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FEBRUARY 1966

35 CENTS

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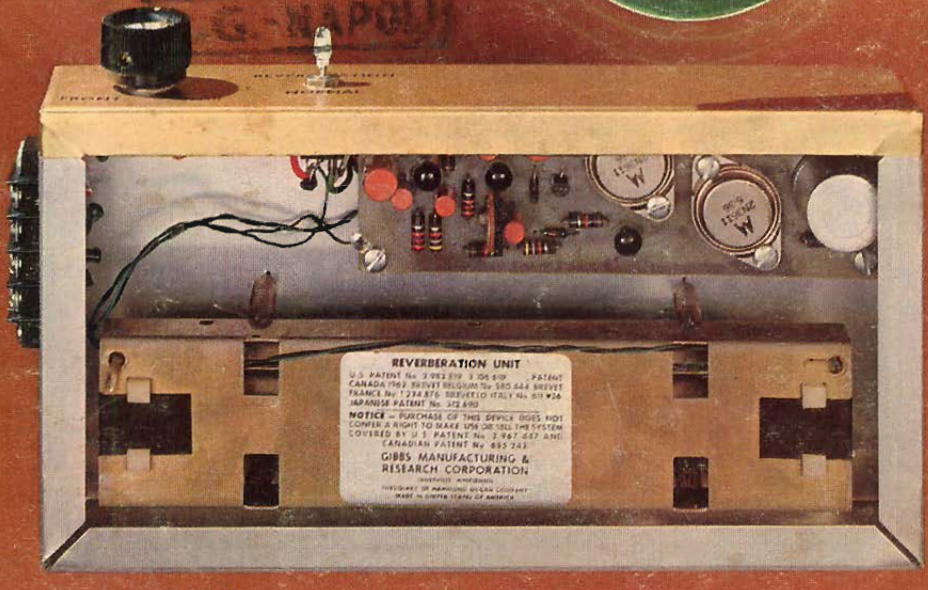
(starting on page 41)



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"Many thanks to NRI for the Electronics training I received. I hold a first class FCC License and am employed as a studio and master control engineer/technician with KXJB-TV."

RONALD L. WOOD, Fargo, N.D.

"I am a Senior Engineering Aide at Litton Systems, in charge of checkout of magnetic recording devices for our computers. Without the help of NRI I would probably still be working in a factory at a lower standard of living."

DAVID F. CONRAD, Reseda, Calif.

"NRI training enabled me to land a very good job as Electronic Technician with the Post Office Dept. I also have a very profitable spare-time business fixing Radios and TV."

NORMAN RALSTON, Cincinnati, Ohio

POPULAR ELECTRONICS

ZIFF-DAVIS PUBLISHING COMPANY

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

This month's cover photo by Bruce Pendleton

VOLUME 24 FEBRUARY, 1966 NUMBER 2

Special Feature

Electronic Construction Projects

Communications

Other Features and New Developments

Departments

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CIRCLE NO. 19 ON READER SERVICE PAGE

LETTERS
FROM OUR READERS

Address correspondence for this department to: Letters Editor, POPULAR ELECTRONICS One Park Avenue, New York, N. Y. 10016

HAMS' QSL "P's & Q's" SHOWING

What's wrong with the hams of today? In the past few months, I have sent out 30 to 40 reception reports to hams with requests for letters of verification or QSL cards; only 12 responded. I know four other SWL's who have had similar results. When I become a ham, I don't think that I will disregard a request for a verification.

GARY HERRON, WPE8IQN
Fraser, Mich.

While listening in on 20 meters, I heard a group of old guys hollering on side bands about the SWL being no good to anyone, and how they wouldn't answer an SWL's card. One old fellow, when he could get his breath, said he didn't have any QSL cards anyway. I have just passed the exams for my General Class ham ticket, and plan to get back on the air. I feel that ham radio operators and SWL's have pretty much the same interests, and can see no reason for a ham not to respond to an SWL.

FERDINANDO O. MARTINO, SR., WPE6EPZ
Sacramento, Calif.

Many times SWL reports to amateur radio operators are not given due consideration by their recipients. While not all reports are worthy of verification by hams, I'm sure when a ham receives a self-addressed, stamped envelope from me he should at least have the courtesy to return my card with the reason for the rejection. I would really appreciate finding out any mistakes I have made in making out a helpful report. After spending $5 and receiving only 10 verifications from 50 reports, I am a little discouraged.

STEVE SMAY, WPEØEAW
Springfield, Mo.

With reference to the letter from Jon Puerner (September, 1965), I have also received a QSL which came a year later, almost to the day, but this QSL came from a ham in Burlington, Iowa. So be patient, hams and SWL's, for you may also receive your QSL's from Ghana and Iowa in the near future.

MICHAEL MCFARLANE, WA9JZL
South Bend, Ind.

STEREO AMPLIFIER SOUNDS OFF

I built the "Two-Compactron Stereo Amplifier" (July, 1965), and am more than

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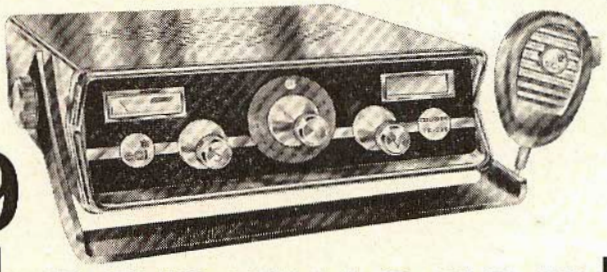

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Yes! I'd like to know all about the $169 Courier TR-23S with the 10 year guarantee!

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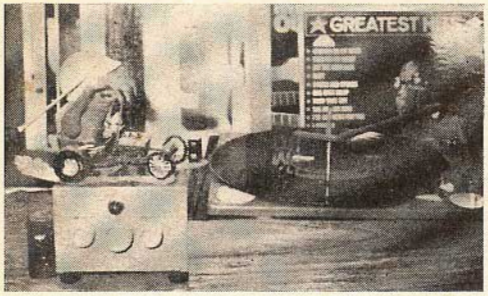
CIRCLE NO. 9 ON READER SERVICE PAGE

LETTERS

(*Continued from page 6*)

pleased with the results. I built it with two modifications: (1) I installed a jeweled pilot lamp fixture with a No. 47 bulb and connected it to the filament leads; and (2) I built the power supply into the changer base, partly for the sake of economy, but mainly to eliminate the clutter of extra connections. The



entire unit is concealed in a louvered-front closet, with a "muffin" fan for ventilation. I am driving two 8-inch speakers, and I must say, at far more than room-filling volume!

BILL FORGOTSTON
Newellton, La.

Good work, Bill, but it looks to us as if that monster in the go-cart at the left has his thumbs in his ears.

D.C.-OPERATED FLUORESCENT LIGHT

Congratulations to Ben Richards for a fine construction project, "D.C.-Operated Fluorescent Light" (July, 1965). I used non-polarized type capacitors for *C1* and *C2*, made by P.R. Mallory & Co., and installed *C3* to take care of any power supply transients. Capacitor *C3* can be used with or without *L1*. Not having a 6-watt lamp immediately available, I tried a 15-watt lamp. The light worked without any apparent ill effect.

R. L. GASTON, W5JUS
Austin, Texas

Thank you for an exceptionally useful construction project—it works fine. The article suggests that a fuse should be placed in the circuit to protect the transistors against application of excessive or wrong polarity voltage, and also states that the fuse may not act quickly enough. Part of the problem can be solved by placing a 500-ma. silicon diode in series with the switch, the cathode side towards the brown lead of the transformer. This will prevent damage from an improperly connected battery.

JACK WERTHMAN
Kansas City, Mo.

THE 51'ST STATE

In the "Amateur Radio" column (November, 1965, p. 93), Garry Shandling, WA7BKG, claims more states in the union than Uncle

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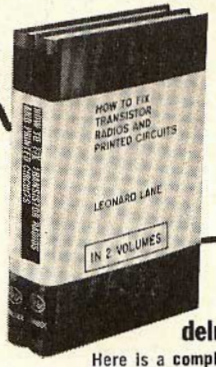

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LETTERS (*Continued from page 8*)

Sam—a total of 51. I would also like to say that the "Unique 99¢ Speaker Enclosure," (same issue) works wonderfully.

NEIL STEIN
Bronx, N. Y.

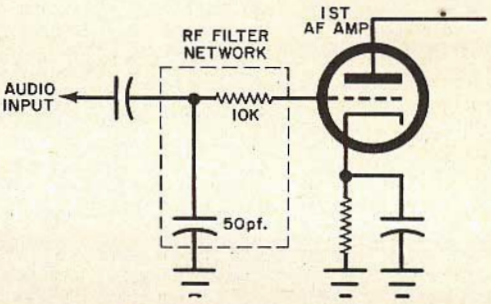
Neil, with transistors taking over, it's quite possible Garry found a "Solid State," or else his computer broke down.

FM BLOCKBUSTER

Down the block from me, about ¼ of a mile, is FM Radio Station KMAX. It comes through beautifully on an FM radio. It also comes through great on the speakers of my tape recorder, and on Channel 3 of my TV set. I should have stayed in New York.

PAUL J. YUDELL
Sierra Madre, Calif.

Paul, did you tell them you were from New York? You can still outwit them though. Simply place a low-pass filter in series with



the first audio amplifier in the tape recorder, and in your TV set. All it consists of is a 10,000-ohm, ½-watt resistor and a 50-pf. capacitor connected as shown. By the way, how long is a block in Sierra Madre?

CAMPER'S SPECIAL NOT DOWN THE DRAIN

I was sorry to learn that reader D. McDaniel (*Letters*, December, 1965, "Camper's Special Down the Drain,") couldn't find a 2N3053 transistor in California's Bay Area. We are the Transitron distributor in the midwest and stock Transitron's 2N3053 @ $1.24. We also have a type 2N3945 @ $1.25 which is a direct substitute for the RCA 2N3053. In San Francisco, the distributor is Fortune Electronics, 3400 Georgia Ave. N.W.

DICK DREHER
Engineering Services Co.
Kansas City, Mo.

Dick, thanks for your help. Quite a few readers have problems getting the parts for our projects. Although it is a trend to blame the magazine and/or the project designer, the manufacturers—and in some instances the stores themselves—are at fault. The manufacturers must cut through the jungle of diode and transistor type numbers. No store

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CIRCLE NO. 30 ON READER SERVICE PAGE

LETTERS (*Continued from page 10*)

can be expected to stock the thousands of semiconductors that the EIA has approved. And what is sold in one store may not be available anywhere else in the city. Substitutions take time to find and, in nine cases out of ten, the store doesn't want to look them up.

EXPERIMENTERS CAN TALK, TOO

I wish to express my appreciation to you. During the last school year, I entered an essay contest run by the National Science Teachers of America and sponsored by the Ford Motor Company. The title of my essay was, "A Transceiver." It was based on a previous project of mine. I won a Regional Award, and a Silver Plaque. Most of my electronics knowledge comes from articles that I have read in your magazine.

JEFF SIEGEL
New York, N.Y.

DIODE ARTICLES PRAISED

Your Fall 1965 Edition of ELECTRONIC EXPERIMENTER'S HANDBOOK requests comments in regard to articles like "The Fabulous Diodes." This article by Louis Garner Jr. is excellent and a very good reference—keep 'em coming. However, my vote for the most engrossing and thought-provoking article goes to Charles Fair's "Using Silicon Diodes" in your July, 1965 issue; it shows actual applications. Also, I was very much impressed with the article by Charles Pirolo, "The Neon Lamp Wonder" (April, 1965), and am completely fascinated by the construction project "Super-Sens" (November, 1965). By the way, I look forward to "Transistor Topics" each month. I am a mechanical engineer, and am just getting my feet wet in electronics.

JOHN A. BRADSHAW
Hillsdale, N.J.

Thank you for your comments, John. It looks like you would have us mix the same brew as we have been doing right along, that is, put more POPULAR ELECTRONICS *articles into the* ELECTRONIC EXPERIMENTER'S HANDBOOK. *The 1966 Spring Edition of this handbook is scheduled to go on sale February 17. Look for it. Incidentally, we changed the name of "Transistor Topics" to "Solid State" to more nearly reflect this state-of-the-art activity.*

OUT OF TUNE

Super-X Pulse Power Pack (*December, 1965, page 42*). The value of resistor *R13* is given in the Parts List as 330,000 ohms. It should read 330 ohms. All other references to *R13* are correct. -30-

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INSTALL THE NEW...

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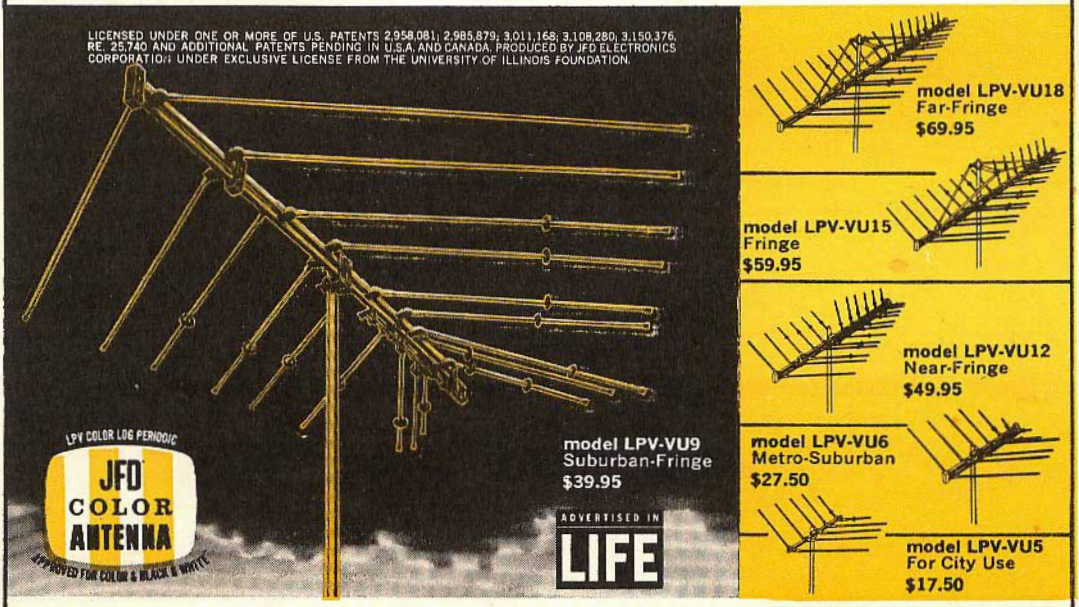


Now you can enjoy the best reception ever on any VHF, UHF or FM/Stereo station—from one antenna, using one down-lead—with the patented new JFD COLOR LPV Log Periodic.

Why cripple your reception with inefficient antenna "hodge-podges?" Choose a powerful space-age JFD LPV . . . see and hear the spectacular difference!

DON'T BE MISLED BY IMITATIONS—NO OTHER ANTENNA WORKS LIKE THE JFD LPV BECAUSE . . .

- Only the LPV is designed according to the **original** log periodic patented design of the University of Illinois Antenna Research Laboratories.
- Only the LPV combines **frequency-independent** design with **capacitor-coupled** electronic dipoles for . . .
- **Higher,** more **uniform** gain and **narrower** directivity on channels 2 to 83—and FM.

SEE YOUR JFD LPV DEALER TODAY!

JFD ELECTRONICS CORPORATION • 1462 62nd Street • Brooklyn, N. Y. 11219

world's largest manufacturer of TV & FM antennas

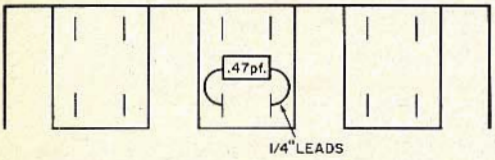
CIRCLE NO. 49 ON READER SERVICE PAGE

PARTS METHODS IDEAS GADGETS DEVICES

TIPS & TECHNIQUES

"GIMMICK" CAPACITOR INCREASES BANDWIDTH OF UHF TV BOOSTER

A variable frequency amplifier, such as the Blonder-Tongue UTB-1 UHF booster, can be easily modified to provide a frequency range from 440 to 910 mc., instead of 470 to 890 mc., to take in part of the UHF radio



ham band and other services. Solder a 0.47-pf. capacitor or "gimmick" across the output resonant tank, and cut the capacitor leads as short as possible—they should be no longer than ¼ inch. Now connect the capacitor across the two tabs sticking out from the center wafer on the bottom of the chassis.

—Ken Greenberg

COPPER TUBING MAKES HANDY KNOB BUSHING

Should you find yourself in need of a control knob for a ⅛"-diameter shaft, but only have ¼" types on hand, you can use a piece of copper tubing as a bushing to bring the knob opening down to size or the diameter of the shaft up to size, depending on the way you look at it. Cut a short length of ¼" copper tubing, slit it so that it fits around the ⅛" shaft, slip the tubing over the shaft, and then fit the knob into place.

—Homer L. Davidson

ADD CHANNELS TO YOUR CB TRANSCEIVER

You can add a switch and a few crystal sockets to your CB transceiver to get more channels—if the unit is not already able to receive all of them. The number of channels is limited only by the type of switch you

(Continued on page 20)

POPULAR ELECTRONICS
READER SERVICE PAGE

You can get additional information promptly concerning products advertised or mentioned editorially in this issue

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Circle the number on the coupon below which corresponds to the key number at the bottom of the advertisement or is incorporated in the editorial mention that interests you.

2

Mail the coupon to the address indicated below.

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Please use this address only for Product Service requests.

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P. O. BOX 8391
PHILADELPHIA, PA. 19101

Please send me additional information about the products whose code numbers I have circled

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26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

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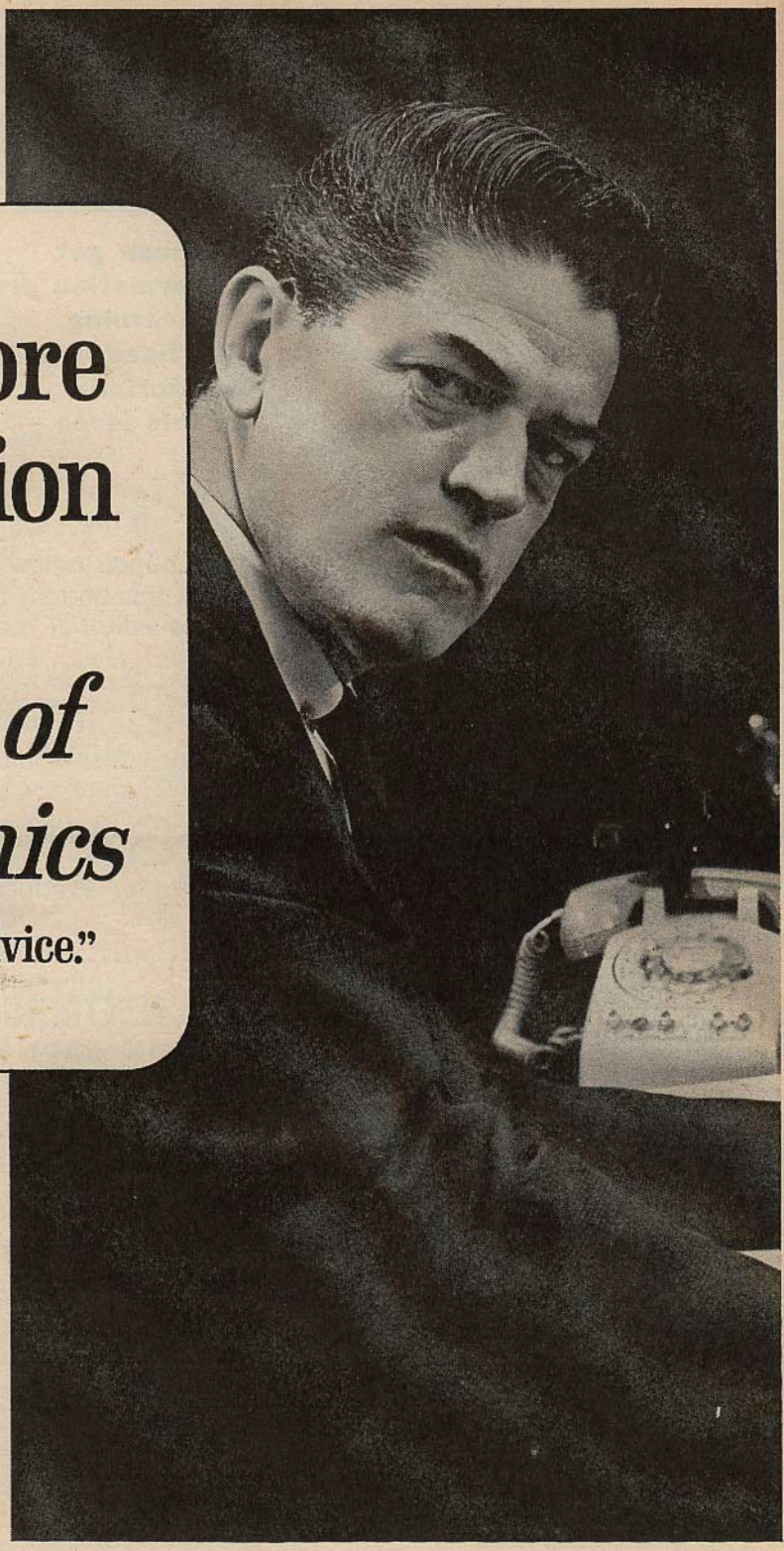

"Get more education or *get out of electronics* ...that's my advice."

Ask any man who really knows the electronics industry. Opportunities are few for men without advanced technical education. If you stay on that level, you'll never make much money. And you'll be among the first to go in a layoff.

But, if you supplement your experience with more education in electronics, you can become a specialist. You'll enjoy good income and excellent security. You won't have to worry about automation or advances in technology putting you out of a job.

How can you get the additional education you must have to protect your future—and the future of those who depend on you? Going back to school isn't easy for a man with a job and family obligations.

CREI Home Study Programs offer you a practical way to get more education without going back to school. You study at home, at your own pace, on your own schedule. And you study with the assurance that what you learn can be applied on the job immediately to make you worth more money to your employer.

You're eligible for a CREI Program if you work in electronics and have a high school education. Our FREE book gives complete information. For your copy, airmail postpaid card or write: CREI, Dept. 1202D, 3224 Sixteenth Street, N.W., Washington, D.C. 20010

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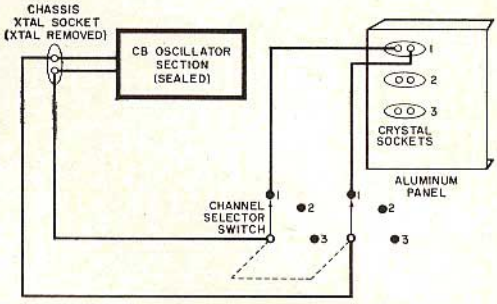
TWO NEW PROGRAMS!

- Industrial Electronics for Automation
- Computer Processing Systems

TIPS

(*Continued from page 14*)

use and the total number of channels allowed. While the diagram shows only a 3-position switch and 3 crystal sockets for simplicity of illustration, an assembly consisting of a 2-gang, 11-position ceramic switch and 11 crystal sockets with appropriate crystals can



be plugged into a crystal socket in your transceiver. Mount the new sockets and switch on an aluminum panel, and orient them to obtain the shortest possible leads.

—*Morris Moses*

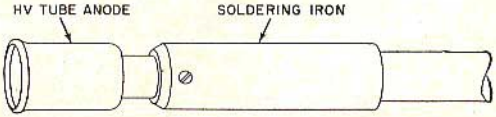
DON'T BE A SOREHEAD —CUSHION THOSE PHONES

Headbands used with conventional type earphones can become quite uncomfortable pressing against the skull, even after short periods of time. An easy way to eliminate this discomfort is to cushion the band with some inexpensive foam rubber or plastic. Just cut a 12"-long strip of the soft material, wrap it around the headband, and tape or cement the end. You can also make a foam cushion for each of the ear pieces, but be sure to cut an opening in the center so as not to obstruct the sound.

—*Art Trauffer*

TUBE ANODE MAKES MINIATURE SOLDER POT

Want an easy-to-make solder pot to use for tinning stranded wire? Locate a burned-out high-voltage rectifier tube such as a 1B3; break the glass and remove the cup-shaped



anode. Then remove the ¼" tip from a heavy-duty soldering iron and insert the anode cap. Allow the iron to heat sufficiently, and feed solder into the newly fashioned cup until it's about three-quarters full.—*Jan B. Rosenbaum*

BUILD 20 RADIO CIRCUITS AT HOME with the New Improved PROGRESSIVE RADIO "EDU-KIT"®

Reg. U. S. Pat. Off.

A Practical Home Radio Course

only $26.95

Training Electronics Technicians Since 1946

Now Includes

- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold in 79 Countries

YOU DON'T HAVE TO SPEND
HUNDREDS OF DOLLARS FOR A RADIO COURSE

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

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

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

FREE EXTRAS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER FROM AD—RECEIVE FREE BONUS RADIO & TV PARTS JACKPOT WORTH $15

☐ Send "Edu-Kit" postpaid. I enclose full payment of $26.95.
☐ Send "Edu-Kit" C.O.D. I will pay $26.95 plus postage.
☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name.....

Address.....

.....

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 653D, Hewlett, N. Y. 11557

CIRCLE NO. 31 ON READER SERVICE PAGE

PRODUCTS *(Continued from page 22)*

PAS-2 and PAS-3 preamplifiers to obtain the benefits of a tone control circuit that achieves the advantages of both switch-type and continuous control systems. According to *Dynaco*, the tone control provides for the removal of all frequency and phase discriminating networks from the circuit in the mechanically centered "flat" position, and at the same time maintains the infinite resolution capability of continuous controls.

Circle No. 80 on Reader Service Page 15

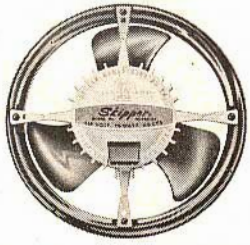
"RADIO ANALYST"

All the necessary functions needed to repair AM and FM auto and transistor radios are incorporated in *B&K Manufacturing Company*'s Model 970 "Radio Analyst." A solid-state instrument, it's complete with power supply, in-circuit and out-of-circuit transistor tester, r.f. and audio signal generators, and a rugged volt-ohm-milliammeter. The Model 970 employs an in-circuit signal injection procedure that works on either power or signal type transistors, and reads good or bad directly on the built-in meter. The power supply provides 1½ to 12 volts for battery substitution, and a separately variable 1½ to 12 volts for bias.

Circle No. 81 on Reader Service Page 15

"SKIPPER" FAN MOUNTS WITHOUT HARDWARE

A small fan that delivers 100 cubic feet of cooling air per minute and requires no mounting screws has been introduced by *Rotron Manufacturing Company*. Although not specifically designed to cool hi-fi equipment, the "Skipper" produces minimum acoustical disturbance. Its 38-db (SIL) noise level makes it ideal for use in ham shacks, test areas, or rooms where quietness is required. The fan comes complete with plug and cord assembly, guards, boot to protect solder connections, and plates to give you a choice of mounting methods.



Circle No. 82 on Reader Service Page 15

SPEAKER SYSTEMS

Want to "build" your own hi-fi system? The six speakers in *University Sound*'s "Mustang" line make possible many combinations, ranging from a small bookshelf system to a huge multi-speaker system with multiple woofers and tweeters. Their physical design and shallow depth styling are said to be ideal for in-the-wall installation and built-in hi-fi/stereo systems. The "Mustangs" vary in size from a full-range 8" speaker to a 12" three-way extended range reproducer; a "Spheri-con" tweeter is included.

Circle No. 83 on Reader Service Page 15

PUSH-BUTTON MULTITESTER

Ten push buttons quickly select operating mode and range on the *Olson* Model TE-192 multitester. The unit has a 30,000-ohm per volt sensitivity for a high degree of accuracy. Features include a 1-volt d.c. full-scale range for measuring critical biasing voltages in transistor circuits, and an "off" switch which damps meter movement for safety during transit. The d.c. voltage range goes from 0 to 1000 volts in six steps, the a.c.-voltage range from 0 to 1000 volts in five steps. Capacitance is measured from 250 $\mu\mu$f. to 0.02 μf., resistance from 0 to 10 megohms in three steps, and inductance from 50 to 5000 h. The Model TE-192 operates on two penlight batteries.

Circle No. 84 on Reader Service Page 15

ELLIPTICAL-STYLUS CARTRIDGE

Audio Dynamics has introduced a new cartridge with a minute moving system that is said to perform below the critical point of record groove yield, assuring true sound from the first playing. Called the ADC 10/E, the new cartridge has a "moving mass" (the weight or inertia of the total moving system) about one-third that of the best magnetic cartridge. Sensitivity of this "induced magnet" cartridge is 4 mv. at 5.5 cms/sec. recorded velocity, channel separation is 30 db from 50 to 10,000 cycles, and frequency response goes from 10 to 20,000 cycles, ±2 db. Tracking force range: ½ to 1 gram.

Circle No. 85 on Reader Service Page 15

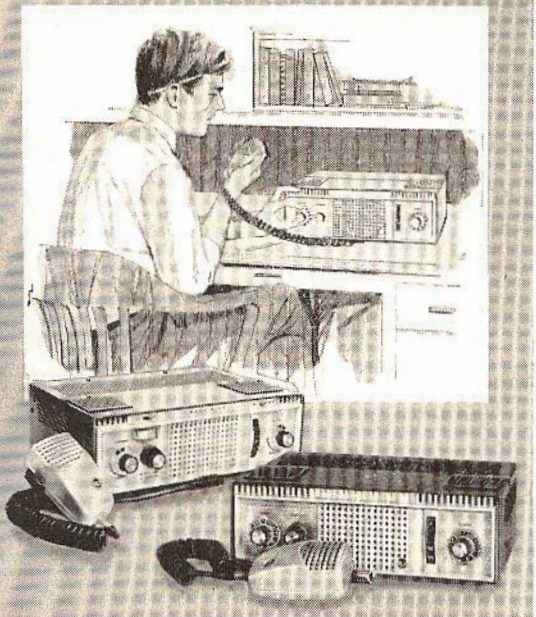
UNIDIRECTIONAL MICROPHONE

The unidirectional pickup characteristics featured in the *Shure* Model 580 "Unidyne A" cardioid microphone are said to have been available heretofore only in much higher priced models. Feedback from speakers or other noise entering the rear of the microphone is eliminated or greatly reduced, voice

CIRCLE NO. 48 ON READER SERVICE PAGE →

The ideal base/mobile combination for CB radio

FOR BASE STATIONS where 117 V 60 cycle AC current is available...



The Low-Cost RCA Mark VIII and Mark NINE

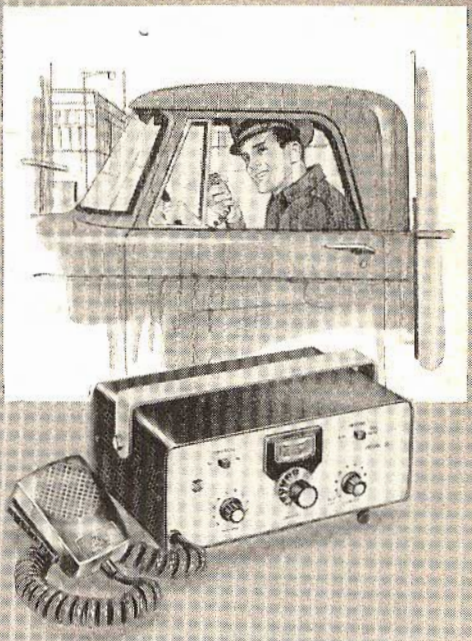
- 9 crystal-controlled transmit and receive channels.
- Tunable receiver for reception of 23 C-B channels; dial marked in both channel numbers and frequency.
- Exceptionally good voice reproduction.
- Highly selective superheterodyne receiver with one RF and two IF amplifier stages.
- Electronic switching—no relay noise or chatter.
- Illuminated "working channel" feature.
- Light and compact—only 3¾ inches high, weighs only 9 pounds with mike.
- Improved Automatic Noise Limiter.

Plus these EXTRA features in the Mark NINE

- Combination "S" Meter and relative RF Output Meter (indicates the relative strength of incoming signal) and Relative RF Output Meter (indicates relative strength of signal being transmitted).
- Spotting Switch. Permits precise manual tuning of receiver without use of receiver crystals.
- External Speaker Jack. Lets you connect an external speaker to set, so that incoming calls can be heard in remote locations.

Mark VIII: $99.95* **Mark NINE: $114.50***

FOR MOBILE UNITS where low power consumption is important...



The all-solid-state MARK 10

- All silicon transistors assure low power consumption, dependable communications at temperatures from —23° to +130° F.
- Compact, lightweight. Fits easily under dash of any car or truck. Only 3⅜" high, 5¾" deep, 8½" wide. Weighs less than 4½ pounds.
- 12 crystal-controlled transmit and receive channels with illuminated channel selector.
- Combination "S" Meter and relative RF Output Meter.
- Operates from 12-volts DC power source (positive or negative ground).
- Crystal-controlled double conversion, superheterodyne receiver provides frequency accuracies greater than 0.004%.
- Separate AGC amplifier eliminates blasting and overloading, minimizes fading.
- Six-stage IF bandpass filter for maximum selectivity without ringing.
- Low-distortion, series-type noise limiter with automatic threshold adjustment.
- Receiver power regulated for maximum stability.
- Acoustically designed cabinet with audio characteristics shaped for maximum intelligibility.
- External speaker jack (de-activates internal speaker).

Mark 10: $189.95*

*Optional distributor resale price.

See them at your Authorized RCA CB Radio Distributor. Look for stores displaying this symbol.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

The Most Trusted Name in Electronics

PRODUCTS (*Continued from page 24*)

quality remains the same whether it is of high or low frequency, and boominess (echoing) is either eliminated or greatly reduced. The "Unidyne A" comes in two versions: a high impedance design for use with any high-gain, high-impedance amplifier, and a low-impedance design for use with any low-impedance amplifier. In addition, the high-impedance unit is available in matched pairs for stereo recording.

Circle No. 86 on Reader Service Page 15

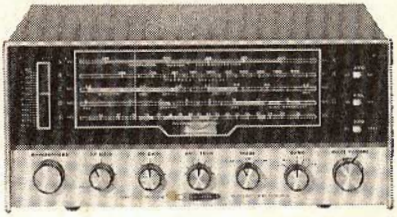
PENCIL-STYLE SOLDERING IRON

Weller Electric Corporation has introduced the SP-23 pencil-style soldering iron. This feather-weight 23-watt iron features a narrow, long-reach stainless steel barrel and a replaceable nickel-plated copper tip, and comes packaged in a hang-up style vinyl pouch. The same iron is available as part of an SP-23K kit; also included in the kit are three soldering tips, five feet of 60/40 rosin-core solder, a handy soldering-aid tool, and complete soldering instructions.

Circle No. 87 on Reader Service Page 15

DELUXE SHORT-WAVE RECEIVER

There are five bands on the *Heathkit* GR-54 SWL receiver; three short-wave bands from 2 to 30 mc., a 550- to 1550-kc. AM broadcast band, and a 180- to 420-kc. aeronautical and



radio navigation band. A comparatively low priced unit, the GR-54 boasts operating features usually found on units costing almost twice as much: SSB and CW reception, a built-in speaker, a transformer-operated power supply, and a built-in code practice monitor. A long-wire antenna kit is included.

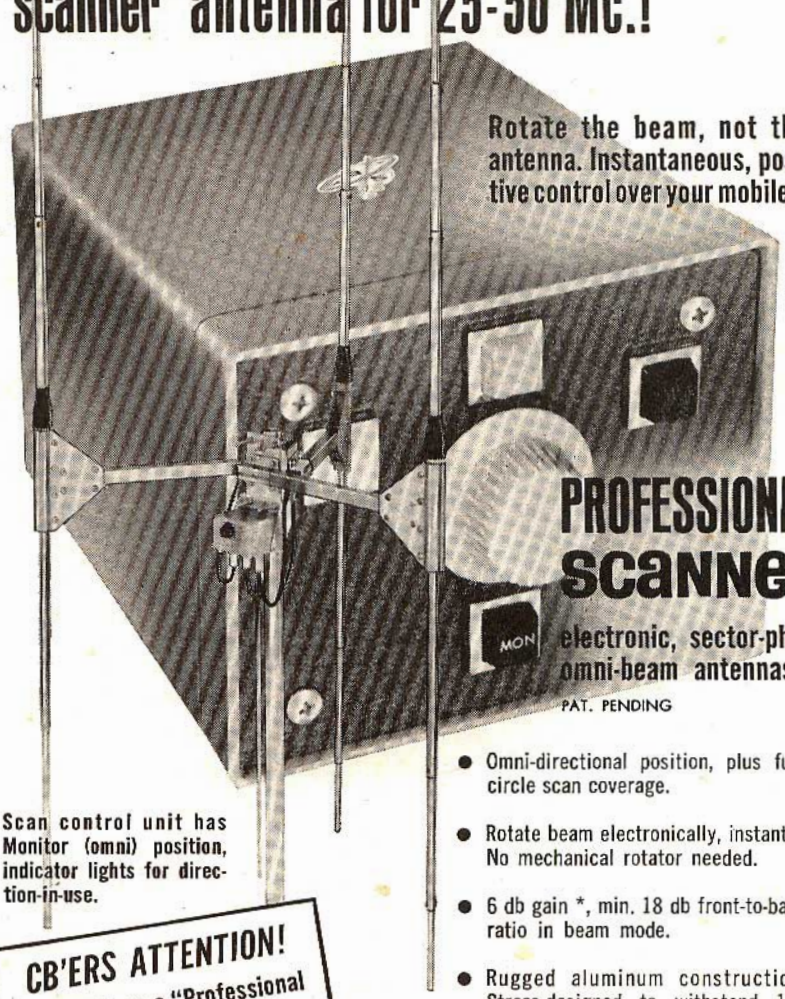
Circle No. 88 on Reader Service Page 15

LASER RODS

Laser rods are now available for the home workshop. *United Electronics Laboratories* is marketing ruby rods of the same chromium concentration and crystallographic orientation as those most commonly used in the nation's largest research laboratories. Offered in two sizes—1.5" long by 0.150" in diameter, and 2.0" by 0.250"—they are sold with complete instructions for assembling the simple electrical components needed to fire the laser beam.

Circle No. 89 on Reader Service Page 15

Now—revolutionary, field-proven "scanner" antenna for 25-50 Mc.!



Rotate the beam, not the antenna. Instantaneous, positive control over your mobiles!

PROFESSIONAL scanner

electronic, sector-phased omni-beam antennas

PAT. PENDING

Scan control unit has Monitor (omni) position, indicator lights for direction-in-use.

- Omni-directional position, plus full-circle scan coverage.
- Rotate beam electronically, instantly. No mechanical rotator needed.
- 6 db gain *, min. 18 db front-to-back ratio in beam mode.
- Rugged aluminum construction. Stress-designed to withstand 100 m.p.h. winds.
- Power rating: 500 watts.
- Every unit individually tuned to your exact frequency, and receives mandatory system checkout.

* Ref., drooping ground plane

CB'ERS ATTENTION!

You can have a "Professional Scanner" cut to operate on CB! Ask your distributor for details or write to us today.

the antenna specialists co.

Div. of ANZAC Industries, Inc.
12435 Euclid Ave., Cleveland, Ohio 44106
Export Div., 64-14 Woodside Ave., Woodside, N.Y. 11377

"Stripes of Quality" ®

CIRCLE NO. 2 ON READER SERVICE PAGE

"Couldn't have worked out better if I'd planned it."

"'What are you going to be?' they kept asking me all through my senior year in high school.

"I didn't know. But I did know I wasn't going to take any old job or try for college until I had plans. And I didn't want to just hang around until I made up my mind.

"I talked to the other guys, my family...everyone. Then I talked to the Army Recruiting Sergeant. And that was the smartest thing I ever did. He didn't try to pressure me. He just answered my questions. With his help, I enlisted for training as a data processing equipment operator.

"It turned out I was a natural for it. Picked it up with the help of some of the best teachers I ever came across. And now I'm an expert in something that will mean good jobs the rest of my life."

An Army enlistment has been the turning point for many men. It can be for you. It can give you the chance to learn any one of over 300 skills, skills you can build your life on. You can travel to countries and places you might never see otherwise. And you'll be proud of what you're doing.

Look into what the Army has to offer. You'll find there's more for you in today's action

Army

OPERATION ASSIST

Through this column we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other P.E. readers. Here's how it works: Check the list below. If you can help anyone with a schematic or other information, write him directly—he'll appreciate it. If you need help, send a postcard to Operation Assist, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give maker's name, model number, year of manufacture, bands covered, tubes used, etc. State specifically what you want, i.e., schematic, source for parts, etc. Be sure to print or type everything legibly, including your name and address. Because we get so many inquiries, none of them can be acknowledged. POPULAR ELECTRONICS reserves the right to publish only those items not available from normal sources.

SCHEMATIC DIAGRAMS

Philco Model 40-190, code 121, circa 1931. Tunes 550-1500 kc., 1.5-3.5, 6.0-18 mc. Has 8 tubes. (Shirley Farrell, 10191-C Cassina Ave., South Gate, Calif. 90281)

Winegard Model RD-300 "Red-Head" TV-FM booster. (Norman Stickler, Rock Port, Mo. 64482)

Federal "Orthosonic" Model A-10 receiver. Battery operated. Has 5 tubes. (Roger DeVries, 40 Ross Ave., Demarest, N.J. 07627)

Philco Model 39-55 receiver. Tunes BC. Has 10 tubes. (Earl F. Gustafson, 5401 Princess Anne Rd., Virginia Beach, Va. 23452)

Gonset Model 3009 automatic tuner. Tunes FM on 30-40 mc. (Paul Brazil, 26 Prospect Ave., Norwalk, Conn. 06854)

Newtronics Model A-1 stereo amplifier. Fully transistorized. (Earl Morwitz, 4222 N. Ashland, Chicago, Ill. 60613)

National Radio Model DCSW3 receiver, circa 1930. Tunes 1.5-15 mc. Has type 36 and 37 tubes. (Thomas L. Greenwood, 2609 La Grande St., Huntsville, Ala. 35801)

Federal Model 804 signal generator. **Weston** Model 891 tube tester. (W. G. Emory, Box 55, Union, S.C. 29379)

RCA Model 87K2 receiver, rating A. Tunes 540-1720 and 2300-22,000 kc. on three bands. (David Lake, Rt. 1, Box 85, Taft, Calif. 93268)

Precision VTVM, Series EV-10-S, circa 1953. (Charles Bien, 2143 N. California Ave., Chicago, Ill. 60647)

E. H. Scott "Philharmonic" receiver. (Henry Davis, 607 S. Third Ave., Maywood, Ill. 60153)

Eccofonic Model #109-B reverb. chamber. (William Russotto, 39 Mora St., Dorchester, Mass.)

TCS-12 surplus transmitter, made by Collins Radio. Tunes 2 to 18 mc. (Mike Johnston, 1610 S. Orange Blossom Trail, Orlando, Fla. 32805)

Majestic Model 70 receiver and power supply, circa 1927. (Norman J. Farrington, 1011 Adams St., LaCrosse, Wis. 54601)

Grundig "Majestic" Model UKW receiver. Tunes AM, FM and s.w. Has 6 tubes. (Agustin Paredes, 1822 N. 36 St., Stone Park, Ill. 60165)

Hallicrafters "Sky Courier." (Dave Bock, 58780 Romeo Plk Rd., Washington, Mich.)

Meissner receiver, circa 1942. Tunes BC, s.w., and FM. Has 8 tubes. (Leonard Raphael, 519 E. 24 St., Brooklyn, N.Y. 11210)

(Continued on page 30)

ASSIST (*Continued from page 29*)

Magnavox Model 38H receiver, ser. X59572, style CPAR 653, chassis #CR178. Tunes BC. (Daniel M. Bayles, 218 S. McKenzie St., Adrian, Mich. 49221)

Atwater Kent Model 42-F receiver. **Federal** Model H-41-25 receiver. (Ted Whitus, 178 Floradale, Tonawanda, N.Y.)

Rogers receiver, ser. 8782, type 6R531. (Harvey Schroyen, UKHM, ELSA, Yukon Territory, Canada)

DeForest 2" scope. (John Johnson, 4825 N. Glickman, Temple City, Calif.)

Hallicrafters Model S-107 receiver. Tunes. 5-31 mc. and 48-54 mc. Has 8 tubes. (William Hyland, 16 Ridgewood St., Waterbury, Conn. 06710)

Stromberg-Carlson No. 320-5 receiver, ser. P28692(1). Tunes BC and s.w. Has 6 tubes. (Kit Pogorsky, 7109 3rd Ave., Brooklyn, N.Y. 11209)

Northern Radio Co. Model 1 variable master oscillator. (Charles Ickes, 1276 Benton St., Barberton, Ohio)

SPECIAL DATA OR PARTS

McMillan "Five." Two audio coupling transformers, 1½" in diameter by 1½" high, needed. (Fred Butterfield, 6 Second St., Brooklawn, N.J.)

Superior Model 600 tube tester. VOM and tube testing data needed. (Dave Bock, 58780 Romeo Plk Rd., Washington, Mich.)

A-C Electrical Mfg. Model A-C Dayton phono-set, circa 1924; tunes BC; has 5 201-A tubes. Schematic and source for tubes needed. (L. P. Card, 392 Lakeview Rd., Yorkton, Sask., Canada)

Crosley Model 11-122U receiver, ser. 29790262; has 5 tubes. Schematic, operating and alignment manual, and case needed. (James M. Saribalis, 737 Niantic Ave., Daly City, Calif. 94014)

Hallicrafters Model S-40-B receiver, circa 1954; tunes 540 kc. to 44 mc. on 4 bands; has 8 tubes. Tuning dial needed. (C. Miller, 10413 Munn, Houston, Texas 77029)

Atwater Kent horn with 6" base or smaller (any condition), Atwater Kent emblem for front panel, and 1"-diameter brown knob with arrow on top needed. (Paul Mundt, 911 E. Evergreen St., Santa Maria, Calif.)

Lear Model 6610PC or 6611PC or 6612PC receiver-phono combo, circa 1947; tunes 530 kc.-18 mc. on 3 bands. Audio amp section needed. (Robert LaRocca, 7205 18 Ave., Brooklyn, N.Y. 11204)

Erwood Model 4112 amplifier; has 7 tubes. Schematic and information on replacement power transformer needed. **V-M** "TRI-O-MATIC" record changer, circa 1950. Center spindle for 45 rpm and cartridge knob used to select needle needed. (Dennis C. Smith, 9201 Meyers Rd., Detroit, Mich. 48228)

Atwater Kent Model 20 receiver. Three short pin type 01A tubes needed. **R27/ARC-5** surplus "Command" aircraft receiver; tunes 6-9.1 mc. Variable capacitor #6558 (62 pf., per section) needed. (David Stefun, 2606 Angie Way, Rancho Cordova, Calif. 95670)

Acrosound Model TO-300 transformer, 6600 ohms p-to-p, for Mullard 520 circuit amplifier needed. (Thomas D. Greene, 175 Kensington Ave., Buffalo, N.Y. 14214)

Essex delay line, 0.6 microsecond delay, 1000-ohm impedance. All available data needed. (Louis Compoginis, 4520 Bailey Way, Sacramento, Calif. 95825)

GE Model X371 and X372 receiver; tunes BC and s.w.; has 11 tubes. Schematic and alignment data needed. (Frederico C. Po, 1573 Doroteo Jose, Sta. Cruz, Manila, Philippine Republic)

Philco receiver, chassis H 48707, circa 1934; tunes 550 kc. to 1700 kc. Schematic, coils, and #77 tubes needed. **Majestic** receiver, chassis 4810-E, ser. A-259537; tunes 560 kc. to 18.0 kc. on 2 bands; has 9 tubes. Schematic and alignment data needed. (Allen Holmes, 1620 Locust Way, Alderwood Manor, Wash. 98001)

Browne-Nobles NB-101 battery-operated broadcast tuner needed. (Henry V. Urban, 67 Poultney Ave., Buffalo, N.Y. 14215)

Kinnard Model Six "Spot-O-Matic" enlarging meter, circa 1947. Resistance cord or value thereof needed. (John Graves, 1663 Brandon Ave., Petersburg, Va. 23805)

(*Continued on page 32*)

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CIRCLE NO. 13 ON READER SERVICE PAGE

ASSIST (*Continued from page 30*)

Phillips Model CM50A receiver; tunes BC and s.w. to 22 mc. on 5 bands; has 5 tubes. Schematic and service info needed. (L. Swiderski, Box 756, Timmins, Ontario, Canada)

R-96/SR surplus receiver; tunes .125-12 mc.; has 11 tubes. Schematic, operating manual and parts info needed. (Larry Long, 45 South St., Holbrook, Mass. 02326)

Atwater Kent Model 33 receiver; has 6 tubes. Operating info, power and voltage specs, alignment data, schematic, parts list and source for parts needed. **RCA** "Radiola 60" receiver; has 9 tubes. Schematic and operating manual needed. (Carlton Mann, Box 314, Hanover, Ind. 47243)

Meissner "Analyst" receiver; has 8 tubes and 4 ray control indicators. Operating instructions, schematic, and d.c. voltmeter needed. (Arnold Walter, 155 Bathurst Dr., Tonawanda, N.Y. 14151)

R-174/URR surplus receiver, ser. 865, made by Emerson Radio; tunes 4 bands, 1.5 to 18 mc. Source for 2 dual antenna transformers (T1 and T5) needed. (Orville Myers, Gen. Del., Beulah, Colo.)

Heathkit Model TS-2 sweep generator. Operating and assembly manual and marker tuning capacitor needed. (E. Gasior, 1752 Spruce Ct., S. Milwaukee, Wis.)

RCA "Radiola 18" receiver, circa 1928; tunes 550-16,000 kc.; has 7 tubes. Schematic and source for UX-171-A, UX-227, UX-280 and UX-226 tubes needed. (Ray Valien, Jr., 2020 Whitmore St., Omaha, Neb.)

Atwater Kent Model 35 receiver, ser. 1001326; has Model H horn type speaker. Schematic and source for parts needed. (Donald Goode, 3918 Doane St., Orlando, Fla. 32809)

RT-18 ARC1 surplus transceiver, ser. A48262. Operating manual needed. (David H. Lawrence, 603 Thompson St., Charleston, W. Va. 25311)

Philco Model 116-122 receiver, circa 1935; tunes long-wave, BC, and s.w. Schematic, operating manual, and source for type 77 and other tubes in unit needed. (Larry Hughes, 1414 W. Flora St., Ontario, Calif. 91762)

Sherbrooke Model 14S1-200 television set, ser. 59450. Schematic and parts source needed. (Fred Pfeffer, 625 Evergreen Ave., Pittsburgh, Pa. 15209)

RCA Model T-60 receiver; tunes BC and 5.6 to 20 mc.; has 5 tubes, tuning eye, push-button tuner. Schematic and source for parts needed. (S. Ordinetz, RFD #2, Chester Depot, Vt. 05144)

Greybar Model 330 or **"Radiola 60"** receiver, circa 1925. Power transformer needed for either unit. (F. Elwood Sayles, 45 Petteys Ave., Providence, R.I. 02909)

ASB-7 surplus receiver, CAY-46ACE. Technical manual and schematic needed. (John Charls, 248 Park St., Lawrence, Mass. 01841)

Sakura Model TR-4E volt-ohmmeter; 20,000 ohms per volt. Selector switch and wiring diagram needed. (Karl Radoy, 1834 N.E. 170, Seattle, Wash. 19855)

Aireon Model 1221A amplifier made for juke box; has 5 tubes. Schematic and operating voltage data needed. (Jonathan L. Bouvé, 24 South St., Hingham, Mass. 02043)

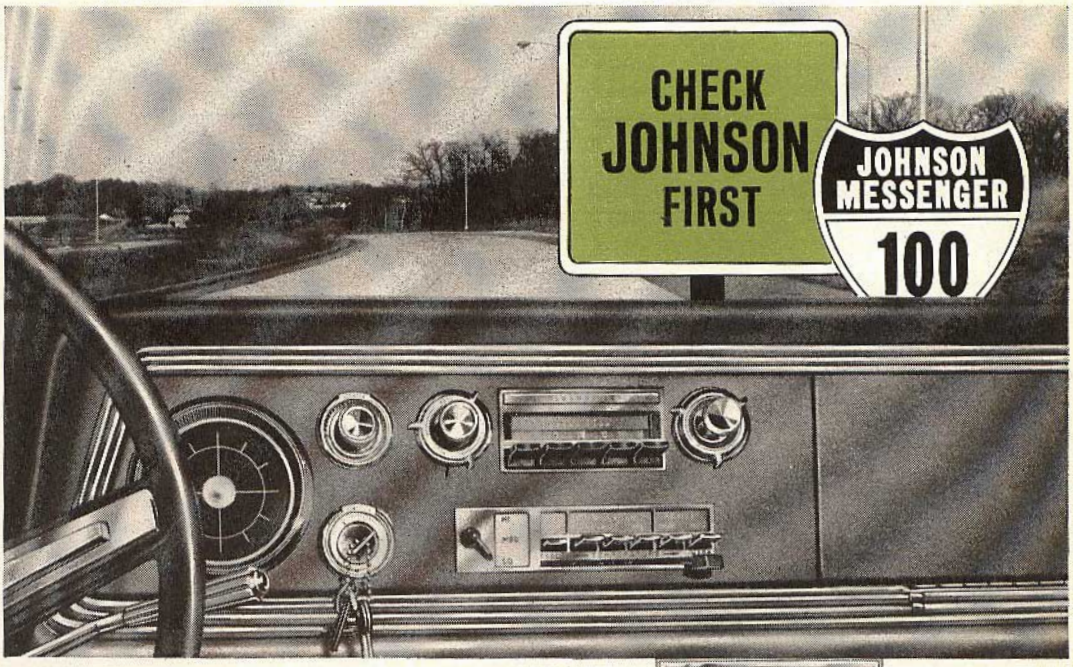
TRC-8 surplus receiver made by Espy Co; tunes FM on 230-250 mc. **TRC-8** surplus transmitter. **AN/APR-4** surplus receiver; tunes 60-280 mc. Manuals needed. (John Rokita, 3701 Pleasant Dr., Sharon, Pa.)

Supreme Model 542 multimeter, ser. 20364. Parts list, operating manual, and meter needed. (Otto C. Andrews, 634 Beaumont Rd., Fairless Hills, Pa. 19030)

RME Model 43 receiver; tunes 540 to 33,000 kc. on 6 bands; has 8 loktal tubes and 1 #80. Operating and servicing manual needed. (Alc T.L. English, 1605 USAF Hospital, Box 83, A.P.O., New York, N.Y. 09406)

RD-142/UN surplus recorder reproducer, made by Olympic Radio; has 2 channels, each channel using 4 heads and 2" tape. Heads, preferably mounted, and/or information on heads wanted. (E. W. Cox, 12905 Superior, E. Cleveland, Ohio 44112)

GE Model E 105 receiver; tunes 540 kc.-1700 kc., 1.7 mc.-6.0 mc., 6.0 mc.-18.0 mc.; has 10 tubes. Schematic and service data needed. (C. Fred Mullins, 3258 Rebert Pike, Springfield, Ohio 45502.) —30—



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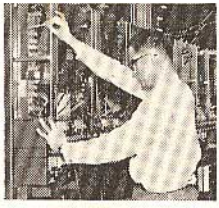

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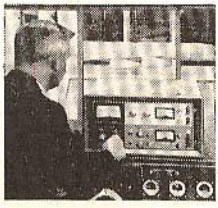

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SATELLITE ACTIVITY REPORT

Orbiting Solar Observatory-2, 136.713 mc., has been shut down by a NASA ground station command. Launched February 3, 1965, OSO-2 returned 2,200,000 bits of information prior to shutdown. It now becomes just another piece of space junk.

Last November, the U.S.S.R.—following its usual practice of discounting the work of other nations—claimed a "first" in color TV transmission using their "Molina-2" communications satellite. The Soviets failed to recall that Relay-1 had been used for color TV transmissions in March, 1963.

Direct broadcasting from a satellite to conventional FM home or short-wave receivers is only three to five years away. NASA is currently evaluating a number of proposals for such broadcasts, though FM is apparently being given the nod. Satellite manufacturers see little difficulty in relaying FM—especially after the spectacular success of the ham "OSCAR" project.

The "profit-making" Communication Satellite Corporation, COMSAT, has ordered four new satellites from Hughes Aircraft. Somewhat similar to the COMSAT "Early Bird," the new satellites will be orbited to provide global TV coverage and simultaneously provide instant voice contact with the Apollo moon astronauts. First of these satellites should be launched within six months.

Explorer-29, launched from Cape Kennedy on November 6, has been used to calibrate camera systems and optical tracking methods. For this work, the flashes from four 1580 candle-second xenon electronic tubes were photographed against a star background. Scientists will use the results of this program for positioning satellites with greater accuracy.

Various SWL's claim that the tracking beacons in the Gemini capsules can be heard with loud and clear signals. The beacons operate on ground command and transmit on 243.00 mc. With a suitable converter, these beacons should be heard within 400-500 miles of any official Gemini tracking station.

As this magazine issue closes, plans to launch OSCAR IV are being finalized. The U.S. Air Force has scheduled the OSCAR IV satellite—designed and built by radio amateurs—for launching from a Titan IIIc rocket. OSCAR IV will be orbited about 20,000 miles high and will have a life span of one year—or until the rechargable batteries run dry. A beacon will transmit on 431.925 mc. and an instantaneous translator will receive on 144.10 mc. and retransmit on 431.935 mc. —30—

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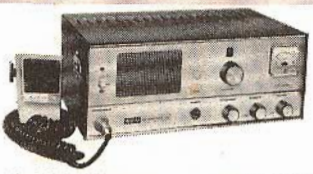

New Model 779 Sentinel 23 CB Transceiver. 23-channel frequency synthesizer provides crystal-controlled transmit and receive on all 23 channels. No additional crystals to buy ever! Features include dual conversion, illuminated S/RF meter, adjustable squelch and noise limiter, TVI filter, 117VAC and 12VDC transistorized dual power supply. Also serves as 3.5 watt P.A. system. **$159.95 wired.**

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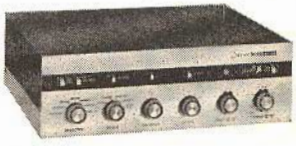

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PART 2: CORRESPONDENCE SCHOOLS

(PART 1: RESIDENT SCHOOLS; SEPT., 1965)

By KEN GILMORE

IN electronics today, it's what you know that counts. There's no room for the half educated, the basement tinkerer, the guy who isn't serious enough to prepare himself with a first-rate education.

And preparation is just the beginning; learning doesn't stop once you're on the job. One educational authority, borrowing the language of nuclear physics, estimates that the "half-life" of even the best technical education is just *ten years*. To put it another way, 50 percent of what you learn today will be as out-of-date as the crystal set ten years from now.

All of this adds up to one thing: If you want to be a member of today's fast-moving electronics team, you'll have to get good basic electronics training, then keep re-educating yourself from there on out.

There are two ways you can get a technical education. One is to attend a regular electronics residence school—a trade school, technical institute, or college. It's a good way—especially for basic training.

But suppose you can't. There's no school in your town, or you have a family to support and can't leave your job. Or you just don't have the cash to go to a full-time school or college. These days, you can get a first-rate electronics education at home. Scores of top-notch correspondence schools now offer an incredibly rich variety of courses, designed to make you anything from a radio repairman to an expert in space communications. And once you're on the job, education through the mails is one of the best ways to keep your knowledge up to date.

Before you go rushing off to the nearest post office to get your application in, however, you'll have to make a couple of basic decisions: (1) Exactly what kind of job—among the many fascinating ones available in the field of electronics—do you want to land, and (2) Which school, which courses, will best prepare you to reach this goal?

To make the right decision, you need information. And that's what you'll find in this article. POPULAR ELECTRONICS has talked to scores of education authorities across the country; we've queried home-study school officials and talked to their students and graduates. Here are their answers to the questions you'll be asking:

What can I learn at home?

The answer is—almost anything. Various schools approach the subject of electronics in different ways, at different levels. Some concentrate in one area. Hollywood's Grantham School of Electronics home study division, for example, specializes in preparing you to get an FCC First Class Radiotelephone license—your ticket to a job in radio or TV broadcasting or as a communications technician. Massey Technical Institute of Jacksonville, Florida, and Chicago's Coyne Electronics Institute emphasize training that will help you go into the radio-TV service business on your own.

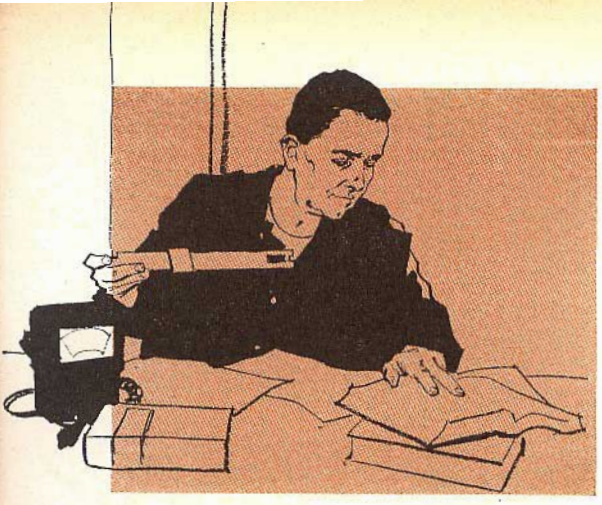
International Correspondence Schools (ICS) of Scranton, Pennsylvania, on the other hand, offers a wide variety of courses: electronics fundamentals, hi-fi and stereo servicing, radio-electronic telemetry, industrial electronics, and many more. At Chicago's DeVry Technical Institute, you can choose among all the standard courses and such up-to-the-minute fields as computer technology and space and missile instrumentation.

Many schools offer courses on several levels. "We advise beginners to take courses in one of our career programs," says Jack W. Friedman, director of the RCA Institutes Home Study School. "These courses begin with basic electronics and lead through advanced material in television, communications, automation and industrial electronics, transistors, or electronics drafting. Our advanced courses, on the other hand, serve more specific needs, such as helping a technician update himself or move to a higher level."

Some schools offer *only* advanced programs. "Many courses are keyed for the rank beginner," says G. O. Allen, president of the Cleveland Institute of Electronics (CIE). "Courses of that type serve a much-needed purpose, but we prefer to leave the manual training to them. For the man who has progressed well beyond the intermediate level, we offer a college-level course in communications engineering." Courses at Philco's Technical Institute in Philadelphia and Capitol Radio Engineering Institute in Washington are also designed for the working electronics technician or graduate engineer who wants to upgrade his skills or keep up to date in this fast-moving field.

What jobs can I prepare for?

There's almost no limit. Home-study graduates of Central Technical Institute of Kansas City, for example, hold such positions as engineering technicians in aerospace research and manufacturing, TV cameramen, studio and recording technicians, maintenance and operating technicians with airlines, police departments, railroads, and public utilities. Some own their own radio-TV repair shops. Virtually every major electronics company in the country and many small ones have on their staffs men working in research and development, in manufac-



turing, in testing—men who got their training or updated their skills through correspondence study.

Take a few isolated examples from one school—National Radio Institute in Washington, D. C. NRI graduate David F. Conrad of Reseda, California, is a senior engineering aide for Litton Systems; he checks out magnetic recording devices for a living. Robert L. L'Heureux of Southboro, Massachusetts, works for the data-processing division of Minneapolis-Honeywell. Walter G. Higgins of Portland, Oregon, was a mailman when he studied electronics at home; after his course, he transferred to the Department of the Interior as an electronics technician and now maintains UHF and VHF communications links. Jim Davis of Long Branch, New Jersey, troubleshoots transistorized chopper-stabilized d.c. amplifiers at Electronics Associates, Inc. The list could go on endlessly.

Most schools claim that between 90% and 100% of their graduates obtain employment in electronics. Says R. Parma of National Technical Schools in Los Angeles, "About 30% of our students are currently employed in electronics. These students feel that they lack the technical skills to achieve advancement in their company. Another 60% of our students are employed outside of electronics, but desire to change their jobs because of the increasing opportunities in this industry."

How long does it take, and how much will it cost?

Time to completion depends on three main things: the contents of the course, how fast you learn, and how much time you put in. Here are some typical examples.

Major programs at Capitol Radio Engineering Institute (CREI) in Washington, D. C., take about three years to complete for the average student studying two to three hours a day. Costs—depending on the subject—hover in the vicinity of $500 to $550 for the entire course. DeVry estimates that the average student studying its $560 course seven to ten hours a week can finish in a year and a half. At CIE an FCC license course costs $325 and ordinarily takes nine to ten months. Coyne's TV servicing course costs $165, will occupy the average student a year and a half.

National Technical Schools in Los Angeles offers a 150-lesson master course in radio, TV, and industrial electronics for $367. Each lesson takes three to four hours, and National Tech urges students to finish at least one a week. Most, however, move faster and complete the course in one to two years.

All times quoted above are average; some students learn faster, some slower. Put in twice as much time, and you'll finish twice as fast. Most schools have a time limit on finishing, too, but will grant an extension if you need it.

One final point: Most schools give substantial discounts for speeded-up payment, even lower prices for cash in advance. All prices given here are for the most extended payment plans the schools offer on a so-much-down, so-much-a-month basis.

By the way, you don't have to hesitate to pay in advance. All reputable schools have fair refund policies if something happens to keep you from finishing.

Once I've received my diploma, are jobs easy to get? Will the school help me land one?

If you don't already have a job in electronics (many home-study students do), most schools will help you find one. Many have formal placement bureaus (some invite you to use their services for the rest of your life); others will simply forward your grades and a letter of recommendation to prospective employers, leaving the bulk of the job up to you. No reputable school, of course, *guarantees* you a job on graduation, any more than reputable universities do.

Just how hard—or how easy—you'll find it to land a job with good pay depends on several things. The training you select is one of the big ones. Naturally, you can't expect to get the same job —or the same pay—after finishing a six-month course in basic electronics as you could after a comprehensive three-year course in industrial electronics or advanced communications systems.

One vital factor in job hunting is frequently overlooked. CIE's Allen puts it this way: "For CIE and other well-trained students," he says, "job placement is not much of a problem—if they will face realities. It seems obvious, but many young men from rural areas or small towns expect to find suitable employment at home. They *may* find it, but they should be prepared to go to the job —the job will seldom come to them. A college graduate seldom works in his home town. The same is true of a highly-skilled professional."

Can home-study graduates compete for jobs with those who get their training in resident schools? "What we're really talking about here," says John Sivatko of ICS, "is what does the employer think. If an industry is unfamiliar with the quality of home-study training, there may be some prejudice against it. The *competence* of the students is not that different; the *attitude of the employer* is the pertinent factor."

W. A. Robinson of DeVry makes another point. "The resident student has the advantage of meeting recruiters from various industries who come to the school to interview. The home-study student, however, must go to the employer for his interview. Where home-study programs compare closely with resident programs, employment will probably depend on how effectively the student presents himself to a prospective employer."

In the past, some employers who hired resident-school graduates regularly were hesitant about putting home-study grads on the payroll. To some extent, the situation still exists. "It is only fair to say that correspondence education does not yet receive the recognition it should as adequate preparation for initial employment in the field," says CREI Executive Vice President L. M. Upchurch. But the situation is changing—rapidly. "I'm happy to say the closed-door attitudes exhibited by many employers in the past have been cast out by progressive companies," says D. A. Lockmiller, Executive Secretary, National Home Study Council. "Now we hear this question: 'What does he know and can he use it well?' That's a far cry from the old insistence on pedigree—'Where did you go to school?' "

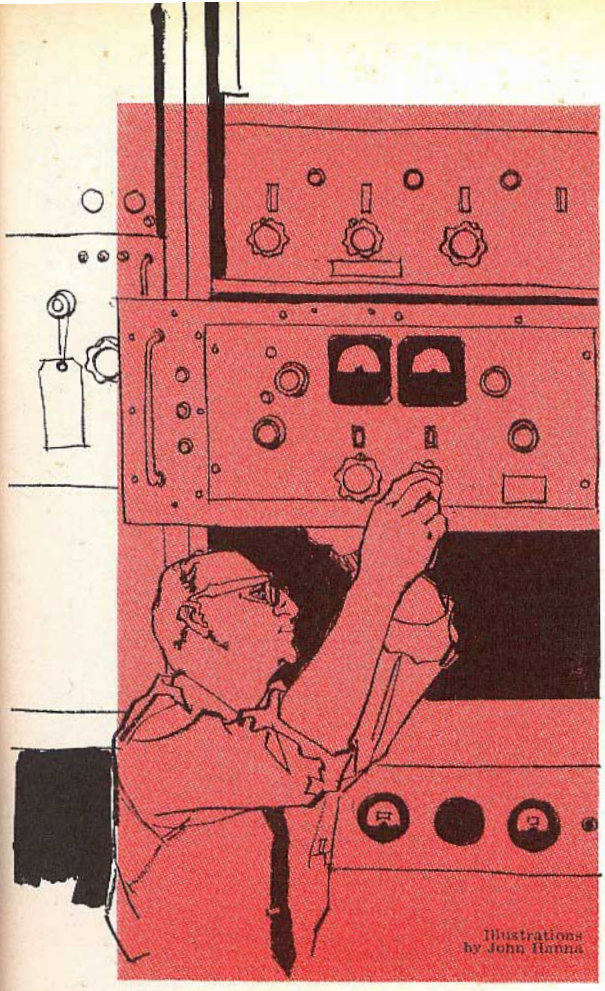
Correspondence school graduates have achieved high-ranking positions in business and industry, too. The national service manager of a large mail order store is a veteran of home study, as are many radio and TV station chief engineers, manufacturers, and company executives. In fact, some educators think that men and women with enough drive, ambition, and self-discipline to complete correspondence courses are likely to be a notch above average. Recently, just on a hunch, ICS sent questionaires to several thousand company presidents around the country, asking how many were former ICS students. About half answered. And of those, an astonishing seven percent were, indeed, ICS alumni. If all former correspondence students had been counted, the number would have been higher.

How about pay?

It's impossible to give precise figures; there's too much variation according to geographical area, amount of training, branch of industry—even the state of business. But here are some samples that will give you an idea of the range. The U. S. Department of Labor's *Occupational Outlook Quarterly* shows average technicians' salaries in private industry starting in the vicinity of $4900 a year. Also, ICS reports that its graduates average $80-$110 a week.

The range, however, can be far wider. "Some of our recent graduates are well over the $10,000-a-year level already," says Allen of CIE. "At the other extreme we have men who, because they are not willing to relocate or enjoy a certain type of electronics work, are making as low as $2 per hour."

Don't overlook the possibility of working for the federal government. Electronics technicians from GS3 to GS9 earn from $4005 to $9425. You may want to take a civil service test at the end of



your schooling to see if you can qualify.

There's virtually no limit to what you *can* make. Start your own business and your ultimate earnings are determined only by the sweat you're willing to put into it and your ability as a businessman. You can advance rapidly working for others, too. Listen to Charles J. Roesle of Washington, D. C.:

"Six years ago I was at the end of any advancement at $5500 per year. But after completing a National Radio Institute course I passed a Civil Service exam for an Electronics Production Engineer at $7000 per year. In May, 1961, I was promoted to Guided Missile Project Officer at $9000 per year. Recently, I was promoted to Guided Missile Supervisor, with a salary of $11,500 per year."

Incidentally, while you're dreaming of future riches, you can begin making your home-study course pay its own way. Peter Cooke of Coyne surveyed the school's 500 most recent graduates not long ago and asked each one how much money—if any—he had made repairing radios and TV sets in his spare time *before* he finished his course. Among them, the 500 students had picked up *more than $100,000* while studying. That's an average of better than $200 each—more than the total cost of the course.

Can I qualify for enrollment?

You can for most home-study courses if you can read and write and really want to get into electronics. The only additional requirements come from schools that offer advanced courses.

For example, CREI expects students to have a high-school diploma and a job or prior experience in electronics. The whole course, in fact, is designed for the working technician who wants to increase his skill and his pay check, not for the beginner.

Several other schools have similar requirements, virtually all for advanced courses. It wouldn't do you much good to take a course in servomechanism theory if you weren't yet on speaking terms with Ohm's law.

How can I pick the right school for me?

It isn't easy. There are hundreds of schools across the country offering thousands of courses. Prices, estimated time to completion, and many other factors vary widely. But the job, while difficult, isn't impossible. Here's advice from the experts on how to proceed.

Says William B. Callahan, president of Chicago's Commercial Trades Institute: "Look for the schools offering courses in the field you want to study. Compare tuition prices, look for accreditation, state licensing, and a good Better Business Bureau record." Adds J. F. Thompson of NRI: "Compare prices, faculty, and reputation. If you're still in doubt,

Where can I get more information?

For more information on who offers which course and on accreditation, write to the National Home Study Council, 1601 Eighteenth St., N. W., Washington, D. C. 20009, and ask for the Directory of Accredited Private Home Study Schools. It's free.

Should kits be included in a home-study course?

A good case can be made either way. "At best," says M. E. Houghton of DeVry Technical Institute, "a kit is a laboratory, a teaching device that's carefully built into the rest of the course. Our students don't just assemble a kit. Eventually they understand exactly why the kit is built as it is."

Another point in favor: The kits to be constructed in many courses are multimeters, signal generators, scopes, and other useful test instruments. If you're planning to go into servicing, these instruments can form the basis of your equipment.

Some schools, such as Coyne Electronics Institute, feel that kits aren't necessary. A kit's primary purpose, the school maintains, is to familiarize the student with actual electronic hardware. "But most of our students begin to repair radios and TV sets almost immediately," says Peter Cooke of Coyne. "So they don't need kits."

Capitol Radio Engineering Institute offers another reason for the non-kit course. "While we recognize the value of properly integrated kit construction in conjunction with correspondence study, we know that many of our students would find the use of kits impractical because of military restrictions, travel, space limitations, and so on," says L. M. Upchurch, Jr. "Further, since our students are already employed in electronics, their daily work frequently gives them the advantages they might otherwise get from working with kits."

One guideline, then, might be this: If you're a beginner with no electronics experience and no prospect of having a chance to work with equipment during your course, you'll probably do well to select a course with kits. If you *will* be working with equipment, or if you're already a practicing technician taking advanced courses, then kits are far less important, and in many cases may not be needed at all.

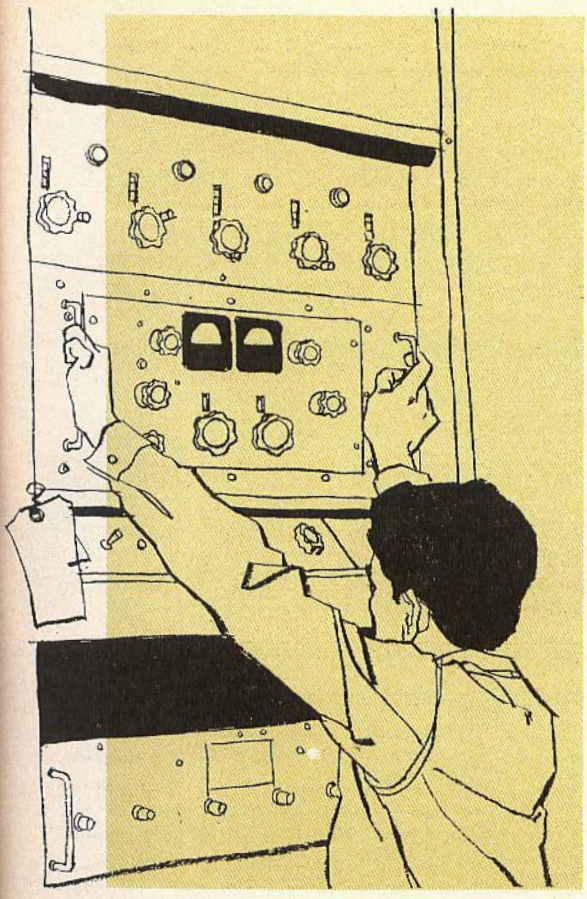
And, of course, there's one other important aspect: Courses without kits, all other things being equal, are certainly far cheaper than those with kits. Some schools offer courses either way.

write one or more graduates." Many schools will supply lists of graduates.

David Lockmiller of the NHSC offers this thought: "First, the school should be accredited by a nationally-recognized accrediting agency. There may be one or two good schools that are not accredited, but it is difficult to evaluate these schools. Look for such things as proof of performance, price, length of the course. Examine a sample lesson, check the employment features. No one of these criteria is conclusive, but they will help you to reach a final decision."

When you're making comparisons, don't overlook some of the special or bonus features a school might offer. Some of these "extras" may not be of value to you, but check to see what's being featured by the school in addition to the regular curriculum. Here are some examples—by no means complete:

- Consultation service. If you have a problem on the job—say in the design of a circuit or repairing a particularly knotty trouble—some schools will have a whack at helping you solve it.
- Schematic service. One school maintains a file of more than a million schematics—from old Atwater-Kent radios of more than three decades ago to the latest color TV sets. For a small fee, the school will copy any schematic and send it to you—an invaluable aid in troubleshooting.
- Course tailoring. Some schools fit the course precisely to your needs. If you already have some background in math or electronics, you can get a series of tests from some schools to see where you stand. Then you start at the right place and don't waste time repeating material you are already familiar with.
- Special devices. A midwest school supplies a projector and training films. Another school sends a transistor trainer —a special board that allows you to rig experimental circuits rapidly. Some



schools offer programmed lessons; others supply slide rules and other devices to help you learn. No one feature should determine which course you select, of course, but consider them along with all other factors.

What does it take to complete a home-study course successfully?

No reputable school will tell you it's easy. But it can be challenging, interesting, rewarding. The completion average for home-study students is higher than the national college average. The drop-out rate in colleges is high—in some cases going up to a peak of 80%—but one out of every three students completes his home-study course.

Why do so many fall by the wayside? "The two most important reasons," says G. O. Allen of CIE, "are motivation of the student and length of the course involved. For example, we conduct many courses for industrial concerns. These courses often take from 18 months to two years. Despite this rather formidable assignment, we frequently have completion percentages for individual companies as high as 90 to 95 percent—sometimes 100 percent. These men are highly motivated because the company provides funds and often company time for training, and is certainly in a position to influence the student's future employment. On the other hand, we sometimes encounter completion rates as low as 10 to 15 percent for students enrolling individually for these same courses. Self-discipline simply does not produce the same results as discipline administered by an employer. In some courses that run up to three years, we experience similar results from our group enrollments, but an even lower completion rate for individual students."

Despite these gloomy statistics, you'll have a lot going for you. "Any reputable school will do all it can to help the student finish the training he has selected," says DeVry's W. A. Robinson. "Most schools keep a steady flow of inspirational and motivational material in the mail, particularly to students who lag. In fact, most schools bend over backwards offering extra help to those they feel need it. In the final decision, however, it is the student himself who makes the decision to complete his training."

"The difference between a completer and a non-completer," adds R. Parma of National Tech, "is the degree to which he allows himself to procrastinate. Procrastination is the student's worst enemy, but the fault does not always lie with the student. Home study competes with the family, sports, TV, etc. But whether or not a student completes his course depends on how he rationalizes the importance of his time and career."

Just who can benefit from home study?

"Anyone who is interested in improving himself," says Robinson of DeVry. "Anyone who will bend his mind and back to the task," adds Hal Kelly of the National Home Study Council.

"The question should be," says John Sivatko of ICS, " 'Who can benefit from study?' *Home* study is just a technique. If you can benefit from any kind of learning, you can benefit from home study."

There's no doubt that the country needs more trained people. "Our economic progress today is being hampered by an increasing shortage of skilled men and women," says NRI's Thompson. "At a time when four million people are jobless, newspapers are crammed with ads for workers who can connect an electronic circuit, program a computer, service aircraft and missile equipment—or even *qualify* for training in hundreds of new skills that were unheard of 20 years ago. To put it another way, there would be virtually no unemployment if today's four million jobless obtained the skills to match business and industry's needs."

Correspondence education could play an increasingly important role in training men and women for tomorrow's ever-more-demanding jobs. In fact, the whole notion got some pretty high-level endorsement recently, as President Johnson voiced this opinion: "Home-study courses are an important link in the ever-lengthening chain of educational services our nation provides for its citizens. They represent an important resource in our society's commitment to provide unlimited opportunities for every American to reach his highest potential."

"We need correspondence education in this country now more than at any time in our past," says G. O. Allen of CIE, who is also the recently-elected president of the National Home Study Council. "We have a tremendous shortage of classroom facilities and qualified teachers, and this shortage is bound to get worse. Correspondence education can easily help fill the gap."

Maybe it can fill a gap in your life, too, and start you on a rewarding career in the important and fascinating field of electronics. -30-

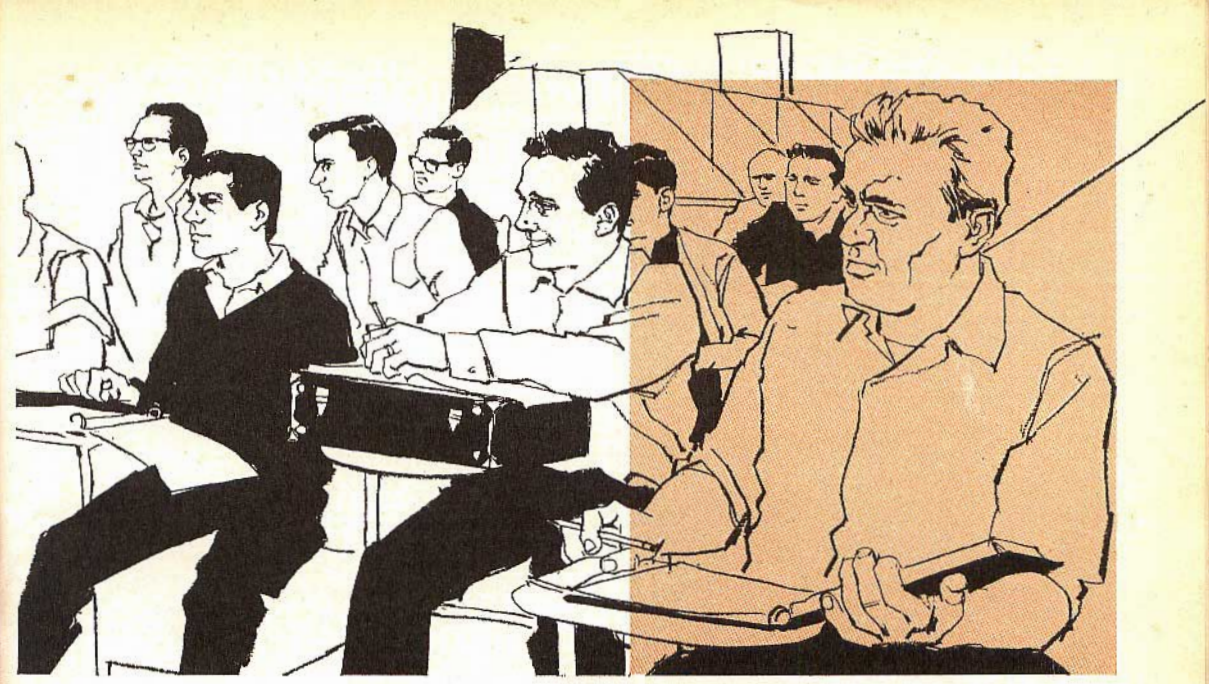
Should I study at home or go to a residence school?

If you're looking for controversy, this is the question to ask. Of course, if you have a job and a family and can't simply take off and go to a residence school, your choice is easy. You'll study by mail.

But what if you do have a choice? There's no doubt that home study has important advantages. Among them: You can study in your spare time, at odd hours, or while traveling. You don't have to leave home or lose income. You can study at your own pace. You don't miss classes; they wait for you if you're sick or busy. You can move from one city to another without missing a beat. And home study is certainly far less expensive than residence training. You'll probably spend less for an entire electronics course lasting two years or more by mail than for one semester in college.

But would you learn more in a regular classroom? Actually, the evidence shows it's the other way around. One study by the dean of the College of Education of the University of Michigan showed that correspondence students did slightly better on exams than others who learned the same material in the classroom. Several other studies showed similar results. "You learn by doing, not by copying someone else," says Richard S. Frazer, president of Christy Trades School. "You learn more thoroughly because you do it all yourself."

Then should you study by mail in *preference* to residence school? "If a home-study student is willing to put forth some effort toward self-improvement, we feel it is comparable to the best resident-school training to be found," says J. F. Thompson of National Radio Institute. "It depends on the individual," says John Sivatko of International Correspondence Schools. "Some people can get more out of a home-study course than they can in residence, and vice versa." G. O. Allen of Cleveland Institute of Electronics agrees. "Much depends on the person," he says, "his goals and motivation, his geographical location, his time availability, the nature of the subject to be learned, etc. I will state, however, that other things being equal, I do believe the student who learns through a good home-study



program not only learns better, but retains it longer."

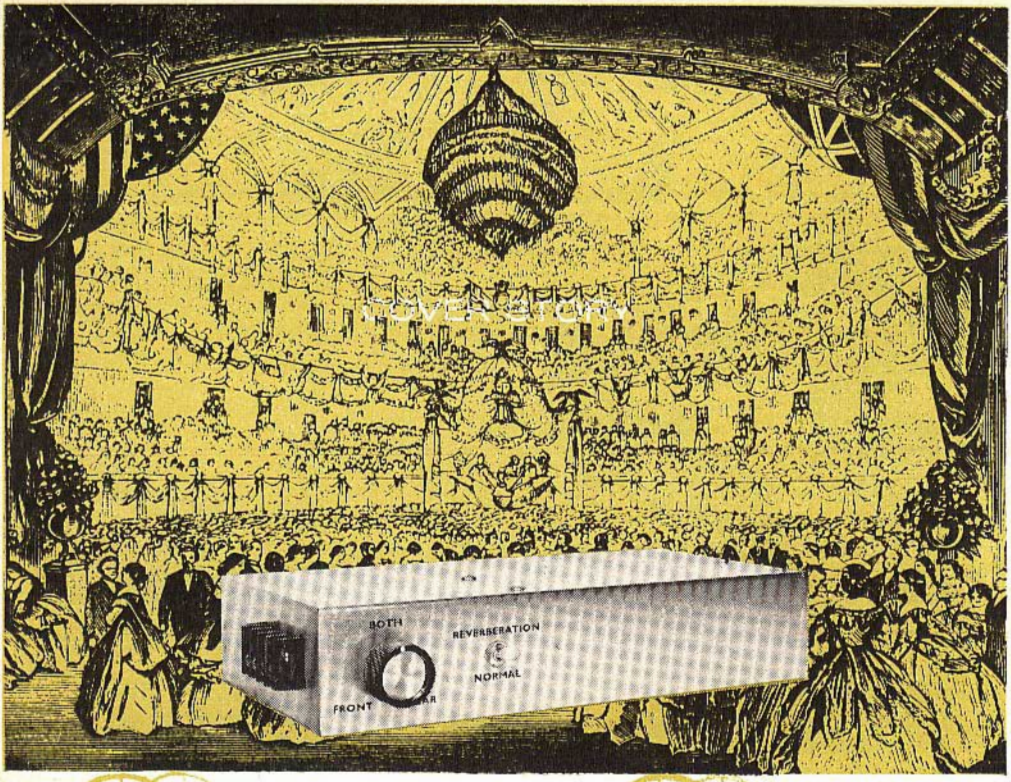
But C. L. Foster of Central Technical Institute says: "We recommend resident school training if it is at all possible. If resident school is not practical, we recommend home-study courses because we believe that worthwhile education can be obtained through home study." And W. A. Robinson of DeVry Technical Institute brings up another point: "Some types of training are offered at a more advanced level in our resident school than through home-study programs. In such cases, we could not provide equivalent home-study training."

Finally, L. M. Upchurch, Jr., of Capitol Radio Engineering Institute sums up his feeling. "We do not know of any authoritative comparative study of correspondence—as opposed to classroom—learning that has indicated any significant superiority of class attendance. Several studies, on the other hand, have shown slightly better results from home study.

"Comparing correspondence and classroom study of technical subjects is difficult in one respect: laboratory work. Because CREI students are, as a condition of enrollment, employed in the field of electronics, we know that to a considerable extent their practical experience gained on the job is a satisfactory substitute for supervised laboratory work. This is not invariably true, however.

"In any case, we would not ordinarily recommend correspondence study to a prospective student with the qualifications, the means, and the opportunity to attend a good residence school in the same field. (Nevertheless, there are some students for whom home study would be the better choice.) Neither would we claim that the average correspondence student completing our course is as well prepared as the average graduate of a comparable program in residence.

"The value of home study," Mr. Upchurch concludes, "is not as a competitor of residence school instruction, but as a valid educational method for individuals who want and need further education, but whose circumstances are such as to make class attendance undesirable or impossible."



By DANIEL MEYER

Reverb for your car

Concert hall on wheels

HAVE you ever noticed the difference between the sound of music indoors and the sound of music out in the open air? This difference is due to the presence and absence, respectively, of reverberation. In an enclosed space, we hear the direct sounds from the performing instruments, and the sounds that are reflected from the walls, ceiling, floor, furniture, and other surfaces.

These reflected sounds reach our ears later and slightly weaker than the direct sound because they have traveled a greater distance. The larger the room, the greater the reverb time, and the greater the decay. If the direct sound is loud enough, it will usually cause more than one reflection . . . each subsequent reflection arriving with greater delay and greater decay.

Reverberation time, as small as it might be, is quite critical. If it is too long, there is a severe echo effect, and if it is too short, the music will sound flat and lifeless, as it would normally sound in a very small room. So important is this reverb time that some concert halls have added electronic reverberation to optimize the natural reverberation characteristics of the auditorium.

For less than $20 plus a little time, you can assemble the reverberation set-

up to be described here for your car radio or your hi-fi set at home. With it, you will be able to electronically enlarge your listening area to concert-hall proportions.

How It Works. A patented Hammond organ reverberation unit, an electromechanical device, is used to delay and decay a portion of the sound. A transducer at one end of the reverberation unit acts like a speaker. It picks up the audio signal from the output transformer in a car radio, converts this electrical energy into mechanical energy, and "excites" a couple of sets of springs which are attached to it. (See Fig. 1.)

The signal, now in mechanical form, travels along the springs and energizes an output transducer attached to the other end of the springs. The output transducer acts like a microphone and reconverts the mechanical energy back into electrical energy. It takes approximately 25 milliseconds for the sound to travel down the springs, but not all of the signal gets past the output transducer the first time. Some of the signal "bounces" back and forth from transducer to transducer, through the springs, one or more times. (This feature is purposely designed into the springs to simulate multiple reflections in a room). The delay line has approximately 40 to 50 db insertion loss and so the reverb signal must be amplified to bring its output signal level back up to the original input level.

Almost any audio amplifier could be used to beef up the output of the reverberation unit and feed the signal to the rear-seat speaker in a car, or to a second speaker in the home. But you can build the amplifier shown here and mount it and the reverb unit in a 5" x 9½" x 2" case.

In the transformerless amplifier in Fig. 2, the signal from the reverberation unit is applied between the base of *Q1* and the sliding contact on potentiometer *R4*, which acts as a stabilizing emitter resistor and level control. This unbypassed resistance introduces degenerative feedback to reduce distortion. Distortion is less than 1% at 3 watts output.

The amplified signal from the collector of *Q1* is capacitively coupled to the base of *Q2*. Transistor *Q2* amplifies the signal and feeds it to the complementary driver transistors (*Q3* and *Q4*). Transistor *Q3* conducts on positive half cycles, and *Q4* conducts on negative half cycles, and drives output transistors *Q5* and *Q6* in a push-pull manner. The voltage drop across *D1* and *D2* forward-biases the driver transistors slightly to prevent

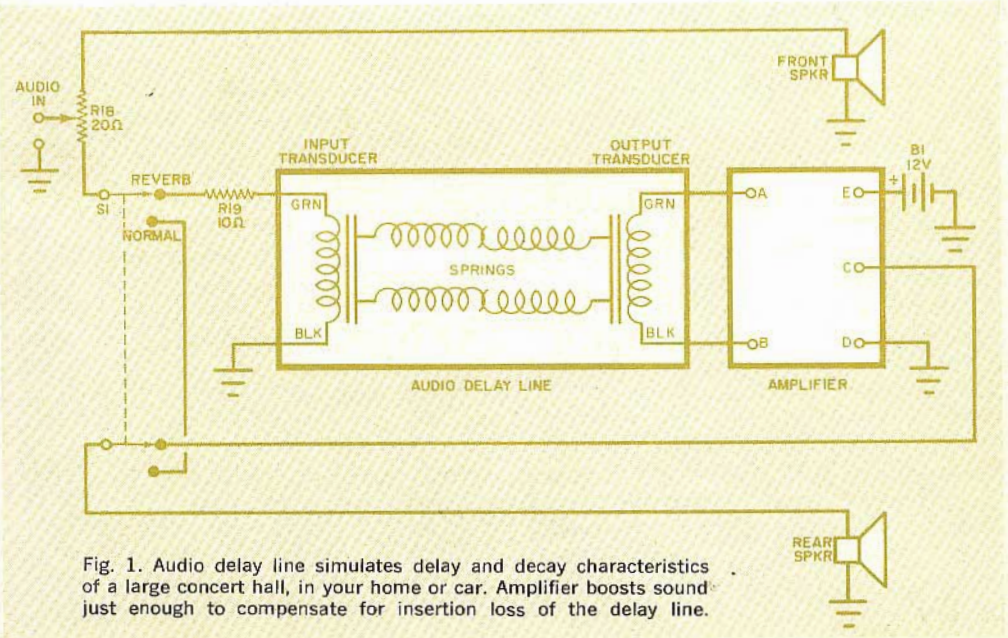


Fig. 1. Audio delay line simulates delay and decay characteristics of a large concert hall, in your home or car. Amplifier boosts sound just enough to compensate for insertion loss of the delay line.

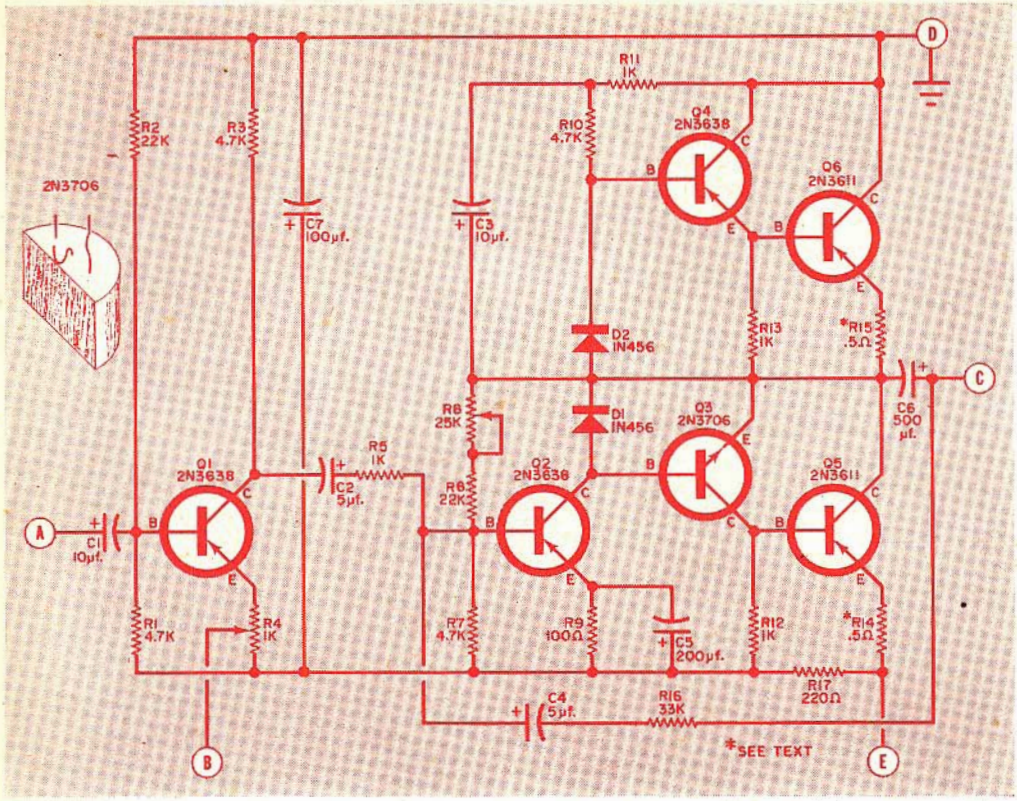


Fig. 2. Signal from the delay line is applied to points A and B, then amplified and fed out to a speaker connected to C and D. Level control R4 is adjusted to obtain equal levels of direct and indirect signals. Amplifier distortion is less than 1% at 3 watts output. Class B operation accounts for high efficiency.

crossover distortion. The diodes also provide temperature compensation.

When reverb is desired, *S1* switches in the second speaker and the fader control (*R18*) controls the percentage or mix of direct and "reflected" sound. When *S1* is in the normal position, the fader control feeds more or less direct signal to either speaker as desired.

Silicon transistors in all but the output stages make the amplifier temperature-stable. The specified output transistors should be used if at all possible; they are inexpensive and have superior leakage and frequency response characteristics.

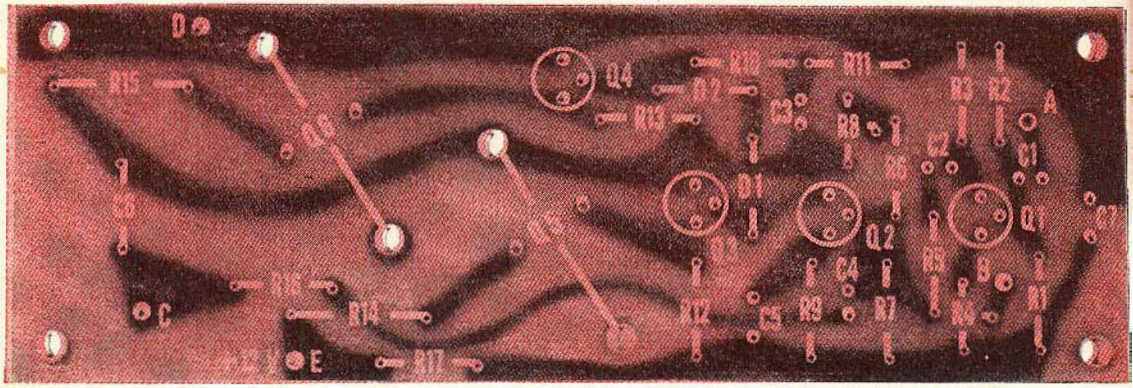


Fig. 3. Non-conductive paint is used on component side of printed circuit board to show location of parts.

PARTS LIST

C1, C3—10-μf., 15-volt electrolytic capacitor
C2, C4—5-μf., 15-volt electrolytic capacitor
C5—200-μf., 6-volt electrolytic capacitor
C6—500-μf., 25-volt electrolytic capacitor
C7—100-μf., 15-volt electrolytic capacitor
C8, C9—1000-μf., 25-volt electrolytic capacitor
D1, D2—1N456 silicon diode
D3, D4—1N1692 diode (50 volts PIV, or better)
Q1, Q2, Q4—2N3638 transistor
Q3—2N3706 transistor
Q5, Q6—2N3611 transistor
R1, R3, R7, R10—4700-ohm, ½-watt resistor
R2, R6—22,000-ohm, ½-watt resistor
R4—1000-ohm printed circuit board type trimmer resistor
R5, R11, R12, R13—1000-ohm, ½-watt resistor
R8—25,000-ohm, printed circuit board type trimmer resistor
R9—100-ohm, ½-watt resistor
R14, R15—½-ohm, ½-watt resistor—see text
R16—33,000-ohm, ½-watt resistor
R17—220-ohm resistor
R18—20-ohm potentiometer
R19—10-ohm, ½-watt resistor
R20—10-ohm, 5-watt resistor
S1—D.p.d.t. switch
T1—Low-voltage rectifier transformer; 117-volt primary, 12-volt secondary with CT (Allied 64 U 733, or equivalent)
*1—Reverberation unit; 8 ohms input, 2000 ohms output (Gibbs Type 5G)**
*1—Printed circuit board, or other suitable wiring board**
1—5" x 9½" x 2" aluminum case (Bud AC-403 or equivalent)
Misc.—Terminal strip, ½" standoffs, nuts, bolts, wire, solder, etc.

*The following parts can be purchased from DEMCO, Box 16297, San Antonio, Texas 78216: reverberation unit, $7; epoxy fiberglass printed circuit board, $2.50; kit, including reverberation unit, printed circuit board and all components for amplifier, except case and external a.c. power supply, $15.00.

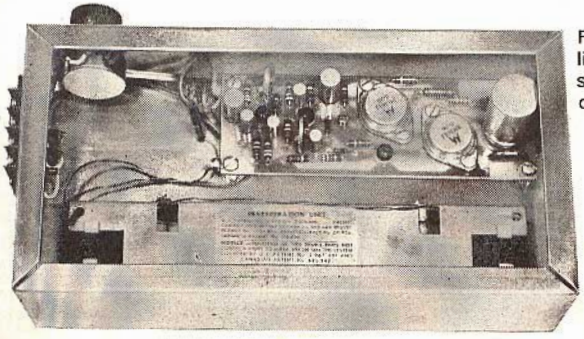
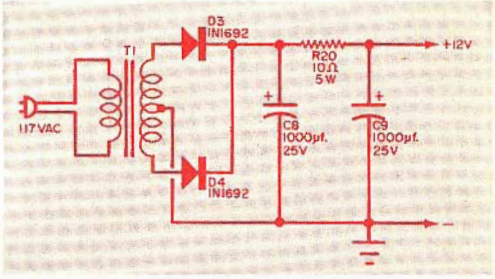


Fig. 4. Bottom view. Reverberation unit (audio delay line) is shock-mounted and hangs from four small springs when the chassis is top side up. Chassis can be mounted under dashboard near the driver.

Since the power amplifier operates class B, standby or low-level operation causes little power drain. Only at full output is the maximum 0.5 to 1.0 ampere of current required. For use in installations other than in cars, the a.c. supply shown in Fig. 3 can be used to power the

(*Continued on page* 98)

Fig. 5. For use in the home, a 12-volt power source is needed. If it is not available from existing equipment, you can build this full-wave power supply.



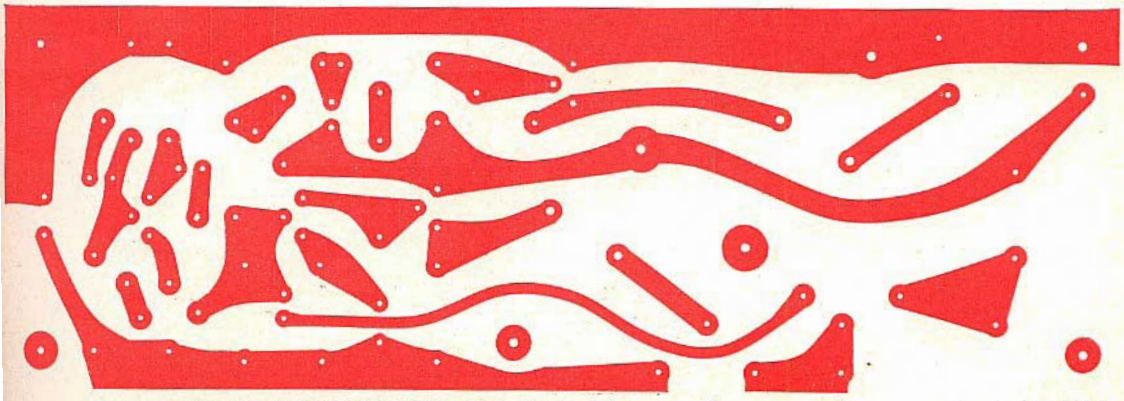
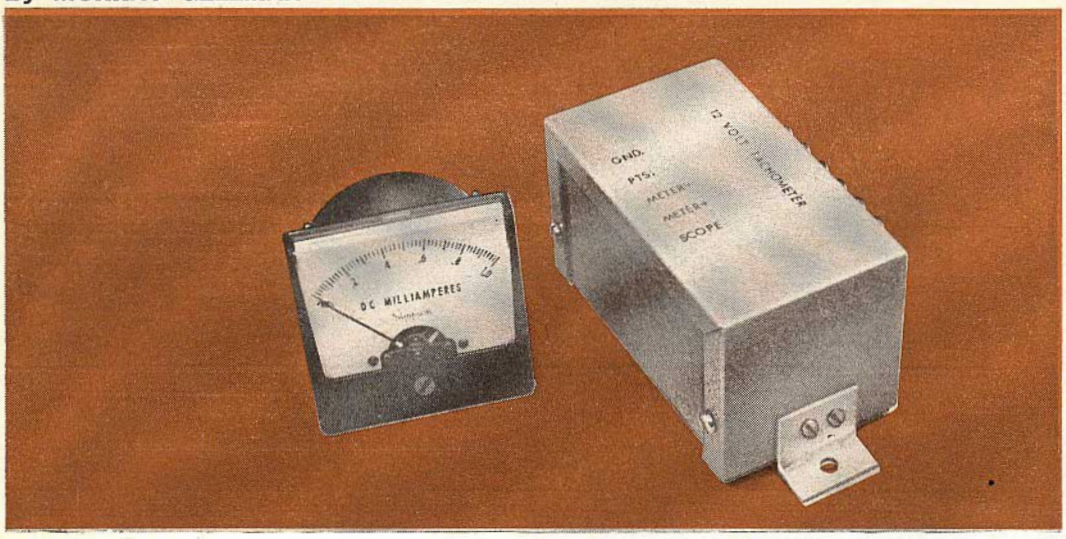


Fig. 6. Foil side of board is shown actual size to help you make your own; however, wiring isn't critical.

SOLID-STATE TACHOMETER for CD

By MURRAY GELLMAN



ABSENCE of inductive kick across the ignition points in a capacitor discharge (CD) or transistor ignition system prevents many commercially available tachometers from operating properly. Some of these tachs use a vibrator type of chopper and batteries; others use diodes and transistors which are not fast enough to give a true rpm indication. Still others, especially those with inductive input components, tend to load down the ignition system, depriving it of a significant amount of high voltage. Here's a tach that requires very few parts and no batteries, is easy to build, and won't steal any high voltage from your spark plugs.

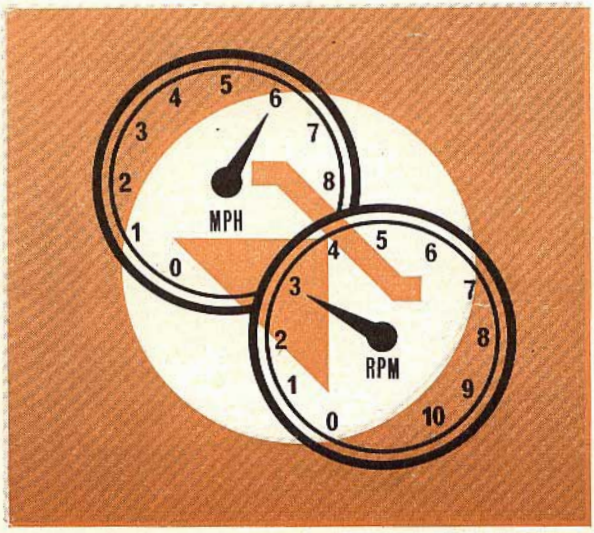
The entire works including the meter can be put into one package, or as is commonly done, divided into two units—the meter, as one unit, acting as a receiver, and the other components in another unit acting as a sender. The receiver can be mounted on the dash or steering column within view of the driver; the sending unit can be located in any convenient place, including the engine compartment—but keep it away from the hot engine.

How It Works. In a negative-ground CD or transistor ignition system, the battery voltage appears across the points as a positive-going rectangular pulse when the points open and close. The pulse is applied across *D1* and *R1*. Zener diode *D1*, a 1N3017, limits the pulse peak applied across the remainder of the circuit to 7.5 volts. Since this is well below the lowest battery voltage in a 12-volt system, the meter readings will not wander with fluctuating battery voltage.

Capacitor *C1* takes on a charge through the meter and resistors *R2* and *R3* and through *D3* when the points are open and the battery voltage is across the points. If the points were to remain open all the time, *C1* would charge up at a decreasing rate until it was essentially fully charged. Current through the meter would fall off accordingly. Initially the meter needle would start out very high on the scale and fall off to practically zero, if the needle could respond fast enough. But the engine doesn't stand still and the points keep opening and closing.

When the points close, *C1* discharges through *D2*, the closed points, and *R1*, and is ready to take on the next surge of current when the points open again. If *D2* and *D3* respond fast enough, then the average current through the meter will depend more upon the number of

or TRANSISTOR IGNITION SYSTEMS



pulses in a given time (frequency) than upon the width or shape of the pulse. The faster the circuit responds, the greater its ability to "track" the leading edge of the pulse.

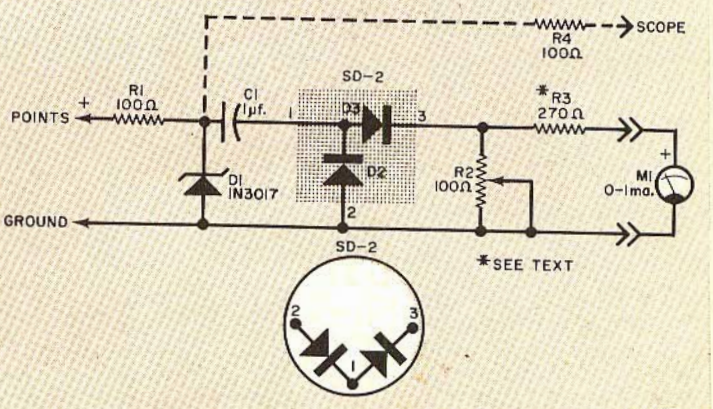
Another benefit of this type of current monitoring is that the dwell time of the ignition points becomes less of an error factor and the meter reading takes on another dimension of accuracy to more perfectly reflect engine rpm. The trick then is to use a pair of diodes that have a high-speed switching action characteristic.

Since we have minimized—if not eliminated—pulse amplitude, pulse width, and pulse shape as meter-response factors, and have "forced" the meter to respond to the leading edge of the pulse, this circuit can be relied upon for extremely accurate readings, and to surpass many commercially available products. As the meter readings are directly proportional to the pulse frequency and since pulse frequency is in direct proportion to engine rpm, the meter can be calibrated to read out rpm.

Resistors *R2* and *R3* are used to calibrate the meter. Resistor *R4* is optional and need not be installed, unless you intend to monitor the waveform across the points with a scope. Not shown is a 0.005-μf. capacitor which can be put across *R2* to act as an r.f. bypass to prevent the tach from causing radio interference.

Construction. All parts except the meter are enclosed in a 2¼" x 4" x 2¼" box. Two small L-brackets are attached to the sides of the box to facilitate mounting. Parts layout is not critical, and a larger or smaller box can be used if desired.

The size of the meter does not matter, either, but the meter movement should be 0-1 ma. for a 10,000-rpm full-scale reading, or 0-500 μa. to obtain full-scale deflection at 5000 rpm. You could then use the existing scale and multiply by 1000 to determine rpm. (A reading of



Current through the meter is a function of pulse frequency; pulse frequency is a function of engine rpm. Fast-acting diodes (SD-2) enable the circuit to respond to the leading edge of the pulses to minimize significance of pulse shape and width. Zener diode D1 regulates voltage peaks to make the readings independent of battery voltage fluctuations.

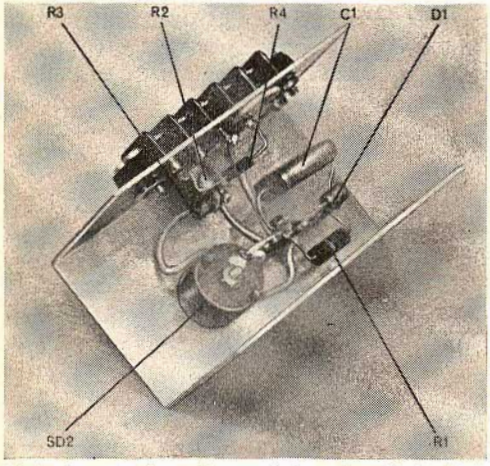
3.5 ma. would indicate 3500 rpm.) When other commercial rpm meters are used, *R3* may have to be jumped, as some of them incorporate 0-2 ma. movements. Regardless of scale markings or meter movements used, you should calibrate the tach before you install it in your car.

Diodes *D2* and *D3* are fast-acting avalanche types, and are available in matched pairs to within 5% for forward conduction, rise time, and linearity. (See Parts List.) These diodes (Module SD-2) are encapsulated in a compound to keep them both at the same temperature. Maximum variation in the rpm reading due to temperature change is less than 1%. You can substitute other fast acting diodes for this purpose, such as 1N64S, but you are more likely to do better with the SD-2 module. By all means observe po-

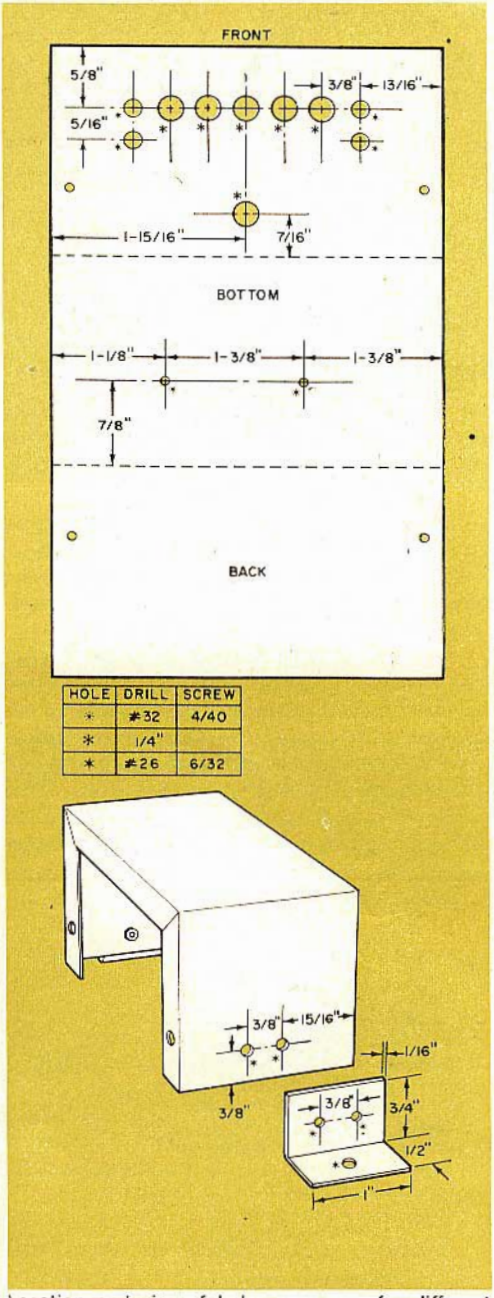
PARTS LIST

B1—12-volt battery
C1—1-μf., 100-volt capacitor (for 6-volt systems or 2-cycle engines, use 2 μf.)
D1—1N3017 zener diode (for 6-volt systems, use a 1N645)
D2, D3—SYDMUR SD-2 module (1N645 or equivalent)*
D4—1N91 diode
D5, D6—1N34 diode or equivalent
M1—0-1 ma. meter for direct calibration to 10,000 rpm (for 5000-rpm maximum reading, use 0-500 μa. meter)
Q1—2N173 transistor
R1—100-ohm, 1-watt resistor
R2—100-ohm carbon, lock-shaft potentiometer
R3—270-ohm, ½-watt resistor
R4—100-ohm, ½-watt resistor
R5—150-ohm, 2-watt resistor
R6—6800-ohm, 1-watt resistor
S1, S2—S.p.s.t. switch
T1—Low-voltage rectifier transformer; 117-volt primary, 24-volt center-tapped secondary
1—2¾" x 4" x 2¼" box (Premier PMC 1003, or equivalent)
Misc.—Terminal strips (2), L brackets (2), machine screws and nuts, wire, etc.

**Available from SYDMUR, P.O. Box 25A, Midwood Station, Brooklyn, N.Y., for $3.50.*

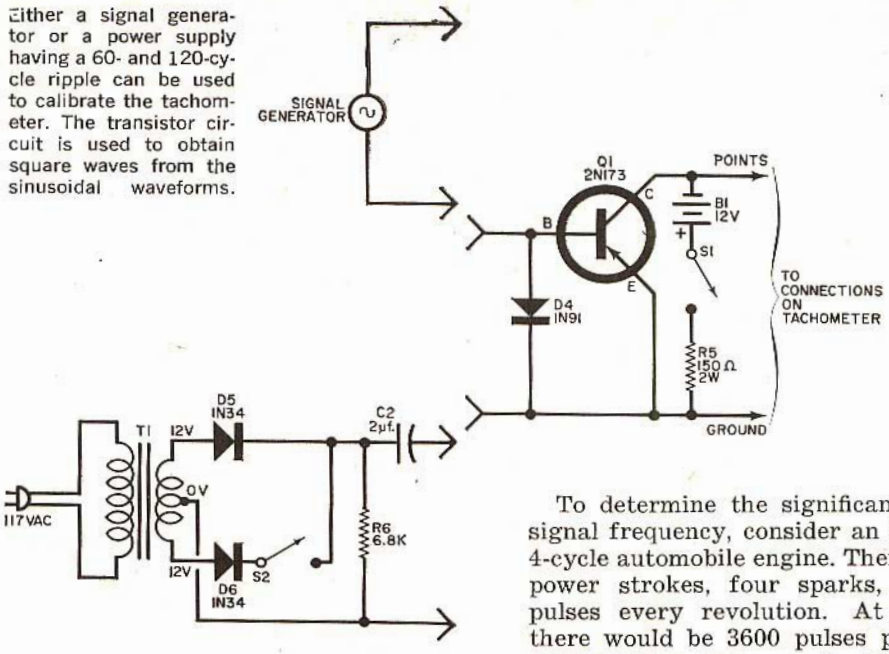


Parts layout of sending unit is not critical. Fast-acting diodes are encapsulated to keep them both at the same operating temperature for minimum error.



Location and size of holes may vary for different style of terminal strip. It's a good idea to lay out all parts before drilling any holes in the box.

Either a signal generator or a power supply having a 60- and 120-cycle ripple can be used to calibrate the tachometer. The transistor circuit is used to obtain square waves from the sinusoidal waveforms.



larity of the diodes and the external connection to the distributor.

Potentiometer *R2* is a locking-shaft type to prevent adjustment drift due to vibration.

Calibration. The tach can be calibrated with an audio oscillator having at least a 10-volt r.m.s. output. You can take advantage of the 60- or 120-cycle pulses developed in an ordinary half-wave and full-wave rectifier circuit as shown in the diagram. When *S2* is open, the output frequency is 60 cycles; and when it is closed, the output pulses occur at 120 cycles. In order to obtain a rectangular pulse which more nearly resembles the pulse from the distributor, you can feed the test signal from the generator or the rectifier circuit through the wave squarer made up of *Q1*, *D4*, *B1* and *R5*.

To determine the significance of test signal frequency, consider an 8-cylinder, 4-cycle automobile engine. There are four power strokes, four sparks, and four pulses every revolution. At 900 rpm, there would be 3600 pulses per minute or 60 pulses per second. Therefore, a test signal of 60 cycles is equivalent to 900 rpm. By the same token, a test signal of 120 cycles simulates 1800 rpm.

For maximum meter accuracy, select a check point as close as possible to the engine speeds you are most likely to attain most of the time. Since circuit action is essentially linear, all you need is a single test point. Refer to the calibration and conversion chart to find out what test signals you can use for 4-, 6-, and 8-cylinder, 2- and 4-cycle engines.

Special Considerations. For 2-cycle engines, capacitor *C1* should be a 2-μf. unit. For 6-volt ignition systems, *D1* should be a 1N3824 zener diode (4.3 volts), *R1* a 39-ohm, 1-watt resistor, and *C1* a 2-μf. capacitor. For positive ground systems, simply reverse the leads going to the distributor from the tachometer. Happy motoring. -30-

CALIBRATION AND CONVERSION DATA CHART

Cylinders	K		fK (4-cycle engine) = rpm			R3
	2-cycle engine	4-cycle engine	60 cycles (rpm)	120 cycles (rpm)	200 cycles (rpm)	(approx. ohms)
4	15	30	1800	3600	6000	47
6	10	20	1200	2400	4000	150
8	7.5	15	900	1800	3000	240

DWELL METER ADAPTER

Use your voltmeter to adjust your ignition points with precision

By DAVID H. BOZARTH

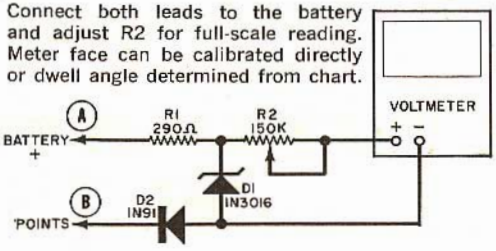
TO OBTAIN the hottest possible spark under most operating conditions in a conventional ignition system, the dwell angle of the ignition points should be adjusted in accordance with the manufacturer's specifications in most cases. If the need for a dwell meter does not justify the cost of purchasing one, you can build this voltmeter adapter to enable your meter to read out dwell angle. By using parts from the surplus market, you should be able to hold the total cost below $2.00.

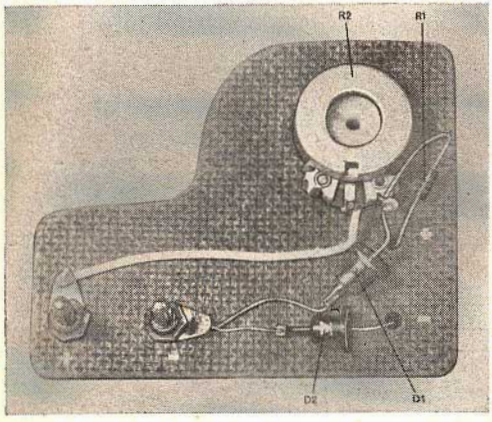
Construction is straightforward and—except for observing polarity—assembly, wiring, and parts layout are not critical. The adapter can be made to plug directly into a voltmeter as shown, or be connected to the voltmeter with a pair of leads. The meter "averages" the pulses and gives a voltage reading which is essentially proportional to the percent of time the points are closed. This percentage may be related to degrees by use of the dwell angle conversion chart on page 92.

To calibrate the adapter, attach lead *B* to the negative side of the battery and adjust *R2* to obtain a full-scale reading on the meter. Use the 5-volt d.c. scale if your meter has one, otherwise the nearest one to it but below the 6.8-volt limit imposed by the zener diode. A full-scale reading would then be an indication of essentially 100% dwell time (points always closed).

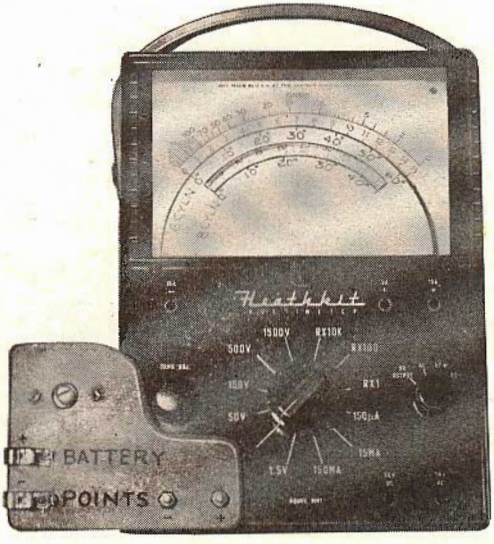
To use the adapter, remove lead *B* from the battery and attach it to the terminal on the distributor going to the primary winding of the ignition coil. (It may be easier to attach the lead to the coil.) On an 8-cylinder engine, for example, if you obtain a 3-volt reading on a 5-volt scale, simply multiply 3 volts by 9 (9° per volt) and you'll arrive at a dwell-angle indication of 27°.

(*Continued on page* 92)





All parts, including banana plugs, are mounted on a piece of fiberboard shaped to conform to the meter.



Only two leads are needed to complete hookup to positive side of battery and ignition points.

ELECTROMAZE PUZZLE

By
ROBERT C. RADFORD

Here's a new kind of crossword puzzle designed to test your knowledge of electronic terminology. Refer to the clues given and fill in the word called for by the first clue. Start at the arrow. Thereafter, fill in each new word called for by the following clues *perpendicular* to each preceding word. The last letter in each preceding word will be common to the first or last letter of each new word, and all words will read vertically downward or from left to right. The tenth word will have a letter in common with the word at the *first exit*. Nine more correct entries will take you to the word at the second *exit*, which will also share a letter with the last of these nine words. In each case, *the first or last letter of the exit word will be the first or last letter of the next word.* An additional nine correct entries will put you at the final *exit* for a perfect score. The Editors invite your comments on this type of puzzle.

Solution appears on page 103

CLUES:

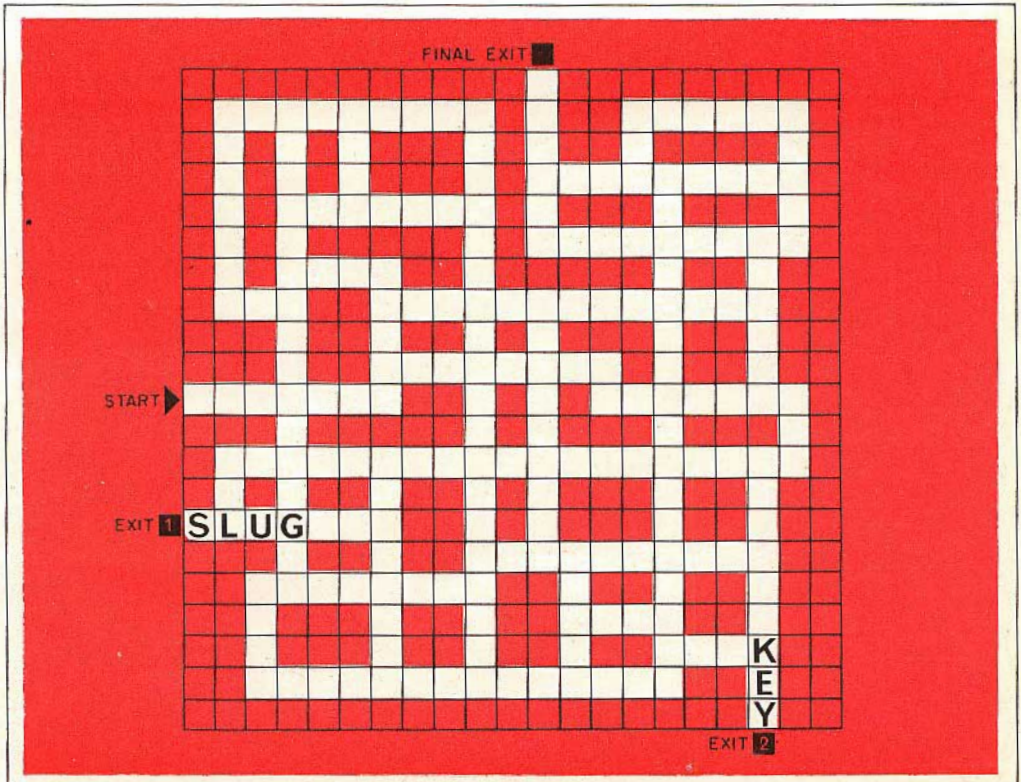
1 A component that introduces inductance in an a.c. circuit.
2 Single unit of a device that converts chemical energy into electrical energy.
3 A luminous glow formed by the difference of potential between two electrodes.
4 Conductors used for transmitting and receiving r.f. energy.
5 Antennas specifically arranged or grouped together so as to produce a desired directivity pattern.
6 High-gain VHF antenna array whose directors are made progressively shorter toward the front of the array.
7 The video information reproduced by a television receiver.
8 Conductor used to establish electrical contact with a non-metallic part of a circuit.
9 Lines produced by a TV receiver flyback pulse.
10 Slang term for ham radio equipment.

Exit 1. The adjustable iron core of a coil.

11 A circuit operating as a switch. The presence or absence of a control voltage can apply or eliminate a signal.
12 Abbreviation for the force that causes current to flow in a circuit.
13 Narrow metallic strips used to produce clutter on enemy radar screen to obscure targets.
14 The paper diaphragm of a loudspeaker.
15 Waveform of a modulated carrier.
16 Two-element electron tube.
17 The unit used to express power ratio.
18 Path of a completed circuit, especially in servo systems.
19 Maximum amplitude of a sine wave.

Exit 2. A hand-operated switch used in radio telegraphy.

20 System of interconnected electrical circuits.
21 Flow of electrons in a vacuum tube.
22 A three-element electron tube.
23 Group of three phosphor dots on a color television picture tube.
24 Slang word for a parabolic reflector.
25 In solid-state technology, empty space in the valence band of an impurity atom.
26 Preparation of a computer routine in machine language.
27 To remove gases from an electron tube envelope.
28 A secondary emission electrode in a multiplier-type phototube.



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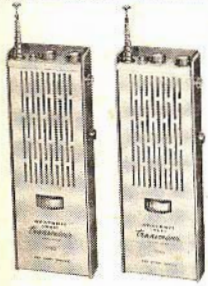

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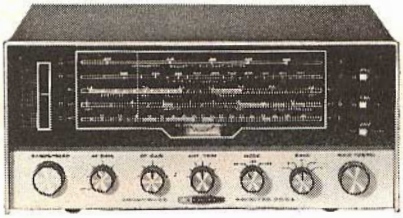

Kit GR-54
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New Deluxe Shortwave Radio!

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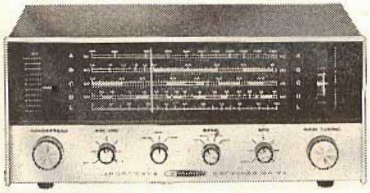

Kit GR-64
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Covers 550 kc to 30 mc—includes AM plus 3 shortwave bands. 5" speaker; bandspread tuning; signal strength indicator; 7" slide-rule dial; BFO; 4-tube circuit plus 2 rectifiers; noise limiter; external antenna connectors; Q-multiplier input; gray aluminum cabinet; AM antenna. 15 lbs.

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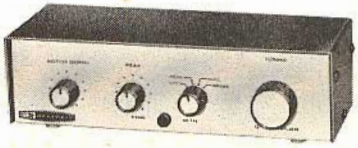

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Use with matching GR-64 (opposite) or similar SWL receivers with IF circuits from 450-460 kc. Creates extra-sharp selectivity through an efficient "Q" of 4000 and provides a notch for adjacent signal attenuation. Includes built-in power supply. Charcoal cabinet gray, front panel. 3 lbs.

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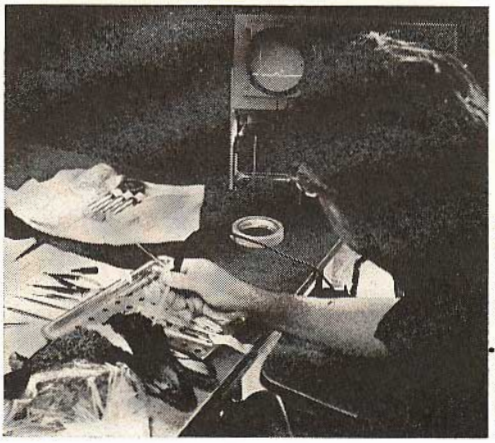
CIRCLE NO. 17 ON READER SERVICE PAGE

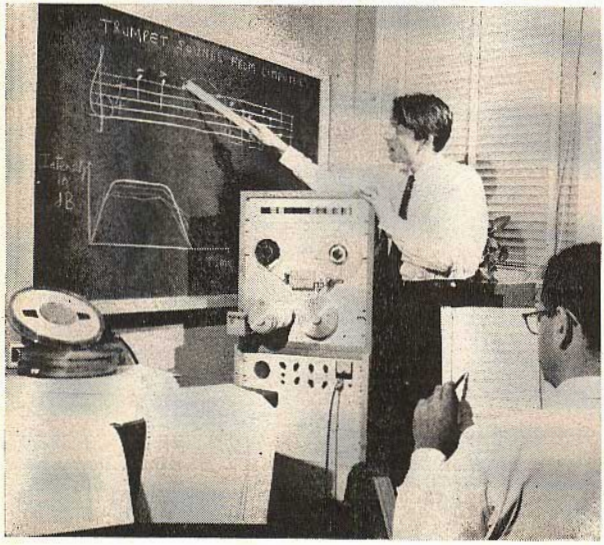
ZERO-BEATING THE NEWS

ULTRASONIC PROBE HELPS SAVE EYESIGHT—Doctors practice locating and removing foreign objects from the eye of an anesthesized rabbit using an ultrasonic probe. The probe, called the "Ekoline 20," and manufactured by Smith Kline Instrument Co., Philadelphia, Pa., emits ultrasonic pulses and picks up the echoes that come back from objects in their path, just like radar. The time difference between pulse and echo, shown as peaks on the scope, indicates the distance between the tip of the probe and the foreign matter. Once pulse and echo coincide, doctors close minuscule forceps attached to the probe tip to remove the foreign object. The device has already saved the eyesight of an 11-year-old boy who all but destroyed an eye when he banged on a cartridge with a hammer; part of the cartridge entered his eye, but it took surgeons a scant 39 seconds to remove it using this instrument. The probe is also finding use in other fields of medicine, and military surgeons in particular are excited over the many possibilities it offers.

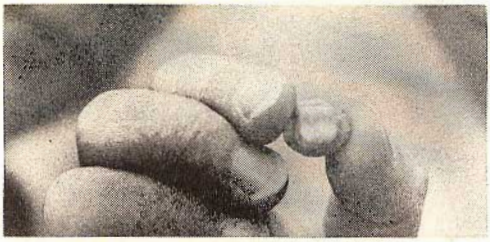


Bernard Cole—Clinical Trends

MR. COMPUTER, PLAY ME A SIMPLE MELODY—You've heard of synthetic fibers, synthetic gems . . . now get ready for synthetic music. At Bell Telephone Labs, Jean Claude Risset, a 27-year-old French physicist and composer, achieved a trumpet effect by using a special computer program. He recorded trumpet tones on magnetic tape. Each recorded tone was then converted into digital form and the digitalized version fed into an IBM computer. The computer analyzed each tone for its frequency spectrum to show relative amplitudes of the frequency components comprising the tone. The spectra were displayed by the computer in graphic form, and from these displays the computer produced similar spectra. It generated numbers which were converted into electrical signals. These signals were fed to a loudspeaker, resulting in reconstructed tones. In listening to the computer-generated tones, 20 people, including several professional musicians, were unable to tell the difference between the computer trumpet and the real one. So far, only single tones have been synthesized. However, Risset believes that it should be possible to synthesize entire orchestral passages. But the computer's real value is in producing novel timbre.

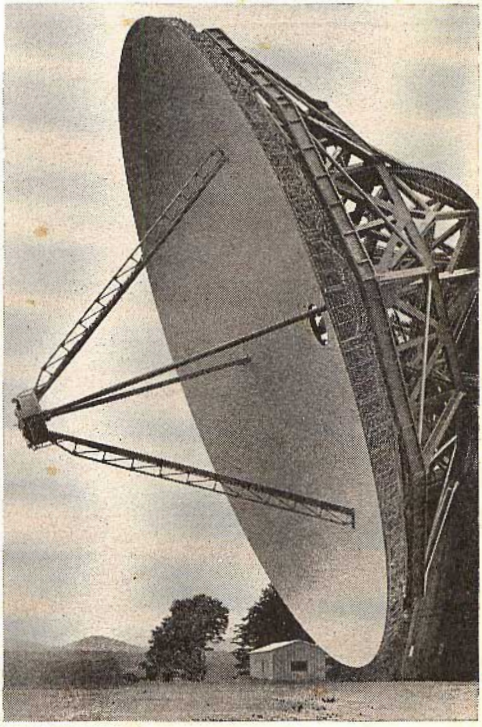


Another unique use of a computer is demonstrated by the Bunker-Ramo "Talking Computer" operating at the American Stock Exchange in New York City. Stock exchange members dial a code number for any stock listed on the exchange, and a clear "voice-response" instantly gives the current price, volume, and trend relating to the stock. Well, its not really a voice, rather a response based upon bits and pieces of information stored in the complex memory of a computer. Invented by Emik A. Avakian and Robert J. Buegler of Bunker-Ramo, this patented voice-response system has been in operation for more than a year. An unusual feature of the system is its ability to accept virtually simultaneously different questions from any number of "query" stations and to simultaneously assemble and send back the respective answers. Thus, no station gets a busy signal or has to wait its turn for access to the computer. This is made possible by a time-multiplexing technique which consecutively connects subscribers to the computer at a fast rate.

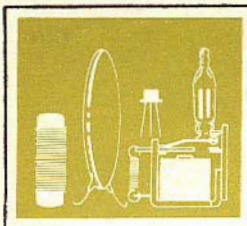


TRANSISTORIZED MOLAR—What you're looking at is a tooth. Not a normal tooth—rather what is probably the most unique molar in the world. Scientists have crammed into it six tiny transmitters, 30 components in all. Developed by Ian S. Scott and Dr. Major M. Ash of the University of Michigan School of Dentistry, the tooth measures directions and pressure of forces impinging on its surface and transmits this data to nearby monitors. The electronic tooth should provide dentists with better guides to restoring teeth that have been damaged or decayed.

DEEP-SPACE PROBER PUT IN OPERATION—The world's most precise radio telescope, a 140′-diameter fully steerable dish for collecting and recording radio signals from outer space, was recently dedicated at the National Radio Astronomy Observatory, Green Bank, West Virginia. This newly completed telescope—with a parabolic collecting surface of more than one-third acre—can be aimed at the tiny, faint radio noises more accurately than any other instrument thus far available. The dish has a 60′ focal length and a surface composed of 60 aluminum panels. Because the telescope moves on two axes, it can be pointed to any region of the sky, and can track a celestial object as it moves across the sky. In normal operation, rotation can be made at speeds up to 150° per minute. This telescope has already proved to be a valuable research tool—astronomers using it for the first time detected and measured a radio emission line from excited hydrogen gas in the Omega nebula, a Milky Way nebulosity, at a frequency of 5009 mc. Since then, the line has been measured in more than 10 other nebulosities. The original observation confirmed earlier predictions of a Soviet astronomer that excited hydrogen gas should emit bright lines in the radio range. It also confirms the announcement last year of the detection of two similar lines by Soviet radio astronomy groups. The new radio telescope is to be used to make detailed measurements of hydrogen radiation from the Milky Way galaxy; to determine the intensity of radio sources at various points in the spectrum; to measure radiation from the moon and planets; and to determine the position and brightness distribution of radio sources when their radiation is cut off as the moon passes in front of them.



"ELECTRONIC SURVEYORS" TRACE OLD-TIMERS' STEPS—One hundred and eight years ago, a party of four men under the leadership of Henry Washington, veteran surveyor (believed to be a nephew of George Washington), surveyed the area of Death Valley, California. The party dragged a 66′ chain across the desert floor, laboriously tensioning it, marking, and moving on. Every one-half mile they were required to drive a four-foot stake into the ground. It wasn't an easy job; in fact, in the time they took to measure 1000 feet, modern-day surveyors can measure 40 miles, and with much greater accuracy. A team from the U.S. Bureau of Land Management recently traced the old-timers' steps using an electronic distance measurer (called the Tellurometer "Micro-Distancer"), which measures distance by transmitting microwave pulses, the travel times of which are converted into miles, feet, and inches. Millions of square miles of the country are still unmapped to precision standards. The Bureau of Land Management, for example, has 16 million acres of unsurveyed land in California alone under its jurisdiction; it is engaged in an ambitious program of running new surveys through 10 million acres of this vast domain within the next three years. Electronics marches on.



PARTS PROFILES

By DON LANCASTER

COMPONENTS 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.

$1 EXPERIMENTER'S THERMISTOR

Here's a $1 thermistor that can be used in an electric thermometer, a liquid level controller or alarm, a time delay relay, and many other devices. The EMC4 thermistor, which is made by Fenwal Electronics, consists of a 2″-long glass tube containing a temperature-sensitive bead at the very tip of the tube. Thus, the temperature of a liquid can be monitored with great accuracy by simply immersing the tip into the liquid.

At room temperature (75°F), the thermistor's resistance is about 135,000 ohms; but for every one-degree (F) change in temperature, its resistance decreases by about 2.5%. When immersed in a liquid, the thermistor responds to temperature change in a fraction of a second. In air, it takes approximately 30 seconds.

For some applications, great care is required to limit the amount of current going to the thermistor. For other applications, current is used to deliberately heat up the thermistor for special effects. Before you set out to design a circuit, you must decide beforehand which technique best suits your application.

The bead temperature of this thermistor

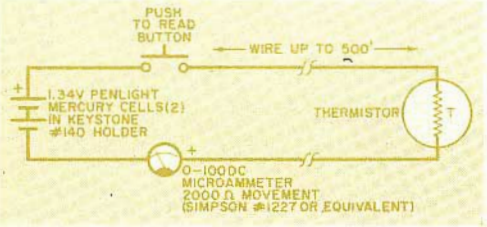


Fig. 1. Basic circuit of electric thermometer using EMC4 thermistor. Operating range is 0° to 115° F.

rises two degrees above ambient temperature for every milliwatt of power dissipated. Thus, for accurate temperature measurements, the thermistor current must be kept low enough to limit power dissipation to well below one milliwatt, unless the self-heating effect is desired.

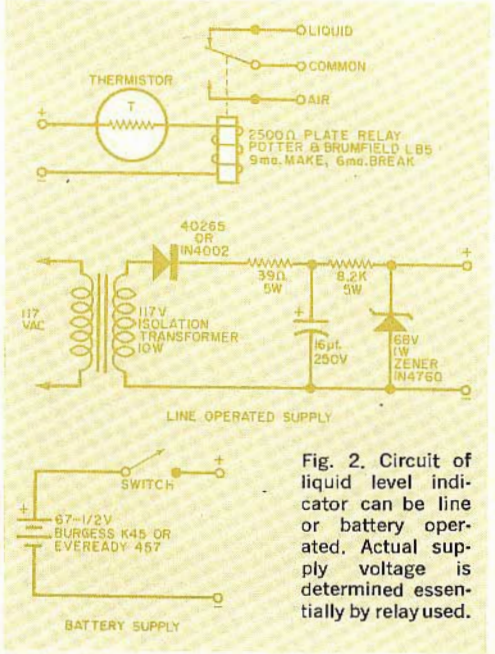


Fig. 2. Circuit of liquid level indicator can be line or battery operated. Actual supply voltage is determined essentially by relay used.

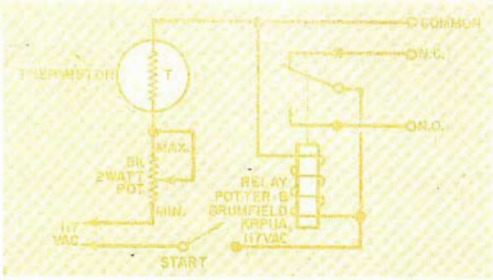


Fig. 3. This time-delay circuit can be adjusted to provide a delay of 0.5 to 15 seconds from turn-on.

Figure 1 shows an electric thermometer consisting of a couple of mercury cells, a d.c. microammeter, a thermistor, and a push-button switch (optional). At room temperature, the circuit current is about 20 microamperes, and the self-heating power is approximately 50 microwatts. This low power raises the bead temperature by only 1/20 of a degree. The circuit has a range of 0° to 115° F, and can be calibrated against a good thermometer. One big advantage of the electric thermometer is that the sensor and monitoring meter can be separated by hundreds of feet, using ordinary copper wire between them, with no loss either in sensitivity or accuracy. This is not true of thermocouple-type temperature meters.

Another application, using the self-heating effect of the thermistor, is shown in the liquid level indicator circuit of Fig. 2. Operation is based on the relatively good conductivity of liquids (especially water) as opposed to air, which is a poor conductor. Thus, when we self-heat a thermistor which has been immersed in a liquid, most of the excess heat is rapidly carried away by the liquid, and the thermistor stabilizes at essentially ambient temperature. Under these conditions, the thermistor has a *low* resistance in air (because it is hot) and a *high* resistance in liquids (because it runs cooler).

A sensitive relay and a thermistor are connected across either a battery supply or the line-operated power supply shown in Fig. 2. The component values have been chosen to give a 10-ma. current in air, and less than 3 ma. in liquid. Both of these currents are easily sensed by the relay used. If it is desired to use a different relay, the supply voltage must be appropriately regulated.

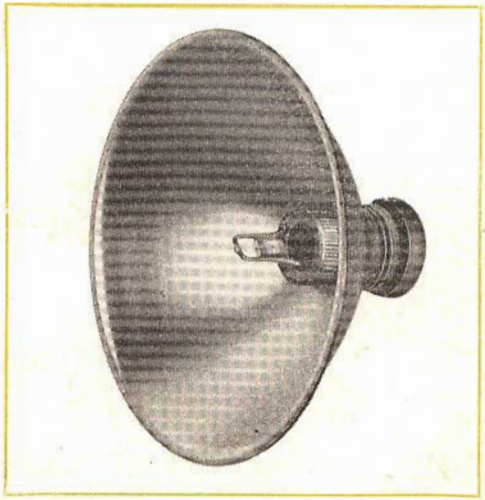
What can you do with a liquid level control? Lots of things. For example, with the relay contacts connected to a buzzer or solenoid valve, you can use this device as an automatic level control for bird baths, fountains, or swimming pools, or simply as an alarm to tell you when the bathtub is full. Two or more of these indicators can be used at different heights in a tank to serve as a *high-low* indicator, or as a depth gauge.

As a final example to show the almost limitless applications of the thermistor, consider the time delay relay circuit of Fig. 3. It provides a delay of from 0.5 to 15 seconds from the time it is turned on, depending on the setting of the potentiometer which varies the current through the thermistor. The more current, the faster the thermistor heats up, and the sooner the resistance drops low enough to cause the relay to pick up. Depending on the choice of relay contacts, the relay can "make" contact only *after* the time lapse, or only *during* the delay time. This circuit can be used for displays, as a phototimer, motor starter, or for an automatic light control to give you 15 seconds to get down the hallway before the light goes out.

You can get data sheets and application notes direct from the manufacturer, Fenwal Electronics, 63 Fountain St., Framingham, Mass., upon purchase of the thermistor which retails for $1. The EMC4 Thermistor Manual and a list of local distributors are available, free, from the manufacturer.

INFRARED PHOTOCELLS RESPOND TO HEAT

Smart crooks can spot ordinary burglar alarms using conventional photoelectric controllers a mile away. But you can trap these experts with Infrared Industries' infrared photocells that operate in total darkness. Or you can use these photocells to make heat-sensing flame detectors for fire alarms or safety monitors. Because infrared photocells respond to heat instead of



light, they can be used in numerous "secret" applications.

An infrared photocell consists of a small chunk of lead sulfide. (galena) mounted at the focus of a mirrored parabola the size of a large flashlight reflector. In the absence of high infrared radiation, it has a resistance of about 1 megohm. In the presence of a light source, such as a match, photoflood lamp, or flashlight, the photocell resistance drops to as low as 200,000 ohms. This 5-to-1 change ratio is quite sufficient to activate a two-transistor relay circuit such as the one described in Lou Garner's "*Super-Sens*" in the November, 1965 issue of POPULAR ELECTRONICS.

The light source can be masked with an infrared filter (supplied with the photocell) that passes only infrared light, giving an invisible beam of heat energy that behaves the same as visible light. If you were to look directly at the light source, you would see only a dark red glow. By properly positioning the light source, even this glow could become unnoticeable. If you put the filter over the photocell instead of over the light source, the photocell would ignore all background illumination and respond only to the infrared energy.

If the photocell is positioned so that it can "look" straight at the beam, its resistance will drop. But if the beam is interrupted, say, by an intruder, its resistance immediately goes up again. This change in resistance can be used to operate a relay. Depending on whether the controlled device is to be turned *on* or *off*, it is then only necessary to choose the proper relay contacts for the desired control.

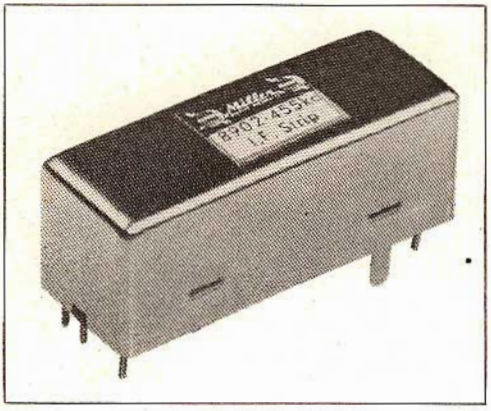
The parabolic shape of the photocell housing makes it highly directional. If this directivity feature is not desired, the experimenter can choose other photocell units that are not equipped with the parabola and filter, at a saving in cost. Mirrors or smooth metal plates can be used to reflect the beam around corners.

There's practically no end to the number of applications to which the infrared photocells lend themselves. Just remember that they behave essentially the same as the more familiar cadmium sulfide photocells, in that their resistance goes down as the incident energy goes up. Remember also that the infrared photocell has a bilateral characteristic, and can be powered by a low-voltage a.c. source, or by a d.c. source. And finally, remember that cadmium sulfide cells are most responsive to orange light while lead sulfide cells (infrared photocells) are most responsive to long-wave heat radiation.

Manufactured by the Photoconductor Division of Infrared Industries, Inc., 63 Fourth Avenue, Waltham, Mass., the B3 SA19 MF photocells with filters are available from Allied Radio (# 7 Z 628, in their industrial catalog) and other parts distributors for $5.75 each.

455-KC. I.F. AMPLIFIER MODULE

A fully assembled and prealigned 455-kc. integrated i.f. amplifier module containing a ceramic filter, two transformers, two transistors, one diode, and associated resistors and capacitors, has been put out by the J. W. Miller Company. The strip is said to



provide a gain of 55 db, an 8-kc. bandwidth at 6 db, and operate on 2 milliamperes from a 6-volt d.c. source.

Measuring a scant ½" x ½" x 1½", the module is ideal for such applications as the i.f. amplifier in a subminiature superhet AM receiver, in the second conversion stage of CB equipment, and as a high-gain i.f. amplifier for radio control gear. The module can also be used as a lock-in amplifier, and as a precision measuring device in carrier control equipment as well as in other industrial instrumentation apparatus.

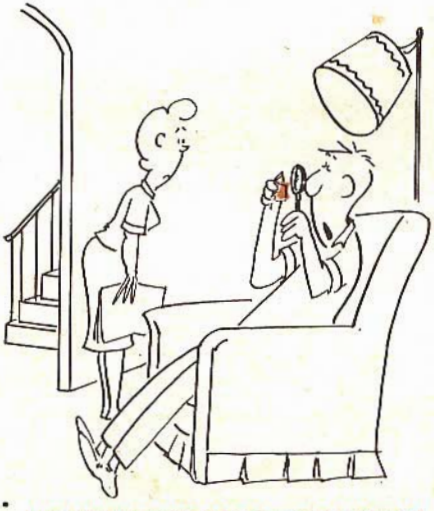
For ordinary AM radio applications, the experimenter need only design up to the mixer output, and then pick off the audio signal at the receiver volume control. The module has its own a.g.c. circuit and provisions for a tuning meter. A choice of input transformer taps optimizes operation for straight amplification or conversion. The case readily comes apart for special requirements, but numerous taps are brought out to allow the engineer or experimenter to conduct a variety of tests or experiments.

The 455-kc. i.f. module (Miller 8903) is available from parts distributors including Lafayette Radio (34 R 8603) and Allied Radio (60 U 099) for $5.75. Data sheet and schematic are supplied with each unit. -30-

THERE'S ONE IN EVERY CROWD

By BUZ HOLLAND
WA4YKK

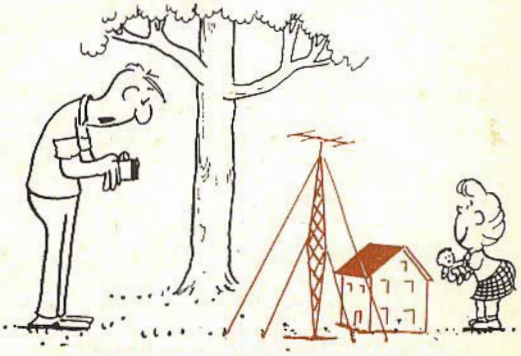
"And then she threw all my QSL cards into the fire."



"I'm studying this manual on transistors."

"Must be on the YL net again . . . he never talks to me like that."

"CQ, CQ, CQ, CQ, CQ, WA4YKK, CQ, CQ, CQ, CQ, CQ, CQ, CQ, CQ. . . . . ."



"Move, Cathy. I'm taking a picture for my QSL card."

MEET THE MINI-ORGAN

It's electronic . . .
it's transistorized . . .
and it's fun
to build and play

By WILLIAM S. GOHL

YOU CAN'T BUY a Wurlitzer organ like the one at Radio City for ten bucks, but you *can* build the Mini-Organ for less than that. Your youngsters will be delighted—and you'll be, too—at the ease with which such well-known tunes as "Red River Valley," "Blue Bells of Scotland," "Home, Sweet Home," and many others can be played on an instrument you can put together in a couple of hours.

How It Works. The Mini-Organ is a two-transistor, battery-operated multivibrator whose frequency (pitch) is determined by the *RC* time constant of *C1-R1* (Fig. 1). The lowest frequency of oscillation—and hence the lowest tone—is determined primarily by the value of capacitor *C1* and series capacitors *C2* through *C8*, while the highest frequency of oscillation (highest pitch) is determined essentially by the setting of potentiometer *R1* in series with resistor *R2*.

When capacitors *C2* through *C8* are alternately switched in series with *C1*, a change is produced in the multivibrator frequency which in turn produces a one-octave musical scale. Depending on the characteristics of transistor *Q2*, capacitor *C9* may be required to aid the multivibrator action. Diode *D1* provides the feedback path to sustain oscillation.

Switches *S1* through *S8* are the push-button operating keys that apply the right amount of capacitance in series with *C1* to produce the desired tones when pressed. Transistor *Q1* is an *npn*, high-current, high-frequency switching type, while *Q2* is a *pnp* audio frequency type which provides sufficient volume for comfortable listening in a small room. If greater volume is desired, the builder can add as many stages of amplification as may be necessary.

Operating power is supplied by four ordinary flashlight cells in series.

Construction. The Mini-Organ can be laid out and breadboarded on wood or on

a perforated phenolic board as shown in Fig. 2. Breadboard dimensions are best determined by the builder. The push-button keys are spaced ¾" apart at the bottom of the panel, and the opening for the speaker is spaced midway between the holes for the keys and the top edge of the panel.

Main power switch *S9* can be combined with the potentiometer, or may be a separate slide or toggle switch as desired. The transistors, the 1-megohm resistor, and the capacitors are mounted on terminal strips.

The entire unit can then be housed in a plastic or wooden case as desired. The keys can either be color-coded or numbered for easy recognition.

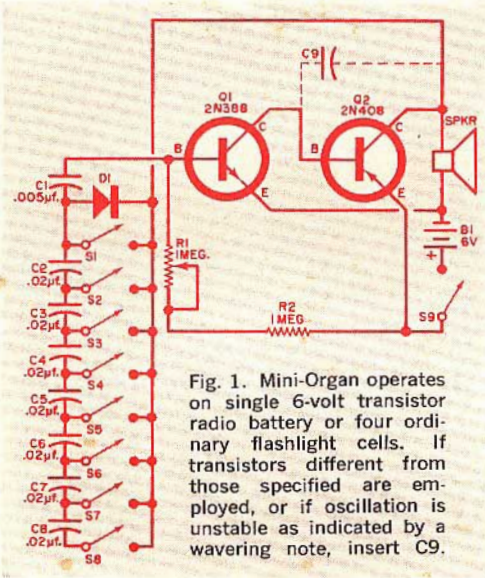


Fig. 1. Mini-Organ operates on single 6-volt transistor radio battery or four ordinary flashlight cells. If transistors different from those specified are employed, or if oscillation is unstable as indicated by a wavering note, insert C9.

Operation. Try out the organ by adjusting the potentiometer at different settings as the keys are depressed. If you want a lower tone, increase the value of *R2* in 500,000-ohm increments. To change the tone range slightly, change the value of *C1* in small increments. Using less capacity will give you a higher tonal range.

From here on, you are on your own. Practice with simple tunes within the instrument's range until you can master your favorites. And have fun. -30-

PARTS LIST

B1—1½-volt cells (4 required)
C1—0.005-µf. ceramic disc capacitor
C2-C8—0.02-µf. ceramic disc capacitor
C9—0.001-µf. ceramic disc capacitor (optional —see text)
D1—1N54 diode
Q1—2N388 transistor
Q2—2N408 transistor
R1—1-megohm potentiometer with switch
R2—1-megohm, ½-watt resistor
S1-S8—Momentary-contact push-button switch
S9—S.p.s.t. switch
SPKR.—8-ohm speaker
1—5" x 7" x 2½" plastic or wooden case
Misc.—5-lug terminal strips (3), small knob, hardware, wire, solder, etc.

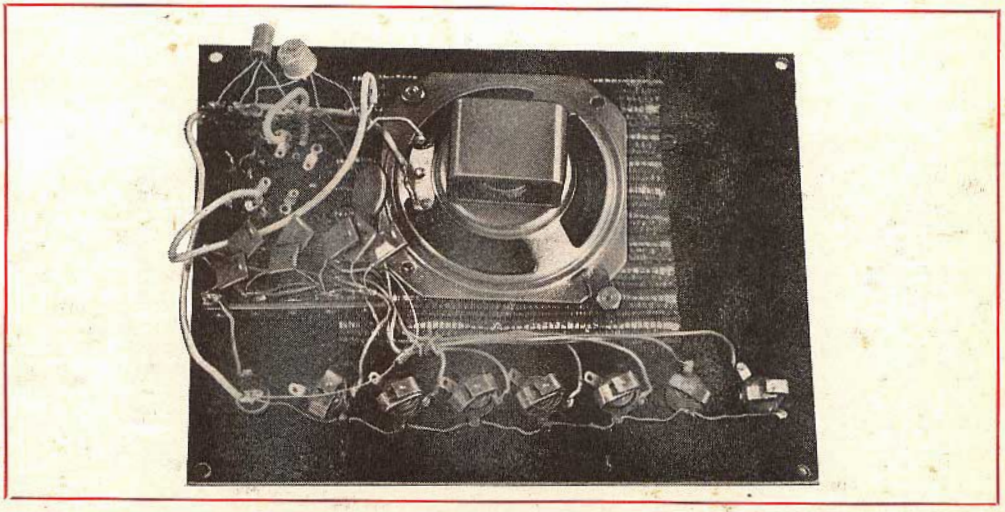


Fig. 2. This photograph shows the rear panel of the author's prototype organ which was later rewired to improve lead dress. Parts are mounted on terminal strips, and the battery is strapped down in the case.

FOUR-LETTER QUIZ

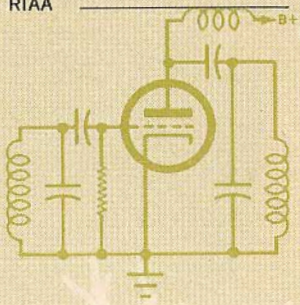
By ROBERT P. BALIN

Electronic technicians, hobbyists, and experimenters must learn the meaning of a large number of abbreviations that constantly appear in technical journals and periodicals. For example, VTVM is quickly recognized as vacuum-tube voltmeter. See how many of the commonly used four-letter abbreviations listed here (1-10) you can match with the sketches below (A-J) most closely identified with the meaning of the terms.

1 AFSK _____
2 DAVC _____
3 FETS _____
4 MOPA _____
5 NTSC _____
6 PMMC _____
7 RIAA _____
8 TPTG _____
9 UJTO _____
10 VSWR _____

(Answers appear on page 108)

A



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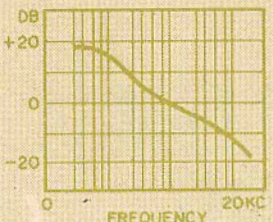
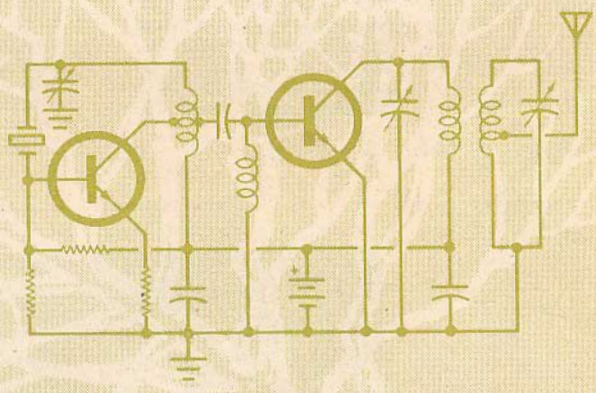


C

D

E

F



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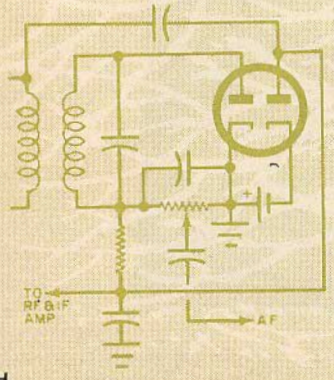

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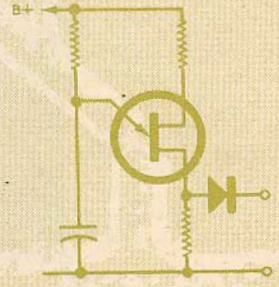


J

ON THE CITIZENS BAND

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

AFTER ripping through Florida last September, hurricane "Betsy" turned her destructive power toward the state of Louisiana. Members of the A.L.E.R.T. CB Club (Allied Louisiana Emergency Radio Team), Baton Rouge, immediately went into standby procedure. ALERT stations tracked the hurricane and were kept informed on current weather bulletins. Although organized only five months earlier, the ALERT group was prepared for the emergency, having held a practice exercise only the week before.

ALERT CB'ERS BATTLE "BETSY"

On the afternoon of September 9, it was announced that the hurricane would move inland at approximately midnight, packing winds up to 130 mph. ALERT members donned old clothes and prepared for the long night, taking their assigned positions throughout the city.

Five base stations were established in different parts of the city. Mobile units were to report to the base station in their area on a specific frequency. ALERT control was set up in the center of the city, operating on channel 23. After the mobile units reported in to their area base station, the base would then switch to channel 23 to relay information to the control center. The 50 mobile and other volunteer units participating were placed at key positions, including the weather bureau, power company, Civil Defense and Red Cross headquarters, and at all school shelters. Additional mobiles patrolled the streets.

When "Betsy" finally hit full force, the power went out and the streets soon became cluttered with fallen trees, power lines, and debris. Shortly thereafter, portions of Baton Rouge became flooded. All outlying base stations reverted to auxiliary power to keep the CB net alive.

For over seven hours, the ALERT group was the only communication facility between the weather bureau and area radio stations geared to keep the public informed. The units at the power company continued to forward reports of dangerous fallen power lines and poles, while CB'ers at Civil Defense and Red Cross stations coordinated a three-way emergency task force. The units at the school shelters kept a vigil on the needs of refugees, and the mobile units continued to patrol the streets, although they were literally stranded due to the blinding wind, rain, and rising waters.

By daybreak of the 10th, the worst was

Here's an unusual application for CB radio. It gives young diabetics attending Camp Sweeney in Gainesville, Texas, an extra health safety margin. The youngsters, all under insulin therapy, participate in a normal, full-scale camping program that includes horseback riding, hiking, water sports, and fishing, as well as archery and arts and crafts. As they go out in groups into the remote sections of the camp for their various activities, counsellors (such as the one shown at left) keep in touch with the base camp (at right) via walkie-talkies, and medical aid can be rushed to any point within the camp area in a matter of minutes. The camp was started in 1950 by the Southwestern Diabetic Association.

over. Rain and minor wind gusts persisted while ALERT base and control stations remained on auxiliary power. By noon, all refugees had left the shelters. Police and power crews had begun their clean-up. Weary CB ALERT personnel, after a job well done, headed home for a much-needed snooze. All members agreed with Curtis B. Lauret, Jr., KMR4417, that "while the club was less than a half-year old, its purpose had matured quite suddenly and successfully."

Blood Donors via CB. The following emergency assist was written up in the *Huachuca Herald*, Sierra Vista, Arizona. Mr. V.E. Patrick, KFA1006, of that city, heard a plea on his Olson "Sidebander" mobile rig for blood needed by a woman who had just been operated on in a hospital in Agua Prieta, Mexico. Two donors were on their way to the hospital, but more were required.

Unable to reach the calling station, Mr. Patrick contacted other CB units in the area whose location put them in a better position to get through. Mr. Patrick then stood by to handle the control and any telephone calls that might be necessary.

In short order, the local CB club, the Cochise County 5-Watters REACT Team, obtained three additional donors through use of their CB gear, and assembled them at the Sierra Vista Police Department. The donors were then transported to Bisbee, Arizona, in a patrol car, where they were transferred to another patrol car and rushed to the city of Douglas. Arrangements had been made via radio to permit the donors to pass through all cities involved without loss of vital time, and clearance had been arranged at the border to permit the final vehicle to enter Mexico and proceed to the hospital.

Just 45 minutes after the appeal that Mr. Patrick heard, the donors were at the patient's side ready to give blood. Three additional standby donors were available during the night in the event a further need arose. The patient's husband was most grateful to the blood donors and all the CB'ers who participated and assisted in the "blood run."

CB'er V. E. Patrick, KFA1006, and his Olson "Sidebander" mobile rig originated a search for blood donors in Arizona that ended up in Mexico.

Compact Shack. Meet Harry C. "Red" Pepper, KHG1742, of Cambridge, Ohio. Harry depends on CB radio to transact business on an everyday basis. He operates a distribution point for the Standard Oil Company. His base dispatching center keeps him in constant contact with his delivery

trucks, providing fast delivery to all points within Guernsey County.

Harry has used the Citizens Radio Service for five years, and he maintains that it gives him better control and eliminates a considerable amount of reruns and backloading. He also has SWL gear in his shack for listening to world news and weather reports, plus monitoring and testing gear.

Report from New Zealand. Our volunteer reporter/friend Dallas A. McKenzie, of the New Zealand Radio DX League, who first informed us of the issuance of a Citizens Band to New Zealanders back in 1963, has just reported the organization of the first CB club in Wellington, N.Z. The club members consist of 1-watt walkie-talkie users who, on occasion, make 20-mile contacts. The club intends to offer its services to Civil Defense authorities—the portable units presently available for CD use are old World War II units like Z.C. 1's, mainly due to import restrictions on equipment.

At the club's first meeting, it was decided to ask the New Zealand Government Post Office (governing body over the service) for a special frequency of 26.575 for club use. A manufacturer has agreed to change club members' tranceivers to the frequency without charge. Present officers are A. Scott, president; L. Coutts, treasurer; Mrs. J. Scott, secretary; and T. Grooby,

(*Continued on page 99*)

SHORT-WAVE LISTENING

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

MONITOR CERTIFICATE APPLICATIONS AND DX AWARDS

MOST OF YOU are aware of the fact that your Short-Wave Editor is in charge of processing the various DX Awards, but you may not know that yours truly also takes care of the Monitor Certificate applications. Some difficulties have arisen regarding both programs, and your cooperation is urgently needed.

So far as the Monitor Registrations are concerned, each application is entitled to a speedy processing. As much as we would like to adhere to this premise, it hasn't always been possible. Every application has to be checked to make sure that the applicant is qualified—and that he hasn't already received his WPE identification. Some applicants are so anxious to get their certificates that they will apply two, three, or even five times within a single month. Extensive cross-referencing on our part has been necessary to avoid the very real possibility of any one person receiving several WPE identifications.

Many applicants have to be contacted for additional information. Some are asked to produce proof that they are qualified. We make it a practice to contact those who list unreasonably large numbers of QSL cards on their applications. For example, one fellow recently listed several hundred thousand QSL's. We asked him to produce at least five for our inspection, and he was unable to produce any whatever.

Others will send in batches of QSL cards that are nothing more than samples of cards, obtainable from many card printers. These applicants are turned down, as are those who are obviously just certificate-seekers who have little or no interest in the hobby.

We send out hundreds of certificates each month. To insure your receiving yours as quickly as possible, we ask that you (1) send in only one application; it will be taken care of just as soon as possible; and (2) do not apply if you are not qualified or if you are not sincerely interested in the SWL'ing hobby.

Processing the DX Awards applications is also time-consuming. In spite of the fact that the rules and regulations specifically state that the listing of states, countries, or provinces *must be in alphabetical order,* many applications contain listings which are haphazardly arranged. In each such case, the listing has to be closely checked to be sure that there are no duplications. Often there are, and additional correspondence is required before the award can be made.

Many SWL's who have already obtained, say, a 25 Countries Award, will at a later

(*Continued on page* 109)

With a Lafayette KT-340 receiver, Steve Kennedy has 20 countries verified out of 25 heard, and 31 states verified out of 36 heard. Otherwise known as WPE4IAX, Steve lives in Sarasota, Fla.

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA

Prepared by ROBERT LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

EST	GMT	STATION LOCATION	FREQUENCIES (MC.)
7:15 a.m.	1215	Helsinki, Finland (Tues. & Sat.)	15.185
		Melbourne, Australia	9.53 or 11.84
		Montreal, Canada	5.97, 15.32
7:30 a.m.	1230	Copenhagen, Denmark	15.165
8 a.m.	1300	Stockholm, Sweden	15.195
9 a.m.	1400	Oslo, Norway (Sun.)	15.175, 17.825
		Quito, Ecuador	15.115, 17.89
6 p.m.	2300	London, England	6.195, 7.13, 9.51
		Moscow, U.S.S.R.	7.15, 7.205, 7.31
7 p.m.	0000	London, England	6.195, 7.13, 9.51
		Moscow, U.S.S.R.	7.15, 7.205, 7.31
		Oslo, Norway (Sun.)	6.185, 9.61
		Peking, China	11.82, 15.06
		Sofia, Bulgaria	6.07
		Tirana, Albania	7.265
		Tokyo, Japan	11.78, 15.135
7:30 p.m.	0030	Bonaire, Netherlands Antilles	9.605 or 11.82
		Budapest, Hungary	7.105, 9.833
		Kiev, U.S.S.R. (Mon. & Thurs.)	7.12, 7.31
7:50 p.m.	0050	Vatican City, Vatican	5.985, 7.25, 9.645
8 p.m.	0100	Accra, Ghana	9.76
		Berlin, Germany	5.97, 6.16
		London, England	6.195, 7.13, 9.51
		Madrid, Spain	6.13, 9.615
		Moscow, U.S.S.R.	7.15, 7.205, 7.31
		Peking, China	11.86, 11.945, 15.06
		Prague, Czechoslovakia	5.93, 7.115, 7.345
		Rome, Italy	5.96, 9.63
8:15 p.m.	0115	Berne, Switzerland	6.08, 6.12, 9.535
8:30 p.m.	0130	Beirut, Lebanon	9.575
		Bucharest, Romania	5.98, 9.57
		Cologne, Germany	6.075, 9.64
		Hilversum, Netherlands	6.085 or 9.59 (via Bonaire)
8:45 p.m.	0145	Stockholm, Sweden	5.99
9 p.m.	0200	Copenhagen, Denmark	9.52
		Lisbon, Portugal	6.025, 6.185
		London, England	6.195, 7.13, 9.51
		Madrid, Spain	6.13, 9.615
		Moscow, U.S.S.R.	7.15, 7.205, 7.31
		Peking, China	11.86, 11.945, 15.06
		Quito, Ecuador	9.745, 11.915

TO EASTERN AND CENTRAL NORTH AMERICA (CONT.)

EST	GMT	STATION LOCATION	FREQUENCIES (MC.)
10 p.m.	0300	Bucharest, Romania	5.98, 9.57
		Buenos Aires, Argentina (Mon.-Fri.)	9.69
		Havana, Cuba	6.135
		Moscow, U.S.S.R.	7.15, 7.31
		Quito, Ecuador	9.745, 11.915
10:30 p.m.	0330	Accra, Ghana	6.11
11 p.m.	0400	Havana, Cuba	6.135
		Moscow, U.S.S.R.	7.15, 7.31
		Quito, Ecuador	9.745, 11.915

TO WESTERN NORTH AMERICA

PST	GMT	STATION LOCATION	FREQUENCIES (MC.)
7:10 a.m.	1510	Cologne, Germany	9.735, 11.795
7:15 p.m.	1515	Berne, Switzerland	11.715
6 p.m.	0200	Melbourne, Australia	15.22, 17.84
6:50 p.m.	0250	Taipei, Taiwan, China	9.72, 11.825, 15.345
7 p.m.	0300	Madrid, Spain	6.13, 9.615
		Melbourne, Australia	15.22, 17.84
		Moscow, U.S.S.R.	9.64, 11.755, 15.14
		Peking, China	9.457, 11.82, 15.095
		Seoul, Korea	11.925
		Tokyo, Japan	11.78, 15.135
7:15 p.m.	0315	Stockholm, Sweden	5.99
7:30 p.m.	0330	Accra, Ghana	6.11
		Prague, Czechoslovakia	5.93, 7.115, 7.345
7:45 p.m.	0345	Berlin, Germany	5.97, 6.16
		Lisbon, Portugal	6.025, 6.185
8 p.m.	0400	Moscow, U.S.S.R.	7.255, 9.54, 9.64
		Peking, China	9.457, 11.82, 15.095
		Sofia, Bulgaria	6.07
8:15 p.m.	0415	Bangkok, Thailand	11.91
		Berne, Switzerland	6.12
8:30 p.m.	0430	Budapest, Hungary	7.105, 9.833
9 p.m.	0500	Cologne, Germany	6.145, 9.735
		Havana, Cuba	6.135
		Moscow, U.S.S.R.	7.255, 9.54, 9.64
10 p.m.	0600	Buenos Aires, Argentina (Mon.-Fri.)	9.69

CST is one hour earlier than EST; MST is one hour earlier than PST.

AMATEUR RADIO

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

A SAFETY BELT MAY SAVE YOUR LIFE

A SHORT TIME AGO, Bill, W5NQR, was atop his 45′ antenna tower putting the finishing touches on the installation of a Mosley TA-33 tri-band beam antenna. He gave a final twist on the wrench to tighten a nut on one of the U-bolts fastening the beam drive shaft to the rotator. The U-bolt snapped, and the wrench flew up and hit him on the forehead. Stunned, Bill slumped against his safety belt as he instinctively wrapped his arms around the tower. There he hung until his head cleared; then, with lots of advice being shouted up from the ground, he carefully loosened the safety belt a bit and inched his way down. After first-aid treatment, Bill went back up the tower, replaced the broken U-bolt, and finished the installation.

Contrast Bill's experience with the tragic experience of a Los Angeles amateur last winter who fell from his tower to his death. Nobody knows exactly what happened, but the amateur in Los Angeles was *NOT* wearing a safety belt.

A good lineman's safety belt is quite an expensive item for an individual to buy. However, it would seem to be an excellent investment for any radio club to make for the benefit of its members. Probably the best place to obtain such a belt is through the local power company or through a company that installs and services towers and advertising signs. Sometimes a good used belt can be obtained quite reasonably when an employee of one of these companies changes jobs and has no further use for his belt. Or you may be able to borrow or rent a safety belt from one of the men over a weekend or on his days off. Get a lesson on how to wear and use it, too.

Even better than renting or borrowing a safety belt is to hire the owner of the belt to help with the actual work. While the price of hiring a good lineman or "rigger" is high (you pay by the hour), it is amazing how much faster and easier an antenna job goes when you are standing on the ground telling the lineman what to do up in the air. The fact is, if you have all the preliminary work done ahead of time and are prepared to tell the lineman exactly what to do when he gets there, what would be an all-day job for you might take the lineman only an hour or two. You will have to tell the lineman what to do, however, because he probably knows no more about putting up antennas than you know about installing polyphase power lines.

AMATEUR STATION OF THE MONTH

Michael M. Dodd, WA4HQW, of McLean, Va., gave his station a professional look by housing his equipment in an attractive, home-constructed console. Major gear shown includes a Johnson "Navigator" transmitter, a Hallicrafters SX-117 receiver, a Heathkit SWR bridge, and a 100-watt, home-built power amplifier. Mike will receive a free one-year subscription to POPULAR ELECTRONICS for submitting the winning photo for February in our Amateur Station of the Month contest. If you would like to enter, send us a clear picture of your station with you at the controls, and some details on your equipment and ham career. Mail your entry to: Amateur Radio Contest, c/o Herb S. Brier, P.O. Box 678, Gary, Indiana 46401.

Starting out as a Novice at the age of 12, Douglas C. Smith, K4OAP, Lauderdale By The Sea, Fla., had worked up to a commercial First Class Radiotelephone license three years later. He is now equipped for SSB, CW, UHF, VHF, and MARS operation.

The two assistant operators below are the daughters of Walt, WA5LZP. All three are waiting to add the state of New Mexico to Walt's 40-meter WAS total.

Annual Novice Roundup. The 1966 ARRL Novice Roundup will take place between 6 p.m., local time, February 5, to 6 p.m., February 20. Each amateur operates a maximum of 40 hours in this contest. Novices work each other and all other classes of amateurs; other classes of amateurs work Novices. You earn one point each time you exchange serial numbers and the names of your respective ARRL sections with each station worked. Your total score equals the number of contact points earned, plus the highest code speed shown on your ARRL code proficiency certificate, the sum multiplied by the number of different ARRL sections worked.

All Novice bands (3.7-3.75, 7.15-7.2, 21.1-21.25, and 145-147 mc.) may be used, and CW-to-CW, phone-to-phone, and CW-to-phone contacts count, but a single station may be worked only once. You can obtain contest log sheets by mailing a request accompanied by a stamped #10 return envelope to the ARRL, 225 Main St., Newington, Conn. 60611. Send your score to the same address by the end of the month.

The ARRL will issue certificates of achievement to the highest scoring Novice in each ARRL section. A list of these sections is printed in each issue of *QST*.

ARRL DX Competition. In this international contest, you operate on phone February 12-13 and March 12-13; and on CW February 26-27 and March 26-27. Starting times are 2400 GMT on the respective Fridays, and ending time 2400 GMT the following Sunday. Amateurs in the U.S. (including Alaska and Hawaii) and Canada work the world on all amateur bands. You send a signal report and the name of your state or province to each DX station worked. The DX station, in turn, sends a signal report followed by his transmitter power. The same DX station may be worked only once per amateur band.

In the U.S., CW stations may work six stations in the same country per band; Canadian CW stations may work eight. There are no quotas on phone. All indications are that the 15-meter band should be wide open for DX during the contest; so we recommend that Novices keep their ears open for DX on the 15-meter Novice band. And General Class operators who overlook the 10-meter band will most likely miss out on some good DX contacts.

If you plan to enter either the phone or CW contest in a big way, send a request for log sheets and other material to the ARRL, together with a self-addressed, stamped envelope.

News From the Club Papers. Who is that knocking? In the U.S., some amateurs have had the thrill of hearing the FCC knock at the door while they were on the air—to check their transmitter power and their compliance with the amateur regulations. In Canada, according to Hugh Cassidy, WA6AUD, in the *San Francisco Section Courier,* the knocking that some amateurs have heard at their doors has heralded the arrival of the Royal Canadian Mounted Police wanting to inspect their radio equipment. There is a very high tariff on imported radio gear in Canada, and apparently someone up there thinks that some amateurs forgot to pay the duty.

According to the October, 1965, *Collector and Emitter* of the Aeronautical Center Amateur Radio Club, Inc., Oklahoma City, this club has voted to award each club member earning an Extra Class license a distinctive club insignia—which is being designed by Bill Moore, K5HTF.

The *U.S. Army Hawaii MARS Bulletin* for September, 1965, may contain one answer to the question asked by some ama-

(*Continued on page* 101)

SOLID STATE

By **LOU GARNER,** Semiconductor Editor

ACCORDING to recent news reports, more and more firms are seriously considering getting into the thin-film and monolithic integrated circuit products market. In fact, if present trends continue, it won't be long before most mass-produced electronic equipment will be utilizing integrated circuits.

This change will not come overnight. It will be more evolutionary than revolutionary; but barring a new breakthrough in technology, or a world-shattering war, the change is inevitable. Just as the transistor has virtually displaced the vacuum tube in audio amplifiers, radio receivers, industrial controls, and even computers, so will integrated circuits displace discrete components in future equipment production. These predictions are based on the following known facts:

- The Admiral Corporation will shortly introduce a color television set using an integrated video detector. Furthermore, except for a vacuum tube in the high-voltage deflection circuit, and the picture tube, the set will be fully transistorized.
- The Ford Motor Co. is planning to use an integrated circuit speedometer/odometer in future models of its popular "Mustang."
- A manufacturer of taximeters is planning to use integrated circuits, developed by Stewart-Warner Microelectronics, Inc., in a new all-electronic taximeter. These meters will be cheaper, smaller, and more reliable than conventional electromechanical types.
- Nearly half the logic circuits used in Honeywell's new flight computer consist of monolithic integrated circuit arrays. Dubbed "Alert," the new computer will be used by NASA and the U.S. Air Force.
- A broadcast-band television receiver, about the size of a deck of cards (1½" x 3" x 4"), has been built by Westinghouse Electric Corp. to demonstrate the use of integrated circuits. Except for an external power supply, the only discrete components in the receiver are the SCR's used for electrostatic deflection, and a 1" CRT. Westinghouse has also assembled a radio transmitter the size of a fountain pen, using similar manufacturing techniques.
- A new marketing group has been organized by RCA to handle the sale and distribution of commercial integrated circuits.
- Integrated circuits suitable for logic and computer applications are now being offered by Fairchild at off-the-shelf prices, competitive with those of medium-quality transistors.
- Hewlett-Packard, one of the world's largest electronic instrument manufacturers, is planning to set up its own integrated circuits manufacturing facility.
- Several manufacturers of semiconductor devices, including Motorola and Raytheon, have produced complete multi-stage, medium-power (1-watt) integrated-circuit audio amplifiers in packages no larger than conventional low-power transistors.
- At least one firm, Stewart-Warner Microcircuits, Inc., has succeeded in putting together a single integrated circuit containing 2000 diodes, 50 transistors, and 100 resistors, on a monolithic chip measuring only 100 by 100 mils!

Reader's Circuit. Submitted by reader Mark Schure (19 Troy Pl., Schenectady, N.Y.), the general-purpose mixer-preamp circuit shown in Fig. 1 can be used for tape recording functions where multiple inputs are desired, with p.a. systems, and with audio amplifiers to provide multi-channel inputs. Featuring high-impedance input, the unit will accept a variety of pickup devices, including crystal microphones, crystal phono cartridges, high-impedance magnetic telephone pickup coils, and guitar microphones.

Mark has used a conventional resistive mixer network followed by a two-stage, direct-coupled complementary audio amplifier (*Q1-Q2*). Jacks *J1* through *J4* provide the signal inputs through respective level controls *R1*, *R3*, *R5*, and *R7*. Individual input signals at *S1-S4* contact terminals are applied across respective isolation resistors *R2*, *R4*, *R6*, and *R8* to master gain control *R9*, where they are combined.

Depending on *R9*'s setting, a portion of the combined signal is coupled through *C1* to the audio amplifier. Resistor *R10* in *Q1*'s emitter serves both to increase the amplifier's effective input impedance and, by introducing degenerative feedback, to minimize distortion and improve circuit stability. The amplified output signal is developed across *Q2*'s collector load resistor, *R11*, and

is applied to output jack *J5* through *C2*. Operating power is supplied by *B1*, through *S5*.

Jacks *J1* through *J4* are standard open-circuit phone jacks, while *J5* is an RCA-type phono jack. The level controls are 0.5-megohm audio taper potentiometers, each equipped with a s.p.s.t. switch. The fixed resistors are all half-watters. Capacitors *C1* and *C2* are tubular paper types although small disc ceramics can also be used. Transistor *Q1* is a 2N218 *pnp* type and *Q2* is a 2N170 *npn* unit. Battery *B1* can be either a 2N6 or 2U6 9-volt battery, or, if preferred, six penlight cells connected in series.

The mixer-preamp can be assembled on an etched circuit board, a perforated phenolic board, or a conventional metal chassis. The assembled unit can be housed in a 4" x 2¼" x 2¼" Minibox, or you may prefer to use a sloping-front meter case instead. Another possible arrangement is to "build-in" the circuit as part of an assembled amplifier.

There's only one point that's likely to cause a little difficulty. Because Mark has relied on *Q1*'s internal leakage to establish a base bias, it may be necessary for you to apply external bias for optimum performance if a low-leakage transistor is used here. Therefore, we recommend that a half-watt fixed resistor be connected between *Q1*'s base lead and the negative battery terminal. The correct value must be determined experimentally but, in general, it should fall between 1 and 5 megohms.

In operation, the microphones or other inputs are connected to the appropriate input jacks, while output jack *J5* connects to the amplifier with which the mixer-preamp is to be used. Use shielded (coaxial) cables to reduce hum and noise pickup.

Manufacturer's Circuit. Hams, students and advanced experimenters working with medium-power, high-frequency circuits should be interested in the r.f. power amplifier design shown in Fig. 2. It is capable of delivering 15 watts at 50 mc. when driven with a 1-watt signal, and is one of several circuits illustrated in Bendix's Engineering Data Sheet for 2N3627-2N3630 *npn* silicon power transistors (Bendix Semiconductor Div., Holmdel, N.J.). The basic circuit design can be modified for use at different frequencies, or at lower power levels, with different transistors and a power supply.

Transistor *Q1* is an *npn* type used in the tuned amplifier circuit. In operation, *C1*, *C2*, and *L1* form a resonant impedance-matching input network. Base bias is supplied by *B1* through choke *RFC1*, which bypasses the r.f. to ground through *C3* and *C4*. The resonant collector load includes *C5* and *L2* as well as an impedance-matching network made up of *L3*, *C8* and *C9*. Collector current is furnished by *B2* through *L2*, and r.f. bypassed by *C6* and *C7*.

Except for hand-wound coils *L1*, *L2* and *L3*, conventional r.f. parts are used in the circuit. The coils all have a 7/16" diameter and are wound of No. 16 wire. Coil *L1* consists of six turns, *L2* of four turns, and *L3* of seven turns. The r.f. choke (*RFC1*) is a standard 7.0-microhenry unit. Transistor *Q1* is a Bendix 2N3629 or 2N3630. Capacitors *C1*, *C2*, *C5*, *C8* and *C9* are air dielectric trimmer capacitors. Capacitors *C3* and *C7* are high-quality ceramic or mica types, while *C4* and *C6* are feedthrough ceramics. Jacks *J1* and *J2* are standard r.f. coaxial connectors.

As is true of most r.f. circuits, layout and lead dress are quite critical and the

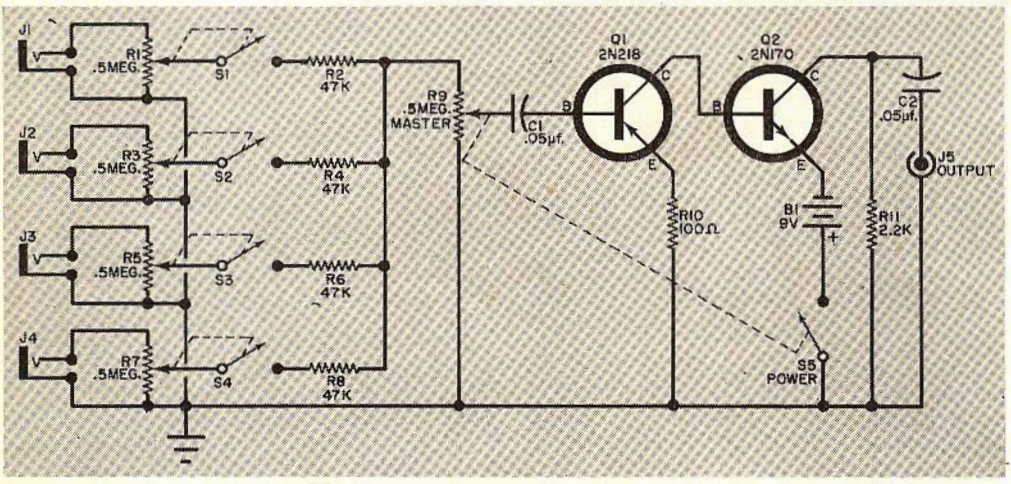


Fig. 1. General-purpose mixer-preamplifier circuit submitted by reader Mark Schure features high-impedance input for crystal microphones and crystal phono cartridges, as well as a variety of other pickup devices.

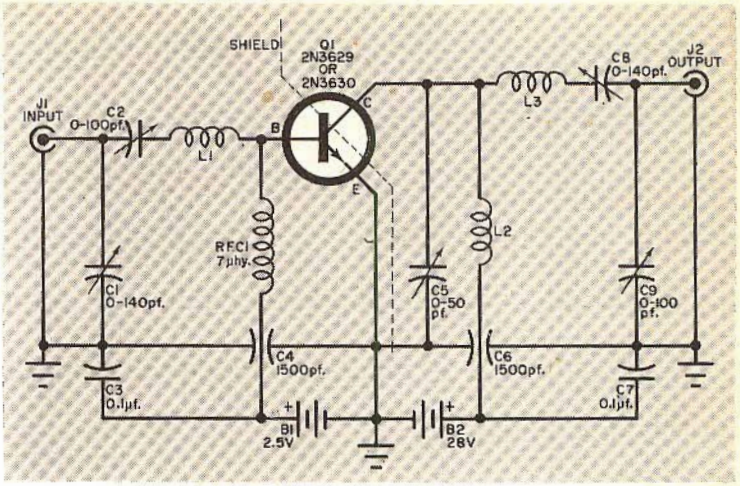


Fig. 2. This 15-watt, 50-mc. r.f. power amplifier is one of many designs described in Bendix Corporation's data sheets on the 2N3627-2N3630 silicon power transistors. Basic design can be modified for applications at other frequencies and power levels.

circuit should be assembled only by those who are thoroughly familiar with good r.f. circuit layout techniques. The circuit should be wired on a metal chassis, and there should be an isolation shield between the base and collector circuits, as shown by the dashed line in Fig. 2. All signal leads must be kept short and direct.

The completed circuit is tuned by adjusting *C1* and *C2* for resonance and proper drive (supplied by an external source) and *C5, C8* and *C9* for collector circuit resonance and a proper output impedance match.

Transitips. Although transistor circuit *efficiency* is a factor often overlooked by hobbyists and experimenters alike, it is of prime importance to design engineers. *Poor efficiency* wastes power, and this may not only reduce useful battery life, but can cause actual component damage.

Efficiency is usually expressed as a percentage figure. It is defined as the ratio of power *out* to power *in,* and is determined by dividing a circuit's output power by its input power, and multiplying the quotient by 100. The theoretical maximum efficiency which can be achieved from a given circuit depends on its class of operation, which can range from 50% for Class A amplifiers to better than 90% for Class C amplifiers. However, these figures are never quite achieved in practice. The numerical difference between the input and output power levels represents a power loss which represents energy dissipated as heat by the circuit components.

Naturally, you can't get something for nothing, and, therefore, you can't obtain more power from a circuit than you supply to it. In practical terms, then, an amplifier delivering several watts can't be operated for any appreciable length of time on a penlight cell or miniature battery, no matter how clever the design.

An example may prove helpful. Consider a push-pull power amplifier stage requiring 12 volts at 833 ma., and which supplies 6 watts of power to a loudspeaker. The input power in watts is,

$P = E$ (volts) $\times I$ (amperes) or,

$P = 12 \times 0.833 = 10$ watts (approx.)

On this basis, the circuit has an efficiency of $100 \times 6/10 = 60\%$. Therefore, the actual power loss is 4 watts (10 — 6). This loss is transformed into heat by the various circuit components, with the greater portion, or "the lion's share," dissipated by the transistors. If the transistors are not adequately heat-sinked, they may overheat and sustain permanent damage.

Here are some practical steps you can take to insure maximum circuit efficiency:

- Use the minimum forward base bias needed to insure adequate gain, good linearity, and minimum distortion. A circuit may operate satisfactorily with excessive bias, but considerable power will be wasted.
- Don't overdesign . . . don't use a power amplifier stage unless power is needed to drive a subsequent stage or external load. Wherever practicable, use low-power rather than high-power transistors.
- Where feasible, use push-pull Class AB or Class B stages in place of the less efficient Class A circuit.
- Make sure that circuit input and output impedances are matched, to insure efficient power transfer between stages or to the load.
- Wherever possible, use high operating voltages and lower currents to reduce *IR* losses; but make sure you don't exceed the transistor's voltage ratings.

(*Continued on page* 101)

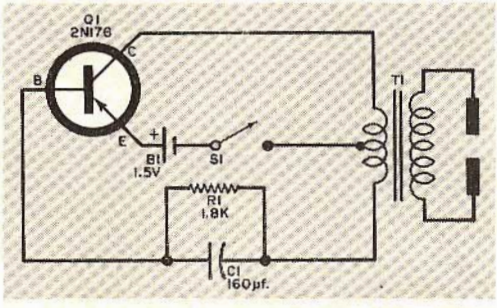
BUILD...

THE TICKLE STICK

Tickler or stimulator—take your pick; once you grab it, you'll let go quick

By FAIRIS S. BURT

ONE LOOK at the foil-covered electronic stimulator is enough to give you the creeps. Do you have enough guts to hold onto it with both hands? Under that shiny aluminum "skin" beats a "stout heart" with enough zip to pulse your muscles without so much as moving a finger. After your first reaction, if you are still holding on, you will feel great—especially after you let go. While it may come as a shock to you, the stimulator is completely safe; there's no dangerous high voltage or current to worry about.



Unusual application of filament transformer steps up Q1's pulse output to excite the electrodes—and any one who happens to be holding on to them.

How It Works. Pulses generated by a simple single-transistor modified Hartley oscillator are transformer-coupled by a reverse-connected filament transformer to a couple of electrodes. Resistor *R1* and capacitor *C1* determine the frequency of the pulses; changing the values of either of these components or changing battery voltage will change the frequency. Different frequencies create dif-

(*Continued on page* 84)

Some Plain Talk from KODAK about Tape:

The lowdown on low-noise tapes . . . and on low-speed tapes

Designing a "low noise" tape is a bit like trying to fit a six-foot man with a pair of pants tailored for a five footer. Cutting off his legs is a solution . . . but it lacks elegance. Tapewise, if all you do is use a low-noise tape, you end up with lowered output; i.e., mighty short legs. And if you push up the gain, where's the low noise you were hoping for?

The art of low noisemanship requires a bit more finesse. And it's not so hard to master if you take a listen to KODAK'S Type 34A Hi Output Professional Tape. Try this test: Listen to a "no signal" tape at high gain. Now turn down the gain until the hiss disappears. Wouldn't it be nice if you could listen to the tape that way? The solution, obviously, is to pick a tape you can put a lot on—and play it back at low gain . . . and low noise, naturally!

Enters the star. Compared to our own Type 31A Standard Play Tape, and to the low-noise product from a competitor we must keep mum about, the chart below reveals that KODAK Type 34A Hi Output Tape gives five or more additional decibels of undistorted output. At similar output levels, Type 34A is just as quiet as the next fellow's. It does this with no increase in print-through over general-purpose tapes. Pretty nice for silence lovers. The values expressed in the chart are in decibels at optimum bias settings using our Type 31A as the reference.

Some like it slow. In medieval times, a favorite subject of theological discussion was just how many angels could dance on the head of a pin. KODAK can provide no informed opinion on this question, but leaps into the fray when it comes to how much signal you can squeeze on a given length of tape. Since tape started, tape speeds have been dropping. First it was 15 ips, then 7½ ips; the day of 3¾ ips is here for some. And the recorder manufacturers still haven't stopped. Who knows where it will end.

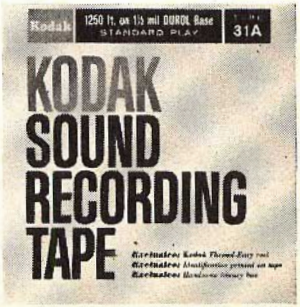
But there are some problems involved. At 15 ips a single cycle of signal at 1,000 cycles-per-second covers 15 thousandths of an inch longitudinally on the tape as it travels by. At 1⅞ ips (to go to extremes) it's down to less than 2 thousandths of an inch. As a result, as tape travel speeds decrease, tape "resolution," to borrow a photographic word, becomes more and more important. A second problem is that external magnetic flux on the tape available to thread the reproduce head also decreases in proportion. This means that you need a high-efficiency tape. Last but not least, the tape itself has to be thin for maximum footage on a given reel. People buy long-playing tapes because they play long.

Put all these problems together and our trusty KODAK 11P ½ Mil Double Play Tape sounds better and better. Look at the chart which compares it to a premium-priced famous name brand recently improved for low speed . . . and to a competitive general-purpose tape. KODAK 11P shows off as well as the first, and better than the second. Figures are in decibels using our 11P as the reference.

	Competitive double play tape	Premium-priced competitive "improved" low-speed tape	KODAK 11P double play tape
Optimum bias	+0.5	—0.5	0.0
Sensitivity at 37.5 mil wavelength	—0.6	—1.2	0.0
1 mil wavelength	—2.5	—0.2	0.0
0.6 mil wavelength	—2.6	+0.4	0.0

KODAK Sound Recording Tapes are available at most electronic, camera, and department stores. New, 24-page, comprehensive "Plain Talk" booklet covers all the important aspects of tape performance, and is free on request. Write: Department 8, Eastman Kodak Company, Rochester, N.Y. 14650.

	KODAK 31A Tape	Premium-priced competitive low-noise tape	KODAK 34A Tape
Bias	0.0	+0.4	+0.8
Sensitivity at 37.5 mil wavelength	0.0	—3.0	+2.1
Input at 2% harmonic distortion	+10.0	+11.4	+13.0
Output at 2% harmonic distortion	+11.5	+10.7	+16.3
Saturation Output	+20.0	+19.0	+23.6
Maximum Dynamic Range	75.0	79.0	79.0



EASTMAN KODAK COMPANY, Rochester, N.Y.

CIRCLE NO. 11 ON READER SERVICE PAGE

ferent sensations, but it's best to stick to the values given in the Parts List.

Construction. All components are mounted inside a cardboard tube about 9″ long and 2½″ in diameter. End plugs for the tube can be fashioned from styrofoam plastic such as that used in packaging. They can easily be cut to shape with a small knife. (If you can't get styrofoam, you can use wood, metal, or even cardboard.) Hollow out one plug to hold the on-off switch. Then drill a ¼″ hole ½″ from each end of the tube to accommodate the wires for the electrodes.

Follow the pictorial diagram when wiring the unit. Note that the transistor is mounted directly onto the transformer mounting flange and the flange is bent upward slightly to allow clearance when you insert the circuit into the tube.

Use long leads between the components and the tube to allow for the removal and replacement of the entire electronic package, or just removal of the battery. Leads of 8″ or more should be used to connect *T1*'s center tap to *S1*, the emitter of *Q1* to the battery holder, and one side of the secondary winding of *T1* to the cardboard tube. The other side of *T1*'s secondary should be made about 12″ long. Strip about 3″ of insulation from the 8″ and 12″ leads attached to the primary winding of *T1*, and insert one lead through the hole in the one end of the cardboard tube and the other lead in the other end of the tube. Wrap the leads around the tube at each end once or twice.

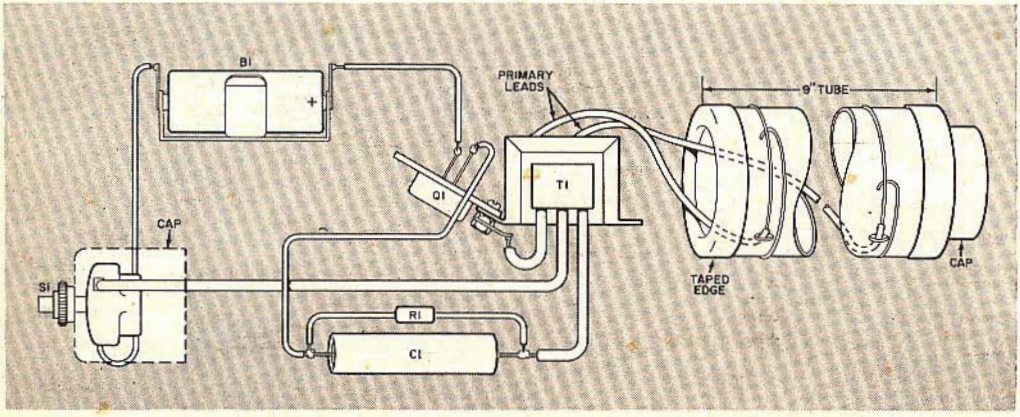
Now cut two 4″ x 14″ strips of aluminum foil and roll them "squarely" over the tube flush with the ends of the tube, leaving a 1″ separation in the middle as shown in the photo on page 82. To obtain good electrical contact with the bared wires coming from the inside of the tube, roll the aluminum foil on tight, smooth and squeeze out any trapped air, and tape the ends. Each strip of foil must make contact with only one lead. Incidentally, a good source of aluminum foil is your local grocery store.

Using the Stimulator. After you insert the circuitry into the tube, tissue or other soft filler can be stuffed in to keep the works in place. Cap the two ends of the tube with the styrofoam, and you're ready to go into the shocking business.

Push the button, hold on to the two aluminum electrodes and you'll feel that stimulating flow of current travel up your arms. Then try it out on your friends. Stimulation, anyone? -30-

PARTS LIST

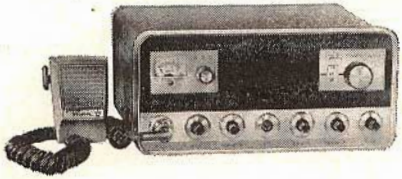
B1—1.5-volt battery
C1—160-μf., 10-volt electrolytic capacitor
Q1—2N176 transistor (or equivalent)
R1—1800-ohm, ½-watt resistor
S1—S.p.s.t. switch
T1—Filament transformer: 117-volt primary, 6.3-volt CT secondary (Thordarson 21F09 or equivalent)
1—9″ x 2½″ cardboard tube (approx.)
Misc.—Aluminum foil, wire, solder, etc.



All components, including battery, fit into cardboard tube. Primary leads from T1 pass through inside of tube to the outside, and are covered with foil. About 1″ of space separates the 4″-wide electrodes.

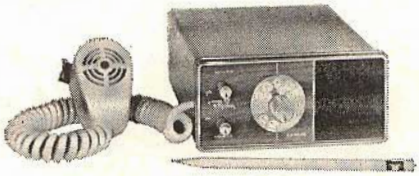
Regency does it again

New! Range Gain II Transceiver ... and still the King of CB



Choose Range Gain II for its outstanding quality features: exclusive double side-band reduced carrier provides horizon-to-horizon coverage; all 23 channel crystal controlled transmit and receive, built-in crystal filter, delta tuning, automatic noise limiter, metered control and adjustable squelch. Choose Range Gain II for outstanding value .....Only $219.95

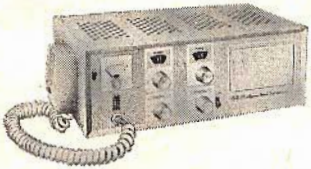
New! All-GO, Solid State Ranger Mobile Transceiver



Get the Ranger for maximum power in minimum size (6⅜" x 2⅞" x 7¾"). Extra-heavy duty transmitter output transistor gives powerful crystal controlled signal on 11 channels; mechanical filter gives the ultimate in sensitivity. Adjustable squelch. Glass epoxy circuit board. External speaker and public address facilities. Get Ranger for only $169.95

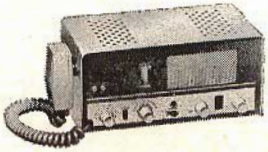
and so does METROTEK

New! Colt 23 CB Transceiver



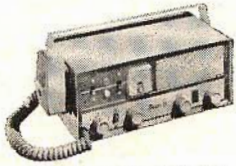
You can get crystal-controlled transmission on all 23 channels with the new Colt 23. What's more, it has many of the features you'd expect to find only on sets costing much more: double conversion superhet receiver, illuminated "S" meter, automatic noise limiter, positive squelch control, mobile mounting bracket, built-in AC and transistorized 12V DC power supply. Complete with channel 11 crystal. $129.95

New! Pacer II CB Transceiver



Eleven crystal-controlled channels for industry's lowest price—is just one of the reasons why Pacer II is your best buy in CB. It also gives a built-in, solid state DC power supply, an ANL switch and a big "S" meter. Plus these important features: 23-channel superhet receiver and a quick-change, external crystal socket. Complete with channel 11 crystal, mobile mounting bracket, AC and 12V DC cords. $99.95

New! Mustang II CB Transceiver



Start in CB for less than $80—When you choose our new Mustang II, you get the answer to a low-cost start in CB. Mustang II has eight crystal-controlled channels, a quick-change, external crystal socket; "S" meter; 23-channel, tunable receiver; positive squelch control. Complete with channel 11 crystal, 12V DC power supply cord. $79.95

Regency Electronics Inc.

Metrotek Electronics Inc.

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CIRCLE NO. 53 ON READER SERVICE PAGE

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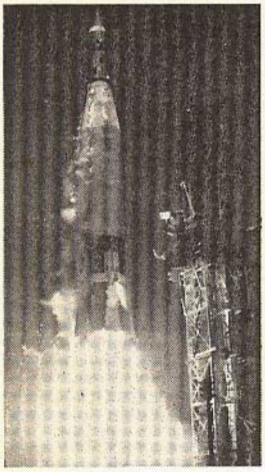
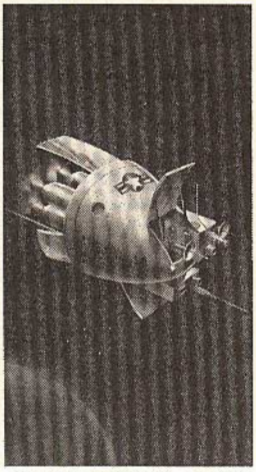
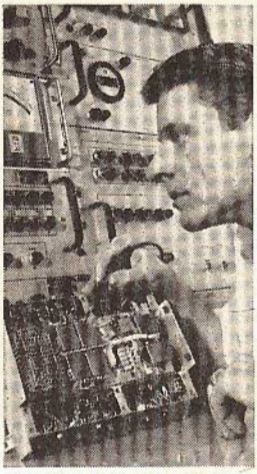


You can install and maintain electronic circuitry in missiles and rockets . . . specialize in microwaves, radar, and sonar.



You can succeed in TV-Radio Communications . . . prepare for F.C.C. License, service advanced satellites for industry and defense.



You can service and repair the electronic "brains" of industry — computers, data processing and other automation equipment.

You can become a highly-paid TV-Radio Technician, an electronics field engineer, or succeed in your own sales and service business.

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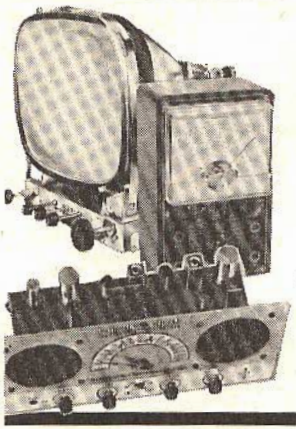

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INDUSTRIAL ELECTRONIC CIRCUITS AND APPLICATIONS

by R. Ralph Benedict and Nathan Weiner

This book represents a thorough revision of *Introduction to Industrial Electronics* written by Prof. Benedict several years ago. New material has been added and other material updated. The first half of the book deals with basic electronics, the last half with the principles of the devices and circuits employed in industrial electronic applications. Practical problems are discussed in conjunction with the theoretical principles, and several chapters are devoted exclusively to semiconductor devices and circuits. The book should be especially useful to the non-electrical engineering college student, and the industrial engineer who wants to bring himself up to date on current practices in industry.

Published by Prentice-Hall, Inc., Englewood Cliffs, N. J. 07632. Hard cover. 527 pages. $14.60.

HIGH FIDELITY SYSTEMS, Second Edition

by Roy F. Allison

Called a layman's guide to the installation and care of sound systems in the home, this expanded and revised edition of *High Fidelity Systems* covers all aspects of choice of equipment, installation, operation, and maintenance in clear, non-technical language. The new material includes specific advice on how rooms with acoustic problems can be improved for better listening and some valuable troubleshooting charts intended to isolate defective components and to illustrate what to look for when trouble starts.

Published by Dover Publications, 180 Varick St., New York 14, N. Y. Soft cover. 90 pages. $1.00.

ELECTRONIC COMPONENTS, TUBES AND TRANSISTORS

by G. W. A. Dummer

Here's an unusual book in terms of its topic and content. It has five chapters dealing entirely with electronic components, from resistors and capacitors to magnetic and

electromagnetic materials and devices. Vacuum tubes, transistors, and other semiconductors are also covered. All components are illustrated either by orthographic or perspective drawings, and each is described in terms of its physical and electrical characteristics. If you want to know more about the basic materials needed for the building blocks of electronic equipment, this book is for you.

Published by Pergamon Press, Inc., 122 E. 55 St., New York 22, N. Y. Soft cover. 166 pages. $3.95.

MICROELECTRIC CIRCUITS AND APPLICATIONS

by John M. Carroll

This book is a collection of about 75 reprinted articles from *Electronics* magazine. Considering the rapid pace of integrated circuit development, some of these articles are only of historical interest. However, this is a handy compilation of useful background information on cryogenics, thin film circuits, opto-electronics, field-effect devices, etc.

Published by McGraw-Hill Book Co., 330 W. 42 St., New York, N.Y. 10036. Hard cover. 360 pages. $9.75.

NEW LITERATURE

Chances are you'll find something of particular interest to you in Edmund Scientific's new 148-page catalog. Among the nearly 4000 items in the Edmund line are such newcomers as a 6-volt nickel-cadmium battery, magnet variety kit, science fun chest, and moire pattern kits. Other items include all kinds of tools, telescopes, intensity lamps, crystal growing kits, magnifiers, solar cells, and almost anything you can think of. Write to Edmund Scientific Co., 107 E. Gloucester Pike, Barrington, N. J. 03007, for your copy.

The Datak Corporation, 63 71st St., Guttenberg, N.J., has put out a 32-page bulletin on "Letraset Instant Lettering." It includes samples of all the type faces and sizes in which these dry transfer sheets of letters and numerals are available, and also covers such related products as "Instantex" texture sheets for tint application, "Presto-Color" color film sheets, and "Project-A-Type" letters and numerals in color for making slides and transparencies. There is a special section for the

LITERATURE (*Continued from page 91*)

electronics industry—including preset words and drafting symbols.

Servicing aids for color television and transistorized radio and TV are emphasized in B&K's catalog of professional test equipment. Among the units described are two transistorized analysts which provide d.c. power, carrier generators with modulation and in-circuit and out-of-circuit transistor testing. For color TV, the catalog covers both a transistorized portable color generator and a complete TV analyst for bench use. Write to the B&K Division, Dynascan Corp., 1801 West Belle Plaine Ave., Chicago, Ill. 60613, and ask for Catalog AP-22.

You can learn all about the various Empire "Grenadier" stereo speaker systems from a new 8-page multi-color folder available from Empire Scientific Corp., 845 Stewart Ave., Garden City, N.Y.

H. H. Scott's new 1966 Guide to Custom Stereo is a colorfully illustrated 20-page brochure which features photographs, descriptions, and specifications of all Scott components, kits and speakers. It also explains how stereo works and how to choose the components most suited to individual acoustic and budget requirements. For your free copy, write to H. H. Scott, Inc., Dept. P., 111 Powdermill Rd., Maynard, Mass. —30—

DWELL METER ADAPTER

(*Continued from page 58*)

Zener diode *D1* is a 1N3016, or equivalent, rated at 6.8 volts at 1 watt. Diode *D2*, a 1N91, protects the circuit from a reverse connection to the battery. The other two components are: *R1*, a 290-ohm, ½-watt resistor; and *R2*, a 150,000-ohm potentiometer.

If your car has a positive ground ignition system, reverse the connections of leads *A* and *B* to the distributor and the battery. —30—

DWELL ANGLE CONVERSION CHART

Full Scale (volts)	Conversion Factor		
	4 Cylinders	6 Cylinders	8 Cylinders
1.5	60°/volt	40°/volt	30°/volt
2.0	45°/volt	30°/volt	22½°/volt
3.0	30°/volt	20°/volt	15°/volt
5.0	18°/volt	12°/volt	9°/volt
6.0	15°/volt	10°/volt	7½°/volt

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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.

WN1DJA—Astronomy and camping; 40 meters; Saturdays and Sundays. (Arthur J. Arruda, Jr., 63 Gifford Ave., N. Dartmouth, Mass.)

WA1DSZ—Music, physical sciences, teen-age net; 80 through 10 meters, AM or CW; 1300 to 2130 EST. (Blair Harden, 39 Hartford St., Natick, Mass. 01762)

WA1FAJ—Stamps, reading, interior decorating; 75 meters, AM; most days of week. (Mark H. Lasner, 19 High Point Rd., Westport, Conn. 06880)

WB2AMN—SWL'ing, professional broadcasting, contemporary music, cars; 2 and 6 meters, phone; holidays, weekends, and after school hours. (Robert Sauter, Front St., Upper Nyack, N.Y. 10960)

WB2BEU—Model airplanes and railroading, fishing, basketball, chess, mechanical drawing; 3.85, 7.27, 14.22, and 21.88 mc., AM phone; 1 to 3 p.m. and 9 p.m. to 12 p.m. daily except Friday. (Larry Robinson, 934 Bronx River South, Apt. L, Bronx, N.Y. 10460)

WB2KDP—Medicine, bacteriology; 40 meters CW and 6 meters phone; daily 5:30 to 6 a.m. EST, Sundays 10 to 12 a.m. (Glenn J. Gerber, 217-16 67 Ave., Bayside, N.Y. 11364)

WB2MBV—Volunteer fireman, cars; 6 and 2 meters; 1900 to 0030 EST. (Stephen Wolf, 962 Allen Lane, Woodmere, Long Island, N.Y. 11598)

WB2QLP—Commercial aviation; 2 meters, AM; most every evening and weekends. (Jordan Mash, 611 Lafayette Blvd., Long Beach, N.Y. 11561)

WB2QWV—Model rocketry, astronautics, science, ham TV, and home-brew projects; 20 meters, SSB; 3 to 6 p.m. EST daily. (Hank Wohltjen, 146 Daleham St., Staten Island, N.Y. 10308)

WB2QXH—Photography, model railroading, and home-brew ham equipment; 6 and 2 meters; weekends, and most evenings on school days. (Rich Brummer, 22 Cottage Dr., Massapequa, N.Y. 11759)

WN2TKP—Shell and rock collecting, antennas; 80, 40, and 15 meters after 3 p.m. EST. (Bob Bersak, 86 Leslie Rd., Colonia, N.J. 07067)

WN2UGP—Chess and coin collecting; 80 meters; weekdays between 1900 and 2100 GMT. (David Cantor, 189 Rider Ave., Patchogue, N.Y. 11772)

WN2UVP—Astronomy, coin collecting, judo and karate; 15 meters, CW; some weekday afternoons after

(*Continued on page 96*)

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HAM HOBBY (*Continued from page 94*)

3:30 EST, weekend days and Saturday night. (Bruce Heimlich, 8-09 Plymouth Dr., Fair Lawn, N.Y. 07412)

WA3DLU—Color photography, also would like to contact WW II buddies of the 773 Tank Destroyer Battalion; 80, 40, 15 meters CW, 6 meters phone; evenings. (John F. de Huarte, 9629 52nd Ave., College Park, Md. 20741)

WN4YQY—Surfing and swimming; 40 and 15 meters, CW; any afternoon, all day weekends. (Dennis Letendre, 300 N.W. 190 St., Miami, Fla. 33169)

WN4ZLC—Reading, stamp collecting, hunting, and radio construction; 40 meters, CW; weekends and holidays. (LeRoy Sansbury, 2934 Temple Lane, Charlotte, N.C. 28205)

WN5NTE—Stamp collecting, model rocketry, and water sports; 80 meters; 7 to 9 p.m., most weekdays and Saturday. (Jimmy Rushing, 602 San Patricio Ave., Taft, Texas 78390)

WB6HBK—Science; 80 to 10 meters AM,CW; Saturday afternoons. (Daniel Beugelmans, 4174 Don Mariano Dr., Los Angeles, Calif. 90008)

WB6OGF—Stamp and coins, athletics, woodworking; 40 through 10 meters CW or AM, daily. (David C. Gilbert, 547 Virginia Dr., Tiburon, Calif.)

WN6RBL—Construction projects, coin collecting, and guitar; 40 meters, CW. (Shan. Jackson, 30 Junipero, Long Beach, Calif.)

WN6RIU—Photography, coin collecting, geology, math, reading; 40 meters; weekdays 3 to 12 p.m. PST, and all weekend. (Andrew Gudas, 518 N. Clover Ave., San Jose, Calif. 95128)

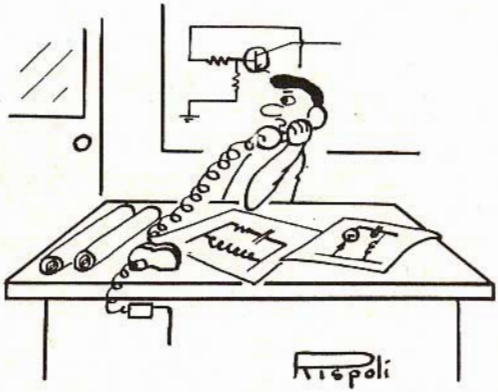
WA6VHL—Model railroading; 80,40,20 meters CW; nights and weekends. (Jerry Leisenring, 14930 Gale Ave., Hacienda Heights, Calif. 91745)

WN7CYY—Stamp and coin collecting, lapidary, boating, private aircraft; 80 meters, sometimes 40 meters. (Roger Attwell, Route 4, Box 500, Everett, Wash.)

W8IEC—Stamp and coin collecting, DX'ing, and member Ford Tin Lizzy Club; 80 through 10 meters, CW. (Steve Solo, 12932 Gable St., Detroit 12, Mich.)

WN8RQA—Reading, flying, boating; 3.735 mc. weekdays 7 to 9 a.m. EST, 21.165 mc. weekends from noon to 2 p.m., and 2 meters phone on Sundays. (Mike Martz, Box 517, Sidney, Ohio 45365)

WAØEXS—Slot-car racing; 80 through 6 meters, mostly SSB, some CW; evenings and weekends. (Charles Bennett, 1407 18th St., Bettendorf, Iowa) —30—



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CIRCLE NO. 47 ON READER SERVICE PAGE

REVERB FOR YOUR CAR

(*Continued from page 53*)

amplifier. It is best to build the power supply in a separate case to avoid hum pickup.

Construction. To simplify matters, a printed circuit board is used for the amplifier, as shown in Fig. 6. It is shown actual size in case you decide to make your own.

Note the lead arrangement for *Q3* (the 2N3706). If bent properly and installed as shown, the flat side of the case will face resistor *R12*. If you cannot locate any proper size 0.5-ohm resistors for *R14* and *R15*, you can make them by winding 15 inches of #36 magnet wire on a resistor body and soldering the ends of the wire to the resistor leads; use at least a 1000-ohm resistor.

The delay line assembly must be shock-mounted to prevent car movements and road bumps from activating the springs. To do this, suspend the reverberation unit from the top of the case with four springs, one in each corner. Allow sufficient clearance between the unit and the case to prevent contact even when you hit the brakes hard.

To mount the springs, drill two small (#60) holes about ⅛" apart for each spring. Start from the inside of the chassis and thread the end of the spring through one of the holes, and then back through the other hole into the case. Do not shorten the leads from the reverberation unit; they must be long enough to allow free movement.

Mount the unit in the case, the open side facing in, as shown in Fig. 4. Dress all the leads from the unit to extend past the output end. The output end of the delay line is the end with the shielded transducer.

Installation. In automotive installations, the fader control and switch can be mounted on a separate panel and located within easy reach of the driver. The leads can then be run to the reverberation amplifier, which can be mounted in the trunk or some other convenient place.

Disconnect the speaker from the car radio's output transformer and connect it to the fader control. Then install a rear-seat speaker and connect it to the fader control. This will allow you to select either direct output to both front and rear speakers, or direct output to the front speaker and reverberation output to the rear speaker. Of course, if your car is already equipped with a fader control and a front and rear speaker setup, you're that much ahead of the game—all you need add is the d.p.d.t. switch (*S1*).

To adjust the amplifier for proper operation, connect it to a 12-volt power supply. It's a good idea to install a 1-ampere fuse in the + lead. Measure the voltage at the collector of *Q5* (it can normally range from 4 to 8 volts) and adjust trimmer resistor *R8* to obtain a 6-volt reading. The purpose of this adjustment is to obtain symmetrical operation.

After you install the amplifier, tune in your favorite program—and enjoy your concert hall on wheels. —30—

ON THE CITIZENS BAND

(*Continued from page 74*)

N. Braddock, and Miss D. Whitham, club committee.

Dallas further relates that CB licensees now number over 1000 in New Zealand, with approximately 400 in the Wellington area. Calls for the area are prefixed as "AK" for the Auckland region, "WN" for Wellington, etc.

Civic Aid. Members of the Tri-County Citizens Band Radio Club, Sterling, Ill., late last year assisted during the Illinois Junior Sports Jamboree held in that city. TCCBRC members intercepted all buses arriving at the jamboree, spacing their arrival at the registration center. Individual members then remained with the buses whenever they were moved during the ceremonies. Two base units were in operation at the junior high school, each on a different frequency. And a club member stayed near the state chairman at all times to inform him of any problem. In addition, club personnel made up a large part of the chaperone forces, providing policing units at the dorms on an around-the-clock basis.

During the jamboree parade, club personnel aided in the formation of sections and helped to keep the parade running smoothly. Later, the group assisted in sporting events by keeping the announcer informed through the use of walkie-talkies. Operators reported times in the running of field and track events as well as the heights and distances met by jumpers. They en-

A special booth was set up by Tri-County CB Radio Club (Sterling, Ill.) members at the Illinois Junior Sports Jamboree where they assisted as described above. Shown in the photo, left to right, are Leo Waldbusser, Larry Meyers, Bob Maxwell, Dave Rearley, Vernon Rosnow (president), and Helen Fransen.

abled the announcer to keep spectators aware of the state of the meet.

By the time the TCCBRC CB operators had delivered attending dignitaries to the awards banquet, they had put in some 620 man-hours, utilizing 33 walkie-talkies, 5 base stations, and 42 mobile units.

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 this column in the last year are requested to do so now. Include your current membership totals, officers, club activities, emergency assists, and sample club decal and membership card. And please continue to provide us with your club newspaper or bulletin on a monthly basis. All groups are urged to send in photographs of activities, emergency teams, assists, and any unusual application connected with CB radio. Forward this material to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. The clubs listed below have recently organized or are bringing us up-to date on their present status.

Vero Beach, Florida: The Dog House CB'ers, Inc. This club has been active since January, 1964. Their call is KMP2992, issued July, 1965, for 50 units. Activities include aiding Civil Defense authorities, and the control station monitors 24 hours on weekends in order to aid the H.E.L.P. program. Club works hand in hand with amateurs in the area; members have been invited to attend classes to qualify for amateur tickets. Present officers include: Ed Ashley, 7Q0834, president (retired); L. B. Ginder, KDI1805, vice president; Bert Oechsle, secretary; Chuck Homer, KDH2258, treasurer; Paul Jacobs, KMP2748, and Frank Melton, KDI2396, communications officers.

Hillside, Maryland: Prince George's Volunteer CB Rescue Service, Inc. Organized in October, 1964, this group provides a mobile CB patrol on the new Capitol Beltway, Rt. 495, surrounding the entire Washington, D.C., metropolitan area. They work with local and state authorities during emergencies, and provide walkie-talkie and mobile units with a special skindiving unit to search areas. Officers: Andrew F. Przekop, KCB1870, president; Owen Mason, KCG1895, vice president; Harriet Fleck, KLV0295, secretary; Carrie Letcher, KCG2384, treasurer; and Jerry Peluzzo, KJE0246, chairman, emergency committee.

New York, New York: The Bronx Westchester CB Association. There are 80 members in this group, which has its own quarters and ham shack. They are equipped with gear and mobile units to help in emergencies at a moment's notice.

Elyria, Ohio: The Lorain County CB'ers, Inc. Present membership: 40. Meetings are held the last Sunday of each month at the Junior Chamber of Commerce building. Present officers: Larry McGough, KLM0698, president; Bill McCabe, KNM3739, vice president; Christine Sparks, KHH2473, secretary; and Darrill Hashman, KHJ3901, treasurer. There are also three trustees, an agent, a sergeant at arms, and a corresponding secretary.

Sarnia, Ontario, Canada: The "21" Club. Organized in May, 1965, this group is involved in emergency search and rescue. Minimum age requirement for membership is "21." The club maintains a ladies auxiliary. Secretary of club: John A. Hall.

Also reporting: In *Daytona Beach, Florida,* Volusia County REACT Team; in *Pontiac, Michigan,* Oakland Social CB's, Inc.; and in *Port Huron, Michigan,* Blue Water Messengers.

I'll CB'ing you!

—Matt, KHC2060

SOLID STATE

(*Continued from page* 81)

● Keep non-working circuit resistances at a minimum. Where large currents are involved, as in multi-watt power stages, use moderate-to-heavy gauge hookup wire.

Product News. A new series of dual trigger diodes is now being produced by the Mallory Semiconductor Co. (424 S. Madison, DuQuoin, Ill. 62832). Essentially symmetrical three-layer avalanche devices, they are designed for use in activating SCR's and bi-switches. The unique electrical characteristic of these diodes causes a symmetrical switching device to fire whenever the breakdown voltage is exceeded in either direction, thus triggering two SCR's with one diode. Identified as the STD series, the new Mallory diodes have a 1-watt power rating and breakover voltage ratings ranging from 24 to 120 volts.

Expensive semiconductors need protection! Recognizing this fact, ATI Industries (9030 Bellanca Ave., Los Angeles, Calif. 90045) is now producing a special high-speed, high-current solid-state switching device designed to protect equipment circuits from overvoltage or overcurrent transients which would normally damage or destroy semiconductors. This semiconductor protector (SCP for short) has a response time of 500 nanoseconds, or less, and is available in models with voltage ratings ranging from 3 to 1000 volts at currents of up to 150 amperes.

That concludes the "SOLID STATE" story for now, fellows. Back next month . . .

—Lou

AMATEUR RADIO

(*Continued from page* 78)

teurs as to why they should join MARS (Military Affiliate Radio System). The Hawaiian MARS director offers to write a letter that should help any member of his MARS group who is drafted by the Army to be assigned to signal work.

In the October, 1965, issue of *Auto Call,* published by the Foundation of Amateur Radio, Washington, D.C., Marty, K3LFN, reports that Bill Grenfell, of the FCC, speaking at the September 11 meeting of the Rock Creek Amateur Radio Association, told about a fellow who included a check for $16 with his license application. The actual fee was $8, of course, so the applicant was sent a refund check for eight dollars. Then the original $16 check "bounced"!

News and Views

C. K. Moon, publicity director of the Poughkeepsie Sports Car Club reports that last September 26 the Poughkeepsie Amateur Radio Club supplied communications for the annual Gibson Girl Rally. Thirty sports cars covered 253 miles of unfamiliar roads and were checked in and out of eight check points by radio. In addition to 2-meter, FM mobile units at each check point, relay stations were installed on two nearby mountains to insure that all reports would reach the control. Communications worked without a hitch . . . **W. Page Pyne, WN3EOP,** 540 North Locust St., Hagerstown, Md., works 40 meters using a home-brew 10-watter feeding a random length of wire and a Knight-Kit "Star Roamer" receiver. On 2 meters, he uses a Heathkit "Twoer" feeding a coat-hanger antenna, which works fine for local contacts . . . **Denny Ferguson, WN4WYC,** 212 Piedmont Ave., Rockmark, Ga., works 15 meters most of the time. His Heathkit DX-40 transmitter, 3-element beam, and Hammarlund HQ-145C receiver have knocked off 45 states and 16 countries. Denny offers to sked anyone needing a Georgia contact and hopes to have his General ticket by the time this is being read.

Rich Casey, WA9LRI, 8939 Parkside Ave., Morton Grove, Ill., works 2 and 6 meters with a Heathkit "Twoer" and "Sixer." On 2 meters, Rich uses a 3-element, home-brew beam 35' high, and he has a dipole under it for 6 meters. In addition, he likes to experiment with other antennas and has worked four states using a clothes-hanger dipole . . . **Robert Mauro, WN2UHY,** 150-30 18th Ave., Whitestone, N.Y., operates on 40 meters. He feeds a 40-meter dipole antenna 25' high with an AMECO AC-1T transmitter and receives on a Lafayette HA-350 receiver. Although his transmitter power is only 8 watts, Bob has worked 12 states and two countries. A 20-wpm code-proficiency certificate and the way he handles his bug key prove that code is not one of his problems . . . **Steve Gard, WN8QWU,** 19141 Warwick Drive, Birmingham, Mich., has just discovered the value of a good receiver and a good antenna. In his first four months on the air receiving on an old, inexpensive receiver and feeding his Heathkit DX-40 transmitter into a nondescript dipole, Steve managed to work five states. Then he got a Hallicrafters SX-100 receiver and put up a Hy-Gain 18-AVQ antenna. Six log hours later, his states-worked total was 22.

Ron Vincent, WA7CGR, 2545 Washington St., Eugene, Ore., runs his EICO 720 transmitter at 65 watts on phone and 75 watts on CW to drive either a Hy-Gain 14-AVS vertical antenna or an 80-meter dipole, and he receives on a Hallicrafters SX-99. With this combination Ron has acquired 48 states worked and confirmed, and cards from 23 of the 46 countries he has worked. When not chasing DX with "high" power, Ron fools around with a 10-watt home-brew transmitter, and is in the midst of building a 5-watt, 80/40-meter transistorized transmitter . . . **Keith G. Beebe, WA4QOO,** 4899 100th Way, North, St. Petersburg, Fla., made over 2000 CW contacts in a year and a half on the air. In the process, he worked 45 states and 19 countries on three continents. Even more to be proud of is his selection for membership in the A-1 Operators' Club; Keith is also a member of the QRP and Rag Chewers' Clubs. WA4QOO's equipment includes a Globe "Sidebander" transmitter, a Lafayette KT-320 receiver, a home-brew 20-meter beam on a 40' tower, and a 40/15-meter inverted-V antenna . . . **Al Klein, W2PMX,** 2686 Colby Court, Brooklyn, N. Y., feeds a "long-wire" antenna between 80 and 15 meters with a Sideband Engineers SBE-33 transceiver. But Al's on-the-air time is being crowded by a new activity. Because he likes to build things, Al offers to build any electronic gadget described in any electronic magazine (although he prefers this one, because he has a complete file of back issues) for about the cost of the parts.

Charles Collingwood, WA8PVN, 823 S. Main St., Findlay, Ohio, uses both a horizontal dipole and a vertical antenna. He drives them with a homebrew 6AG7-807 transmitter running a power of 75 watts, and receives on a Knight-Kit R-55A receiver. Operating on 15 meters exclusively, Chuck has worked 13 states, nine of them confirmed . . . **Mark Kellog, WNØMSX,** 3341 So. 106th St., Omaha, Nebr., has worked 22 states, but he has great difficulty getting QSL cards from any stations except W9's. Mark loads his Globe "Chief" to 75 watts to excite his 40-meter dipole, and he receives on a Hallicrafters SX-99 . . . **Bruce Kaplan, WN3DYC,** 29 Homestead Rd., Levittown, Pa., has something that many Generals in his area do not have—a QSO with Wyoming. His tools are a Heathkit DX-35 transmitter and a Knight-Kit R-55A receiver. Mark also has 16 other states besides Wyoming worked . . . and he just received a Hammarlund HQ-100A receiver for his birthday.

"See you" in the Novice Roundup or in the DX Contest. Send your "News and Views," photos, and club bulletins for the next column to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Indiana 46401.

73, *Herb, W9EGQ*

ELECTROMAZE SOLUTION

(*Puzzle appears on page* 59)

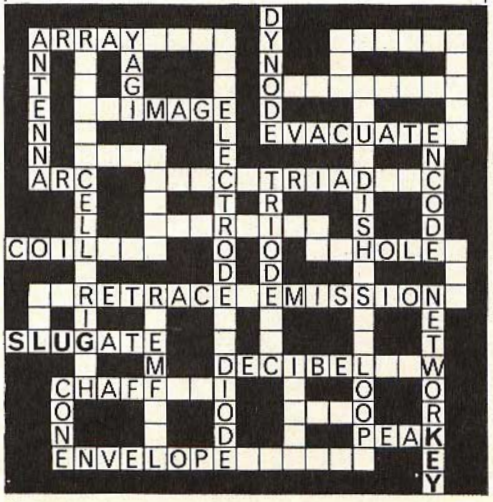
1 Coil
2 Cell
3 Arc
4 Antenna
5 Array
6 Yagi
7 Image
8 Electrode
9 Retrace
10 Rig

Exit 1. Slug

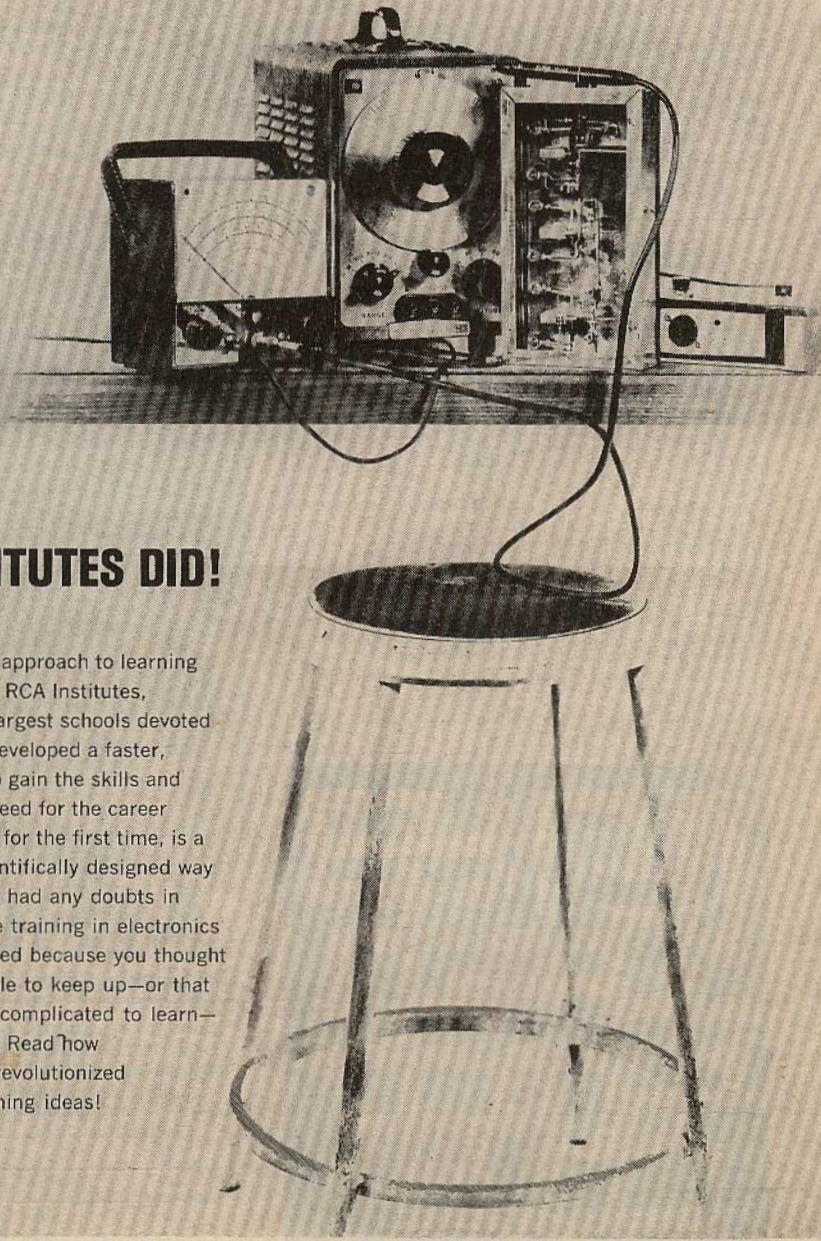
11 Gate
12 EMF
13 Chaff
14 Cone
15 Envelope
16 Diode
17 Decibel
18 Loop
19 Peak

Exit 2. Key

20 Network
21 Emission
22 Triode
23 Triad
24 Dish
25 Hole
26 Encode
27 Evacuate
28 Dynode



SOMEONE SHOULD DEVELOP AN EASY WAY TO LEARN ELECTRONICS AT HOME



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Automatic Controls. Prepares you to be an Automatic Controls Electronics Technician; Industrial Laboratory Technician; Maintenance Technician; Field Engineer.

Digital Techniques. For a career as a Digital Techniques Electronics Technician; Industrial Electronics Technician; Industrial Laboratory Technician.

Telecommunications. For a job as TV Station Engineer, Mobile Communications Technician, Marine Radio Technician.

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FOUR-LETTER QUIZ ANSWERS

(*Quiz appears on page* 72)

1 — D AFSK (Audio Frequency Shift Keying) is a type of modulation where the carrier is shifted between two discrete frequencies, and is often used in RTTY (radioteletype) communications work.

2 — H A DAVC (Delayed Automatic Volume Control) circuit does not apply a negative control voltage to the grids of the controlled amplifier tubes until the input signal is large enough to overcome a predetermined bias on the d.a.v.c. diode.

3 — A FETS (Field-Effect Transistors), like vacuum tubes, are basically voltage amplifiers and have high input impedance. Conventional transistors are generally current amplifiers, and have low input impedance.

4 — G A MOPA (Master Oscillator Power Amplifier) is a radio transmitter consisting of an oscillator and an r.f. amplifier.

5 — I The NTSC (National Television Standards Committee), a group representing the major television manufacturers, research laboratories, and broadcasters, prescribed the system used to transmit and receive commercial television in the United States.

6 — F The PMMC (Permanent Magnet Moving Coil) meter movement (D'Arsonval meter) employs a pointer mounted on a pivoted coil, a permanent magnet, and current-carrying coil return control springs.

7 — C The RIAA (Record Industry Association of America) equalization curve is a standard widely used by the phonograph record industry.

8 — B A TPTG (Tuned-Plate Tuned-Grid) oscillator employs parallel resonance in both plate and grid circuits, and the frequency of oscillation is dependent on the resonant frequency of each of the tuned circuits.

9 — J The UJTO (Unijunction Transistor Oscillator) utilizes the stable firing voltage characteristics of the transistor in a relaxation circuit.

10 — E The VSWR (Voltage-Standing-Wave Ratio) is the ratio of the characteristic impedance of a transmission line to the impedance of the load connected to the output end of the line.

SHORT-WAVE LISTENING

(*Continued from page 75*)

date submit a list of 25 additional countries for a "50" award, along with a notation to refer to their original listing of 25 countries —not an easy task by any means, considering the huge volume of applications that are processed. And often we find, once again, that the applicant has submitted one or more duplications and, again, additional correspondence is necessary.

To insure your receiving your DX Awards as quickly as possible, we ask that you (1) be sure that your listings are in alphabetical order, thus automatically eliminating duplication, and (2) each time you apply for a higher award, send in a *complete* list. You will find this easy to do if you keep a copy of the list you submitted for the lesser award.

If you intend to apply for any of the DX Canada Awards, the provinces now deemed acceptable include: Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, Yukon Territory, and Northwest Territories. For award purposes, the Yukon and Northwest Territories are being considered as provinces.

Photo, Anyone? Would you like to have your picture in this column? Send us a black-and-white photo of your SWL "shack" with you in it. The photo should be at least 4" x 6" and should have good contrast; blurred prints cannot be properly reproduced. And all of the equipment shown must be identified by make and model number. Mail the photo to: Short-Wave Editor, P.O. Box 333, Cherry Hill, N.J. 08034. Be sure that it is one you can spare for we cannot return it.

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 Eastern Standard 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 Monitor Registration 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 all contributors.

Algeria—*R. Algiers* is noted on 6175 kc. from fade-in around 2200 with Eng. to 2230 and Spanish to 2300/close. This is in parallel to 9685 kc. and to the 100-kw. medium-wave outlet on 890 kc., which has also been reported in East Coast areas.

Austria—Vienna has revised its schedule. It now reads: to the Orient at 1700-2200 on 11,845 kc. (replacing 9610 kc.); to South America at 0000-0200 on 17,785 kc. (replacing 11,905 kc.); to India and Indonesia at 1300-1500 on 17,770 kc. (replacing 17,800 kc.); to Australia and New Zealand at 0900-1100 on 17,875 kc. (replacing 17,810 kc.); to Japan at 1100-1300 on 11,875 kc. (replacing 11,725 kc.); and to South Africa at 0700-0900 on 17,875 kc. and at 1500-1700 on 17,770 kc. (17,750 kc. is no longer in use). *R. Sweden* reports that xmsns from Vienna may be changed often and, in some cases, overseas programs may be partially suspended because the station will begin broadcasts with 100-kw. xmtrs in late 1966.

British Guiana—Station ZFY, Georgetown, was tuned on 5980 kc. at 0940 with singing; at 0948 with an ID for *R. Demerara,* then local news; at 0955 with an ID and music; and at 1000 with a commercial, ID, and time given as 6:15 a.m. A morning devotional service followed.

Burma—Station XZK2, Rangoon, 4797 kc., has been monitored with the carrier on at 1055, music and s/on anmts at 1100 in Burmese. The 6032-kc. outlet carries Program I (also in Burmese) at this time and is heard frequently.

Cambodia—*R. Phnom Penh,* 5940 kc., is noted at times with the best signal around 1020-1045 when there are songs and anmts in (probably) Cambodian. This channel usually has considerable RTTY QRM.

Chile—Seldom heard is *La Cruz Del Sur,* Santiago, 11,848 kc. Badly squeezed by Paris and *R. Teleco* (Paraguay), it has a religious program at 2330.

China—"To improve reception for our listeners on the East Coast of N.A., we have made some changes . . ." Peking now beams to this area at 0000-0100 on 15,060 and 17,680 kc., and at 0100-0200 and 0200-0300 on 7035, 9480, 11,945, 15,080, and 15,095 kc. Other xmsns were noted on 15,370 kc., in addition to their Spanish beam at 0045, and on 11,505 kc. in Chinese from 2353 to past 0000 with six time pips at 0000.

Colombia—A new or possibly misplaced Colombian on 6117 kc. bears further checking. With an ID of *R. Centro Populare,* it is heard from 0040.

Cyprus—The BBC Near East Mediterranean Re-

CLANDESTINE STATIONS

An unidentified "U.S.S.R. regional" station noted often on 5915 kc. is the quasi-clandestine *Bizim Radyo,* whose xmtr is reportedly in Bucharest. An ID in Turkish was caught just before the 2058 s/off.

R. Libertad's often-quoted "25-meter" frequency has been found to be 11,865 kc., on which the station was logged at 0000.

Radio Peyk-e Iran, according to an item from *R. Switzerland,* broadcasts in Persian and Arabic from 1350 to about 1800 on 9560, 11,410, and 11,695 kc. It is surmised (the report states) that the anonymous programs are compiled in East Germany and broadcast from xmtrs in Bulgaria in the direction of Iran and Iraq. *(Editor's Note:* American sources have, for some time, thought that the broadcasts originated from a 50-kw. xmtr in the Russian sector of Berlin, Germany.)

A station has been heard on 4190 kc. with the call-sign WERG and a location somewhere in New Jersey. Playing old and modern pop records, it identified as "The last word in radio, WERG, New Jersey, on 4190 kc." It was tuned at 2310-2325 when the announcer said it would move to 4340 kc. No move was made, however, and it returned to the air from 2335 to 2352, when operations apparently ceased. Does anyone have any further information on this station?

SHORT-WAVE ABBREVIATIONS

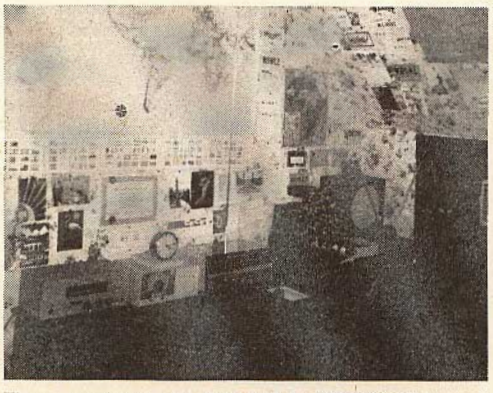
anmt—Announcement	QRM—Station interference
BBC—British Broadcasting Corporation	R.—Radio
Eng.—English	RTTY—Radioteletype
ID—Identification	s/off—Sign-off
kc.—Kilocycles	s/on—Sign-on
kw.—Kilowatts	VOA—Voice of America
N.A.—North America	xmsn—Transmission
	xmtr—Transmitter

lay at Limassol operates on 15,420 kc. with Eng. until 1700 and again at 1900.

Czechoslovakia—Prague's winter schedule reads: to Europe at 0800-0930 in German, at 0930-1100 in German to Austria, at 1100-1200 in French and at 1200-1300 in Italian on 6055 and 9505 kc., at 1200-1230 in Eng. on 9560, 11,960, and 15,285 kc., at 1230-1300 in Spanish (Saturdays and Sundays) and at 1300-1330 in Spanish on 6135, 11,960, and 15,285 kc., at 1300-1430 in Italian (Saturdays and Sundays) on 6055 & 9505 kc., at 1700-1730 in Italian, at 1830-1900 in Spanish and at 1900-1930 in Eng. on 5930 and 7345 kc.; to Africa at 1500-1530 in Swahili and at 1530-1600 in Eng. on 7345, 9550, 11,990, and 15,285 kc. (and on 6055 kc. to Europe and N. Africa), at 1630-1730 in Arabic on 7285, 9795, and 11,990 kc., at 1730-1830 in Eng. on 5930, 7285, 7345, 9795, and 11,990 kc., at 1830-1930 in French on 7285, 9795, and 11,990 kc., at 1930-2030 in Arabic and at 2030-2130 in French on 5930, 7345, 9795, and 11,990 kc.; to South and Central America at 2130-2230 in Portuguese and at 2230-2300 in Czech and Slovak on 5930, 7345, 9795 and 11,990 kc., at 2300-0000 in Spanish, at 0000-0100 in Portuguese and at 0200-0300 (to Central America and Mexico) on 5930, 7115, 7345, 9795, and 11,990 kc.; to N.A. at 1330-1400 in Czech and Slovak (Sundays only) and at 1400-1500 in Eng. (Sundays only) on 15,285, 15,448, and 17,825 kc., at 0100-0200 and 0330-0430 in Eng. and at 0300-0330 in Czech and Slovak on 5930, 7115, 7345, 9795, and 11,990 kc.; to the Far East and Australia at 0700-0800 in Eng. on 9505, 15,230, 15,285, and 21,450 kc. (and on 6055 kc. to Europe). Medium-wave xmsns to Europe include one at 2305-2330 in Eng. on 1097 kc. Several reporters also indicate that the African Service at 1530-1630 is now being carried on 15,200 kc.

Ecuador—Station HCMR1, *R. Cayambe*, Cayambe, rarely heard, has been noted in New England around 0300 with Spanish music on 3640 kc.

Ethiopia—Station ETLF, *R. Voice of the Gospel*, Addis Ababa, has Eng. from 0330 on 7165 kc. on Tuesdays, Wednesdays, and Thursdays as indicated last month. This is preceded by an Arabic xmsn from 0300 and followed by another Arabic



Three receivers are featured in the listening post of David Smith, WPE1GBC, Everett, Mass.: a Hallicrafters S-120, a "Realistic" 148/175 fire/police receiver, and, for standby, a Hallicrafters S-119.

period from 0400. The 9755-kc. outlet is tuned at 1400-1430 in native language and native music after an opening ID in English.

Formosa—*Voice of Free China,* Taipei, carries Eng. at 0250-0350 on 7130, 11,825, 11,860, and 15,345 kc., at 1000-1045 on 7130, 9655, 9685, 11,825, and 11,860 kc., and at 1530-1610 on 7130, 9685, 9720, 11,725, 11,825, 15.125, and 17,890 kc. The "Dragon Show" is aired at 1130-1200 on 7130, 9685, 9720, 11,725, and 17,890 kc. West Coast monitors report that the 1530-1610 kc. xmsn can only be heard on 9685, 9720, and 11,725 kc.

Gilbert & Ellice Islands—*R. Tarawa* operates VTW2, 4912.5 kc., and VTW3, 3220 kc., in Eng. on Thursdays at 0730-1030 and in Gilbertese daily except Thursdays and Saturdays at 0430-0700. The only xmsn noted in the U.S. in recent weeks was in Washington, D. C., a tentative logging of the Eng. program.

Haiti—Station 4VB, Port au Prince, formerly known as *R. Commerce,* was calling itself *La Voix de la Revolution Duvalieriste* in Eng., Spanish and French when noted on 5983 kc. from 0200 to 0400.

Israel—There is an additional xmsn on Sundays (possibly in Eng. but this is not confirmed) at 0900-1000 and in French at 1000-1100 on 11,910 kc. to Europe and on 9009 kc. to South Africa. In the evening, French begins at 2015 and Eng. at 2040-2100 on 9009, 9625, and 9725 kc.

Korea (North)—*R. Pyongyang* (or *R. Korea*—either or both may be used) has Eng. at 2300-0000 on 11,748 kc. to S. E. Asia. They open in Chinese at 2200.

Lebanon—Beirut has a xmsn to North and Latin America at 0130-0400 in French and Spanish on 9675 kc., but they still ID as operating on 9710 kc.

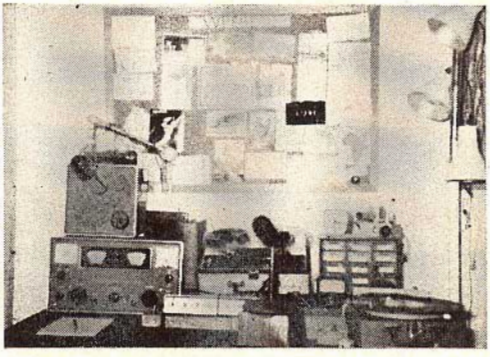
Luxembourg—*R. Luxembourg* has been noted from 2315 with Eng. religious programs on 6090 kc.

Malaysia—The Commercial Service of *R. Malaysia* is noted at 1000-1030 on 7300 in English. *Voice of Malaysia,* 6175 kc., signs on at 1115 in Eng. to S. E. Asia, Australia, and New Zealand, and gives dual channels as 11,900, 7100, and 6100 kc. English news is given at 1130. *R. Malaysia Sarawak* has Eng. on 5037 kc. at 1300-1400 and on 4950 kc. at 1400-1600.

Mexico—Station XEUMT, *Universidad Iberoamericana,* Sisoguichi, Chihuahua (mailing address: Mexico City) is on the air weekdays only with s/off at 2330 on 5960 kc. They broadcast educational programs.

Monaco—*Trans World Radio,* Monte Carlo, has Eng. xmsns on 7260 kc. on Mondays, Tuesdays, Thursdays and Saturdays at 0630-0730, on Wednesdays and Fridays at 0630-0715, and on Sundays at 0630-1230.

Netherlands—The Eng. schedule for *R. Nederland,* Hilversum, effective until March 6, reads: to N.A. at 1555-1615 (Tuesdays and Fridays) on 15,-



A Hammarlund HQ-100A receiver is used by Tom Kent, WPE8ETL, Shaker Heights, Ohio. A DX'er for only two years, Tom already has 78 countries logged.

SHORT-WAVE CONTRIBUTORS

Dave Siddall *(WPE1EBN)*, Hyannis, Mass.
Stanley Mayo *(WPE1GEK)*, Portland, Maine
Edward Kalin *(WPE1GEL)*, W. Hartford, Conn.
Perry Brainin *(WPE2KVK)*, Bronx, N. Y.
Bernard Greene *(WPE2MNJ)*, Brooklyn, N. Y.
Lothar Koenig *(WPE2NTB)*, Fort Hamilton, N. Y.
Ray Schlegel *(WPE2OAO)*, Rochester, N. Y.
Bernard Kinahan, Jr. *(WPE2OEE)*, Yonkers, N. Y.
George Sprout *(WPE3GMW)*, Reading, Pa.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Jimmy Dearing *(WPE4IES)*, Roanoke, Va.
Paul Judkins *(WPE4ISO)*, Herndon, Va.
Jack Keene *(WPE5BMP)*, Houston, Texas
Gary Kieffer *(WPE5DZD)*, Tecumseh, Okla.
Shaler Hanisch *(WPE6BPN)*, Pasadena, Calif.
John Woltjen *(WPE7OB)*, Salt Lake City, Utah
Tom Kent *(WPE8ETL)*, Shaker Heights, Ohio
John Rosenbaum *(WPE9HTO)*, South Bend, Ind.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Douglas Hammock, Jr. *(WPEØEOF)*, Morehouse, Mo.
Bert Pestor *(VE3PE9L)*, Sudbury, Ont., Canada
Trevor Burke *(VE7PE1AW)*, Victoria, B. C., Canada
Roy Cohen, Plainview, N. Y.
Bob Hill, Washington, D. C.
Gary Tremblay, Bakersfield, Calif.
John Young, Jr., Redondo Beach, Calif.
John Zapisek, Wading River, N. Y.
Radio Prague, Prague, Czechoslovakia
Sweden Calling DX'ers Bulletin, Stockholm, Sweden
Swiss Broadcasting Corp., Berne, Switzerland

425 and 11,730 kc., at 2030-2050 (Tuesdays and Fridays) on 11,730 and 9525 kc., at 2055-2150 (except Sundays) and at 1855-2020 (Sundays only) on 9590 and 6085 kc., and at 0125-0220 (via Bonaire) daily on 9590 kc.; weekdays only to Australia and New Zealand at 0725-0820 on 9715, 11,730, and 11,970 kc., to S. Asia at 1425-1520 on 15,425 and 17,810 kc., to Africa and Europe at 1855-1950 on 6025 and 9590 kc., and to Europe at 1955-2050 on 6025 and 6085 kc. There is a xmsn from Bonaire, daily, at 1955-2050 on 15,220 kc. The "Dutch By Radio" course has been discontinued and replaced by "What's In The Paper?". "Holland Makes It" has been superseded by "Holland in 1990."

Nigeria—*Voice of Nigeria*, Lagos, 7275 kc., has an Eng. news summary from 2200 to 2205 s/off dual to 15,255 and 11,900 kc., but the 7275-kc. xmsn is not announced.

Peru—A station noted on 6350 kc. is thought to be *R. Pacifico*, Lima, in a possible move from 9675 kc. It was noted around 0300 on an irregular schedule and may give ID as OAZ4K.

Station OAX5X, *R. Nazca*, Nazca, 4790 kc., is tuned at 0501-0518 under nearly impossible RTTY QRM. *R. Luz*, Lima, 3355 kc., is poor to fair at 0335 with Latin American music.

Portugal—*Emissora Nacional*, Lisbon, has added these new services: to Canada at 0300-0345 on 5975 kc. (tuning locates French at 0255, Eng. to at least 0320); to New Zealand at 0730-0815 and to the Far East at 0815-0900 on 7130 and 9645 kc.; to Europe at 2015-2100 on 6025 and 7225 kc.

Rwanda—The new *Deutsche Welle* relay station in Kigali (250 kw.) is on the air, and Eng. is scheduled to W. Africa at 0630-0715 on 11,905 kc., at 1215-1300 on 17,765 kc., and at 1745-1830 on 17,805 kc.; and to East Africa at 1015-1045 on 9735 kc. and at 1545-1615 on 9695 kc. Some testing is still in progress on 17,755 kc. around 1740-1945, and on 17,770 kc. between 1820 and 0100 in German, English, and French; reports are requested.

Spain—A new frequency of 9760 kc. is being used by *R. Nacional Espana*, Madrid, for Eng.-speaking listeners at 0220-0230. The program consists of light music, talks, and report requests.

Switzerland—Berne has been heard on 11,920 kc. from 2300 s/on in Spanish and later in French. Their latest schedule lists three xmsns to N.A. daily at 0115-0245 on 9535, 6120, and 6080 kc., at 0415-0545 on 6120 kc., and at 1215-1345 on 11,715 kc.

Thailand—A report from Thailand to *R. Sweden*

indicates that the Ministry of Communications has, in principle, approved a plan to allow the erection of a *VOA* short-wave xmtr in northern Thailand. The planned power is 400 kw.; target date is towards the end of 1966.

U.S.S.R.—Ashkabad, Turkmen SSR, 4825 kc., has been logged once at 0130 when the powerful RTTY station that usually blankets this frequency was off. A man spoke in Turkmen at 0130 and a woman in Russian (probably a Moscow Home Service relay) at 0210.

Vatican City—*Vatican Radio* is excellent to 1640 s/off in an African language on seldom-heard 11,875 kc.

Vietnam (North)—According to a recent schedule, Hanoi broadcasts in Eng. at 0500-0515, 1300-1330, and 1530-1600; in French at 2245-2300, at 0415, and at 1400-1430; in Cambodian at 0930-1000 and 1230-1300; in Laotian at 0900-0930 and 1200-1230; in Thai at 0530-0600 and 1300-1330; in Cantonese at 1130-1200 and 1430-1500; and in standard Chinese (Mandarin) at 1530-1600 and 0430-0500; all on 9760, 9840, 11,640, and 11,840 kc. Other xmsns were noted from 1050 to past 1130 with music and native-language news on 11,760 kc.; at 0330-0400 on 15,140 kc.; at 0400-0430 on 15,155 kc.; and at 0430 and around 1600 on 15,170 kc.

Vietnam (South)—Saigon is noted on 4877 kc. from 1045 to past 1140 with Home Service programs of light music and Vietnamese language. Saigon carries French daily at 1100-1200 and Eng. at 1200-1300 on 9755 kc. —30—

DX STATES AWARDS PRESENTED

To be eligible for one of the DX States Awards designed for WPE Monitor Certificate holders, you must have verified stations (any frequency or service) in 20, 30, 40, or 50 different states in the U.S. The following DX'ers have qualified for and received awards in the categories indicated.

FIFTY STATES VERIFIED

Jonah Heffler (WPE2GPN), Bronx, N. Y.
Robert Ramlow (WPE9FTQ), W. Allis, Wis.
David Smith (WPE1GBC), Everett, Mass.

FORTY STATES VERIFIED

David Rodgers (WPE5DRJ), Buffalo, Okla.
Park Barton (WPE4INA), Troy, Ala.
Robin Martin (WPE2GEH), Glen Head, N. Y.
Ernest Wesolowski (WPEØAHV), Omaha, Nebr.
Alan Raylesberg (WPE2MKW), Bayside, N. Y.

THIRTY STATES VERIFIED

Gary Atkins (WPE4EHL), Louisville, Ky.
David Nager (WPE2NLK), Bronx, N. Y.
Kenneth Fraga (WPE2NPH), New York, N. Y.
Phil Swingley (WPE9HLR), Muncie, Ind.
Ronald Dohmen (WPEØEGH), New Prague, Minn.
Ralph Brown, Jr. (WPE9HQO), Lake Forest, Ill.
Gale Shafer (WPE7CGB), Deming, Wash.
Richard Lauhead (WPEØDTX), Elwood, Nebr.
Charles P. Mohr, Jr. (WPE2MKI), White Plains, N. Y.
Robert Coleman (WPE4FXO), Atlanta, Ga.
Stephen B. Olsen (WPEØEAE), Robbinsdale, Minn.
Robert H. French (WPE8FGH), Bellaire, Ohio
Arnold Galina (WPE1FQS), Worcester, Mass.
Mike Patton (WPE51AA), Houston, Texas
John Draut (WPE2JVI), Riverdale, N. Y.
Robert Astmann (WPE2LWS), Kenmore, N. Y.
Dwayne Hannah (WPE5DEM), Houston, Texas
Mary Pollack (WPEE4BPQ), Hickory, N. C.
Fred R. Miller (WPE3GIV), Olmstead AFB, Pa.
Larry Hoffman (WPEØEGK), University City, Mo.
Robert T. Rooney (WPE3AE), Ridley Park, Pa.
Stuart I. Hecht (WPE4HKV), Jacksonville, Fla.
Joseph V. Muckin (WPE2MKF), Spotswood, N. J.
Douglas Messimer (WPE3FMZ), Enola, Pa.
Ray K. Hartman (WPE9GON), New Berlin, Wis.
Ovide Brudo (WPE1EEX), Methuen, Mass.

TWENTY STATES VERIFIED

Donald Stock (WPEØEHP), Waukon, Iowa
Steve Smay (WPEØEAW), Springfield, Mo.
Dick Stout (WPE9GWL), Chatham, Ill.
Donald Reinholz (WPE8CRH), Oakland, Calif.
Mike Mitock (WPE8HUA), Lorain, Ohio
Ed Rudder (WPE4EXY), Halifax, Va.
Richard Kindt (WPE3GKQ), Cleona, Pa.
Wm. D. Kasperkoski (WPE2MRL), Ontario, N. Y.
Robert M. Johnson (WPE6GAL), Big Bend, Calif.
Dale Meyer (WPE8IIV), St. Clair Shores, Mich.
Elliot Straus (WPE2NOO), West Orange, N. J.
Dennis Zink (WPE4IIR), Charlotte, N. C.
Winston Young (WPE6EQI), N. Hollywood, Calif.
David E. Bono (WPE6FVS), San Lorenzo, Calif.
Alan Pinney (WPE2MKQ), Nutley, N. J.
George E. Molnar, Jr. (WPE2MWB), Buffalo, N. Y.
Gerald R. Dalum (WPEØDEH), Minot AFB, N. D.
Jim Mahoney (WPE6GRI), Oakland, Calif.
James S. Wilkie (WPEØDXR), Columbia, Mo.
Richard B. Cooper, Jr. (WPE1GHI), Wayland, Mass.
Gene Boling (WPE9HQP), Muncie, Ind.
Gary Zukowski (WPE9HPY), Cicero, Ill.
J. David Raycroft (VE3PE2FE), Hamilton, Ont., Canada
Andy Fritz (WPE2NIM), South River, N. J.
Martin Schneider (WPE2SV), Watertown, N. Y.
Morris Sorensen (VE3PE2EI), Toronto, Ont., Canada
Steve Okino (WPE8IPH), Dayton, Ohio
Dave Schmidt (WPE3GKR), Green Ridge, Pa.
Philip Smith (WPE8IIA), Dayton, Ohio
Harvey Lindenbaum (WPE4HIF), Surfside, Fla.
Dennis Balls (WPE3GII), Homer City, Pa.
Stuart Grade (WPEØDDO), Sioux City, Iowa
John Kotlarik, Jr. (WPE9HTD), Chicago, Ill.
Mike Cischoff (WPE4IJC), Fort Thomas, Ky.
Frank Stone (WPE3EAJ), Philadelphia, Pa.
Thomas Berry (WPE4HPS), Niceville, Fla.
William Zlobik (WPE2NQN), Bridgeton, N. J.
Arnold Matsunobu (KH6PE3O), Keaau, Hawaii
Ray Wasky (WPE8FCK), Cleveland, Ohio
Mario Calleri (WPE1FFP), Lincoln, R. I.
John P. Kowolik (WPE2LZL), New Hyde Park, N. Y.
Gerry Cohen (WPE1FNT), W. Hartford, Conn.
Ronald Brown (WPE3FNR), Baltimore, Md.
Donald E. Robinson (WPE4IKL), Athens, Tenn.
Dwain Davis (WPE1GJO), Cranston, R. I.
Rick Warner (WPE7CFV), Eugene, Oregon
John Rosenbaum (WPE9HTO), South Bend, Ind.
Robert Weitzel (WPEØEKA), Seward, Nebr.
Clarence Hagerman (WPE2NRU), Delaware, N. J.
John Fallows (VE4PE6J), Winnipeg, Man., Canada
Lyle Fredell (WPE7CHK), Tacoma, Wash.
Howard Lyhte (WPE2FYB), Bronx, N. Y.
John Dyckman (WPE8BY), Canfield, Ohio
Ted Van Beek (WPE7BWV), Morristown, N. J.
James Kobus (WPE7CGW), Ferndale, Wash.
John Hall (WPE2LZO), Hornell, N. Y.
George Holley (WPE8IPD), Grosse Pointe Shores, Mich.
Randy Burg (WPE6GAR), Beverly Hills, Calif.
Michael Busse (SV1PE1E), Athens/Psihicon, Greece
Steve Barley (WPE4IEL), Bassett, Va.
Bruce Reynolds (WPEØEKU), Warrensburg, Mo.
Steve Passner (WPE2NSC), Bloomfield, N. J.
Mike Nichols (WPE4IKN), Atlanta, Ga.

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.
READER RATE: For individuals with a personal item to buy or sell. 55¢ per word (including name and address). No Minimum! Payment must accompany copy.

GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. Additional words may be set in bold caps at 10¢ extra per word. All copy subject to publisher's approval. Closing Date: 1st of the 2nd preceding month (for example, March issue closes January 1st). Send order and remittance to: Hal Cymes, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, SCR's, zeners, parts. Poly Paks, P.O. Box 942, Lynnfield, Mass.

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ELECTRONIC Ignition Kits, Components. Free Diagrams. Anderson Engineering, Epsom, New Hampshire 03239.

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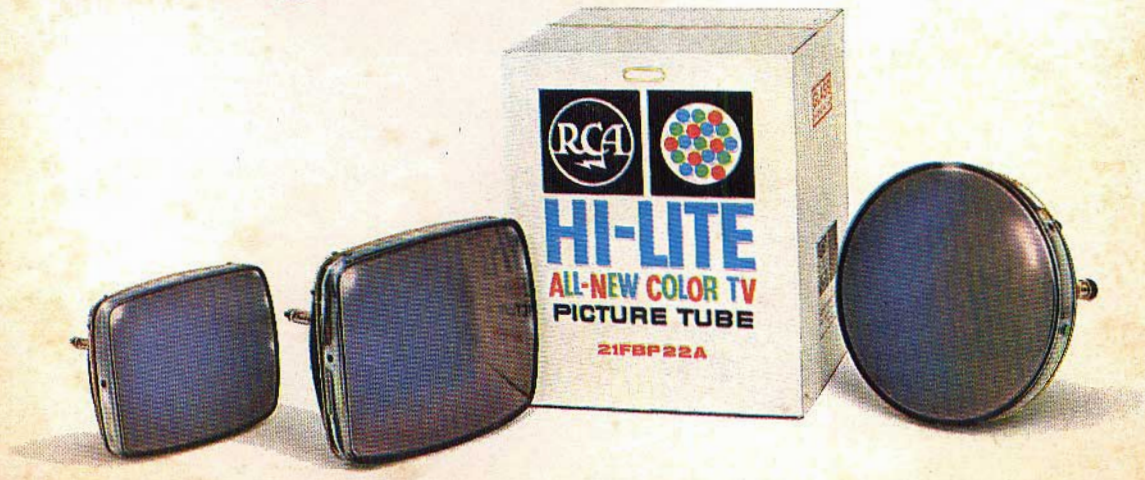

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