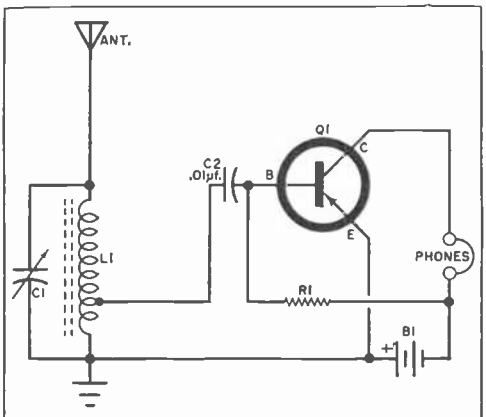


Fig. 5. In the modification of the basic receiver, C2 in series with Q1's base lead serves to block the d.c. shorting action of L1, while R2 applies a forward base bias. This circuit configuration permits the use of a high-gain, low-leakage transistor to obtain maximum sensitivity, since the effects of Q1's internal leakage are minimized.

Q1's internal leakage is not as critical a factor, and a high-gain, low-leakage transistor can be used for maximum sensitivity. The value of *R1* is somewhat critical, however. Its value must be chosen so that neither detection nor gain is adversely affected. In practice, the correct value can best be determined by trial. Typical values will range from 100,000 ohms to 1 megohm, depending on *Q1*'s characteristics.

The next step is to provide regenerative feedback. One popular arrangement for accomplishing this is shown in Fig. 6. The basic circuit is essentially unchanged except

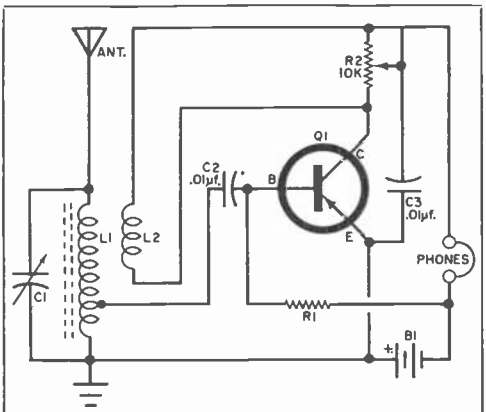


Fig. 6. Here the basic receiver circuit has been modified to provide positive feedback. Added are feedback coil L2, shunt control R2, and r.f. bypass capacitor C3, all of which provide an overall improvement in the receiver sensitivity.

for the addition of feedback coil *L2*, shunt control *R2*, and r.f. bypass capacitor *C3*. In operation, a portion of the amplified signal is coupled back to *L1* through *L2*, and amplified again by *Q1*. The net result is an overall improvement in sensitivity.

For AM broadcast-band operation, *L2* generally consists of from 10 to 25 turns of enameled wire ranging in size from #24 to #30, closely wound at the ground end of *L1*. Potentiometer *R2* serves as an adjustable load across *L2* and thus as a regeneration control. Coil *L2* must be correctly phased for best results. If properly connected, circuit gain will increase; if reversed, circuit gain will decrease. Ideally, the circuit will oscillate when *R2* is adjusted for minimum loading. As before, *R1*'s value is somewhat critical and can be determined best by trial.

Naturally, this brief discussion of the single-transistor receiver cannot include all possible modifications. However, if you remember the basic principles we've covered when working with your own circuits, you should be able to obtain optimum performance.

Until next month . . . HAPPY NEW YEAR!

—Lou

AMATEUR RADIO

(*Continued from page* 80)

to: Louisiana QSO Party, % Bill Allen, W5NQR, 155 Karen Drive, Lafayette, La. 70503.

YASME Foundation Reactivated. Older DX chasers will recall the YASME Foundation which sponsored Danny, VP2VB, and Mac, WØMLY, (and possibly others) on many DX-peditions in the 1950's and early 1960's. Well, the foundation has been reactivated to sponsor both Lloyd (W6KG) and Iris (KL7DTB/6) Colvin on a worldwide DX-pedition. Permission to operate in approximately 150 countries has been requested, and the Colvins are already on the way. Keep your ear open for them on 7005 and 14,050 kc., CW, and 7095, 14,105, and 21,400 kc., SSB (plus or minus 5 kc.) at their various stops. Send QSL cards accompanied by stamped return envelopes to: YASME Foundation, P.O. Box 2025, Castro Valley, Calif.

FCC and Other News. Think you have TVI troubles? From FCC reports, via *Auto Call*, September, 1965, Seattle postal author-

ities used radio in an attempt to trap a man suspected of using the mails for extortion. The frequency selected was near one of the Seattle TV channels. This gave many of the TV audience whose receivers had inadequate selectivity to reject the government signal something unusual to listen to, and many hurried to the post office to be in on the capture. Unfortunately, the suspect didn't show up. The Seattle P. O. doesn't plan to use the same frequency for future undercover operations.

Because of the difficulties sometimes involved in getting registered letters delivered if an addressee is not at home when the letter arrives, the FCC now sends "show cause why your license should not be revoked" and similar notices by regular mail.

While on the subject, it is again time to warn all licensees to answer all FCC mail promptly. If you don't answer within 10 days, wheels start turning that could result in the suspension of your license or the imposition of a fine of $100 or more. The most common cause of failure to answer FCC notices is moving and not applying for a modified license for the new address.

Florida Skip reports that on July 14, 1965, Dr. Jim Hirschman, K4TCV, and Dr. Tom Baker, WA4JTS, successfully received an electrocardiogram (EKG) of the heart of a 15-year-old African boy transmitted from W7HH/MM located on the Hospital Ship *Hope* anchored in the harbor at Conakry, Guinea. The doctors said the success of the experiment showed the possibility of future radio tranmission of EKG's from ships at sea and remote areas of the world in emergencies.

News and Views

If you need a Delaware contact, **Jim Kanich, K3UMC,** 111 Halcyon Dr., New Castle, Del., may be your man—if you catch him before he moves to Florida this winter. Jim went from Novice to Extra Class in three years, and his Johnson "Viking Challenger" transmitter running 120 watts to excite a dipole antenna has worked all states, all continents, and over 100 countries for DXCC. He receives on a National NC-105. When not hamming, Jim participates in physique and weightlifting contests . . . **Alexander L. Birch, K7WQS,** North 5403 Maple St., Spokane, Wash., takes a dim view of the "break-break'ers" on 75-meter phone who can't seem to make a contact of their own but are adept at breaking into and taking over someone else's contact . . . **Mike Calvert, WN2QOE,** 343 S. Webber Drive, Chittenango, N. Y., has worked 38 states, a number of Canadians, and Puerto Rico without working a single "7"! Mikes uses an EICO 723 transmitter, a National NC-57 receiver, and an inverted-V antenna on 80 and 40 meters, where he hears a few "7's" in the pre-dawn hours. **Philip Kelly, WN7DKA,** Rt. 1, Box 638, Camas, Wash., may be just the fellow that WN2QOE is looking for. Phil would like to sked readers of POPULAR ELECTRONICS, especially those on the east coast. Phil uses a combination 80/40 meter dipole

excited by a "Globe Scout 680" transmitter and receives on a National NC-77X helped along with a Heathkit Q-multiplier . . . **Mike Czuhajewski, WA8MCQ,** RFD 3, Paw Paw, Mich., "started to live" when he obtained a good receiver—an RME-4350. With it and a Heath AT-1 feeding an 8'-high antenna, Mike has worked 12 states and has 56 QSL cards to show for 156 QSO's. He is also a member of the Rag Chewers' Club.

Patti Rocki, W9FTQ, 8208 W. Tesch, Greenfield, Wis., agrees with WØEYC on combining amateur radio with other hobbies. Among hers are playing the guitar and singing, writing music, SWL'ing, making scrap books, writing to pen pals, collecting bottles of beer—one of a kind—and making wooden QSL cards. So Patti has plenty of things to talk about on the air. Her OM thinks it is funny to ask another ham over the air if he or she is married, names of the children, etc. But Patti thinks it is silly to talk to someone for years on the air and know all about his equipment and nothing about the operator. You'll find W9FTQ on 6 meters using one or more of the following: Clegg 99'er, Gonset-III "Gooney Box," or G-50, Hallicrafters HT-40, National NC-98, and Heathkit "Sixer."

We always like to hear about family stations. **Sid (W2IVX)** and **Ted (WB2PSG) Moskowitz,** 74 Beverly Rd., Hawthorne, N. J., are a father-and-son team. Using a Johnson "Invader" transmitter, Johnson "Thunderbolt" amplifier, and a Drake 2-B receiver plus an RME-23 preselector, they have worked 110 countries and 50 states between them. They mention a cubical quad antenna, but they probably have at least one more, because they work 40 through 10 meters. As a Novice, Ted worked 70 countries and 38 states. Sid also works mobile . . . **Donna M. Lane, WB6AUB,** 1352 Delores St., San Francisco, Calif., now 14, got her Novice license at the age of 10 and has had her General license for a year and a half. As a Novice, Donna worked only 2 meters with a Gonset "Gooney Box" feeding a 19" whip antenna, and naturally she worked only locals. Now she has a Galaxy-III transceiver feeding a Hy-Gain 14-AVS vertical antenna, and has worked 47 states and 20 countries. Also occupying an honored place in her ham shack is a 20-wpm code-proficiency certificate (and the 25 wpm sticker is on the way). Donna's grandparents, WA6QZA and WA6PTU, gave her the amateur radio bug . . . **Walt H. Edminster, WA5LZP,** 1506 Dewey Lane, Alamogordo, New Mexico, is a missile engineer and moves so often that he is constantly starting over on WAS. He has 47 states confirmed this time, mostly on 40-meter CW, where he likes to rag-chew.

Bill McGrew, WAØEMC, Pretty Girl Ranch, Anselmo, Nebr., works phone once in a while but much prefers code operation. As a Novice, he had 47 states confirmed. Now he has all 50 worked and confirmed on 80-meter CW with a power input never exceeding 75 watts. Bill's tools of achievement are a WRL "Meteor-175" transmitter, Hallicrafters HA-5 VFO, and TO electronic keyer abetted by a Drake 2-B receiver and a dipole antenna . . . In five months, **Jerry Ginsberg, WA6NFI,** 2437 Irma Way, Castro Valley, Calif., has worked 144 countries on 20-meter, 2-way SSB. Of course, running a power of 90 watts (PEP) to a Heathkit HX-20 into a Hy-Gain 14-AVQ vertical antenna at a 3000'-high location overlooking the Pacific Ocean and the entire San Francisco area may explain his excellent results. Jerry also works 15-meter CW occasionally and reports that he often hears DX'ers calling Novices below 21,100 kc. without being answered.

Why not start the new year by sending us your "News and Views," a picture of the shack—and yourself—and a copy of your club bulletin. Mail them to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Ind. 46401.

73, *Herb W9EGQ*

ON THE CITIZENS BAND

(*Continued from page* 78)

ists failed. Not many people *will* stop at 1 a.m. to see why a stranger stands beside his car waving his arms, for a number of reasons. However, the eventual establishment of CB monitors and travelers along our nation's highways will enable a channel 9 user to at least report the situation he has just passed, even if he is fearful of stopping to investigate. But we have yet to hear of a CB'er who would pass an emergency without offering assistance!

1966 OTCB Club Roster. In order to keep our roster of active clubs current, all CB clubs, rescue teams, and special police groups who have not reported to us in the last 12 months should do so now. Include your current membership totals, officers, club activities, copy of bylaws and constitution, and sample decal and membership card, if available. And please send us your club newspaper or bulletin on a monthly basis. All groups are urged to enclose photographs of activities, emergency teams, emergency assists, and any unusual application that would interest other CB users. Forward this material to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

Denver, Colorado: Colorado Citizens Band Association. This club was incorporated in Colorado in April, 1965, to serve the entire state. President: Steve G. Morton.

Richmond, Indiana: Eastern Indiana Emergency Communications Net. Members of REACT, they have plans for a mass meeting on REACT objectives to encourage Citizens Banders to join and to explain REACT to law enforcement agencies.

Niagara Falls, New York: Mighty Milliwatts. This club is primarily interested in the use of Part 15 walkie-talkies for rescue operations and public service. Organized two years ago, they work closely with the Niagara Falls CB Club. Officers: Pat Gorman, KID1566, president; Chuck Gandt, vice president; Joseph Falcone, KLP6556, secretary/treasurer.

Philadelphia, Pennsylvania: Y.C.B.A. of Pennsylvania. Recently teamed with REACT, this club serves the Philadelphia area and surrounding counties with an emergency net. Officers: William Johnson, KKG3127, president; John Hersker, KMG-1720, vice president; William Tapper, KKG-4742, secretary; Tom Rudisill, KMG2632, treasurer. There are also two communications officers, a news editor, two reporters,

(*Continued on page* 106)

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and a sergeant at arms. Our thanks to the Y.C.B.A. of Pennsylvania for making us an honorary member.

Columbia, South Carolina: Central South Carolina Citizens Radio Club. Organized in 1962, this group publishes an excellent monthly newspaper, *The Carrier,* compiled by a staff of four. Meetings are held on the second Friday of each month at the Davis Hotel.

Fulton, South Dakota: The Circle CB'ers. Recently organized with 19 members, this club has rented a school for monthly meetings held every second Saturday. A constitution, membership rules and bylaws have been written and approved by the present membership. They monitor channel 9.

Rhinelander, Wisconsin: Vacationland CB REACT Team. A membership of 47 is spread throughout 18 Wisconsin cities: St. Germain, Eagle River, Lac Du Flambeau, Bowler, Wausau, Schofield, Laona, Land-O-Lakes, Deerbrook, Crandon, Antigo, Pickerel, White Lake, Three Lakes, Hazelhurst, Starlake, Summit Lake, and Rhinelander. Present officers: J. H. McCormick, president; Don Meyer, vice president; Joe Holeton, secretary/treasurer; and Betty Perkovich, recording secretary.

Also reporting: In *Denver, Colorado,* St. Anthony's CB Emergency Group; and in *Florence, Kentucky,* CB Club of Kentucky.

I'll CB'ing you,

—Matt, KHC2060

PARTS PROFILES

(Continued from page 70)

gives you a photoflood control center that lets you control each light independently, and get perfect shadow control and greatly prolonged bulb life. For this application you can use SCR's, TRIAC's, or just plain power diodes (the latter gives you only OFF-DIM-BRIGHT positions).

There are many other applications, but we'll mention just one more. The cabinet can house a heavy-duty SCR power control for use in your workshop. Select the type of control that has a heavy three-lead cord and automatic torque feedback to provide precise control for any ⅜" or ½" electric drill. You can get technical details from any SCR manual.

The utility cabinet is available from most Bud distributors, including Allied Radio, Burstein-Applebee, and Lafayette Radio. The price for the smallest cabinet (CU-463) is $5.50. Larger sizes are priced up to $10.35. —30—

SHORT-WAVE MONITOR CERTIFICATE APPLICATION

ALL radio listeners interested in furthering the hobby of SWL'ing—regardless of whether you DX on the BCB, VHF, TV, SW, or FM bands—are eligible to apply for a POPULAR ELECTRONICS "Certificate of Registration." You must have verified (have QSL cards from) a minimum of five radio stations, of which one was outside the borders of the United States. There is no age limit, or special equipment qualification; the only requirement is that the applicant have a sincere interest in radio communications.

All certificates are filled in and lettered before mailing; they are mailed flat and unfolded. If you want to register and receive your WPE identification sign, fill in the application blank below. Mail with 50 cents in coin (or stamps) to: MONITOR, P.O. Box 333, Cherry Hill, N.J. 08034. (Personal checks will not be acceptable). Canadians should use their own currency, and other applicants not in the U.S.A. should use 10 International Postal Reply Coupons. Allow 4-6 weeks for processing.

(Please Print) (Do not fill out)

Name . . . . . .

Street, City and Zone . . . . . .

State and Zip . . . . . .

Receivers in use Make . . . . . Model . . . . . .

Make . . . . . Model . . . . . .

Age . . . . . Occupation . . . . . .

Ham/CB call-letter assignment(s) . . . . . .

I listen mostly to SW Broadcast Hams CB BCB VHF VLF . . . . . .

I use the following antennas . . . . . .

I have QSL cards and countries verified. Check if subscriber to P.E. . . . . .

Signature . . . . . Date . . . . . .

SHORT-WAVE LISTENING

(*Continued from page 75*)

wide use. No information was given as to the location of the station but observers between Baltimore and New York City have heard it on frequencies around 18,000 and 19,100 kc. One reporter claims that the *Blue Eagle* is drowning out a local AM broadcast station. Further details will be forthcoming if and when they become available.

A letter was received from the Canal Zone regarding U. S. Army Station ACA which signs on as *Alpha Charlie Alpha*. The letter did not specify that the report to the station was verified although it did include date of reception. This one is operating on approximately 6850 kc. Reports can be sent to Headquarters, Stratcom Facility Canal Zone, Radio Facilities Operations Division, Drawer 924, Fort Clayton, Canal Zone.

All Cable and Wireless outlets in the Western Hemisphere have received orders from their London headquarters to the effect that any reception reports should be referred to London. The headquarters will then reply with a polite form telling the listener that, in accordance with the Geneva regulations, they are not verifying any reports. It would seem that listeners will have to turn to either the standard AM broadcast band or to the amateur bands in order to get verifications from many of the Caribbean islands.

From Lima, Ohio, comes word that the Lima Symphony Orchestra was recently featured on a half-hour broadcast over *Radio Australia*. One of our own monitors, Joseph Arndt, WPE8CQN, of that city, had sent a recording of the orchestra to the ABC along with a number of tape recordings of transmissions from the station. Reports reaching our office indicate that *Radio Australia*'s symphony music director was highly pleased with the quality of the orchestra. It is unfortunate that word of this program was not received in time for us to publicize it in this column so that we all could have tuned in.

Use of GMT. As announced last month, we are changing over to the use of GMT (Greenwich Mean Time) with this issue. Greenwich Mean Time is five hours ahead of Eastern Standard Time, eight hours ahead of Pacific Standard Time. Please make all of your future reports in GMT or, if this is not convenient for you, please indicate clearly the time zone that you are using in your reports.

Current Station Reports

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Greenwich Mean Time (GMT) and the 24-hour system is used. Reports should be sent to SHORT-WAVE LISTENING, P.O. Box 333, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the fifth of each month; be sure to include your WPE identification, and the make and model number of your receiver. We regret that we are unable to use all of the reports received each month, due to space limitations, but we are grateful to everyone who contributes to this column.

Algeria—The latest schedule for *Radiodiffusion-Television Algerienne,* Algiers, is: French at 0630-0830 (Sundays at 0700-0900) and 1700-2200 on 6175 and 9685 kc., and at 1200-1430 (Saturdays to 1700. Sundays at 0900-1700) on 9685 and 11,835 kc.; Eng. at 2200-2230 (news at 2200) and Spanish at 2230-2300 on 6175 and 9685 kc.

Belgium—Brussels is noted on 11,895 kc. to N.A. in French and Flemish with news, topical talks, and a variety of pop, jazz, and dance music; frequent ID's are given in French. Another outlet on 6125 kc. is noted in the same languages at 0000-0030.

Brazil—After three years, a verification is finally in from *R. Palmares,* Maceio, 3245 kc. Their schedule is 0900-0300 daily on ZYL22, 890 kc., and ZYL23, 3245 kc. Their address is Praca Dom Pedro II, Sem nº, Maceio, Alagoas, Brazil, but reports apparently are not appreciated very much.

Cameroon—According to a recent verification, *R. Garoura* is scheduled from Monday through Saturday at 1645-2200, Sundays at 1100-2200, on 5010 kc. Reports indicate that the s/off may run as early as 2130.

China—*R. Peking* has been heard on 5850 kc. (a move from the listed 5860 kc.) at 1035-1040 in Russian; the ID was given as *Govorit Pekin* by a woman at 1040. Another outlet, unlisted, is 16,375 kc., noted in Chinese at 0025 with heavy fading, a female talker but no music; this may be a Home Service station.

Colombia—*La Voz de Tolima,* Ibaque, 6040 kc., has been observed using its old call-signs of HJLA/HJLB when identifying at 0130 in Spanish. Would this indicate a return to the former call-sign system in Colombia?

R. Villavicencio, 4877 kc., has been logged at times prior to 0200 with Latin American pop music and rarely given ID's. There is heavy QRM from a Brazilian on 4876 kc. and from an Ecuadorian on 4875 kc.

Congo (East)—*R. Interprovinciale du Katanga,* Elisabethville, is once again active on 11,868 kc. It has been heard with a gospel-type program in French at 1745-1800, native music to 1845, songs by children to 1915. An ID and an announcement followed.

Dahomey—*La Voix de la Revolution,* Cotonou, 7635 kc., has been found on this new and rather odd channel from 1925 to past 2045; bongo drums were heard at 1930-1949, guitar music and an ID in French at 1949, and music to 2015, followed by

SHORT-WAVE ABBREVIATIONS

ABC—Australian Broadcasting Corporation	ID—Identification
AM—Amplitude modulation	IS—Interval signal
anmt—Announcement	kc.—Kilocycles
CBC—Canadian Broadcasting Corporation	kw.—Kilowatts
Eng.—English	N.A.—North America
FCC—Federal Communications Commission	QRM—Station interference
GMT—Greenwich Mean Time	QSL—Verification
	R.—Radio
	s/off—Sign-off
	s/on—Sign-on
	xmsn—Transmission

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Act of October 23, 1962; Section 4369, Title 39, United States Code).

1. Date of filing: October 1, 1965.

2. Title of publication: Popular Electronics.

3. Frequency of issue: Monthly.

4. Location of known office of publication: 307 N. Michigan Avenue, Chicago, Illinois 60601, Cook County.

5. Location of the headquarters or general business offices of the publishers: One Park Avenue, New York, New York 10016.

6. Names and addresses of publisher, editor, and managing editor: Publisher, Phillip T. Heffernan, One Park Avenue, New York, New York 10016; Editor, Oliver P. Ferrell, One Park Avenue, New York, New York 10016; Managing Editor, Robert Cornell, One Park Avenue, New York, New York 10016.

7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.) Ziff-Davis Publishing Co., One Park Avenue, New York, New York 10016; Amelia Ziff, David Ziff, One Park Avenue, New York, New York 10016; William Ziff, One Park Avenue, New York, New York 10016; Priscilla Stafford, One Park Avenue, New York, New York 10016.

8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None.

9. Paragraphs 7 and 8 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. Names and addresses of individuals who are stockholders of a corporation which itself is a stockholder or holder of bonds, mortgages or other securities of the publishing corporation have been included in paragraphs 7 and 8 when the interests of such individuals are equivalent to 1 percent or more of the total amount of the stock or securities of the publishing corporation.

10. This item must be completed for all publications except those which do not carry advertising other than the publisher's own and which are named in sections 132.231, 132.232, and 132.233, Postal Manual (Sections 4355a, 4355b, and 4356 of Title 39, United States Code)

	Average No. Copies Each Issue During Preceding 12 Months	Single Issue Nearest To Filing Date
A. Total No. copies printed (Net Press Run)	504,146	489,577
B. Paid circulation		
1. Sales through dealers and carriers, street vendors and counter sales	118,467	107,150
2. Mail subscriptions	287,523	288,090
C. Total paid circulation	405,990	395,240
D. Free distribution (including samples) by mail, carrier or other means	5,276	4,153
E. Total distribution (Sum of C and D)	411,266	399,393
F. Office use, left-over, unaccounted, spoiled after printing	92,880	90,184
G. Total (Sum of E and F—should equal net press run shown in A	504,146	489,577

I certify that the statements made by me above are correct and complete.

PHILIP SINE, Treasurer

an ID and a political speech. This was parallel to 9650 kc. after 2015. Reports indicate that it may have been a test xmsn for it has not been noted since.

Ecuador—Station HCJB, Quito, has been logged on 15.405 kc. at 1800-1900, native language to 1830, Eng. from 1830 to 1900; this was dual to 17,890 kc.

Station HCRP1, *R. Catolica*, Quito, has reappeared on 5062 kc. after months of inactivity with the usual Latin American programs to 0300 s/off, although it may run as late as 0345 at times.

Ethiopia—Station ETLF, *R. Voice of the Gospel*, Addis Ababa, operates on 11,875 kc., not 11,785 kc. as indicated in one of the recent schedules; look for it from 1840 to 1900 with an African language, an ID in Eng. at 1900, and then a newscast after a brief piano interlude. The station can also be heard on 7165 kc. with s/on in Eng. at 0330 on Tuesdays, Wednesdays and Thursdays beamed to Arabia and the Gulf Coast; after the opening anmt, it goes into Arabic.

Ghana—*R. Ghana*, Accra, has Eng. to N.A. at 0330-0430 on 6110 kc. and to the Caribbean at 2000-2100 on 9760 and 11,800 kc. Other channels monitored: 21,720 kc. from 1638 to 1645 s/off in an African language but continuing past 1645 on 21,545 kc.; 15,285 kc. in Eng. with African music at 1715-1730; 3240 kc. from 0550 with Eng. news but not dual to either 3350 or 3366 kc.; 4980 kc. at 0627 with Eng.; and on 3366 kc. at 2302 s/off giving parallel channels as 3350, 4825, and 4915 kc.

Greece—The most recent schedule received (and possibly partially outdated already) from Athens reads: 0700-0815 (Sundays at 0550-0815), 0900-1000 (except Mondays), 1030-1300, 1330-1515, 1630-1700, and 1830-1900 on 9505 and 11,720 kc.; 1730-1800 and 1930-2100 on 15,345 and 17,745 kc.; 2200-2230 and 2300-2330 on 15,345 and 11,720 kc. All xmsns are in Greek. Reports go to: HNBI, Technical Services Directorate, P. O. Box 360, Athens, Greece. This is a new address.

Iran—*R. Iran* now has Eng. at 2000-2030 on 7135 kc., replacing 15,110 kc. The 3784.5-kc. outlet is noted at 0241 in Persian, at 0242 with Strauss waltzes, dual to 7065.5 kc. S/on on the latter frequency has been irregular, from before 0145 to as late as 0240, even though the scheduled s/on is 0230. At times the audio has faded out completely although the carrier has remained at strong level, indicating testing.

R. Tabriz, 6224.5 kc., opens at 0224 and is heard until 0330/fade, all Persian, with frequent ID's as

Medium-Wave Stations

During the long winter evenings, try for some of the following stations, all recently logged. They are listed by frequency in kilocycles.

675	TIU, R. Musical, San Jose, Costa Rica
737	R. Clube de Mozambique (from 0420 s/on)
764	Dakar, Senegal
820	HJED, La Voz del Rio Cauca, Cali, Colombia
834	R. Belize, British Honduras
940	XEQ, Mexico City, Mexico
1035	4VEH, Cap Haitien, Haiti
1050	XEG, Mexico City, Mexico (Eng. around 0200)
1065	R. Americas, Swan Island
1088	Lagos, Nigeria (0435 s/on; dual to 1358 and 1458 kc.)
1375	St. Pierre & Miquelon Islands
1415.5	Bamako, Mali (s/on at 0445)
1540	ZNS, Nassau, Bahamas

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Noordin Ghani, Penany, Malaysia
Wayne Harrell, El Dorado, Ark.
Bob Hill, Boston, Mass.
Gordon Nelson, Watertown, Mass.
Joe Piechuta, Plantsville, Conn.
S. Stokes, New York, N. Y.
James Talley, Columbus, Ga.
John Zapisek, Wading River, N. Y.
Sweden Calling DX'ers, Stockholm, Sweden

Inja Irana, R. Tabriz. This station may have moved from 6155 kc. and does not operate in dual with either 7065.5 or 3784.5 kc.

Korea (North)—Pyongyang, 15,520 kc., is noted at 0535, dual to 14,520 kc. There is an ID at 0557, and it is off the air by 0600.

Malaysia—*R. Malaysia,* Kuala Lumpur, is believed to be the station found on 6175 kc. with a new xmsn, opening with an IS of about 15 rapid notes on chimes, from 1109-1115. An anmt in Eng. states that the xmsn is intended for Australia and New Zealand and is broadcast on 6100, 6175, 7100, and 11,900 kc.

Maldive Islands—*R. Maldive Islands,* Male, still appears to be operating in an experimental stage. The latest monitored schedule: 0230-0430 and 0930-1200 on 7450 or 7150 kc.; 0500-0700 and 1200-1700 on 3280 or 3225.5 kc.; and 0700-0930 on 9645 or 9552 kc. The programs consist of long-play albums of recorded music in Eng., Hindi, Sinhalese, Tamil and Male, but nothing in Japanese as previously reported. The language is changed each half hour and there is an occasional ID in Male. English news, picked up from various other stations, is aired at 0300, 0900, 1500, and 1700. The ID is *Male Cineco Radio Atolinara nombra 2-3,* or, in Eng., *This is Radio Maldive Islands broadcasting from Male, the capital of the Maldive Islands.* The engineer in charge is ham radio operator VS9MWA.

Netherlands—Two mid-day (local time) xmsns from *R. Nederland,* Hilversum, are presently being noted with good signals on the West Coast. On Sundays the "Happy Station Program" is good at 1900-2020 on 11.730 kc., and the daily broadcast to Europe and N.A. on 11,970, 9590, and 6025 kc. at 2000 is generally fair to good on 11,970 kc. but inaudible on the other two frequencies. Both xmsns are in English.

Netherlands Antilles—The 1955-2050 Eng. xmsn of *R. Nederland,* relayed by *Trans World Radio,* Bonaire, is now on 15,165 kc. (replacing 15,220 kc.)

DX Country Awards Presented

To be eligible for one of the DX Country Awards designed for WPE Monitor Certificate holders, you must have verified stations in 25, 50, 75, 100, or 150 different countries. The following DX'ers recently received their awards.

Seventy-Five Countries Verified

Richard Grab (WPE2HYM), Elmhurst, N. Y.
Charles Matterer (WPE6DGA), San Leandro, Calif.

Fifty Countries Verified

John Long (WPE3DYU), Lebanon, Pa.
Martin Schneider (WPE2SV), Watertown, N. Y.
Wade Smith (WPE3FGX), Wayne, Pa.
Reed Khan (HL2PE1H), Seoul, Korea
Robert Brickner (WPE3FYF), Pittsburgh, Pa.
D. D. Hirst (WPE5CFU), Snyder, Texas
Thomas Giacopelli (WPE2KOQ), Tuckahoe, N. Y.
Michael Fletcher (WPE4DPS), Warner-Robins, Ga.
Claude Kumjian (WPE2LVS), Elmont, N. Y.
Reg Firth (WPE2GFO), Amsterdam, N. Y.
Richard Cohen (WPE1EWL), Winthrop, Mass.
Ernest Zecchini (WPE1CIH), Lawrence, Mass.
Bobby Conder (WPE4HQT), Winston-Salem, N. C.

Twenty-Five Countries Verified

Wayne Scott (WPE5WTS), Galena Park, Texas
Jim Gordon (WPE9HHZ), Monroe, Wis.
Mac Stewart (WPE2JKV), Mooers, N. Y.
Mark Petruzzi (WPE1GEJ), Waterbury, Conn.
Victor Fields (WPE9GYY), Montezuma, Ind.
G. Michael Woloch (WPE3GHS), Baltimore, Md.
Eric Mac Calla, Jr. (WPE1FVY), Bridgeport, Conn.
Ronald Whiffen (WPE2NFX), Richmond Hill, N. Y.
Patrick Horner (WPE3GBC), Denton, Md.
Alan Pinney (WPE2MKQ), Nutley, N. J.
Russell Anderson (WPE8DFW), Muskegon, Mich.
James Reda (WPE3FXA), Beaver, Pa.
Marc Arenstein (WPE4GSP), Richmond, Va.
David Johnson (WPEØELO), Denver, Colo.
Allan Jones (VE3PE2AM), Islington, Ont., Canada
Douglas Smith (WPE4IFN), APO, New York, N. Y.
Loren Decker, Jr. (WPE5CQH), Waco, Texas
Bob Scott (WPE4HHX), Kingsport, Tenn.
Kenneth M. Schabelski (WPE9HPV), Chicago, Ill.
Thomas Berry (WPE4HPS), Niceville, Fla.
Ira Schultz (WPE2NGG), White Plains, N. Y.
Jay Hans (WPE2NGJ), White Plains, N. Y.
Roger Camire, Jr. (WPE1GEK), Manchester, N. H.
Gary Fredricks (WPE7CGG), Eugene, Oreg.
Richard Warner (WPE7CFV), Eugene, Oreg.
Marion Lilienthal (VE3PE2DO), Waterloo, Ont., Canada
Ted Templeton (WPE3EZV), Saegertown, Pa.
Ned Stearns (WPE8HYW), Warren, Ohio
Richard Walters (WPE6CBY), Indio, Calif.
Robert Anthony (WPE2MFI), Denville, N. J.
Robert Gross (WPE2NNH), South River, N. J.
Richard Story (WPE2NFY), Bloomfield, N. J.
Arnold Galina (WPE1FQS), Worcester, Mass.
Peter Glenn (WPE2JMT), Morristown, N. J.
Bruce Reynolds (WPEØEKU), Warrensburg, Mo.
James Burton III (WPE4HTE), Staunton, Va.
Bruce Pankratz (WPEØEKB), St. Paul, Minn.
Steve Shimko (WPE3GKL), Baltimore, Md.
Gerald Clough (WPE5ECF), San Marcos, Texas
Roger Vincent (VE2PE1GW), Tracy, Quebec, Canada
Bradley Connors (WPE3FWZ), Chevy Chase, Md.
James A. Sloman (WPE3BZC), Levittown, Pa.
Edward M. Madej (WPE1GEM), Indian Orchard, Mass.
Larry Erickson (WPE2NBO), New Shrewsbury, N. J.
Paul R. Donegan (WPE6FRW), Glendale, Calif.
Joseph Aman (WPE4IFM), Clifton Forge, Va.
Lloyd A. Scott, Jr. (WPE4SI), Bartow, Fla.
Stephen Slavsky (WPE2LGJ), Bronx, N. Y.
Ed Rudder (WPE4EXY), Halifax, Va.
Edward P. Hensel (WPE3KG), Laurel, Md.
Alan Raylesberg (WPE2MKW), Bayside, N. Y.
Charles Crawford (WPE9HHF), Evansville, Ind.
Dennis Zavasky (WPE8HUY), St. Clair Shores, Mich.
Paul R. Schildgen (WPE5BZU), Tacoma, Wash.
Kenneth B. Meyer (WPEØDVW), Overland, Mo.
Donald Celler (WPE2MNI), Madison, N. J.
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Charles Learn (VE3PE2FA), Brantford, Ont., Canada
Richard Lee Kramer (WPE2NJH), Passaic, N. J.

to W. Africa, daily except Sunday. This program features news, commentaries, light and classical music, variety shows, and topical talks.

Nigeria—A new frequency for Lagos is 21,685 kc., noted from 1554 to 1600 in Eng., and from 1600 in Arabic. The station has also been heard at 1240-1310 with carrier signal and test tones but no programming.

Norway—R. Norway's latest schedule reads: to W. Australia at 0745-0815 on 7240, 15,175, and 17,825 kc.; to W. Africa at 1100-1230 on 9610, 15,175, and 17,825 kc. Other xmsns: 1300-1430 and 1500-1630 on 11,850, 15.175, and 17,825 kc.; 1700-1830 on 9610, 11,850, and 15,175 kc.; 1900-2030 on 7240, 9610, and 11,850 kc.; 2300-0040 on 6185, 9610, and 11,850 kc.; and 0300-0430 on 2185, 7240, and 9610 kc.

Pakistan—Karachi is on 4980 kc. in an Oriental language and has been noted from 0150 to 0220 with numerous clear ID's.

Peru—A midwestern area logging is OAX9D, *R. Tropical*, Tarapoto, 9710 kc. Look for it around 0350 with Spanish music and Eng. ID's and anmts. It generally signs off at 0400.

Station OBX7C, *R. Onda Azul*, Casilla 112, Puno, is operated by the American Maryknoll Fathers on 4800 kc. much after the pattern of *R. Sutatenza*, Colombia. It is heard from 0200 to 0400 closing, and is reportedly a tough station to obtain a verification from in spite of its American administration.

Reunion—*Radiodiffusion de la Reunion*, St. Denis, has moved from 4807 kc. to 4820 kc. where it has been noted in French with semiclassical music around 0250. Dig deep for this one; there is usually a teletype station on the channel.

Rwanda—The new *Deutsche Welle (Voice of Germany)* relay station at Kigali has been heard in the U.S.A. on 17,770 kc. at 2230-2330 and in Europe

at 0415-0845 and 1150-1405, mostly with old American pop music and ID's in German, French and English. Overseas reports indicate that they may be testing on 9725 kc.

Saudi Arabia—Jeddah is noted on 17,838.5 kc. from 1440 to 1554 s/off in Foreign Service programs in Persian or Urdu and Arabic.

Senegal—Dakar is noted on 4910 kc. with French at 0700. They QSL'd recently in two weeks time.

Somali Republic—Late reports indicate that *R. Mogadiscio* has moved from 7160 kc. to 7120 kc., where it is noted at 0317-0330 in Eng., and from 0330 in Arabic or Somali.

South Africa—The Africa Service of *R. South Africa*, P. O. Box 8606, Johannesburg, is scheduled at 0300-0400 on 6150 and 7270 kc., at 1000-1300 on 15,220 and 17,805 kc.; at 1300-1655 on 11,900 and 15,220 kc.; at 1655-1800 on 9525 and 11,900 kc.; and at 1800-2115 on 7270 and 9525 kc. Sunday programs start at 1100.

Spain—*Radio Nacional de Espana*, Madrid, has completely revised its Eastern European Service. Nine languages have been dropped. Now scheduled is Ukrainian at 0530, Czech-Slovak at 0630, Hungarian at 0730, Polish at 0800, and Serbo-Croat at 0900-0930, all on 6140, 7105, and 9695 kc. These programs are repeated twice, at 1200-1600 on 6130 kc. and at 1600-2000 on 9615 kc.

U.S.A.—Station KA2XFW, Washington State University, operates an ionospheric radar station on 11,815 kc. 24 hours daily and is also listed for—but not yet heard on—17,835 and 30,600 kc., all with 5-kw. power.

U.S.S.R.—Tashkent, Uzbek SSR, 5925 kc., opens daily at 0000 with an IS on a native instrument resembling either a horn or a cello, followed by a xmsn in the local dialect; no Russian was noted. Dushambe (formerly Stalinabad) operates on 4635 kc. rather than on 4640 kc., as listed in some sources, around 0030-0045 in Russian. Minsk, Belorussian SSR, 5940 kc., opens at 2125-2130 with a 10-note IS on chimes; s/on annt is by a woman, followed by a march and a talk in Belorussian. All of these stations require careful tuning as the transmissions are regional and buried in QRM.

Venezuela—The Venezuelan operating on 5040 kc. is not *Ecos del Zulia*, but *R. Maturin*, a new outlet for medium-wave YVOR (1180 kc.), heard at 0124-0208 with many ID's and commercials for firms located in Maturin. No call-sign was given for the short-wave outlet.

Station YVMO, *R. Lara*, Barquisimeto, 4849 kc., is definitely operating on this new channel. It closes at 0400 with the anthem.

One of the easiest stations to log in this country is YVLK, *R. Rumbos*, Caracas, 4970 kc. It is generally good from 0000 to 0300.

Vietnam (South)—Saigon is heard on 7245 kc. from 1045 to 1058 in Vietnamese with some singing, and news at 1058, and on 4877 kc. from 1035 to past 1100, with no trace of polar flutter. The latter broadcast was in Vietnamese also and seemed to feature a program for children (possibly bedtime stories); a newscast was given at 1101. —30—

RECTIFIER QUIZ ANSWERS

(*Quiz appears on page* 53)

1	6 ohms	6	12 ohms
2	12 ohms	7	9 ohms
3	24 ohms	8	2 ohms
4	3 ohms	9	6 ohms
5	6 ohms	10	10 ohms

ELECTRONICS MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. 90¢ per word (including name and address). Minimum order $9.00. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.
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JAPAN & Hong Kong Electronics Directory. Products, components, supplies. 50 firms—just $1.00. Ippano Kaisha Ltd., Box 6266, Spokane, Washington 99207.

CANADIANS, TRANSISTORS AND PARTS. Free catalogue contains reference data on 300 transistors. J. & J. Electronics, Dept. PE, Box 1437, Winnipeg, Manitoba.

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IB3	.92	6AL7	1.95	6L6G	.98	7X6	1.35	14Y4	1.75
IH5	2.59	6AM8	1.25	6L6GC	1.61	7X7	2.75	19	1.00
IL6	2.60	6AN8	1.35	6L7M	2.48	7Y4	2.35	2050	1.25
ILA4	1.30	6AQ7	1.37	6N7M	1.75	7Y7	1.79	22	1.15
ILA6	1.49	6AR5	.91	6P5	2.50	7Z4	2.25	24A	1.35
ILC5	1.05	6AS5	.92	6Q7	1.95	8AU8	1.39	25C5	.65
ILC6	1.80	6AS7	2.85	6S7	1.95	8BQ5	.99	25CD6	1.94
ILD5	1.95	6AT6	.58	6S8GT	1.50	8CG7	.86	25DN6	1.95
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IN5	.85	6AU6	.59	6SF5	1.08	8JV8	1.32	26	1.40
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IV	1.85	6B8	2.46	6SL7GT	1.19	12AT7	1.03	35L6	.86
IW2	.79	6BA6	.60	6SN7GT	.89	12AU6	.71	35W4	.35
2A3	3.50	6BA8	1.39	6SQ7GT	1.23	12AU7	.83	35Y4	1.62
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2X2A	1.95	6BK5	1.25	6U5	2.35	12BA6	.56	37	1.10
3A3	1.18	6BK7	1.14	6U8	1.12	12BE6	.59	38	1.10
3A5	1.10	6BQ6	1.45	6V6GT	.74	12BH7	.96	39/44	.95
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