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SEPTEMBER 1965

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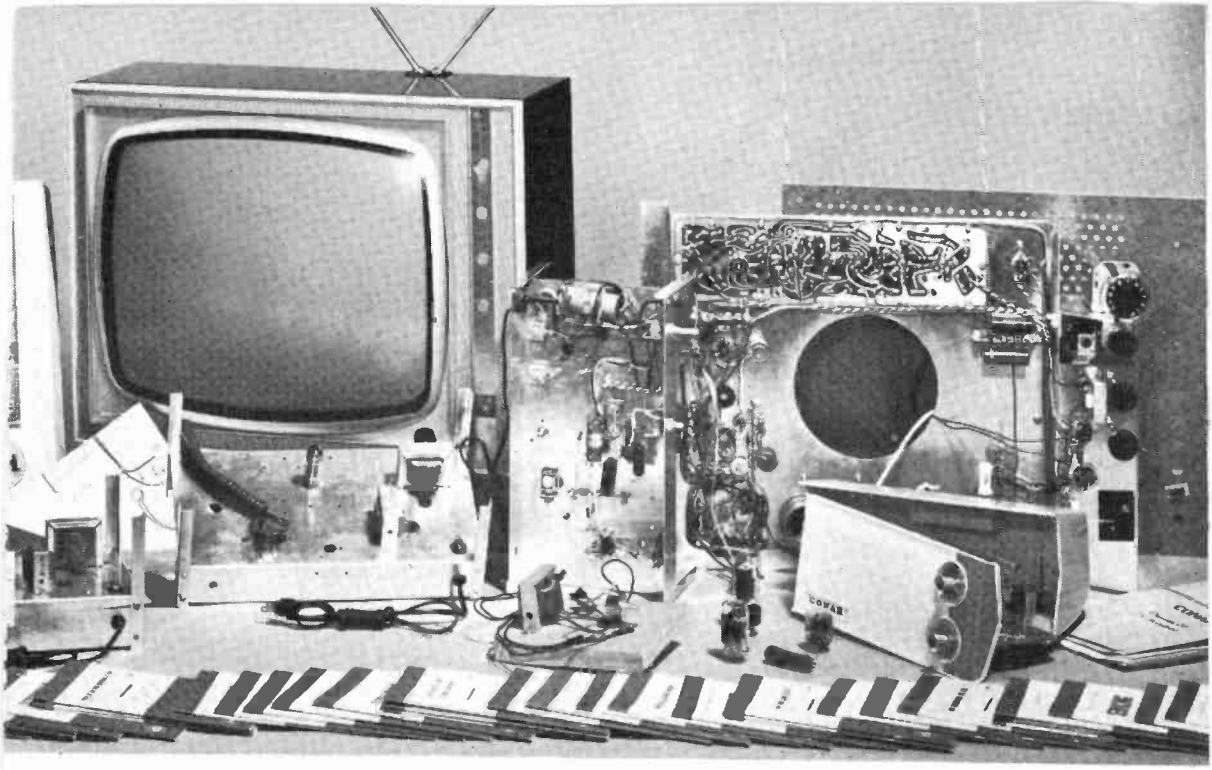

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POPULAR ELECTRONICS

ZIFF-DAVIS PUBLISHING COMPANY

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This month's cover photo by Bruce Pendleton

VOLUME 23 SEPTEMBER, 1965 NUMBER 3

Special Feature

Electronic Construction Projects

Amateur, CB, and SWL

Electronic Features and New Developments

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CIRCLE NO. 33 ON READER SERVICE PAGE

LETTERS FROM OUR READERS

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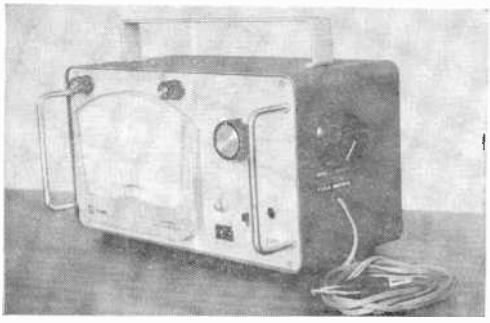
Higher-Powered Dymwatt

■ A lot of interest is being shown by theater lighting directors and others in a low-cost *higher power* lighting control than "The Dymwatt" (May, 1965). G.E. makes a heavier Triac, the SC45B, which can be employed in the Dymwatt circuit, provided a larger heat sink is used. The cost is only a dollar or two more. With the larger Triac, a total of 1150 watts of light at 117 volts can be controlled. These Triacs do not operate properly on 220 volts; perhaps future models will. And at present there is a barrier at about the 1200-watt level, between low-cost controls and expensive, complicated ones.

DONALD E. LANCASTER
Phoenix, Ariz.

Improved Auto Analyzer

■ I made a simple addition to the "Knight KG-375 Universal Auto Analyzer," (February, 1965) to increase its versatility in checking generator and other charging circuit components. I mounted a 25-ohm, 25-watt rheostat on the right side of the



cabinet and use it to vary generator or alternator current for more accurate and complete testing. Most factory and general auto repair manuals explain fully how to use this control. Incidentally, I also added a handle on top of the unit—it sure needs one.

VICTOR E. KELLY
Redondo Beach, Calif.

You Can't Beat Canadian P.O.

■ As a Canadian Postal employee for 18 years, I feel that I must clarify Melvin Baer's letter in the May issue. Mr. Baer suggests that a Canadian Postal Money Order would save the customer the present 8½% exchange, as the U.S. Post Office accepts them at par. Canadian Postal Money Orders are payable in the currency of the country on which they are drawn. A Canadian purchaser

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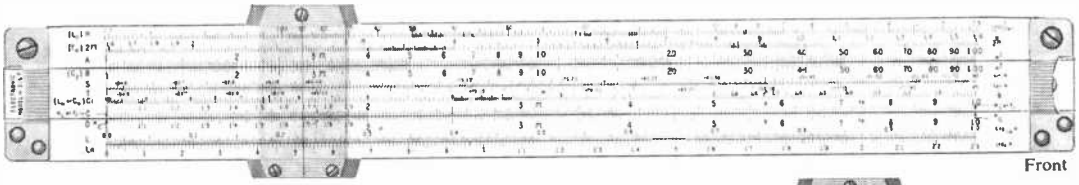
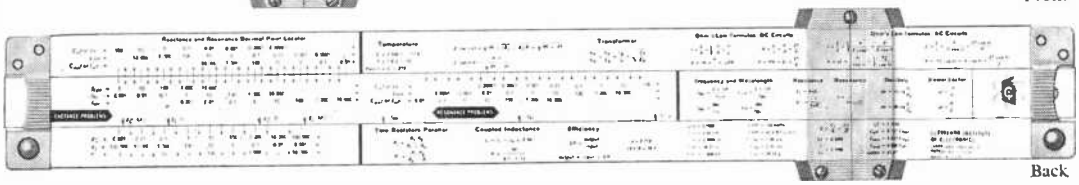


Front



Back

This amazing new "computer in a case" will save you time the very first day. CIE's patented, all-metal 10" electronics slide rule was designed *specifically* for electronic engineers, technicians, students, radio-TV servicemen and hobbyists. It features special scales for solving reactance, resonance, inductance and AC-DC circuitry problems . . . an exclusive "fast-finder" decimal point locater . . . widely-used formulas and conversion factors for instant reference. And there's all the standard scales you need to do multiplication, division, square roots, logs, etc.

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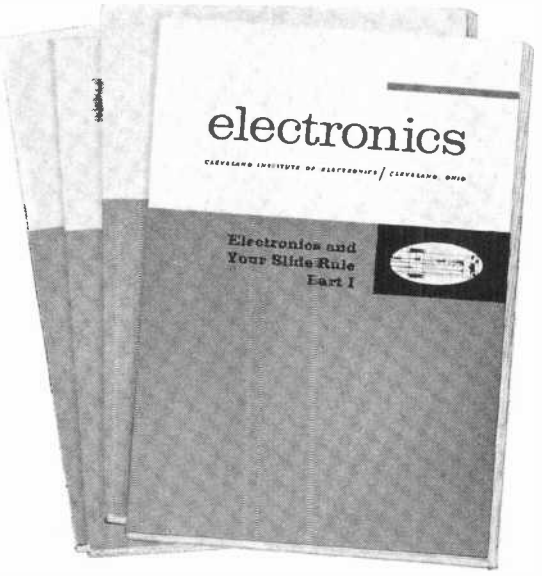

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LETTERS (Continued from page 6)

of a $10 order, payable in the U.S.A., pays $10, plus 85 cents exchange, plus a fee of 18 cents, for a total of $11.03 in Canadian funds.

A. Roy Taylor, VE3AHY
Stratford, Ont., Canada

Parts Procurement Problem in Turkey

■ I buy POPULAR ELECTRONICS every month. The projects are very interesting and useful and seem to be easy to build. But American readers don't know how fortunate they are to be able to buy the components called for in the plans. I have to think about it for a long time before I start to build anything—I can't always get the needed parts. I wanted to build the R/Ceiver and the R/C Transmitter, (April and June, 1965), but couldn't buy the transistors, relay, and crystal. You see, I can't just order parts from the States—sending money is prohibited. Won't you please publish projects your foreign readers can build?

Yusuf Tolkum
Nalbandoglu man.
Taskapi cad. No. 25
Bursa, Turkey

Yusuf, there are many American readers who sympathize with you on your parts problem. Perhaps if you became a "pen pal" with other experimenters, you might be able to arrange a way to swap some "gifts." We are printing your full address so that interested readers in the U.S.A. will be able to start the ball rolling by writing to you.

Calling Miniature Car Collectors

■ I am a French electronics student and would like to go to the U.S.A. as soon as possible to continue my electronics studies. In order for me to do so, I need money. I have 200 European-type small

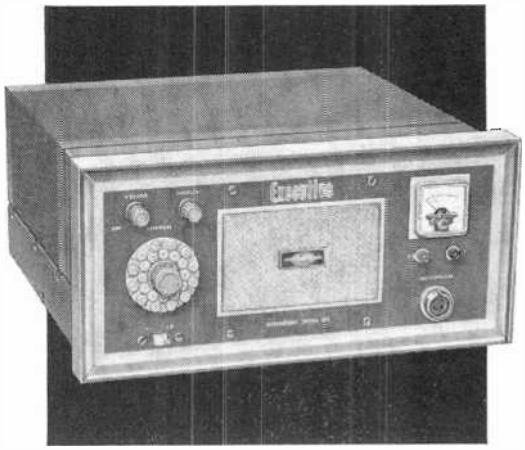
metal model cars, built to 1/43 scale, all in very good condition, which I would like to sell. Included in the collection are 1953 to 1964 Dinky-toys, Corgi, Solido, Rio, Mercury, Dalia, Dugu, Lioncar, etc. There are some Japanese types also. I would like to get $300 if possible.

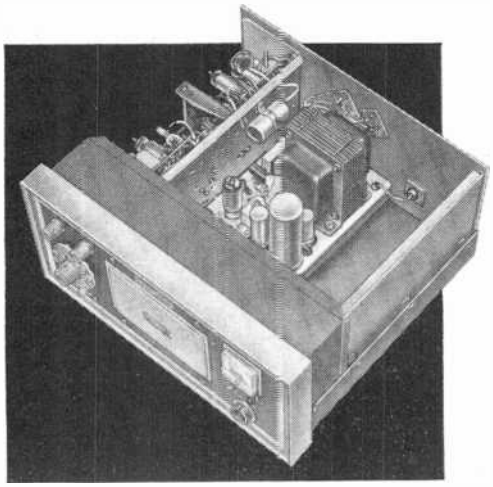
M. Lacave Alain
36B Boulevard Gorbella
Nice, France

"Steam" Power

■ With reference to the "Steam-Powered Ham Rig" (July, 1965), instead of using water and flame

NEW
FROM INTERNATIONAL





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CIRCLE NO. 17 ON READER SERVICE PAGE

LETTERS

(*Continued from page 8*)

to build up a head of steam to drive the engine, try dry ice. You may be able to get some from a local dairy. Put small pieces into the boiler, close it, and presto, you have a good head of "steam." As a precaution, wear gloves when handling the dry ice.

P. S. CUNLIFFE
Montreal, Quebec, Canada

QSL's Better Late Than Never

■ I sent a reception report to the Ghana Broadcasting Corporation on April 30, 1964. Their QSL came one *year* later—almost to the day. So, take heart, fellow SWL's; if you live long enough, you may still get that missing verification.

JON PUERNER
Fort Atkinson, Wis.

Class H License: Pro and Con

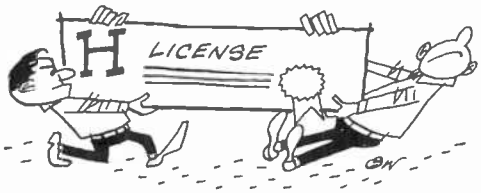
■ At a time when thinking amateurs and responsible administrators are considering an upgrading of the Amateur Radio Service, suggestions such as Dana Griffin's "Old-Timer Proposes A Class H License" (July, 1965) are a mockery. Anyone who cannot acquire a code proficiency of 5 wpm and the technical knowledge required of a Novice licensee has no right to be called an amateur, let alone claim a portion of the Amateur Radio Service spectrum.

THEODORE J. COHEN, W9VZL
Madison, Wis.

■ . . . Little would be accomplished by opening up the 10-meter band to CB'ers. It would eliminate one of the incentives for becoming a bona fide amateur . . .

BILL KLERONOMOS, WN9OZC
Westchester, Ill.

■ . . . When one considers that eight-year-old children have passed the Novice test with flying colors and that many hams have held a General Class



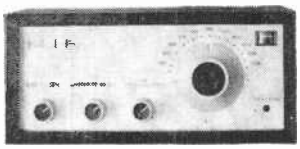
license since their early teens, it is difficult to understand why these would-be hams can't or won't take the amateur tests . . .

J. L. RANDALL, JR., WA5BEN
Shawnee, Okla.

■ . . . Why do so many people want something for nothing? It makes me sick. We hams have had to earn our place on the airways . . .

WARD LINDSEY, WA4WOC
Jacksonville, Fla.

■ . . . I think Mr. Griffin has come up with the answer for CB'ers. I have been using CB radio for business and for communications with my neigh-



'Hey – who shrunk yer tuner ?'

To lots of people, there's trauma in a small stereo tuner. Traditionally, the multiplex tuner has been a big heavy monster. It's hard to accept that a unit that sits easily in the palm of your hand can outperform most of its bulky and cumbersome predecessors.

KLH's brand new Model Eighteen multiplex tuner is just about nine inches long. And no matter how you look at it, that's small for a high performance stereo tuner.

But the Eighteen isn't small just so that you can amaze your friends. It's small so that it will be the perfect mate for the KLH Model Eleven, Model Fifteen, Model Sixteen or any other good amplifier. It's small so that it won't waste precious space in today's homes and apartments. It's small so that it's less likely to be damaged or thrown out of alignment in normal handling and transportation.

And it's small because it works best that way.

Judged on an absolute basis, the performance of the Model Eighteen is comparable to that of tuners costing much more. When its price is taken into consideration, its performance can be described as truly incredible.

Like the most expensive tuners, you'll find the Eighteen a pleasure to tune. With Zero Center Tuning, there's no 'maybe area'. The meter tells you when you're tuned in and when you're not. The planetary tuning system we've used is mechanically the most accurate and trouble free. The tuning vernier has the silky yet positive feel that marks high quality engineering. The Stereo Indicator Light automatically identifies multiplexing stations as you tune.

But there is no vacuum tube tuner, at *any* price, with the ultimate reliability of the Model Eighteen. Beyond the fact that the Eighteen runs cool; beyond the fact that transistors don't age, the Model Eighteen has 4 IF stages employing transformers of extremely low mass. The slugs are less subject to jarring and misalignment when the Eighteen is shipped from the factory, or handled, than with heavier instruments. As a result, Model Eighteens in normal use will require substantially less maintenance and service than old fashioned tuners.

There's one more way the Eighteen differs from expensive tuners. It's not expensive. About $130. Hear it at your KLH dealer's and judge for yourself.

Just don't call it cute. It's very sensitive.

LETTERS

(*Continued from page* 10)

bors for many years, even before I had a telephone. I would like to talk to more people and at greater distances from my home than present restrictions allow . . .

KENNETH DOEBBELING, 17Q2349
Ness City, Kan.

■ . . . Just what everyone needs. It would uncrowd the CB band for sure . . .

JOHNNY MORCOMBE, KDE0821
Jamestown, Tenn.

■ . . . I agree, but a Class H Operator should at least be required to obtain a Third Class Radiotelephone Permit to be sure he has a basic knowledge of radio law and operating procedures.

GEORGE HEMINGWAY, KBC1745
Taftville, Conn.

■ . . . A good idea. Term of license could be five years, non-renewable . . .

MIKE RUBAITZ, WN9POC
Beloit, Wis.

The overall response to Dana's suggestions was about evenly divided—all CB'ers in favor, most hams against.

Rheostat vs. Potentiometer

■ In "The Dymwatt," (May, 1965), the schematic shows the center and one side of the potentiometer in use, while the pictorial shows the center and both side lugs connected. Can you explain which lugs should be used?

BILL MOONEY
University City, Mo.

Sure thing, Bill. You could wire up the control either way. While the schematic is correct, the hookup in the pictorial shows a bit of finesse . . . by tying the unused end of the potentiometer to the wiper arm, which is connected to the center lug, there is a tendency to increase the life of the control, minimize any arcing that might take place as the wiper arm moves over the resistive element, and reduce the effects of a noisy control. Consider, for example, that the control is set somewhere in the middle, at about 125,000 ohms, and, in the process of adjusting the control, the slider bounces off the resistive element. The resistance in the circuit would jump to infinity and then back to 125,000 ohms. That's quite a jump. If the wiper arm were attached to the unused end, the jump would be only to 250,000 ohms.

P.E. Success Story

■ I have subscribed to POPULAR ELECTRONICS since 1955. With the help of your magazine I have won four science awards at regional and state science fairs; and I have had many hours of enjoyment building many of your construction projects. The magazine has given me an incentive in electronics, and I hope to further my education in this field.

JAMES E. HILL
Jacksonville, Fla.

(*Continued on page* 100)

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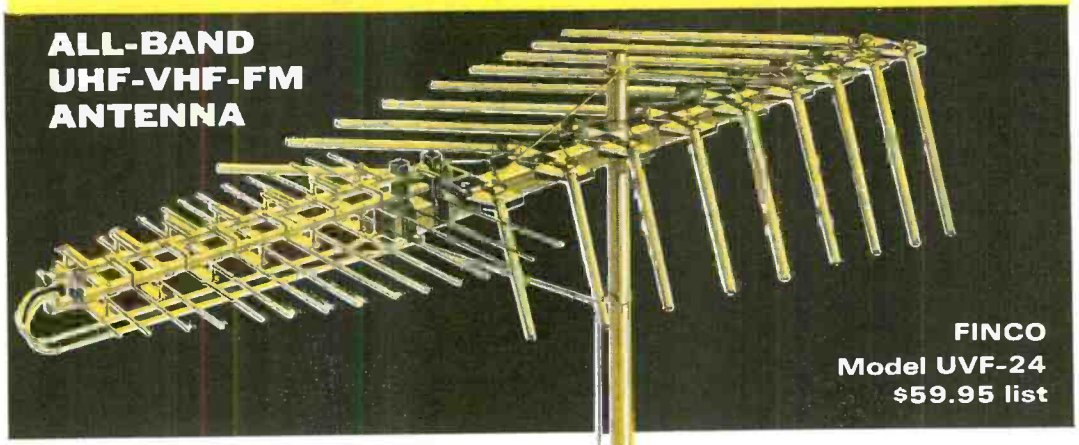

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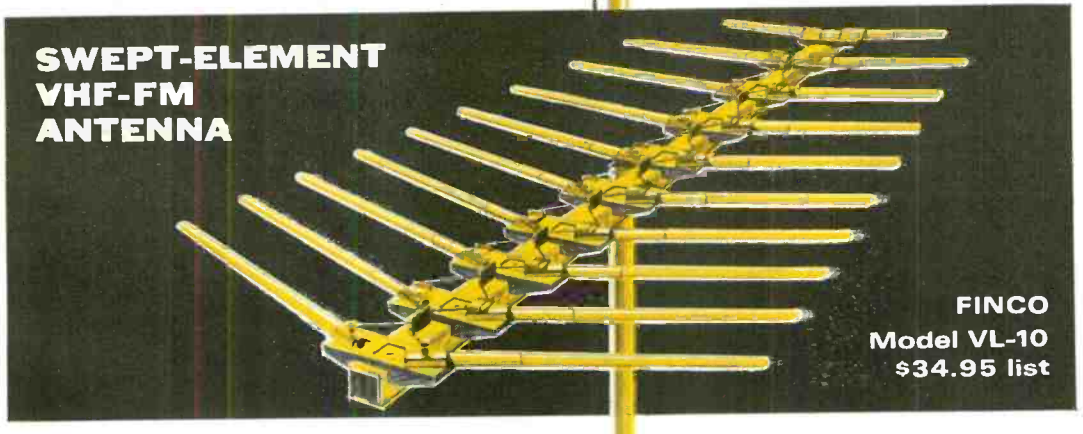

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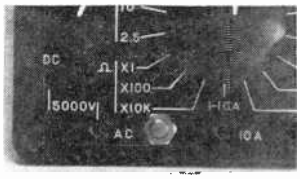
CIRCLE NO. 10 ON READER SERVICE PAGE

TIPS & TECHNIQUES

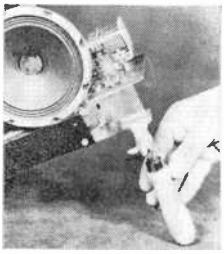
ADD PUSH-BUTTON ZEROING TO YOUR OHMMETER

You can add an instant zeroing feature to your ohmmeter by inserting a push-button s.p.s.t. switch in the ohms or positive input line to the range selector of the meter. Break the existing line going to the input jack and connect the normally closed contacts across the break, with the fixed pole toward the jack and the movable throw toward the meter. Wire the normally open contact to the common input line. Depressing the button will now short both input terminals of the meter and enable you to set the ohms-adjust control to obtain a zero reading without having to remove the test leads from the circuit under test.



—Stanley E. Bammel

HAND VISE "FOOTS" CHASSIS ON THE BENCH



A small hand vise can be used to support a radio, amplifier or TV chassis in almost any convenient position, to facilitate assembling or servicing. If more "feet" are needed, two or more vises can be employed. Three or four vises will support a record changer and enable you to observe the action both above and below the deck.

—H. Leeper

OSCILLOSCOPE PROVIDES STEREO-VIDEO SCENARIO

Want to add a real eye-catcher to your stereo hi-fi set? Attach an oscilloscope

(*Continued on page 20*)

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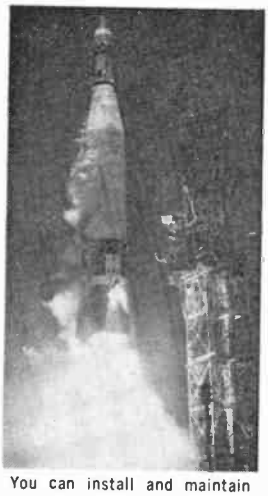

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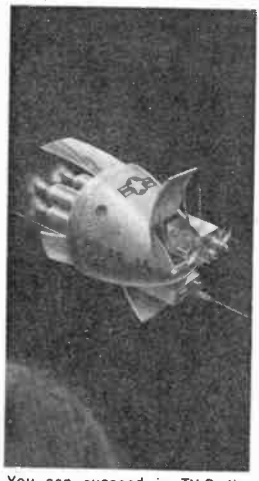

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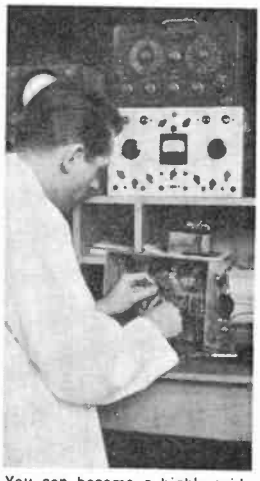

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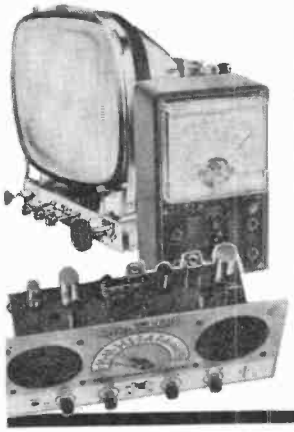

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Tips

(*Continued from page 14*)

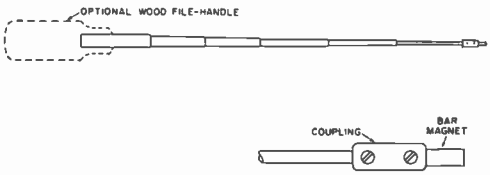
across your speaker leads . . . the right channel to the scope's vertical input, and the left channel to the horizontal input. You'll be able to write your own plot to fit the action of the strange and various patterns that dance across the screen. Between "paragraphs" you can check amplifier phase and balance, and get a good idea of the musical character of your program.

—Robert Hendrickson

AUTO ANTENNA BECOMES MAGNETIC PICKUP TOOL

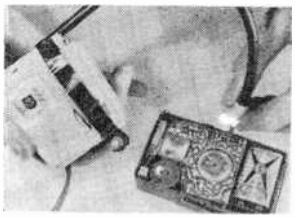
When auto antennas break, most of them do so at the base, leaving the major portion of the antenna intact. You can make a handy magnetic pickup tool for retrieving metal objects from hard-to-get-at places by attaching a small magnet at one end of the remaining antenna and a handle at the other end. The telescoping sections of the antenna enable you to extend your reach as needed. The magnet can be secured with a control-shaft coupler, string, or tape.

—Martin Leff



CONVERT YOUR OLD SHAVER INTO A VIBRATOR TOOL

By adding a flexible shaft equipped with a suitable cutting tip to your old electric shaver, you can convert it into a handy cutting or burnishing tool. Secure the outer portion of the cable to the shaver with a suitable clamp, and the inner portion of the cable to the shaver's armature. In addition to the usual applications of this tool, it can be used to remove unwanted solder between contacts, to clean up areas between foils, and to cut conductors for isolating and testing circuits.



—John A. Comstock

(*Continued on page 95*)

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CIRCLE NO. 35 ON READER SERVICE PAGE

NEW PRODUCTS

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

1,000,000 OHMS-PER-VOLT VOM

No amplifiers. No zero drift. No warm-up. No power requirements. But *Triplett's* Model 630-M is said to combine the sensitivity of a vacuum-tube voltmeter with the convenient portability of a volt-ohm-milliammeter. Incorporating a basic 0-1 d.c. microampere suspension type movement that includes the Triplett "BAR-RING" magnet, it will make current measurements from 20 nanoamperes and voltage measurements from 5 millivolts. The 630-M also features 20,000 per volt a.c. sensitivity, ±1½% d.c. accuracy, and ±3% a.c. accuracy.

Circle No. 75 on Reader Service Page 15

SOLID-STATE STEREO RECEIVER

Measuring only 9½" x 5¼" x 12½" deep, the *Olson* Model RA-727 solid-state stereo receiver has a frequency response of 30 to 30,000 cycles, and an amplifier output of 44 watts music power. Tuner sensitivity is 1 μv. A meter in the dial window indicates proper tuning and, when switched, also serves as a balance meter. A stereo indicator lights automatically when the unit is tuned to a multiplex station, and colored indicator lights tell you at a glance which mode of operation the receiver is in.

Circle No. 76 on Reader Service Page 15

STEREO ADAPTER CABLE

It's now possible to interconnect—without soldering—foreign-built tape recorders to American made microphones, headphones, amplifiers, and speakers. *Switchcraft's* Model 330G adapter cable is designed to plug directly into the 5-hole sockets found on Elber, Grundig, Korting, Norelco and Sony tape recorders, Grundig radios, and many other pieces of foreign-built equipment. It can also be used to interconnect preamplifiers and crystal or ceramic high-impedance cartridges to many recorders.

Circle No. 77 on Reader Service Page 15

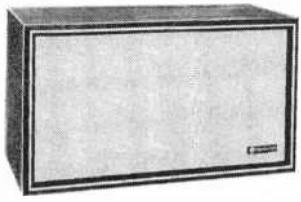
TV SWEEP CIRCUIT ANALYZER

You can analyze sweep problems in minutes with the *Sencore* SS137 sweep circuit analyzer. It provides all the necessary voltage and current measurement ranges and substitute signals to isolate and analyze sweep troubles in both black and white and color TV sets. The universal horizontal and vertical substitute oscillators have a variable output from 0 to 280 volts peak to peak, and the actual output voltage can be read directly in peak-to-peak volts on the built-in VTVM. A special probe provides two ranges, 0 to 30 kv. and 0 to 10 kv., for high-voltage and focus-voltage measurements.

Circle No. 78 on Reader Service Page 15

BOOKSHELF SPEAKER SYSTEMS

Three "Criterion" bookshelf speaker systems have been announced by *Lafayette Radio Electronics Corporation.* All three utilize bass reflex design with a tube-type ducted port of proportioned size to provide the correct acoustic tuning of the enclosure, with back waves reinforcing front sound radiation to provide greater bass response. Each enclosure is constructed of solid ¾" wood, internally braced and lined with sound-absorbent material. The Criterion "50" (20 watts) and "100" (30 watts) are two-way systems, with an 8" woofer and a 10" woofer, respectively, and a 4" cone-type tweeter. The Criterion "200" (40 watts) has a 3" metallic dome-type super tweeter in addition to an 8" mid-range speaker and a 12" woofer.



Circle No. 79 on Reader Service Page 15

"METER-SENTRY"

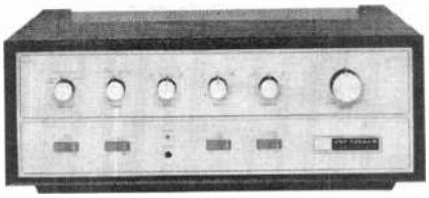
All types of meter movements can be protected against overload damage by *Semitronics'* Model MS-10 "Meter-Sentry." A special Semitron silicon diode designed to take

(*Continued on page 24*)

WANTED

KIT BUILDERS TO CONSTRUCT THE WORLD'S FINEST LOW-COST AMPLIFIER

NO EXPERIENCE NECESSARY



Now, for the first time in high-fidelity history, you can own a truly distinguished stereo control-amplifier for only $99.50 —if you're willing to build it yourself. And, thanks to the exclusive Fisher StrataKit method, you need absolutely no experience to construct the Fisher KX-90 StrataKit.

Assembly takes place by simple, *error-proof* stages (Strata). Each stage corresponds to a *separate* foldout page in the uniquely detailed instruction manual. Each stage is built from a *separate* packet of parts (StrataPack). Major parts come already mounted on the extra-heavy-gauge steel chassis. Wires are *pre*cut for every stage—which means every page. All work can be checked stage-by-stage and page-by-page before moving to the next stage.

The end result is a genuine Fisher stereo control-amplifier with 40 watts of clean power that can drive even the most inefficient speakers to their maximum performance levels. Advanced preamplifier features include rocker switches and complete phono/tape facilities. And you can rest assured that the Fisher KX-90 StrataKit you have built will be fully equal in performance as well as reliability to its factory-wired prototype. Fisher guarantees it.

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109

CIRCLE NO. 11 ON READER SERVICE PAGE

PRODUCTS (*Continued from page 22*)

surges up to 25 amperes when used with meters of from 20-μa. to 5-ma. sensitivity, it is quickly and easily externally connected directly across meter movement terminals. It bypasses any overload currents around the instrument, thus preventing meter burnout and needle damage.

Circle No. 80 on Reoder Service Page 15

PORTABLE AM RADIO KIT

Featuring six silicon transistors and two silicon diodes, the Model GR-24 radio kit introduced by the *Heath Company* is said to have a performance equal to that of eight-transistor portables. It is powered by six size "D" flashlight batteries that cut the operating cost to one-tenth that of typical pocket-size portables. The GR-24 boasts a 4" x 6" oval speaker for "big-set" sound, an r.f. stage, and a double-tuned i.f. stage for greater sensitivity and selectivity, plus an audio output stage that is diode-biased for top performance over a wide temperature range. For easy station selection, there's a slide-rule dial, convenient "thumb-touch" controls, and smooth vernier tuning. A built-in ½"-diameter rod antenna picks up distant stations.

Circle No. 81 on Reoder Service Page 15

10-METER BAND CONVERTER

Want to listen in on the 10-meter amateur phone band with your automobile radio? *Instrument Devices Corporation* has introduced a solid-state, self-contained 10-meter converter for use with standard car radios. No soldering is required to install the Model SS-Ten, which lets you tune from 28.400 to 29.450 mc. immediately. And you can switch your radio back to the normal broadcast bands by means of a single on-off switch. Weighing only six ounces, the Model SS-Ten can be either kept in the glove compartment or attached under the instrument panel. It comes complete with battery and installation instructions.

Circle No. 82 on Reoder Service Page 15

GLOBAL TIME CONVERSION WATCH

The global wristwatch available from *Nordlund Radio Products* will tell hams and SWL's the time in any world time zone as well as the local time. The rotating rim is etched with the names of 24 major world cities. When the local city on the rim is set even with the user's local time on the 24-hour "day-night" dial, the time in any world zone can be read directly. The Swiss-made jeweled movement is anti-magnetic, and the watch has a luminous dial, sweep-second hand, and unbreakable main spring.

Circle No. 83 on Reoder Service Poge 15

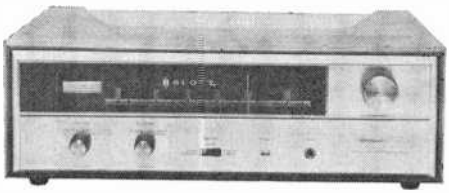
ADJUSTABLE-SOCKET POCKET WRENCH

When you apply thumb pressure on the plunger head of the *G & G Tool Company's* "Tip Wrench," the jaws open and slide out to the desired size. As thumb pressure is released, a slight downward pressure locks the jaws into position. The "Tip Wrench" tightens or loosens hex and square nuts and bolts, deep slotted machine and pan screws, in hard-to-get-at places. Since it holds the object firmly, it eliminates fumbling. The shock-proof tool comes in four sizes, with a capacity ranging from No. 2 to No. 12 nuts and bolts.

Circle No. 84 on Reoder Service Page 15

SOLID-STATE FM STEREO TUNER KIT

A new "tri-modulation meter" is incorporated in the *Scott* LT-112 solid-state FM stereo tuner: a front panel meter function switch allows the tuner meter circuit to be used as (1) a signal strength indicator or (2) a zero-center indicator or (3) a precision alignment meter. In addition, three stereo outputs are



available, one of them located on the front panel to allow the use of portable tape recorders without disturbing the installation of the tuner. The LT-112 kit can be assembled in less than six hours, since all difficult or critical circuitry is pre-wired, pre-tested, and pre-aligned at the factory. Parts are sealed in clear envelopes which are number-keyed to the life-size construction book, and all wires are pre-cut and pre-stripped to the proper length.

Circle No. 85 on Reoder Service Page 15

REPLACEMENT PARTS PACKAGE

"Benchmate" is an 18" x 24" display board which contains 35 assorted circuit breakers, rectifiers, resistors, chemical fuses, and transformers. Available from *Workman Electronic Products, Inc.*, it's a "package" of replacement parts claimed to take care of 75% of all radio and TV repairs (except tubes). With each "Benchmate," a five-year rechargeable flashlight is given free.

Circle No. 86 on Reoder Service Poge 15

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IONOSPHERIC RADIO PROPAGATION

by Kenneth Davies

It has been 17 years since the National Bureau of Standards first published its classic soft cover book, *Ionospheric Radio Propagation*. The science of predicting how radio waves get from one place to another on this globe of ours has changed in that interval. In this up-dated version, the author has drawn upon the resources of the Bureau of Standards to matter-of-factly summarize our knowledge—à la 1965. All the aspects of radio transmission are discussed—some with deep mathematical interpretations, some without. This volume is an important source book on a vexing subject.

Published by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Hard cover. 470 pages. $2.75.

RADAR LICENSE ENDORSEMENT HANDBOOK

by Edward M. Noll

Written especially for the holder of a first- or second-class radiotelephone or radiotelegraph license, this book strives to provide information to help the reader prepare for his FCC radar endorsement license examination. It starts out with a brief review of radar principles, then describes some standard components and a few typical small boat radar sets, and concludes with a set of questions and answers. The book is well illustrated and easy to read, although not intended for the novice.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Soft cover. 175 pages. $2.95.

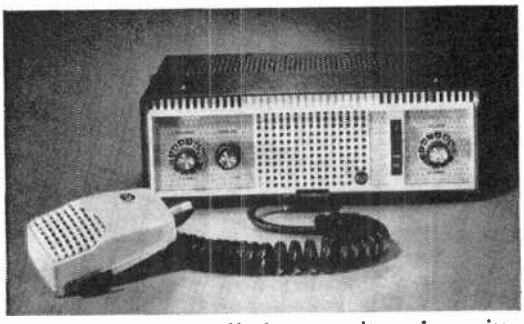
INTRODUCTION TO ELECTRIC CIRCUITS (Second Edition)

by Herbert W. Jackson

This classroom text has been brought up to date and considerably expanded. The author has perfected his technique of physically establishing what a circuit should do and then mathematically proving that the

(*Continued on page* 30)

IF THE RCA MARK VIII C-B TRANSCEIVER IS SO GREAT AT $114.95*...

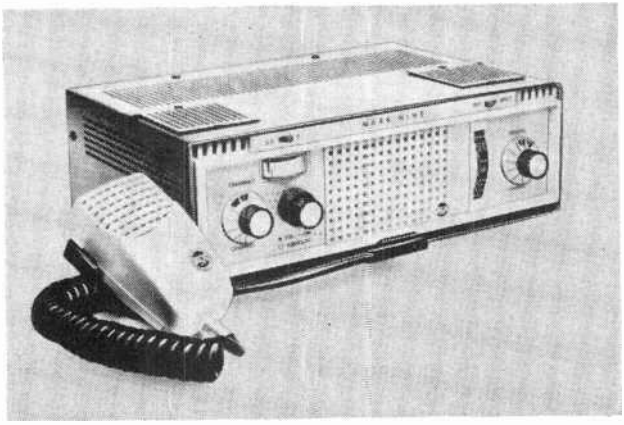


- 9 crystal-controlled transmit and receive channels
- Tunable receiver for reception of 23 C-B channels; dial marked in both channel numbers and frequency
- Exceptionally good voice reproduction
- Highly selective superheterodyne receiver with one rf and two if amplifier stages
- Electronic switching—no relay noise or chatter
- Illuminated "working channel" feature
- Light and compact—only 3½ inches high, weighs only 8 pounds with mike; fits easily under the dashboard of even a compact car
- Improved Automatic Noise Limiter to reduce effects of ignition and similar interference

...HOW COME THE NEW MARK NINE IS WORTH $20.00* MORE?

It has all the Mark VIII features— PLUS these additional features...

- Combination "S" Meter and Relative RF Output Meter. "S" Meter indicates the relative strength of incoming signal in "S" units. RF Output Meter (EO) indicates relative strength of the signal being transmitted.
- Spotting Switch. Permits precise manual tuning of receiver without use of receiver crystals. Receiver can be tuned (or "spotted") quickly to any incoming channel for which you have a transmit crystal. This means, when you buy crystals for extra channels, you can (if you wish) omit the RECEIVE crystals and buy only TRANSMIT crystals. This feature alone pays the price difference if you use a number of channels.
- External Speaker Jack. Lets you connect an external speaker to the set, so incoming calls can be heard in remote locations.



GET THE FACTS. Write for free descriptive folder on either the Mark VIII or Mark Nine to: Commercial Engineering, Department 1133R, RCA Electronic Components and Devices, Harrison, N. J.

Available Through Your Authorized RCA C-B Radio Distributor

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*Optional distributor resale price.

CIRCLE NO. 34 ON READER SERVICE PAGE

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NEW KITS

New 23-Channel, 5-Watt Transistor CB Transceiver

Kit GW-14
$89.95
(Assembled GWW-14, $124.95)

23 channel transmit & receive capability. All-transistor circuit for instant operation, low battery drain . . . only .75 A transmit, .12 A receive. Only 2⅞" H x 7" W x 10½" D . . . ideal for car, boat, etc. ½ uv sensitivity for 10 db signal plus noise to noise ratio. Front-panel "S" meter, adjustable squelch, automatic noise limiter, built-in speaker, ceramic PTT mike, charcoal gray aluminum cabinet. 8 lbs.

New Transistor FM Stereo Tuner . . . Build In 6 Hours!

Kit AJ-14
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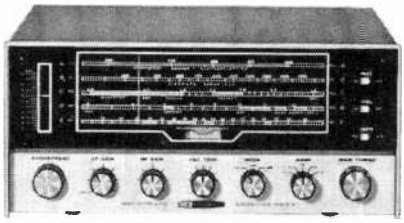
(less cabinet)

World's easiest to build stereo/hi-fi kit . . . takes 6 hours or less. 14-transistor, 4-diode circuit for cool instant operation, natural transistor sound. Phase control assures best stereo performance. 4-stage IF for high sensitivity. Filtered outputs for direct stereo recording. Automatic stereo indicator light, preassembled & aligned "front-end." Install in a wall or either Heath cabinet, (walnut $7.95), (metal $3.50). 6 lbs.

New Deluxe Shortwave Radio



Kit GR-54
$84.95

Compare it to sets costing $150 and more! 5 bands cover 200-400 kc, AM, and 2-30 mc. Tuned RF stage, crystal filter for greater selectivity, 2 detectors for AM and SSB, tuning meter, bandspread tuning, code practice monitor, automatic noise limiter, automatic volume control, antenna trimmer, built-in 4" x 6" speaker, headphone jack, gray metal cabinet, and free SWL antenna. Assemble in 15 hours. 25 lbs.

New 6-Meter SSB Ham Transceiver

Kit SB-110
$320.00

Full SSB-CW transceive operation on 6 meters. 180 watts PEP SSB—150 watts CW. Operates fixed or mobile; PTT and VOX. Switch selection of upper sideband, lower sideband, and CW. Covers 50-52 mc with crystals supplied, total coverage 49.5-54 mc. Famous Heath SB series Linear Master Oscillator for true linear tuning. Built-in 100 kc calibrator and antenna switching. Accessory mobile mount, SBA-100-1 . . . $14.95. 23 lbs.

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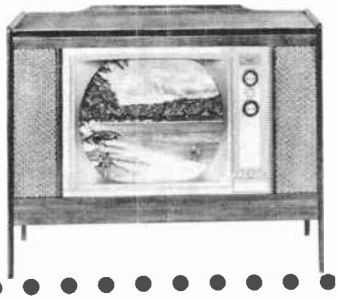
NEW LOW PRICES

New Low Price On Deluxe 21" Color TV



Kit GR-53A
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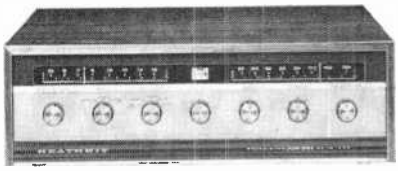
(less cabinet)

Ends costly color TV servicing . . . only set you adjust and maintain yourself. Only color TV you can install 3 ways . . . wall, custom or Heathkit cabinets. Tunes all channels for 21" of the best color pictures in TV plus true hi-fi sound. Assembles in 25 hours . . . no special skills needed. 127 lbs. Also new low price on preassembled Heathkit cabinets: GRA-53-7, walnut cab. (illust.), 85 lbs. . . . $108; GRA-53-6, walnut-finish hardboard cab., 52 lbs. . . $46.50.

New Low Prices On Heathkit Stereo/Hi-Fi



Kit AR-13A
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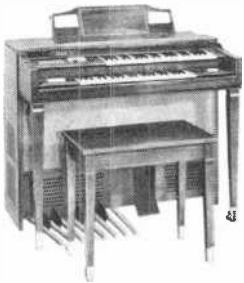
Kit AJ-33A, transistor AM/FM/FM stereo tuner . . . $94.50
Kit AJ-41 (tube), AM/FM/FM stereo tuner . . . $112.50
Kit AJ-12 (tube), FM/FM stereo tuner . . . $65.95
See them all in FREE Heathkit catalog.

New Low Prices On Heathkit®/ Thomas Organs



Kit GD-983
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CIRCLE NO. 13 ON READER SERVICE PAGE

LIBRARY (*Continued from page 26*)

circuit operated as it should have. A wonderful idea, because in design work it would be done the other way around. Highly recommended as a semi-advanced text for the serious student.

Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. Hard cover. 554 pages. $14.00.

MATHEMATICS FOR ELECTRONICS ENGINEERS AND TECHNICIANS

by Norman H. Crowhurst

The author of this book has tried to apply programming techniques to the learning of mathematics as applied to electronics. In this regard, only limited success has been achieved. The book is, essentially, a compilation of technical data and formulas presented in a manner designed to help students of the art understand an inherently difficult subject. Your reviewer feels that the novel presentation has not made the subject any easier.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Hard cover. 256 pages. $6.95.

MOST-OFTEN-NEEDED 1965 RADIO DIAGRAMS

by M. N. Beitman

Perennial edition (Volume R-25) containing the wiring diagrams of several hundred portables, clock radios, combinations, etc.

Published by Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. 192 pages. Soft cover. $2.50.

Free Literature

A handy "Semiconductor Replacement Guide" has been published by Radio Corporation of America, Harrison, N.J. This 16-page booklet describes the RCA line of replacement transistors and rectifiers, discusses replacement and operating techniques, and lists many transistors and rectifiers together with recommended replacement types. Copies are available through RCA-franchised component distributors . . . Five "Ampli-Vox" easy-to-use sound systems for a variety of portable, mobile, and stationary p.a. applications are described in Catalog B278 (4 pages) put out by Perma-Power Company, 5740 N. Tripp Ave., Chicago, Ill. 60646. Complete specifications are given, and a full line of accessories is also covered. —30—

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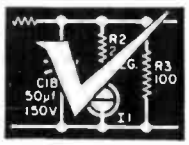


OPERATION ASSIST

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 40-140 receiver, code 121. Tunes BC, police, s.w., TV and audio. Has 6 tubes. (James A. Taylor, 1027 Globe, Houston, Tex. 77034)

Lafayette Model LA-75 guitar amplifier. (M. Ross, 795 Pelham Parkway No., Bronx, N. Y. 10467)

Philco Model 65 receiver. Tunes AM only. Has 6 tubes. (Gary Barnhart, Chilhowee, Mo. 64733)

Philips Model B4XO6T receiver. (Melvin C. Gonzalez, David, Chiriqui, Panama, A. C.)

Spartan receiver, ser. L-1869, circa 1929. Has 10 tubes. (Dan Bower, 8196 Webster Rd., Clio, Mich.)

Pierson Model KE-93 receiver, ser. 3461. Tunes 7 bands. Has 12 tubes. (John Sullivan, 1909 N. Forgeus, Tucson, Ariz. 85716)

NARCO Vht #1 "Omnihomer," ser. 1209. Has 15 tubes and 122.8, 122.1, 122.5, 122.7 crystals. (A. J. Effenberger, Route 2, Suring, Wis. 54174)

Corvair Model 10SK63 receiver. Has 10 transistors. (Larry R. Brown, 508 Easton Rd., Pearisburg, Va. 24134)

Air King Model 222 receiver, ser. 763341. Tunes BC. Has 4 tubes. (Charles Lingard, Box 853, Brookings, Oreg.)

Kennedy Model 110 receiver, ser. 1525. Tunes 170 to 26 meters. Has one tube. (Peter Paul White, 5147 S. Rutherford Ave., Chicago, Ill. 60638)

Eddystone Model 1670A receiver, type 8670A, ser. K10808. Tunes 150 kc. to 30 mc. on 4 bands, leaving out 1500 kc. to 3.7 mc. (Loran Goulden, Gunning Cove, Shelburne Co., Nova Scotia, Canada)

Hilton Model T822 or GFM931 receiver. Has 6 transistors. (Martin Benns, Jr., 1524 St. Jolial Ave., Norfolk, Va.)

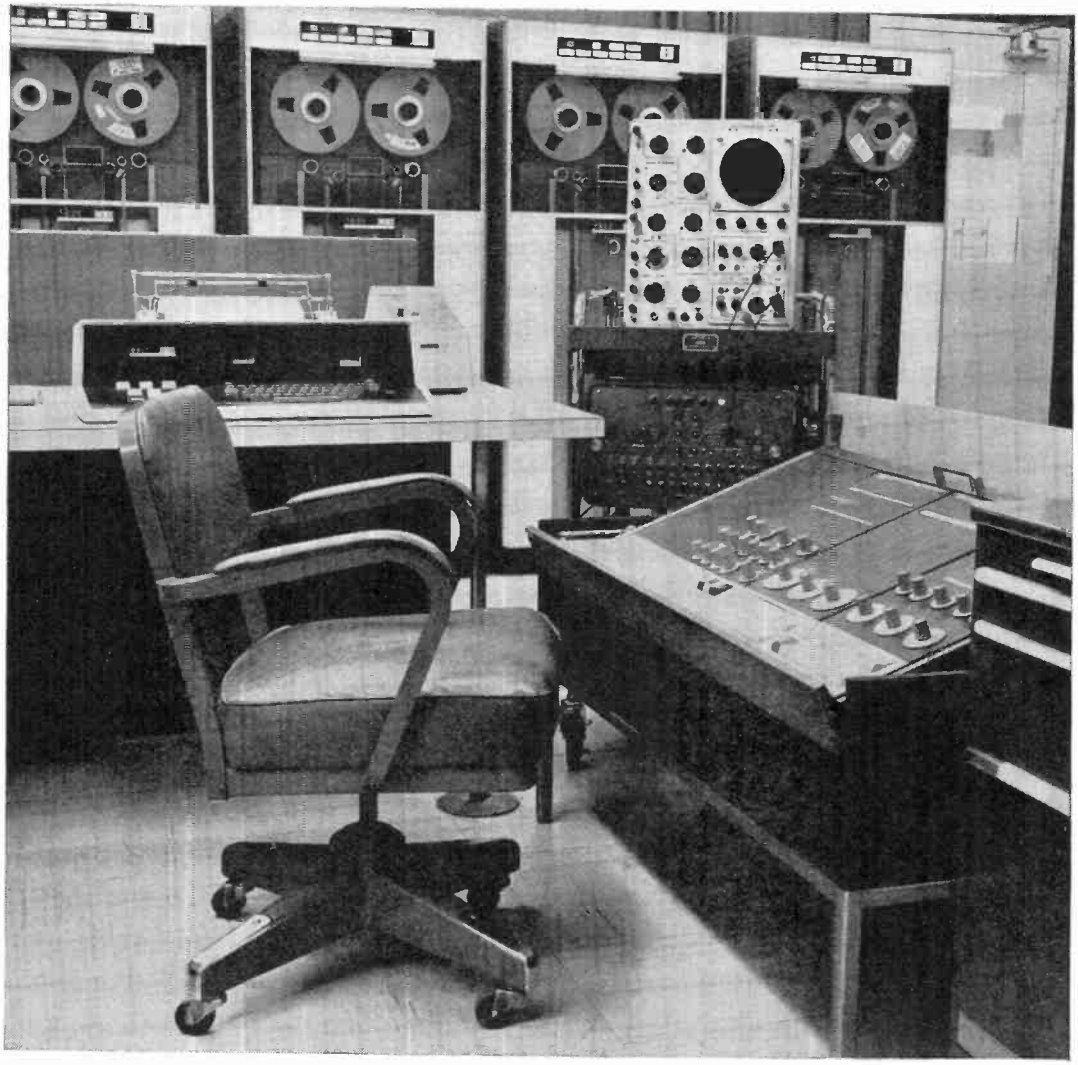
E. H. Scott receiver, ser. Q252, model unknown. Has 12 tubes. Tunes .55 to 22.5 mc. (George W. Lewis, 70 Ridgebury Dr., Xenia, Ohio 45385)

National Model T-40 receiver, circa 1950. Tunes BC and s.w. (Russel E. Thorpe, 15552 Stone Ave. N., Seattle, Wash. 98133)

Sears Roebuck receiver, ser. 101 614-1. Tunes 550 kc. to 18 mc. on 5 bands. (Richard Clinard, 235 Forrest Park, Madison, Tenn.)

RCA AVR 20-A, circa 1940. Has 4 tubes. (Bill Higdon, Roy, Utah 84067)

(*Continued on page* 38)



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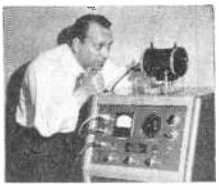

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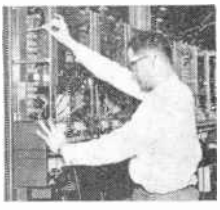

Mobile Radio, Microwave, and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.

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ASSIST (*Continued from page 32*)

Aetna TRF receiver. Tunes BC. Has 4 tubes. (Robert Pogson, 300 Victor St., Winnipeg 10, Manitoba, Canada)

Philco AE 41073 receiver, circa 1947. (Fred Joyce, 554 Van Court, Hayward, Calif. 94544)

Shell Model FM-800 FM tuner. (Jamie Padover, 810 DeHaro, San Francisco 7, Calif.)

GE Model G-86 receiver. Tunes 540 to 18,000 kc. Has 7 tubes and tuning eye. (Jerry Webb, 417 W. Second St., Peru, Ind. 46970)

Eldico Model TR-75TV 60-watt CW transmitter, circa 1950. (Harry Fink, 162 Windsor Rd., Pawtucket, R. I. 02861)

Zenith Model 6D118 receiver, circa late 1930's. (Hal Denman, 855 Dobbs Ferry Rd., White Plains, N. Y. 10607)

Siemens Super G63USA. Has EL84, EABC80, EM80, EC92, ECH81, EF89 tubes. (Ervill E. Bishop, 160 No. McKinley Place, Monrovia, Calif. 91016)

Atwater Kent Model 52 receiver, ser. 3187923, circa 1920. Tunes BC. (Thomas Lazet, 208 Barker St., Ridley Park, Pa. 19078)

Harvey Wells Model T-90 transmitter. (Richard Smither, Route 4, Box 91, Danville, Ill.)

Superior Instruments Model 670 multimeter. (Richard G. Stuermer, G-3491 W. Home Ave., Flint 4, Mich.)

Bendix "Skipper" marine-band transceiver and power supply. Has 8 tubes. (Deane Williams, 32 Robindale Dr., Kensington, Conn. 06037)

Precise Model 801 electronic counter (kit). (William B. Adams, 9400 Rockville Pike, Bethesda, Md. 20014)

Dumont Model OBL-1 oscillograph, type 245. (James R. Throop, 5408 Berry Hill Rd., Norfolk, Va. 23502)

Seeburg "Symphonola" amplifier, type 825-5, ser. 1695. **Zenith** receiver, circa 1939; has 9 tubes; tunes 550 kc. to 18 mc. (C. A. Parent, Stittsville, Ontario, Canada)

Western Electric CW-46048D receiver, circa 1941. Tunes 180 kc. to 13 mc. (Lloyd A. Scott, Jr., Route 1, Box 366D, Bartow, Fla. 33830)

Superior Instruments Model CA-11 signal tracer, circa 1945. **Superior** PB-210 VOM and capacitance tester, circa 1945. (Alvan P. Eddy, Box 111, Hampton, S. C.)

Precise Model 308 oscilloscope, ser. 2185. (E. F. Wadsworth, 1035 Oliver St., Victoria, B. C., Canada)

Radio City Products Model 664 vacuum-tube voltmeter, ser. 5590. (Carl G. Berthel, 577 Otter St., Bristol, Pa. 19007)

McMurdo Silver "Vomax" 900 VTVM. (Harold Soloman, 945 Edmund Ave., St. Paul, Minn.)

Philco 368-3962 3" oscilloscope, ser. 513. (William Miller, 54 Oak St., Presque Isle, Maine)

Pierce Model PEC-100 transmitter. (Henry P. Heim, 15 Flynt St., North Quincy, Mass. 02171)

SPECIAL DATA OR PARTS

Hickok Model 550X tube tester. Operating manual and schematic needed. (Thomas Cooper, 58 Chicago Ave., Bellmore, L.I., N. Y. 11712)

Panoramic adapter BC 1032-A and radio receiver BC 794-B. Instruction book needed. (J. O. White, Route 1, Clearbrook, Minn.)

Heathkit Model AR-3 receiver, circa 1957. Power transformer part 54-36 needed. (Bruce Cohen, 3706 Eastman Rd., Randallstown, Md. 21133)

Solar Model CF "Exam-eter" capacitor checker, ser. F91977, type 1.6, circa 1940. Operating manual needed. (T. B. Martin, Rm. 3B-111, Bell Telephone Labs., Whippany, N. J. 07981)

Hickok Model OS-8/U oscilloscope. Operating manual needed. (J. D. Steele, FRD #1, Monette, Ark.)

Atwater Kent Model 10-B receiver; breadboard 1923-1924; has 5 201-A tubes. Battery hookup and schematic wanted. (John Boyd, 7434 15 Ave., New Westminster, B.C., Canada)

(*Continued on page 101*)

NOW...GET THE FINEST *STEREO TEST RECORD* ever produced for just...$4.98

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UNIQUE FEATURES OF HiFi/STEREO REVIEW'S MODEL 211 STEREO TEST RECORD

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- White-noise signals to allow the stereo channels to be matched in level and in tonal characteristics.
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The result: the HiFi/STEREO REVIEW Model 211 Stereo Test Record!

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

ALSO: ✓ Stereo Spread
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PLUS SUPER FIDELITY MUSIC!

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HiFi/STEREO REVIEW's Model 211 Stereo Test Record will give you immediate answers to all of the questions you have about your stereo system. It's the most complete test record of its kind—contains the widest range of check-points ever included on one test disc! And you need no expensive test equipment. **All checks can be made by ear!**

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

DON'T MISS OUT—ORDER NOW

The Model 211 Stereo Test Record is a disc that has set the new standard for stereo test recording. There is an overwhelming demand for this record and orders will be filled by POPULAR ELECTRONICS promptly upon receipt. At the low price of $4.98, this is a value you won't want to miss. Make sure you fill in and mail the coupon together with your check ($4.98 per record) today.

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This is the Model Seventeen. A speaker that brings a whole new level of sound quality — a new distinction to speakers costing under $100.

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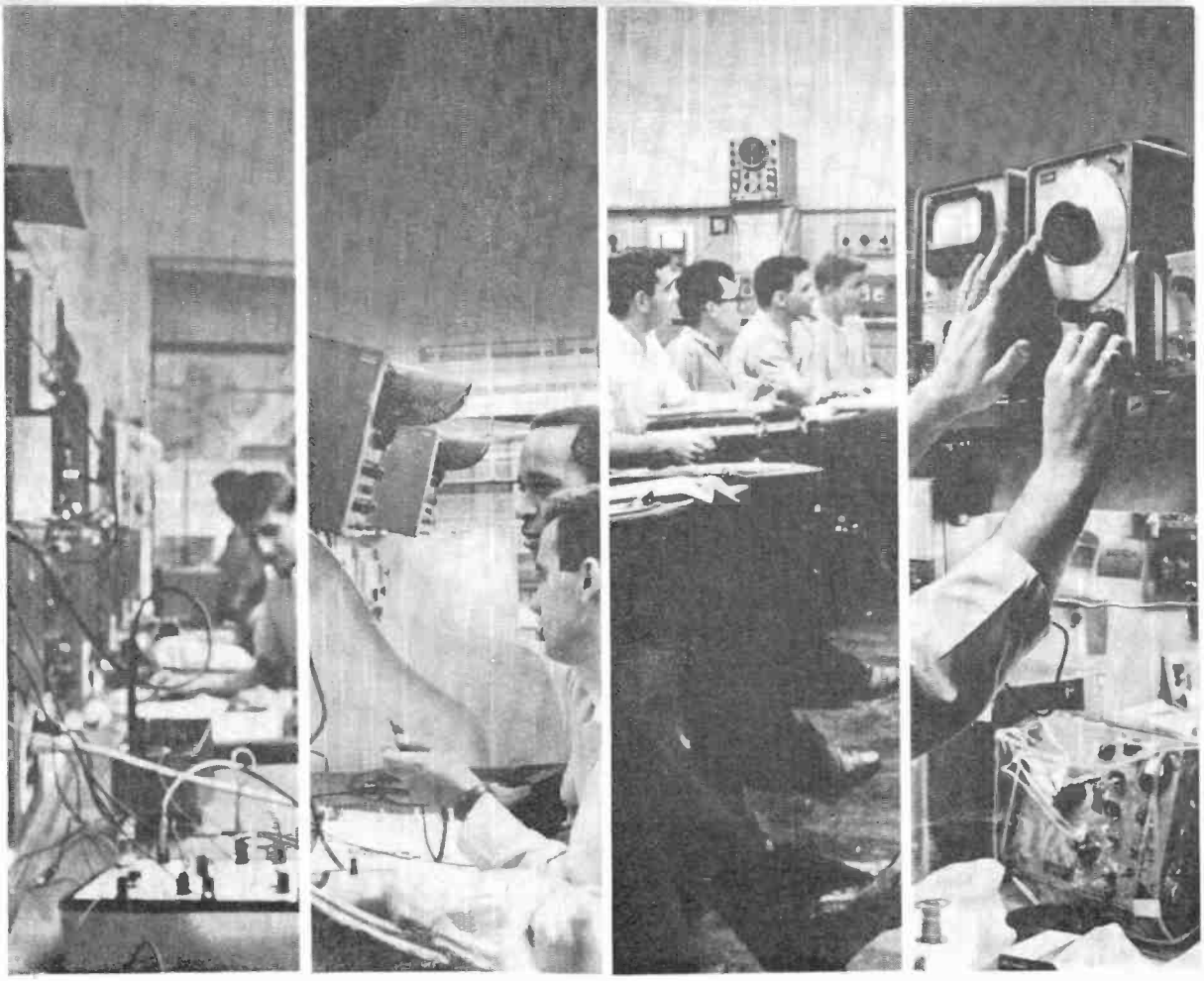


PROJECT CHOOSE

You can activate one of thousands of career openings if you have the proper training

PART 1: RESIDENT SCHOOLS

(PART 2: CORRESPONDENCE SCHOOLS; FEB., 1966)

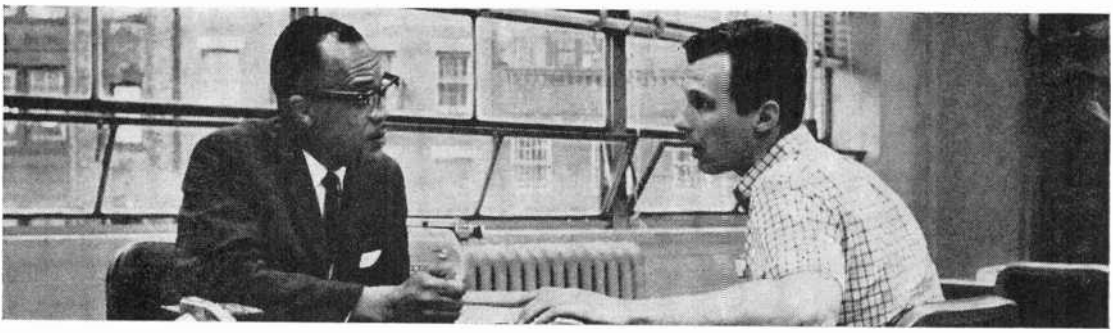
By KEN GILMORE

IN Whippany, New Jersey, Richard J. Ewalt carefully checks out a complex piece of computer test gear he helped design. The equipment will become part of the Nike-Zeus anti-missile system developed by Bell Laboratories, Ewalt's company.

In Edwards, California, Loren E. Hirman sets up a series of subcarrier oscillators in a telemetry system. The device is used to transmit data from planes being tested by Hirman's company, General Dynamics.

In Albuquerque, New Mexico, Harry F. Chaney shoves a batch of tubes on a special test board into an oven, checks their performance at different heat levels to see how they'll operate under extreme temperatures. He works for the Electron Tube and Semiconductor Devices Division of Sandia Corporation, a leading company in atomic energy development.

Photos taken at RCA Institutes by Christopher Sheridan



All three of these men—Ewalt, Hirman, and Chaney—are electronics technicians, vital members of today's electronics team. For men—and women—interested in electronics, it's a good team to join. The industry is advancing rapidly; new people are needed badly. Pay is good, working conditions usually top rate, and jobs are almost universally interesting.

But there's a catch. If you're untrained, don't bother to apply. A few decades ago, a bright young man could pick up enough know-how working around the local radio repair shop to qualify for a job chasing electrons. Or he could work in a plant and with a little study on the side eventually learn enough to get promoted to an electronics job. But no more. Today, you've got to know what you're doing. That means a good technical school education.

The first thing to decide is where you want to fit into the electronics picture. In general. today's technical school programs are designed on three different levels.

Engineering Technology. To become an engineering technician, you'll spend two to three years at one of the top technical institutes, a junior college, or a division of a regular four-year college that provides an engineering technology program. In most cases, you'll end up with an A. S. (Associate in Science), an A. S. E. E. (Associate in Science, Electrical Engineering), an A. A. S. (Associate in Applied Science), or some similar degree. The course will cover virtually the same areas in math, the sciences, and engineering that regular electronics engineers study. And as with engineers, you'll spend most of your time— 60 to 80 percent of it—in class. Lab courses account for the other 20 to 40 percent.

Toward the end of your training, you'll have the opportunity to specialize. At New York's RCA Institutes, for example, you can become an expert in communications or computers. At Capitol Institute of Technology in Washington, D. C., you might choose communications engineering, nuclear instrumentation, or control systems as your field of concentration.

The engineering technician's program, while at college level, is designed for the man who wants to work with hardware. "It depends on what he wants to do after graduation," says Edward Norman, Capitol's Dean. "Does he want to hold down a desk and let paper be the prime result of his effort? Then he'd probably be happier as an engineer. But if he wants the more practical type of employment where he can actually get his hands on a few parts now and then, he'd probably like being an engineering technician better."

"There is heavy emphasis on math and physics in an engineering technology course," adds Mike Terzian, Dean of Administration at RCA Institutes. "Since it's a college level course, a student can get credit for most of the work he does if he should later decide to go to college for an engineering degree.

"Meanwhile, after a little over two years, the man who finishes our T-3 course [RCA's program at the engineering technology level] is ready to go to work. The majority of our graduates get jobs in research and development. A project engineer will design something—say a piece of data processing equipment which is supposed to meet certain specifications. Now it's up to the engineering technician to build the prototype from scratch. He punches out the chassis, lays out the circuit, builds it and tests it to see if it meets specifica-

"Just how for you're able to get depends on . . . how hard you're willing to work"

tions. If not, he may recommend modifications."

"Engineering technicians also do other types of jobs," says Richard Ungrodt, Dean of Engineering of the Milwaukee School of Engineering. "They might be part of a team that works out production techniques. And some of them work in sales and maintenance. You'll frequently find engineering technicians assigned to computers, for example. In the old days, you'd find an engineer doing this job, and sometimes you still do. But a lot of this work can be done by top-level engineering technicians. So they're really doing engineering level work."

Industrial Technology. "This program is designed for the fellow who wants to do service type work," says C. L. Foster, president of Central Technical Institute of Kansas City, Missouri. "He may maintain two-way radios in a fleet of trucks, or enter the broadcast field. Or he may work for the same company as the engineering technician, doing work on a less complex level."

"There's not so much math in his curriculum," says RCA's Terzian, "and there's more lab work. His training is aimed toward analysis and troubleshooting, rather than design. It's a good course for the guy who doesn't have college in the back of his mind, and there's a steady demand for people with this training."

A man preparing for an industrial technician's job may spend a year to a year and a half in school. He'll get a diploma or certificate when he finishes, but if he ever decides to go to college, he'll have to start at the beginning; his credits won't be transferable.

Service Technology. A service technician may work in a service shop, troubleshooting radio and TV sets and hi-fi gear. In industry, he might do routine production testing or wiring on a production line. But because his skills aren't up to those of the engineering or industrial technician, he's not able to compete for jobs as well as his more highly trained colleagues.

"As the demands of industry have increased in the last ten or fifteen years," says Mike Terzian, "technicians have needed more training. The man with only a service technician's background isn't likely to be able to hold down more than a routine job. And demand isn't too strong; sometimes we have trouble placing them."

"The only place we offer a radio and television servicing course per se is in our night school," says J. J. Gershon, Dean of Chicago's DeVry Technical Institute. "We feel that competition being what it is, our graduates need more than just a background in radio and TV."

Of course, it's one way to get started in electronics. If you can't afford to take a longer course, you might become a service technician, then go on with further schooling on a part-time basis after you get a job. Generally, a service technician's training takes 6 to 12 months of full-time schooling, up to two-and-a-half years in night school.

Can I prepare for a technician's job through home study?

The answer to this controversial question depends on whom you ask. Generally, most schools agree that you can't reach the engineering technician's level or get an associate degree through the mail.

"There's no comparison between resident and home study training," says DeVry's Gershon. "Resident training is certainly more desirable. But if a man has a family or can't leave a certain area, then he has no choice. He can

profit from home study, even though he can't attain the same level that he could in resident school."

"Home study is more oriented toward radio-TV servicing and manufacturing—assembly line work—than residence schools," says Harry Rice, Dean of RCA Institutes home study division. "But home study graduates also get jobs as broadcast engineers and technicians in industry, and they open their own businesses."

A somewhat different view is taken by one official who asked that his name not be used. "I don't recommend correspondence training to any young man who is seriously interested in a career in electronics," he says flatly. "If he's lucky, he might get a job on a production line doing routine wiring or testing. But it would be very difficult for him to get a real technician's job."

Some schools take another view. "The main difference between residence and correspondence schools is that in residence school you learn the material in a much shorter time," says Norman of Capitol Institute. "And, of course, the lab work can't be the same." Capitol Radio, a home study school formerly affiliated with Capitol Institute, requires that a home-study student be actively working in the electronics industry. Therefore, the reasoning goes, he doesn't need the same laboratory work as students fresh out of high school. But this is a unique requirement on the part of Capitol Radio.

Foster of Central Tech also claims advanced standing for his home-study curriculum. "Our home study program very closely approaches the engineering technician's program," he says. "We can't say it's absolutely equivalent, because we do not go into higher math and practical laboratory work is limited. But a home-study graduate is certainly prepared for a job at the industrial technician's level."

How's the job outlook?

If you're trained as an electronics technician, job finding won't be a problem. The Technical Institute Division of the American Society for Engineering Education estimates that some 16,000 engineering technicians are graduated each year. But the Bureau of Labor Statistics of the U. S. Department of Labor places the *demand* at about 80,000 a year. That

Training You'll Need For Various Jobs In Electronics

TRAINING LEVEL	JOBS QUALIFIED FOR*	DEGREE OR CERTIFICATE	LENGTH OF TRAINING	TRANSFER CREDIT TO COLLEGE
Service technician	Radio-TV service Communications trouble-shooting, maintenance Broadcast engineer Sound system trouble-shooter Assembly line wiring Routine production line testing	Certificate	6-12 months	No
Industrial technician	Field service technician Computer technician Junior R&D engineering technician Communications installation, maintenance Broadcast engineer Production line testing supervisor	Certificate	1-1½ years	No
Engineering technician	Field service technician Computer technician R&D Engineering technician Senior engineering technician Associate engineer	Certificate or Associate Degree	2-3 years	Yes (exact number of credits transferable depends on college)

**There may be some overlap, but in general each level of technician is fitted for a certain range of duties.*

"The engineering technician's program . . . is designed for the man who wants to work with hardware."

means more than five jobs available for each man trained.

Milwaukee School of Engineering says it could easily place twice as many graduates if it had them. RCA reports that 90 percent of its industrial and engineering technicians have jobs lined up even before they graduate. The other ten percent aren't looking for jobs; they're foreign students returning home, young men going into the service, and so on. Other top schools report a similar situation.

By the way, the door is open for girls. "They can work in electronics as well as men," says Terzian. "And in most places they have no trouble getting a job."

How much can I make?

Starting salaries vary, of course, in different parts of the country, at different companies, and for technicians with varying amounts of training. Generally, though, an engineering technician might start in the vicinity of $500 a month. Some, of course, don't make that much; others make more. An industrial technician might earn $50 or $75 less to start with; a service technician could average about $325 a month.

There's almost no limit to how far you can advance, and most technical graduates tend to do well. DeVry made a survey recently of 43 graduates picked at random. They had graduated from two to fifteen years earlier. About 35% were in military service or just out, or were in the process of attending other schools, or just didn't answer. Of the remainder of these 43 graduates, two had become vice presidents of companies, three held the title of chief engineer, one was a principal engineer (assigned to handle projects other engineers couldn't), six were engineers, and one was working toward his master's degree. Other titles: one senior design engineer, one supervisory engineer, one district engineering sales manager, one international marketing manager, one field service administrator, four engineering assistants, two technical staff assistants, and one senior technical writer.

Sometimes technical school graduates even reach top management positions. Cyril J. Statt, who graduated from Central Technical Institute in 1940, is now manager of manufacturing at General Electric's computer plant in Phoenix, Arizona. And Richard Wainwright, a 1954 graduate of Capitol Institute of Technology, is president of his own company, I-TEL, Inc., of Wheaton, Md, which designs and manufactures microwave filters. Just how far you're able to get depends on your ability, your training, and how hard you're willing to work.

What does it take to qualify for a technical school?

While schools vary somewhat in their admission requirements, most of them that will train you to be a high-level engineering technician accept only high school graduates with at least a C average. They usually also require one or two years of algebra, one of geometry, and one of physics or chemistry.

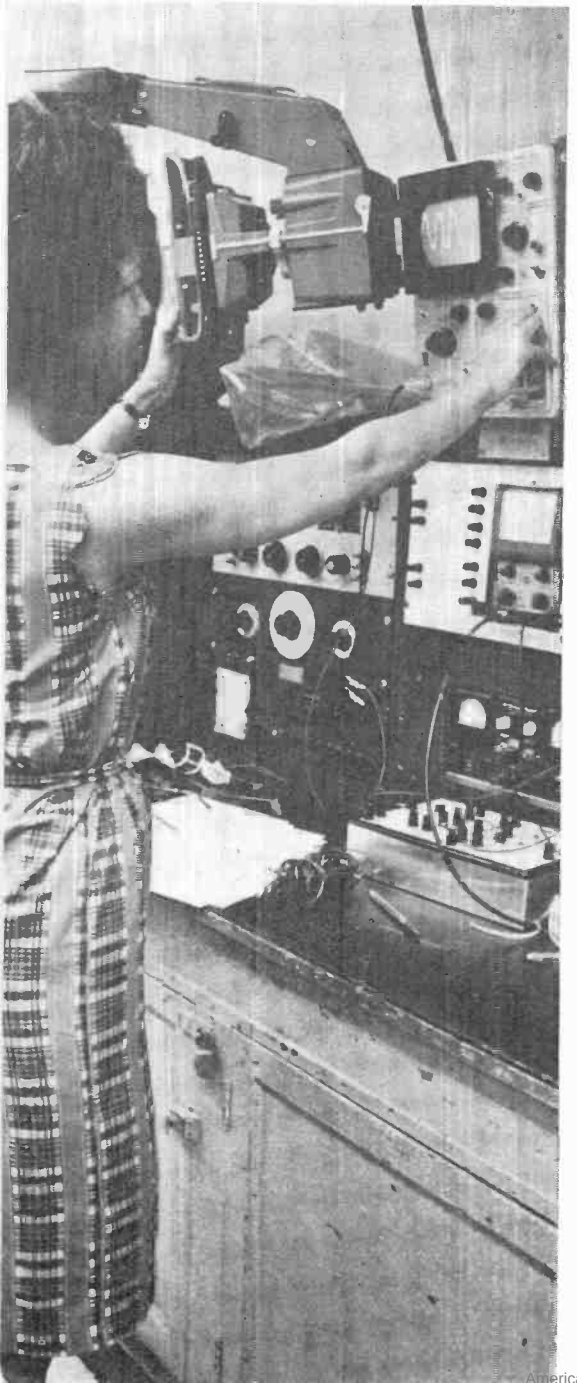
Requirements do vary, though. Milwaukee wants a background with four years of high school math through trigonometry; others have their own additional requirements. It's a good idea to check with schools you're interested in while you're still in high school, so your courses can be tailored to meet the requirements. If that's not practical, then get all the math and science you can. But don't neglect English, either. Most schools emphasize technical report writing.

Many schools give entrance examinations. If you're not up to the minimum level in any subject, you may be required to take remedial courses before you can enroll in the regular technician's program.

If you enter industrial or service technician's training, some or all of these requirements may be waived. Check with the schools you're considering for entrance requirements at the various levels.

Incidentally, most physical handicaps won't stop you in electronics. One that

"If you're trained . . .
finding a job
won't be a problem."



will keep you out of some jobs: color blindness. Many technicians must be able to read the color codes on resistors and other parts.

And don't think you have to be fresh out of high school to qualify. Many schools have older students who worked for a while before deciding what to do. RCA had one graduate in 1960 who had been a locomotive engineer for 20 years when he quit his job to become a technician. He has recently been promoted by his company to the job of master technician, and was invited this year to read a technical paper describing some of his work at a conference of military electronics experts.

How much will it cost?

Generally, tuition for an engineering technology course, lasting two to three years, will cost anywhere from a little under $2000 to almost $3000. You can pay as you go along, by the week ($20-$25) or by the month or semester. Two-year courses, naturally, tend to cost less than three-year programs.

Living expenses vary considerably, depending on the city. RCA Institutes, for example, estimates that it costs students $30 to $50 a week to live in New York. Central in Kansas City, on the other hand, says that students get along for $25 a week. All schools will help you find a place to room and board; some have school dormitories.

Incidentally, the tuition at a given school is generally the same, no matter what level training you're taking. The difference comes in length; you'll spend six months in some of the simpler service technician's courses, three years in the more rigorous engineering technology programs.

If the total cost of going to school and living in a city away from home is too much for your budget, you might be able

to work part time. "At least 75 percent of our full-time students work," says Foster of Central.

"If a student wants to work," adds Gershon of DeVry, "we'll help him find a part-time job. A student who works can usually earn enough to pay for either his tuition or his living expenses, but not both. On a normal day, he'll spend two hours in lab, four hours in class, and have two or three hours of homework. That's eight or nine hours on weekdays, and then we load him up with homework for the weekend. So anyone who wants to work in addition to this heavy load is going to be a busy fellow."

Terzian of RCA agrees. "It's very difficult to work and complete the T-3 program. But some students do it."

Ungrodt of Milwaukee is more pessimistic. "It's really practical only if a student is willing to take more than two years to get through a two-year course. If a student works half time—20 hours a week—and is a very good student, he might be able to carry a 14-credit load instead of the usual 18-20 quarter hour credits. But he shouldn't plan to do it on a regular basis."

If you do have to work, though, most schools have facilities for helping you find a part-time job that will interfere least with your studies.

How about holding down costs by starting your training through the mail, then finishing up in residence? You'll have to check with the individual school here. Central has a regular program designed to let you learn as much as possible at home, some others will work out such a schedule on an individual basis, others discourage it. But if the school you want to attend does offer such a plan, you can cut down the total cost of your technician's training by taking advantage of it.

How do I choose a technical school?

It isn't easy. There are hundreds of schools across the country that teach electronics; some are excellent, others barely passable. And it's not always easy to tell which is which.

If you must stay at home, and if your town has only one school, then you have no problem. You'll take whatever is available, and hope it's a good school. But if you can pick and choose, here are some guidelines.

First, if you're still in high school, go to the guidance department. Chances are they'll have detailed information about many schools both in your neighborhood and farther away. Second, if you're going to take an engineering technology course, find out whether the curriculum at the school you're considering is accredited, either nationally or regionally. Ask local educators—school or college officials—about regional accreditation. For national listings, see the *Where To Write For More Information* section of this article. Lack of accreditation doesn't necessarily mean it's not a good school, but you'll want to check more carefully if the school isn't an accredited one.

Third, write the schools you're considering and ask for their catalogs. Compare the courses listed. You'll find that some schools offer a far broader program and courses on a much higher level—calculus, digital circuits, microwaves, telemetering and servomechanisms, for example—than others. Even among accredited schools, some obviously give far more than others. Incidentally, you'll generally find that those with broader courses take longer—and, of course, cost more. Finally, check the faculty listing. Faculty members of top-rated schools have impressive qualifications, both in academic degrees and experience.

WHERE TO WRITE FOR MORE INFORMATION

National Directory of Schools and Vocations. Miller & Brown, State School Publications, N. Springfield, Pa. One of the most complete lists of technical schools.

List of Accredited Curricula Leading to First Degrees in Engineering Technology in the United States. Engineers' Council for Professional Development, 345 E. 47 St., New York, N.Y. 10017. 25 cents.

Characteristics of Excellence in Engineering Technology Education. Professor W. Leighton Collins, Executive Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill. 61801. 25 cents.

The Engineering Technician. Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill. 25 cents.

Your Opportunties in Industry As a Technician. National Association of Manufacturers, 2 E. 48 St., New York 17, N.Y. Free.

How To Choose Your Technical Institute, by Hartung. Bellman Publishing Co., Cambridge 38, Mass. $1.00.

The following can be ordered from National Council of Technical Schools, 1507 M St., N.W., Washington 5, D.C.:

Directory of Approved Technical Institute Courses. Free.

Admission Requirements for Approved Technical Institute Programs of Higher Education. A review of the high school background best suited for success in technical institute programs. 5 cents.

Code of Minimum Standards. This code sets forth the requirements of the NCTS for approval of Technical Institutes. 3 cents.

The Electronic Technician. Electronics has become a major field of employment with electronic technicians in great demand. This monograph details the work of these technicians and the industry which employs them. 5 cents.

The Engineering Technician: His Education, Entrance Into Industry, and Place on the Engineering Team. A set of charts placing the technical institute program and the engineering technician in proper relations. 5 cents.

The Technician and the Engineer. Reprint of an address by Dean C. J. Freund, University of Detroit. 3 cents.

The Technical Institute: Its Relation to Engineering Education and Trade Training. Reprint of an address by the late Dean C. W. Beese of Purdue University. 9 cents.

Have I got what it takes for technical training?

Experienced teachers and administrators at the best technical institutes can tell almost at once whether an enrolling student is going to complete his technological training successfully. Certain characteristics show up in almost every successful student. Here are the signs some leaders in the industry look for:

Norman of Capitol Institute of Technology: "Good math background or aptitude. Inclination toward practical work. And a great deal of motivation."

R. E. Baird of the Oregon Technical Institute: "While in school, he will work. If he doesn't understand, he will let you know in no uncertain terms, and will hound you until he does understand. He really wants to learn."

Terzian of RCA Institutes: "First, a sincere interest in the field. Second, self discipline; the ability to sit down and do the assignments, prepare the reports, do the homework. He doesn't have to be exceptionally brilliant, but it helps if he enjoys math and physics and is good at them."

Gershon of DeVry Technical Institute: "Perseverance and desire are more important than high academic ability. I'd rather give the poorer student who wants to work a lot of help to bring him up to the proper level than have the gifted one who won't work or just isn't interested."

Foster of Central Technical Institute: "We look for a man who is primarily interested in technical rather than research type employment. He'll have to like to work with his hands."

Ungrodt of Milwaukee School of Engineering: "Ability to work and interest in the subject matter. He should be a good math and science student. But the ability to work is the most important thing. A man who wants to get something can really work. And he has something when he's through."

What he has, of course, is the key to a career in electronics. Do you have the qualifications? If so, pick out a good school and prepare yourself for a lifetime of employment in one of the most exciting fields on earth. -30-

Where there's smoke, there's fire; where there's fire, it may be too late; this detector "sees" the smoke and warns you

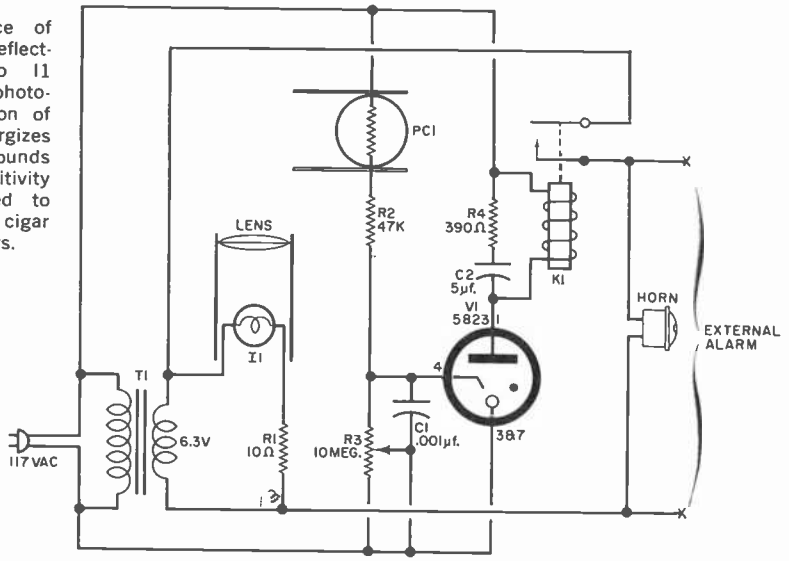
BUILD A SMOKE ALARM FOR YOUR HOME

By H. ST. LAURENT

SMOKE can cause as much as, or more, loss of life and property damage than fire. In many instances, smoke is present long before a fire is actually detected. Homes and business establishments are often equipped with either simple or elaborate fire alarms, but relatively few of them have any provision for smoke detection. Early warning of the presence of smoke can give you enough time to either put out a fire and minimize damage, or—escape.

Fortunately, most smoke is lighter than air, and rises. It will accumulate

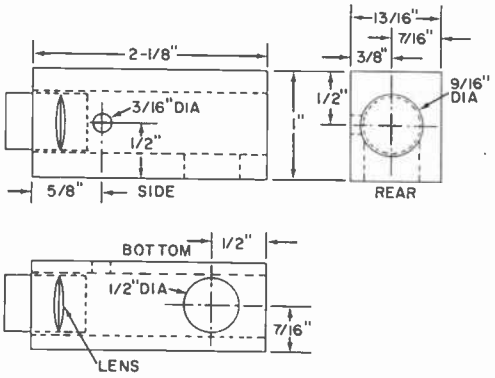
In the presence of smoke, light reflected from lamp I1 reaches the photocell (PC1). Action of PC1 fires V1, energizes the relay, and sounds the alarm. Sensitivity can be adjusted to allow for heavy cigar and pipe smokers.



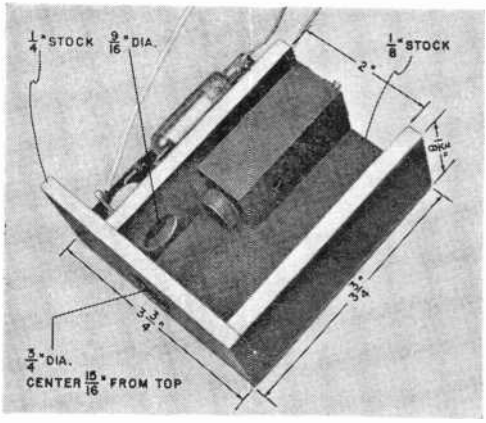
on the ceiling and build down. A room almost filled with smoke may have an area close to the floor that will allow a safe crawl space for escape. By the same token, if a smoke alarm were located near the ceiling, it would sound an alert long before a dangerous concentration of smoke accumulated. Here's a smoke detector you can construct complete with a built-in alarm for about $10.00.

How It Works. A light source consisting of a lamp, lens, and shield aims a narrow beam of light about 1 inch in front of, and at a right angle to, the "line-of-sight" of a cadmium sulphide photocell. The cell is recessed in a lighttight cylinder and does not "see" enough of the light to trigger the alarm under normal conditions.

When smoke enters the chamber, it interferes with the light beam and causes the light to be reflected in many directions. Some of these reflections strike the photocell. Under the influence of light, the resistance of the photocell decreases and causes a higher voltage to appear across *R3* and on the starter electrode (pin 4 of *V1*). When the starter



Light-source barrel is made from a block of wood. Size of lens opening can be varied to accommodate your lens. Use a cardboard tube as an extension.



Photocell is mounted at right angles to the sharply focused light. Paint inside of the wooden smoke chamber flat black to minimize light reflections.

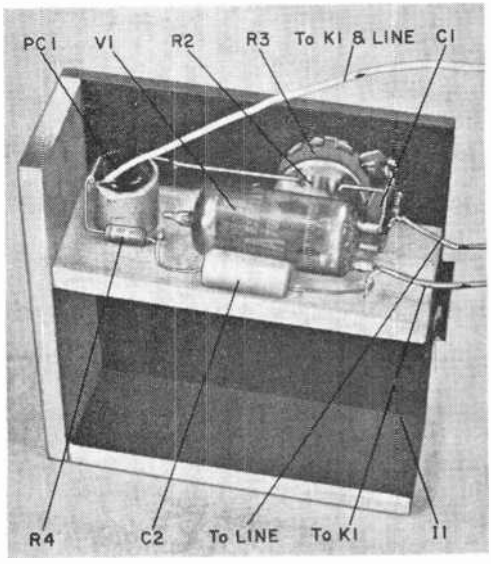
electrode voltage reaches the firing point (approximately 50 volts), the tube conducts, energizes the relay, and activates the alarm. The alarm will shut off when the smoke has cleared the chamber in the smoke detector.

Potentiometer *R3* serves as a sensitivity control and is usually adjusted to require a fairly large volume of smoke to trip the alarm in order to prevent a false alarm, which could be caused by a number of people smoking in a confined area. Transformer *T1* provides 6.3 volts to the lamp (*I1*) and to the horn; *R1* is a current limiter, and tends to protect and increase the life of *I1*; *R2* serves as a makeup resistor and prevents the resistance divider network across the 117-volt line from drawing too much current in the event that *R3* is inadvertently adjusted too close to minimum resistance; capacitors *C1, C2* and resistor *R4* are uncritical circuit stabilizing components.

Construction. The smoke chamber is made of wood stock lattice strips or other suitable ¼" x 1¾" lumber and ⅛" Masonite or other tempered board. The lens and photocell holders are made of a heavy manila paper and glued in place. If necessary, you can modify the diameter of the holders and the openings in the lens block to allow the lens and photocell to fit properly. The distance between the lens and the lamp will vary in accordance with the focal length of the lens, and should be adjusted to give the sharpest beam of light possible.

Attach the lamp socket to the lens block with a small ¼" wood screw. A green or red plastic window can be placed over the front opening of the lens block to cut down some of the glare from the lamp. This light from the front opening only serves as a pilot to let you know that the lamp and power are on. Cover the smoke chamber and other internal surfaces with a flat black paint to minimize stray reflections.

The cabinet is made of standard 2½" x ⅜" pine panel stock. A slot cut about ⅛" from the edge of the panel stock, and about 3/16" deep holds a metal grille in place when the sides are assembled, and dresses up the appearance of the cabinet. An alternate method is to rabbet the top edge of the four sides so that the grille can be set flush, then topped off with ½" half-round molding. All cabinet and smoke chamber parts are glued in place, with the exception of the back cover which has a ⅜" hole near the top, center, to accommodate a hook

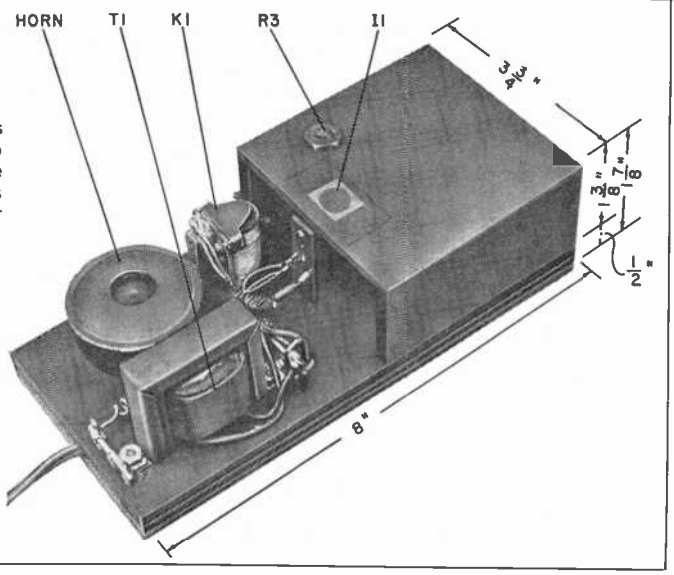


Remove unused tube pins and use a drop of cement to hold the tube in place. Lamp I1 is inside the barrel. A cardboard tube holds the photocell (PC1).

PARTS LIST

C1—0.001-μf. ceramic capacitor
C2—4- or 5-μf., 50-volt electrolytic capacitor
I1—Pilot lamp (GE 12 or equivalent)
K1—3500-ohm, s.p.s.t., N.O., miniature relay (Guardian E-3772 or equivalent)
PC1—Cadmium sulphide cell (Clairex Cl-504 or equivalent)
R1—10-ohm, ½-watt resistor
R2—47,000-ohm, ½-watt resistor
R3—10-megohm potentiometer, linear taper
R4—390-ohm, ½-watt resistor
T1—117-volt to 6.3-volt, 1-ampere filament transformer
V1—5823 glow tube
1—Horn (imported type used on bicycles)
1—14-mm. x 34-mm focal-length lens (any double convex lens that fits is suitable)
1—Lamp socket (Dialco 19-07 or equivalent)
Misc.—Tube pin sockets (3) removed from miniature socket, wood, 4" x 8" metal grid, quick-setting glue, wood screws, etc.

The electronic components, including a completed lens and photocell assembly (unwired), are available for $10.75 postpaid in USA from Lectromek Co., 166 Wendell Rd., Warwick, Rhode Island 02888



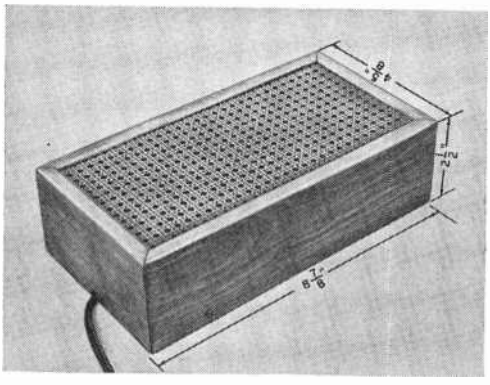
The smoke chamber should be as lighttight as possible to keep the detector immune to outside light. The plastic window lets you see if the lamp and power supply are in working order.

or other wall hanger for holding the finished smoke alarm. Complete all wiring and mounting of parts before you screw down the back cover.

When the back cover is secured, slip the unit into the cabinet. It should fit snugly. Two 6 x ¾" half-round head wood screws on each side of the cabinet will hold the alarm in the cabinet.

Installation and Adjustment. Installation is simple—you just hang the unit in an upright position, as high as you can on a wall of the area to be protected, and plug the line cord into the nearest 117-volt a.c. outlet. Be sure smoke chamber inside cabinet is pointing up.

Before adjusting the unit, set the sensitivity control in the minimum position (counterclockwise) to keep the alarm off, and allow about five minutes of warm-up time for the detector to stabilize itself. Then all you have to do is rotate the sensitivity control until the alarm sounds, and back off slowly until the alarm stops. That's all there is to it. You can check this setting by blowing some smoke through the lower half of the metal grid and waiting for the smoke to reach the chamber: if all is well, the alarm will go on.



Completed unit is mounted vertically, as close to the ceiling as possible. Rising smoke enters smoke chamber through metal grille to set off the alarm.

Sometimes line voltage variations will modify the sensitivity characteristic after you have set the sensitivity control. So, from time to time, blow some smoke into the unit to see that it is working. If the unit tends to "false alarm" because of a normally smoky room condition, or because of upward line voltage variations, densensitize the detector a bit by a slight counterclockwise adjustment of the control.

Another way to adjust the detector is to use a Variac and step up the line voltage to 125 volts, then slowly rotate the control until the alarm just sounds off. With the control in this position, the alarm should function properly over a line voltage range of 105 to 120 volts. If, for some reason, line voltages in excess of 125 volts are regularly encountered, the Variac voltage should be adjusted accordingly. -30-

Answers Please: Heathkit Electronic Organ

The 5 Most frequently asked Questions about the $800 Heathkit GD-983

IN THE PAST few years, the Heath Company has introduced several kits that have fired the imagination of kit builders. Color TV, photographic equipment, ham, and CB gear are all now prominent members of the Heathkit family. Last spring when Heath announced its deluxe all-transistor electronic organ —the Model GD-983, selling for $799 including bench—a new era of kit construction was started. Unlike most kit items, where the builder is the sole user, the electronic organ is a family project—built mostly by the husband and/or son, but used mostly by the wife and/or daughter.

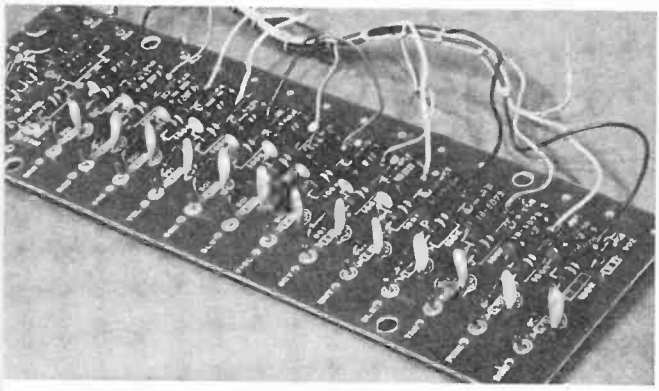
The Model GD-983 represents a large investment for many families, and your Editors have seen the same five questions concerning this organ appear and reappear time after time. Here are our answers—based on actual experience.

Is a kit worthwhile?

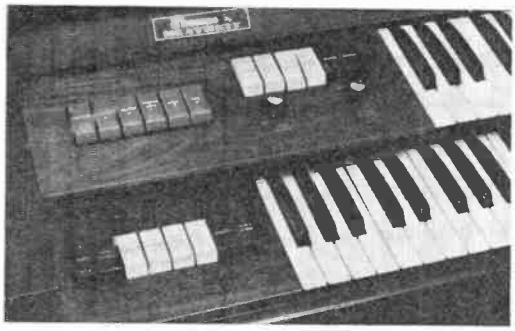
The only way to answer this question accurately is to get out and shop around for an electronic organ. The first thing you'll discover is that the Heathkit GD-983 is functionally a carbon copy of the Thomas "Coronado." You'll then find that the wired Thomas organ sells for $400-plus more than the GD-983.

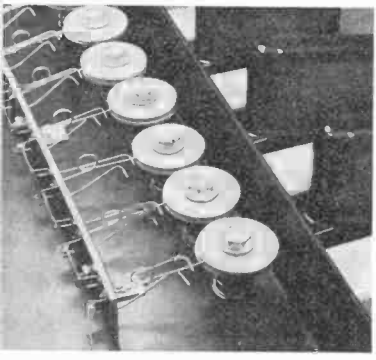
Some of the other organ manufacturers will have organs in the same price category. Compare—preferably with the assistance of someone that knows organ

The pedal keyer circuit board can be wired in about one hour. This is one of the various circuits that are easy to wire because of the printed circuit board. The cabling leads connect to the 13 pedals of the bass manual.



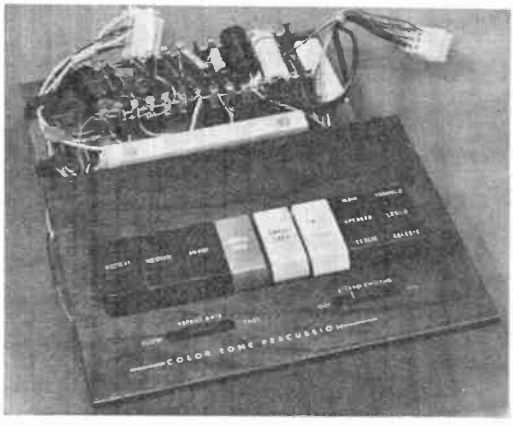
Two cheekblock and tab assemblies appear at the left of the keyboards. The bottom switches control the voices of the pedals and the upper switches all of the swell complex voices—the major ingredient in setting the "tone" or character of the organ sound.





These heavy-duty springs are in the 13-note pedal bass manual. Builder assembles the contacts which are connected via a preassembled cable harness to the pedal keyer circuit board.

The cheekblocks (percussion shown at right) are individually wired by builder and can then be set aside until positioned in the organ body.



voicing—what you would be getting, dollar for dollar. There is very definite and discernible value in the Heathkit organ. A few hours spent shopping around will satisfy any qualms you might have.

By the way, look out for hybrid organs combining tubes and transistors. Such organs need warm-up time to get started and more frequent retuning. The GD-983 can be tuned by the most tone-deaf builder. Its transistor circuit draws little power and is "instant on."

Who can safely build an organ this complicated?

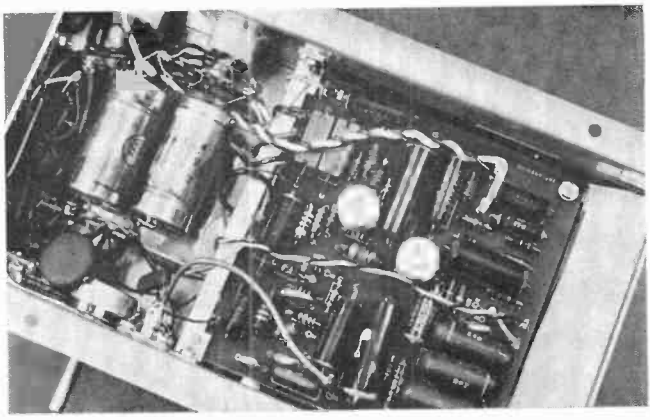
Almost anyone. The tens of thousands of dollars that the Heath Company spent in converting the Thomas organ into a kit are evidence of Heath's faith in this project. Much of that money went into the assembly manual with its hundreds of pages and foldout diagrams.

There is nothing unusual, awkward, or even very difficult about building this organ. Let's not kid one another that the organ is not complicated—for it is—but the complexity is in the multiple circuits used to generate and route the musical tones. Just don't expect to wire the GD-983 up the first night.

What about assembly time?

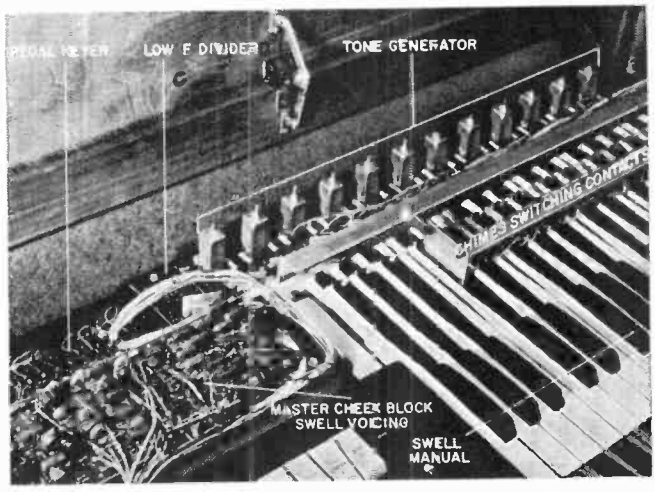
Just how rapidly you can assemble the GD-983 will depend on your work habits. Since a sizable percentage of organ construction is mechanical—as opposed to component installation and wiring—you'll need a combination of semi-skills. However, since Heath supplies several of the more important tools with the GD-983, and since the diagrams are so carefully prepared, the mechanical assembly is not troublesome.

You can cut down the assembly time by asking your son, daughter, or wife to work along with you, building the keyboards, soldering the swell keyer cable harness, setting switching contacts, etc.

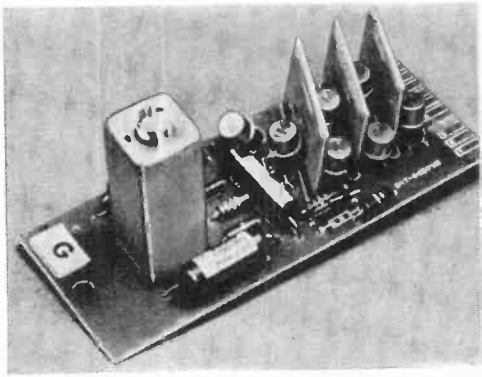


Power amplifier for the organ is mounted alongside the expression pedal (volume control). A circuit board is used here to hold amplifier drivers and vibrato oscillator. The amplifier is rated at 37 watts output of music power.

Looking inside the organ with the top holding the music stand raised and latched into position, the builder gets the view at left, below. The "complexity" shown here is not as difficult to assemble as it might seem.



Eleven tone generators must be assembled by the builder. The twelfth generator is supplied by the manufacturer pretuned to C#. Each generator consists of seven transistors, three P.E.C. dividers, and tunable transformer. The builder tunes up the organ by "beating" the output of one generator against the harmonic of another generator.



A reasonably adept kit builder who will follow instructions to the letter can be ready to start tuning the organ in 73-75 hours, although there would certainly be no shame involved in taking another 9-10 hours to reach the same point. An ultra-fast kit builder *might* have everything done in 65 hours, but that's pushing it.

Do I observe any special precautions?

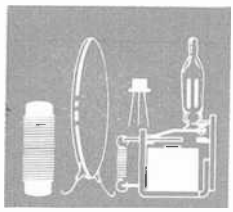
Liberal use of printed circuit boards makes major inroads toward the elimination of wiring errors in the GD-983. To be on the safe side, the use of heat sinks when soldering every transistor or diode in place is highly recommended. You *can* use pliers, but spring-loaded miniature heat sinks are cheap and available at every radio parts store. Soldering connections to the printed circuit boards must be done carefully to insure the absence of cold joints.

Take your time when soldering the swell keyer cable harness—it'll pay off in the elimination of servicing problems. Actually, though, the kit is so foolproof that observing only minimum precautions in assembly will put the organ into operation the first time it's plugged in.

How does it sound?

In one simple word—great! The GD-983 is a versatile organ with 17 basic voices, sustain, reverb, treble accent, vibrato, tremolo, Celeste, Leslie, etc. Other voices may be generated by combining those already available. In tone quality, the GD-983 is comparable to wired organs selling for twice the kit price.

The finished appearance of the GD-983 belies the fact that it is a kit, and most listeners will refuse to believe that you assembled it with your own little pinkies. And well they might—the sound is room-filling with a richness that will be a joy to any family for years to come. -30-



PARTS PROFILES

By DON LANCASTER

COMPONENTS OF THE MONTH

POPULAR ELECTRONICS presents a new, exclusive "Parts Profiles" feature to provide you with exciting information about new—and not so new—electronic components and devices that are inexpensive, interesting, unusual, and useful. More space-age products are now available to individual and commercial users. Also, commercial items formerly available only in quantity lots for industrial buyers may now be available in individual units from the manufacturer or from your parts distributor.

These products will usually enable you to build more interesting projects at less cost, in less time, and with improved performance. Because of the possible uniqueness, or newness, of the "Components Of The Month," some difficulty may be experienced in obtaining some of these items. However, all items covered in "Parts Profiles" will be available nationally from at least one reliable source of supply. The manufacturers of these products will either sell them to you directly, or make them available through their distributors. In most cases, your best bet will be to try the distributor first.

New prices break and new sources of supply appear so fast that it is virtually impossible to keep up with them, but your distributor should be able to keep you informed. Give him a chance to tell you about them. The next time you see him, ask him, "what's new?" If he answers "nothing," hand him a copy of POPULAR ELECTRONICS. Chance are that you will broaden some horizons.

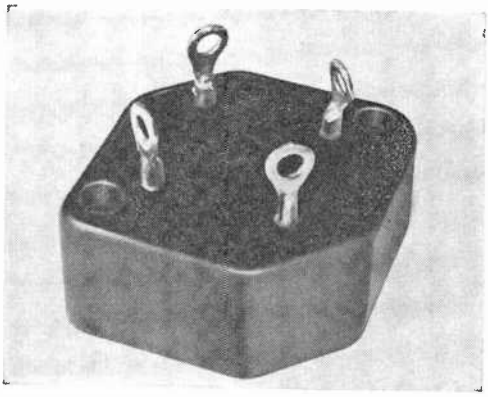
Free data sheets, catalogs, and other descriptive literature are usually available. Ask for them, and take advantage of this material.

FULL-WAVE BRIDGE RECTIFIER MODULE

A fistful of power that can easily satisfy most experimenters' requirements up to 10 amperes, without a heat sink, is contained in a fully insulated case only 2½" long. The full-wave bridge rectifier assembly incorporates four silicon rectifiers which can take up to 125-volt, a.c. input, and can withstand an astonishing instantaneous short circuit on the order of 150 amperes—considerably more than the house mains can supply, particularly if they are properly fused. Because of this fact, the bridge assembly is almost, but not quite, impossible to burn out.

The assembly can be mounted—without a socket or other fittings—directly on a chassis or printed circuit board with two #6 machine screws. Another possibility is to cut the lugs off flush with the top of the terminals and mount the assembly on a printed circuit board. The terminals can then be soldered to adjacent printed conductors. Keep in mind that a 10-ampere current requires at least a ⅛"-wide conductor of 2-oz. (weight-per-square foot) copper. Use heavier gauge or wider strip if possible.

If you use a capacitor-input filter circuit following the rectifier assembly, it's a good idea to insert a low-ohmage resistor in series with the filter to keep surge current down to a safe level. With a capacitor-input



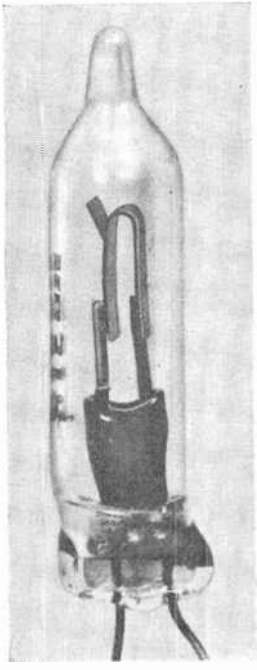
filter the d.c. output of the bridge will be about 1½ (actually 1.414) times the r.m.s. input voltage. Thus, a 117-volt a.c. input will give you about 165 volts of d.c. at the output. This is important to remember, particularly in d.c. filament supplies. Five volts from a transformer can give you more than 6.3 volts of d.c. output if the circuit is lightly loaded.

($4.85 from distributors. Data sheet DS 6022. Motorola Semiconductor Products Inc., Box 955, Phoenix, Ariz. 85001)

MITE-T-BREAKERS

Tiny, foolproof, automatic, self-resetting circuit breakers that cost less than fuse and fuse-holder assemblies, and look like oversize neon lamps, can carry up to four amperes of current—depending upon the model. Each model has a bimetallic element hermetically sealed in an inert atmosphere. Action is independent of ambient temperature.

Although the "Mite-T-Breakers" are intended for 117-volt a.c. operation, they are strictly current-dependent devices, and work equally well on low-battery voltages, or any a.c. or d.c. source up to about 200 peak volts. Current through a breaker in excess of its rating heats up and expands the bimetal element enough to open the contact and break the circuit. It opens on a 100 percent overload. (A two-ampere unit breaks at four amperes, etc.) The breaker will continue to try to make contact every few seconds or so after opening, and will continue to cycle until the load fault is cleared. When the load current returns to normal, the breaker stays closed, for normal operation.



These breakers are ideal circuit protectors for electric motors, motor controls, power tools, light dimmers, etc. Because of their cyclic action, they can be used as high-power flashers. A 400-watt flasher can be built for less than a dollar. A breaker's life is rather short in this type of operation, but by adjusting the load to slightly more than a 100 percent overload, a time cycle of one second on and a few seconds off can be realized, making the breaker quite suitable for temporary displays or exhibits. The short life, in this instance, is more than offset by the very low cost for the high current-handling capability.

(MB-315, 316, 317, and 318, 1, 2, 3, and 4 amperes respectively, 25 cents each from Sylvania distributors. Other models, which light up when there is a circuit fault, are 36 cents each.)

150-WATT POWER TRANSISTOR FOR $1.32

A germanium power transistor (TIX-3027) with a 150-watt, 40-volt rating good to beyond 100 kilocycles can serve almost as a universal high-power solid-state device for hi-fi amplifier output stages, power inverters, d.c.-to-d.c. converters, power supply regulators, audio oscillators, etc.

This transistor has a very interesting combination of ratings that makes it ideal for experimental projects. With a heat sink, it will dissipate up to 150 watts of power;

without any heat sink whatever, it could run at a 2-watt continuous power level.

A pair of these transistors can be used to make a hi-fi output stage with excellent frequency response and a substantial power rating. A typical class B amplifier may have an audio output of 20 watts, 20-cycle to 20-kc. frequency response, and a power gain of 18 db. You would need less than a third of a watt of drive power to obtain full output.

The d.c. current gain is a guaranteed minimum of 70 at low current levels, and can go as high as 250. The 40-volt rating isn't bad, but if you need a higher voltage capability, 100- and 120-volt models are available at a slightly higher price. At high power levels you'll have to watch the heat-sinking just as you would with any germanium power unit. An insulated mounting kit is provided with each transistor. Combine this with some silicone grease and you will be able to run the transistor at full power.

Or, if switching type circuits are more your cup of tea, a power unit can be made to convert a 12-volt battery source into a 117-volt a.c. supply operating at a nominal frequency of 60 cycles. The a.c. output is

usually clean and stable enough to run a phonograph or portable radio, as well as shavers, trouble lights, soldering irons, etc. The transistors can switch an output load of up to several hundred watts. Efficiency is on the order of 75 percent, and can be increased substantially by using a special (fairly expensive) toroidal "square loop" transformer.

If a power transistor is needed just to absorb power, as in d.c. power supply regulators and motor controls, these transistors are well suited to this type of service because of their high-power capability. Handbooks containing circuit design and applications of power transistors can provide you with the necessary data and parts lists to enable you to build your own devices.

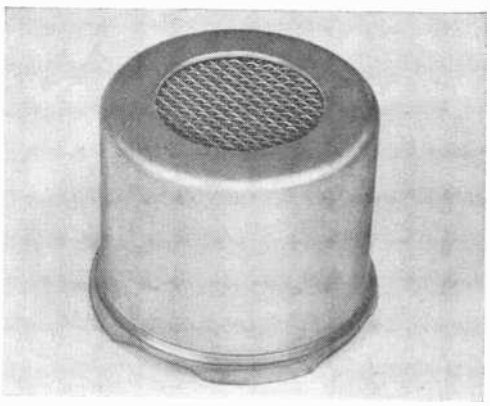
(Model TIX-3027, $1.32 from distributors. Data sheet DL-s 645053. Texas Instruments Inc., Semiconductor Components Div., Dallas 22, Texas)

ULTRASONIC SPEAKER/MICROPHONE

Here's an interesting component for the advanced experimenter. This low-cost 40-kc. transducer is generally used in TV remote controls and burglar alarms, but its small size and good sensitivity make it extremely useful for a wide variety of experimental circuits.

There are a number of circuits that can be built up using one or a pair of these transducers. In a remote control circuit, the transducer acts as a microphone, and picks up any 40-kc. "sound" in its vicinity. This "sound" is amplified, detected, and used to operate a relay. A small aluminum rod of proper dimensions is often used as a tuning fork type of transmitter to create the "sound."

It is possible to have several separate control circuits without adding transducers. For example, four aluminum rods, resonant at 38, 39, 40, and 41 kc.; four filters, each tuned to a different rod; and four relays, each connected to a different filter, can be combined to make up a typical remote control for TV or other multi-function application.



You can make a combination burglar and fire alarm employing the Doppler effect with two transducers; one to act as a 40-kc. oscillator, and the other as a 40-kc. receiver. The received signal is amplified and mixed with the transmitted signal. The difference frequency (which will be zero if there is nothing moving, or will be some low audio frequency if anything is moving within the range of the alarm) is amplified, detected, and used to trip an alarm relay. Because there is considerable movement of hot gases before and during a fire, these heat currents can trip the alarm as effectively as an intruder. Commercial variations of this circuit are so sensitive that small animals can be detected. Anything bigger than about 5 inches square, and moving, no matter how slow, can trip the alarm.

An ultrasonic walkie-talkie for license-free communications can be made by amplitude-modulating a 40-kc. oscillator with a microphone, and feeding the resultant signal to the transducer which emits the energy into the air. Another transducer in another walkie-talkie acting as a receiver, up to several hundred feet away, picks up the 40-kc. energy, amplifies, detects, and then energizes a speaker or set of headphones. Parabolic reflectors can be added to the transducers to direct the ultrasonic energy for use outdoors, or to increase distances between sender and receiver.

Other applications may suggest themselves, but here are a few more you can contemplate. Any object coming between the transmitter and the receiver interferes with the signal path . . . this gives you a proximity detector, or a counter. If you pulse the transceiver and measure the time it takes the signal to bounce back . . . you have a near-distance radar that can be used as a navigation aid for the blind, a distance measuring device, an outdoor area intrusion alarm, or an automotive safety gadget to alert you to tailgaters. How about a garage door opener? There would be one hitch . . . you might have to devise a coding system to prevent someone from just jingling keys to open the door. While you are thinking of more applications, keep in mind that the transducer is a crystal, and can be used as a 40-kc. crystal oscillator.

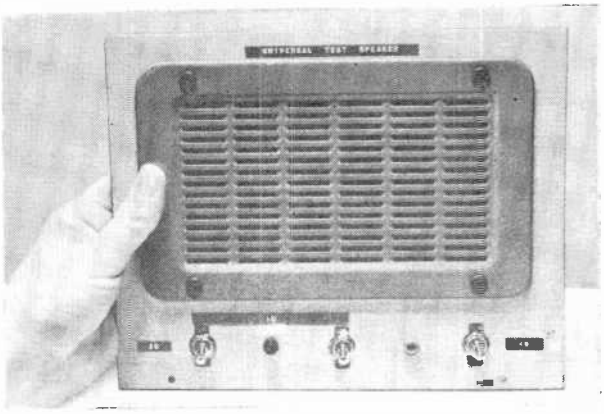
(Model TR7, $5.00. Data sheet 771. Massa Division of Cohu Electronics, 5 Fottler Rd., Hingham, Mass.)

"POP" RIVETS

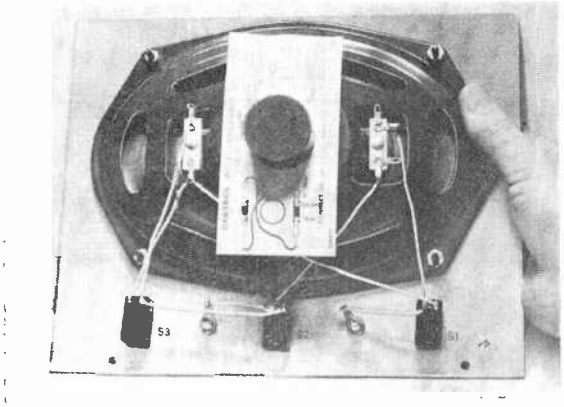
Low-cost, shakeproof, easily set rivet-type fasteners (about 2 cents each) replace #6

(*Continued on page* 103)

TRANSFORMERLESS MULTI-IMPEDANCE TEST SPEAKER

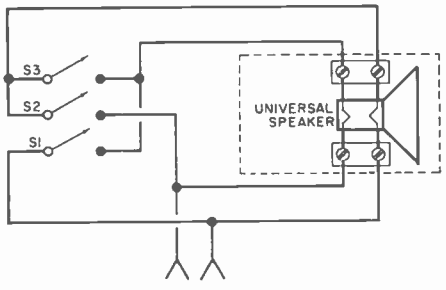


Install the speaker in any suitable enclosure, or wall-mount it behind a baffle. Simply flip the appropriate switches to obtain desired impedance.



The input jacks on either side of S2 can be eliminated by connecting the test leads directly. Before mounting, check voice coil phase and wiring details.

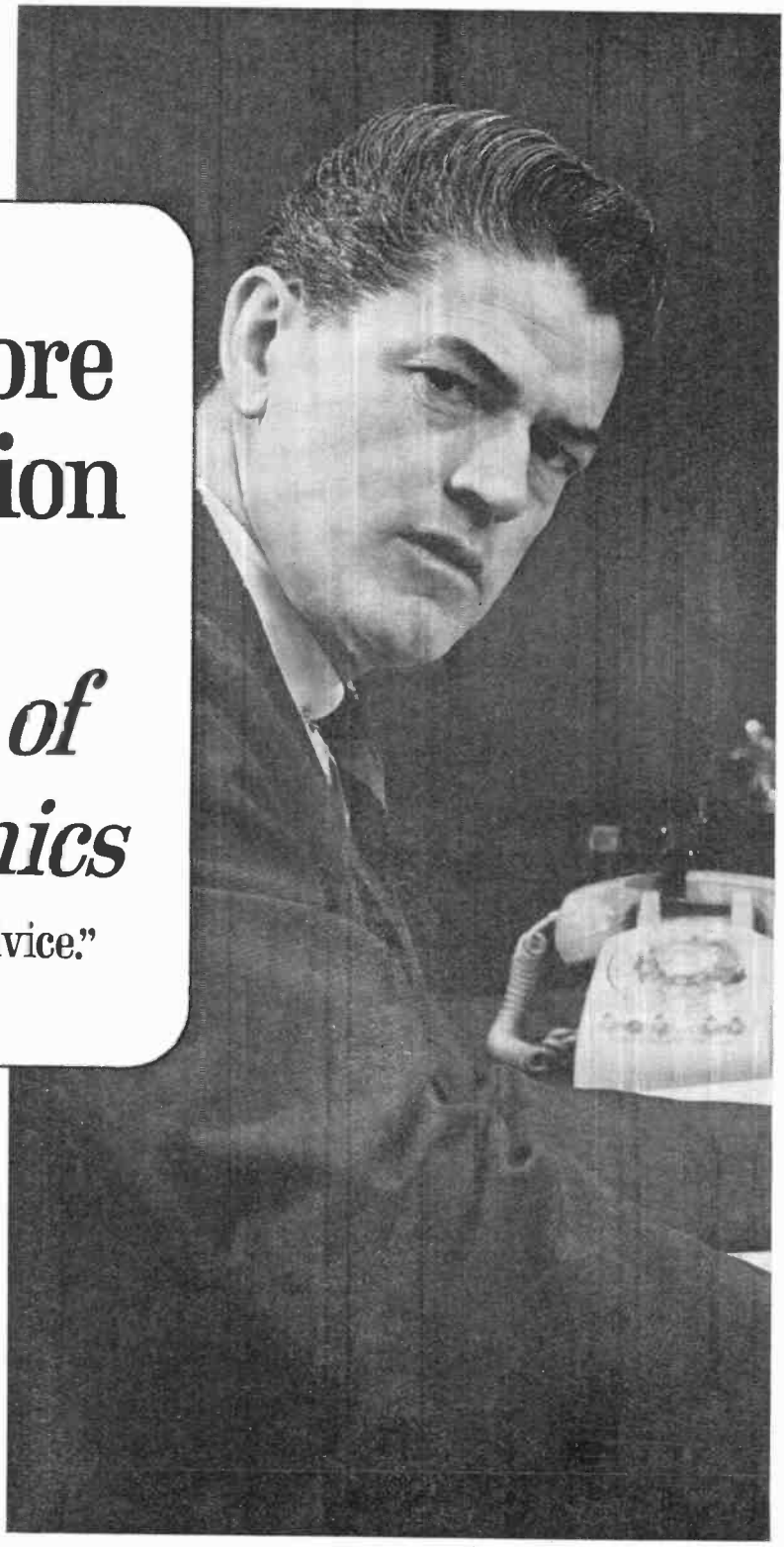
MOST universal test speaker assemblies make use of a conventional speaker and a multi-tapped output transformer to provide a range of different output impedances. Here's a dual-voice-coil speaker that can be connected as shown to provide output impedances of 10, 20, or 40 ohms. The speaker, an Oaktron multi-impedance model or its equivalent, and switches and jacks can be mounted on a piece of Masonite.



The two 20-ohm voice coils are tied together: in series by S3 to effectively obtain 40 ohms impedance; and in parallel by S1 and S2 for 10 ohms. Either S1 or S2 alone provides a 20-ohm speaker load.

The test speaker is easy to operate: simply switch on *S3* for 40-ohm operation, *S1* or *S2* for 20-ohm operation, or *S1* and *S2* for 10-ohm operation. Avoid flipping *S3* with *S1* or *S2* on as it will short the output. Switches not actually being used should be in the off position. Should you experience low speaker volume in the 10-ohm position, try reversing speaker leads *1* and *2* to correct for a possible out-of-phase voice-coil condition. —*Homer L. Davidson*

"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. 1209C, 3224 Sixteenth Street, N.W., Washington, D.C. 20010

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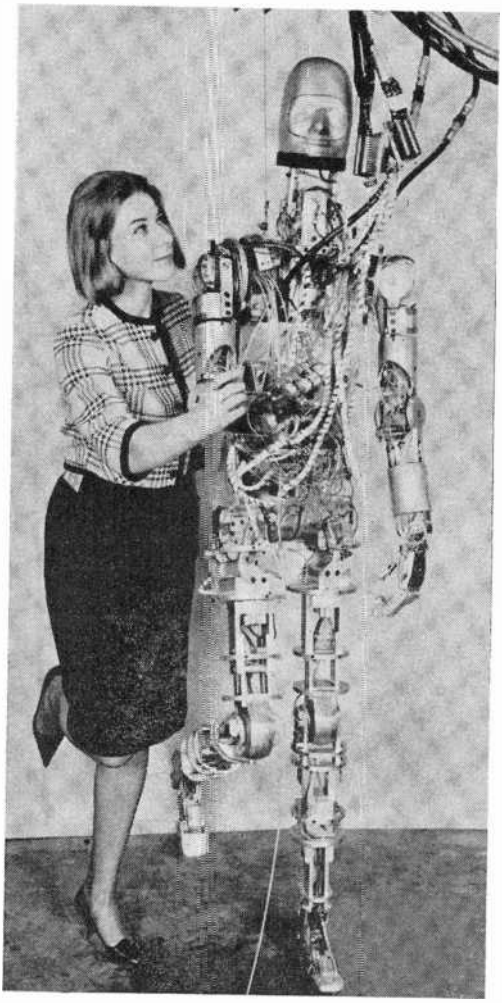
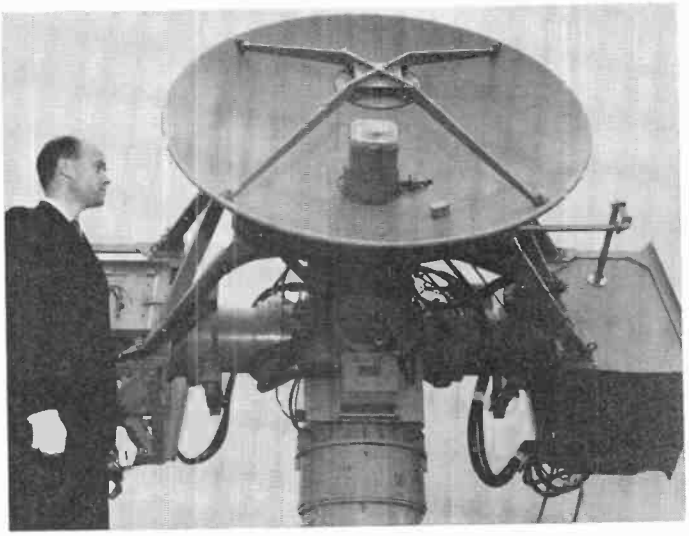
ZERO-BEATING THE NEWS



"MAY I HAVE THE NEXT DANCE?"—Perhaps he can't Watusi, but once fitted with a space suit this 230-lb. robot developed by ITT Research Institute will give suit designers data concerning resistance offered by pressurized suits to an astronaut's movement. One of the most man-like machines ever developed in terms of body movement capability, it measures precisely the amount of force it generates in any one of its simulated movements of the human body. Called a "power-driven articulated dummy," it's powered by oil fed through a blood-vessel-like system.

THROWAWAY BATHYTHERMOGRAPH—General Motors Defense Research Laboratories have developed an inexpensive and expendable bathythermograph for measuring and recording ocean temperatures from the surface to a depth of 1500 feet while a ship is cruising at any speed. Weighing only 7½ pounds and shaped like a small bomb, the instrument has a terminal sink rate of 25 feet per second. As it sinks, a sensitive thermistor picks up temperature changes and telemeters them back to the ship. Since the rate of fall is known, temperature conditions at all depths can be quickly determined if no obstructions are met. Prior to its development, ships either had to slacken their speed or come to a standstill to collect these data, a costly operation both in terms of the extra fuel used and, in time of war, the vulnerability to submarine attack. The instrument may prove very important to the nation's antisubmarine forces in checking sonar conditions.

COLD COLOSSUS—NASA scientists have successfully operated a high field strength cryomagnet (extremely low temperature magnet) having a volume many times larger than any previously known. By running the magnet with eight coils and a power input of one million watts, they obtained a magnetic field up to 50 times stronger than the magnetic force used to hoist autos in junk yards. The coils of the magnet are submerged in liquid neon at −410°, which decreases the electrical resistance of aluminum some 500 times. The cryomagnet will provide research facilities for magnetics, solid state physics, plasma physics, and the effects of high strength magnetic fields on life.

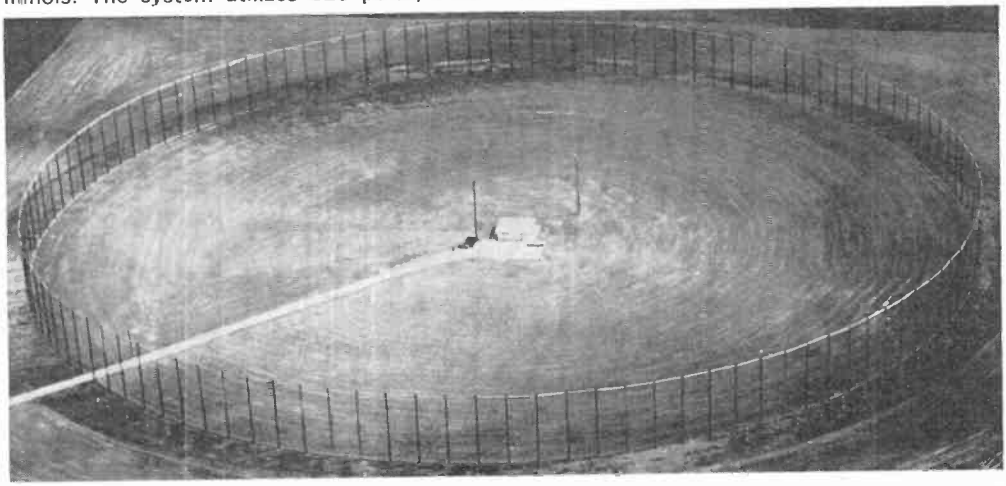


MINIATURE ANTENNA—This 6'-diameter antenna, part of the AN/SSC-2 shipboard satellite communications set, gives the U.S. Navy the capability for instant ship-to-shore and ship-to-ship communications. Built by Hughes Aircraft Co., it provides one two-way voice channel and up to 16 two-way teletype channels. The AN/SSC-2 will transmit through the "stationary" Hughes-built "Syncom" satellites, and with frequency modification will be able to transmit through the new military satellite network planned by the Department of Defense. Designed to augment the high-frequency radio now in use, the AN/SSC-2 operates in the microwave region, unaffected by QRN.

COMPUTER SPEEDS TEACHING—Sylvania Electric Products Inc. has developed a computer-controlled, audio-visual method of teaching Morse Code. It equips a trainee with earphones, typewriter, and an electronic display board outlining an unlettered keyboard. He is taught to depress the typewriter key corresponding to a light on the display each time he hears the "dot-dash" signals representing the same letter. Gradually the display lights are delayed so that he responds to audible signals only. The system can be expanded to teach 50 trainees simultaneously.

COAL POWERS TV—At the Westinghouse Research Laboratories a standard television set is operating directly from a handful of powdered coal in order to demonstrate an experimental 100-watt fuel cell system which converts gases from the coal directly into electricity. The system consists of a fuel cell battery and a chemical reactor. The gases extracted from the coal, mainly hydrogen and carbon monoxide, interact with the fuel cells to produce electricity.

IONOSPHERIC INVESTIGATOR—Changes in the ionosphere which affect radio communications are being studied with this huge radio direction finding system at the University of Illinois. The system utilizes 120 poles, each 65 feet high, in a 955'-diameter circle to support a reflective screen of 960 vertical wires. Around the outside of the screen are 120 antenna units, each 16 feet high, connected to receivers located inside the building.



PHASING SPEAKER SYSTEMS

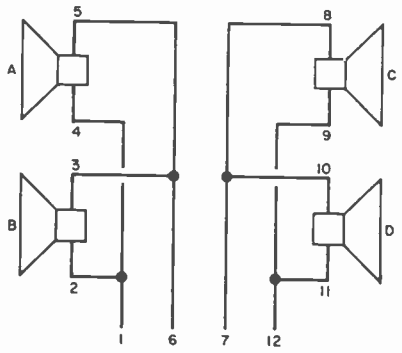
How to use an audio generator to phase stereo and mono speakers and enclosures

By JOHN A. DEWAR

EVERY AUDIOPHILE knows that his speakers must be properly phased if he is to get the best performance out of his hi-fi system. Basically, phasing involves connecting the speakers so they will aid—rather than oppose—each other. Any number of speakers in one or more cabinets, in a stereo or mono system, can be phased with an audio generator.

There are circumstances when speakers appear to be in phase mechanically, but not in phase electronically, because of speaker placement within a cabinet, speaker or cabinet location in a room, or differences in amplifiers, if more than one amplifier is used to feed different banks of speakers. You can use an audio generator to phase your speakers electronically.

An audio generator is desirable because an appropriate test frequency can be selected and you can actually hear the difference in sound levels when speaker phase is switched. When different types of speakers—such as woofers and mid-range units—are to be phased with each other, the frequency of the test signal should be within the response range of both speakers. A signal in the vicinity of the crossover point should be used. If you don't know the crossover frequency, simply select a signal that can be heard from both speakers almost equally. Almost any frequency between 200 and 1000 cycles will do. Fortunately, this technique also corrects for any massive phase shift in a crossover network or in the amplifiers.



When speakers are in proper mechanical phase, they are not necessarily in proper electrical phase. One way to achieve optimum listening is to use a signal generator and phase the speakers in each enclosure and then phase the enclosures.

Phasing Your Speakers. If you are working with more than one enclosure and there is more than one speaker in each enclosure, first phase the speakers in each enclosure, and then phase one enclosure with the other. Feed the signal from the audio generator into an appropriate input of the amplifier rather than directly to the speakers, and set the gain controls to obtain a comfortable volume level.

Let us consider speakers *A* and *B* to be in one enclosure, and speakers *C* and *D* to be in another, as shown in the diagram. To phase speakers *A* and *B*, listen to them after you have silenced the others. Reverse leads 2 and 3, and listen again. You may have to do this several times to determine which way the speakers sound louder. When the sound is louder, the speakers are in phase.

A third, fourth, fifth, etc., speaker in the same cabinet, if present, should be individually compared with speaker *A* in a similar manner.

(*Continued on page* 102)

GRANDMA'S BREADBOARD UPDATED

Old-timers used wood screws to mount radio parts on wooden breadboards

The modern experimenter employs perforated metal or copper-clad circuit boards

By LOU GARNER

IN THE OLD DAYS, radio engineers and hobbyists alike built their radio transmitters and receivers on Grandma's breadboards. They used wood screws to mount tube sockets, tuning capacitors, transformers, inductors, and other large parts to the breadboard. Then heavy bare wire, called "busbar," was used for all circuit wiring.

While this rather "primitive" approach might seem cumbersome, it did offer many advantages to the pioneer radio worker. For one thing, wooden board was cheap and plentiful. For another, it could be used over and over again. Also, because all wiring was open and accessible, the layout could be changed at will. Voltage and current measurements could be easily made at any point in the set, and trimmers and other "gimmick" capacitors, as well as inductors, could be adjusted conveniently. (See Fig. 1.)

Then, something happened. Radio blossomed out of its state of adolescence, and the "professionals" began switching to the well-known metal chassis. But, until today, many old-timers have successfully resisted this changeover, and have clung for dear life to Grandma's wooden breadboard. For convenience, some engineers still use wooden breadboards in their experiments with new circuit designs.

Even though the *wooden* breadboard is no longer in widespread use, the name "breadboard" lingers on and has come to denote *any circuit wired for experi-*

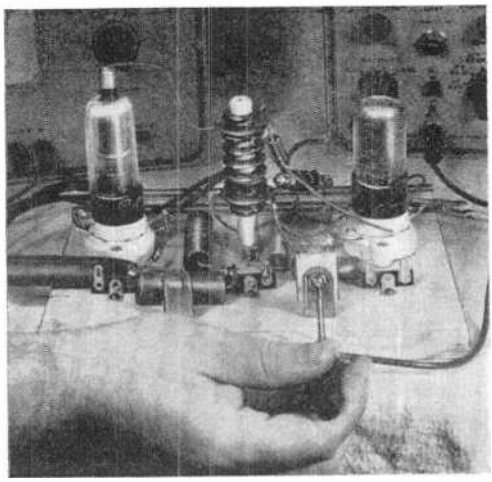


Fig. 1. All parts of this "classic" breadboard are readily accessible. Tests and adjustments are made conveniently from top of "chassis."

mental or test purposes, even when assembled on a metal chassis, or in nearly final form.

Breadboarding, then, is an old and honorable art, practiced by professionals and amateurs alike. It is useful to anyone attempting to develop a new circuit, or modify an existing one. Generally, it is the essential step between the first idea for a new circuit and its final appearance as a finished functional product.

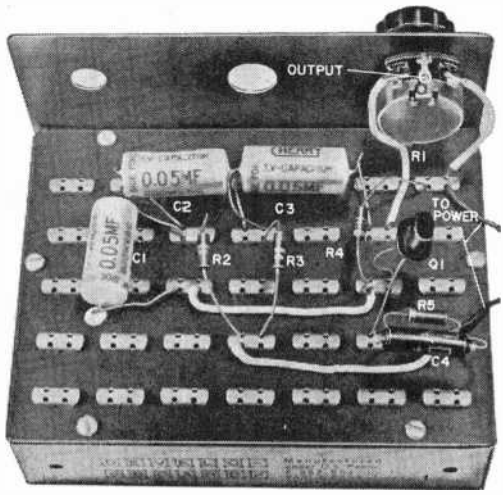
Because of the role played by breadboards in the design and development of experimental as well as commercial electronic equipment, manufacturers across the nation have developed, and are now marketing, a multiplicity of metallic and composition "breadboards" and breadboard accessories for use by the experienced electronics equipment designer as well as by the novice.

Circuit Layout Considerations. Sometimes (but not always), a circuit can be laid out on a breadboard exactly as it appears on a schematic diagram. An example of this type of circuit is shown in Fig. 2. Here, an experimental phase-shift audio oscillator schematic is shown breadboarded on a Vari-L "Develoboard" chassis. Note the one-to-one correspondence between the schematic symbols and the physical components.

However, all layouts are not as simple and straightforward as the oscillator circuit described. Radio-frequency amplifier circuits, for example, have their own peculiarities that must be considered during the layout of any r.f. circuit. To facilitate circuit layouts, some commercial breadboards (e.g., designs by Phillips-Advance and Electronic Training Aids) are supplied with a transparent plastic base to enable hand-drawn schematics to be used as wiring guides.

As a rule, when breadboarding, component leads are left full length until all tests are completed. There are exceptions, of course. Where VHF or UHF circuits are involved, the layout and wiring procedures can be quite critical, and it's usually necessary to "custom-tailor" component leads to the shortest lengths possible. For even an inch of wire may act as a very high inductance or as an antenna.

Commercial Breadboards. Some of the kits offered, such as those by Darco and Vero, have been so carefully designed



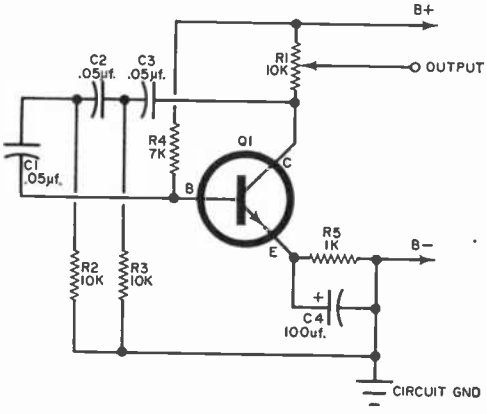


Fig. 2. This phase shift audio oscillator mounted on Vari-L Develoboard closely approximates its circuit diagram layout.

and manufactured, that their etched circuit boards provide a professional, finished look to the assembled circuit. Other kits, such as those put out by Aladin, Alden, Vector, and Vicon, allow you to assemble your circuit in an almost finished form at the outset. Thus, the circuits built can be used as production prototypes. Still other kits, such as those made by Circuit Structures Labs., DeVry, Electronic Training Aids, Phillips-Advance, Photographic Instruments Co., Sheatz, Vari-L, and Buckeye are designed primarily to afford maximum reusability and, therefore, are especially well suited for student use and school applications.

As a general rule, all the kits available from a single company are basically similar, the chief difference being in the number and variety of components and accessory items included in the basic package. Naturally, the larger the kit, the more expensive it is. There are a few firms, including Aladin, Electronic Training Aids, and Vector, who offer several different types of kits.

Breadboard Connectors. There are three basic types of breadboard terminal connectors: solder, solderless, and combination types. Of the three, the solder type represents the nearest approach to conventional wiring. It insures neat, low-resistance connections, although it is not recommended where repeated circuit changes might be required.

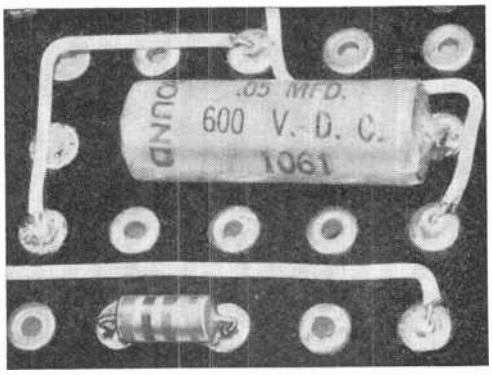


Fig. 3. Portion of a circuit breadboard on a Darco base. Solder-filled eyelets serve as connection terminals.

The *solder* type connectors are featured in the Darco, Vero, and Vicon kits. They are also featured in some of the kits put out by Aladin, Alden, and Vector. The breadboards put out by both Darco and Vero include connectors. The Darco connector consists of a solder-filled eyelet as shown in Fig. 3; connections are made by simply holding the tip of a hot soldering iron against the eyelet, and then inserting the component lead or wire into the eyelet as the solder melts. In the Vero kit, the components and leads are soldered directly to the copper strips etched on the circuit board. Vero also features terminal pins with an annular groove for attaching wires; the pin, which has self-cutting serrations under the head, is inserted by means of a special tool. (See Fig. 4.)

The Vicon kits feature lap-solder connections and do not employ special terminals. Aladin and Vector, on the other hand, supply conventional terminals in some kits, solderless connectors in others, while still other kits feature all three basic types.

Many types of *solderless* connectors are available on the open market. All are designed to maintain pressure contact, and many hold up to six wires. These connectors can be divided into three groups: (1) those using metal springs as shown in Fig. 5; (2) those using elastic (rubber-like) materials as shown in Figs. 6 and 7; and (3) those made of straight spring-like metal as shown in Fig. 8.

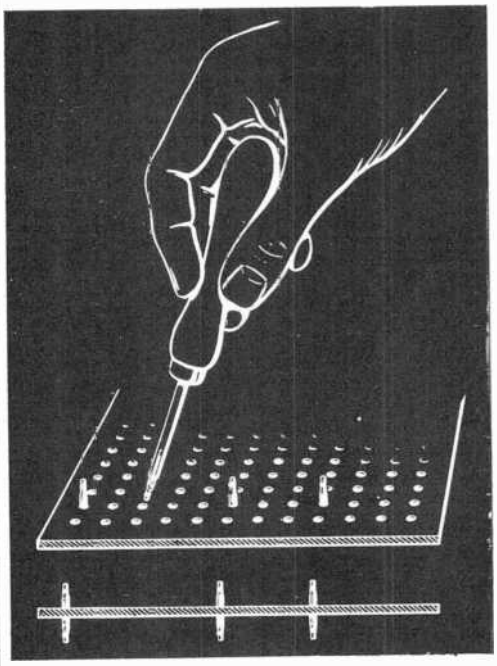


Fig. 4. These Vero connectors feature terminal pins with self-cutting serrations. A special tool is used to push pins down into the holes.

Where an ordinary coil spring is used, connections are made by inserting the leads between the coils, as in Fig. 5(A). The plastic knob and plug are optional and are not furnished by all firms. Vector's spring-clip terminal (B) uses the coil spring principle in a modified manner; the spring is mounted on a slotted terminal and component leads are inserted in the slot as shown, and held in place by spring pressure. An altogether

different type of terminal is featured in Vari-L's "Develoboard" kit as shown in Fig. 5(C). A flat spring is shaped over a piece of solid wedge-like metal. Grooves are cut in the wedge to accommodate circuit wires, with corresponding holes provided in the top surface of the spring.

DeVry's "Paromel" kits feature plastic modules containing specially shaped flat spring contacts. In both solder and solderless types, lead connections are made simply by inserting wires through the appropriate holes in the terminal. Buckeye kits feature spring-clip connectors which can be plugged into any position on the perforated chassis. Electronic Training Aids features what they call a "Flexi-Klip" terminal. It is a rubber-like sleeve placed over a metal tube, as in Fig. 6(A). The rubber sleeve holds component wires firmly against the tube, and banana plug connectors may be inserted into the tube for test purposes. A typical wiring application using these connectors is shown in Fig. 7.

An inverted version of the sleeve design is shown in Fig. 6(B). Here, the connector consists of a metal cup fitted with a rubber tube. The tube is removed

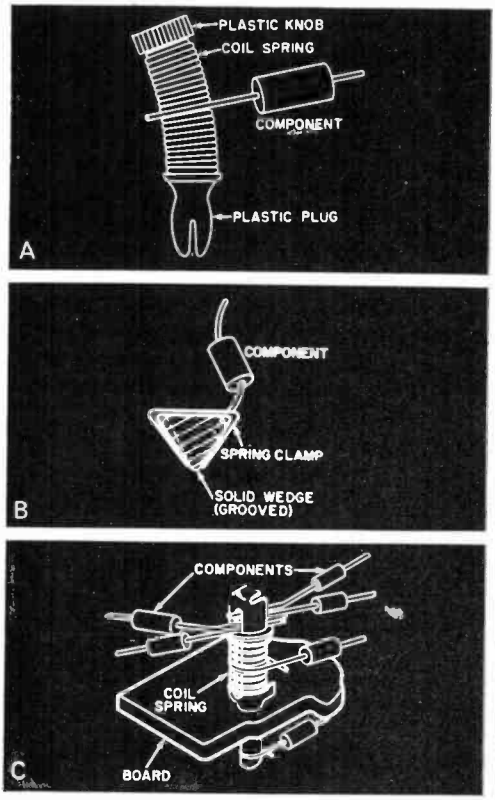


Fig. 5. Solderless connectors using wire springs. Shown in (A) are coil springs (B) Vector's "Springclips" and (C) Vari-L's terminals.

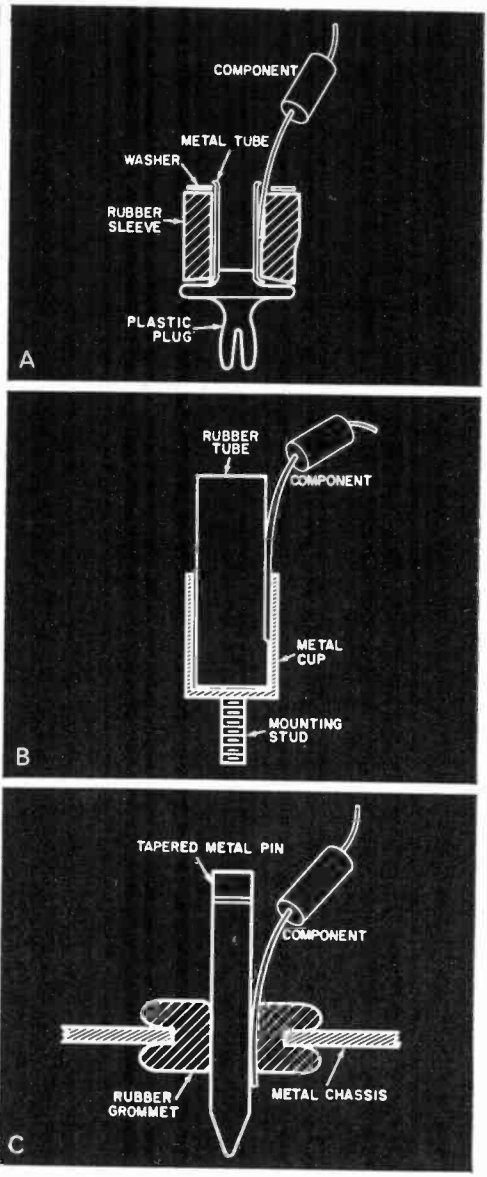


Fig. 6. Solderless connectors using rubber-like materials. Shown are (A) ETA's "Flexi-Klip" rubber sleeve type, (B) tube and cup type, and (C) PIC's grommet and pin type.

List of Breadboard Manufacturers

MANUFACTURER	TRADE NAME	CONNECTORS REQUIRED	KIT PRICE	COMMENTS
Aladin Kits Company 1167 Hilda St. Anaheim, Calif. 90283	Genie, Geniebord	Solder terminals and coil springs	$9.95-$23.85	Wide variety of kits, some suitable for semi-permanent assembly
Alden Products Company 222 Main St. Brockton, Mass.		Turret terminals	11.25-395.00	Excellent for prototype work and limited production runs
Buckeye Stamping Co. 555 Marion Rd. Columbus, Ohio 43207	Buckeye	Spring clips	8.95	Especially suited for transistor circuits
Circuit Structures Laboratories 1024 West 9th St. Upland, Calif. 91786		Rubber cell	N.A.	
Darco, Inc. 10611 Concord St. Kensington, Md.		Premounted eyelets	14.95-49.95	Excellent for developing and testing of etched circuit layouts prior to etching
DeVry Technical Institute 4141 Belmont Ave. Chicago 41, Ill.	Paromel	Spring clip modules	37.50	Connectors may be stacked; interlocking chassis boards featured as accessory items
Electronic Training Aids Company P. O. Box 53 Cambridge, Mass.	Flexi-Klips, Koil-Klips	Both coil spring and rubber sleeve types	3.95-39.95	Extremely versatile; wide selection of accessories available
Phillips-Advance Control Company 59 West Washington Joliet, Ill.		Coil spring Binding posts	34.95	Component and tool drawer featured; gold-plated connectors, slide-out schematic board
Photographic Instruments Co., Inc. 1163 West Walnut St. Des Plaines, Ill.	Pin-Up	Rubber grommet and metal pin	16.50	Heavy-duty perforated metal chassis; excellent for circuits with heavy components
Precision Metal Products Company 41 Elm St. Stoneham 80, Mass.		Turret solder types	13.95	May be used for semi-permanent assembly as well as breadboards
Sealectro Corporation 139 Hoyt St. Mamaroneck, N. Y.	Selectoboard, Proto-kit		19.70-28.00	Matrix for crossbar switching and programming breadboards
Seezak Products, Inc. 5057 West Washington Blvd. Los Angeles, Calif. 90019			N.A.	Wide selection of "universal" chassis rails and perforated boards for custom assembly
Sheatz Electrode Company 6506 Ridge Drive Washington, D.C.		Coil springs	2.65	Lowest priced kit offered; "twist-in" connectors on Masonite base featured
Vari-L Company, Inc. 207 Greenwich Ave. Stamford, Conn.	Develoboard	Wedge springs	18.50	Excellent for circuits involving up to three stages; front panel and chassis featured
Vector Electronic Company, Inc. 1100 Flower St. Glendale 1, Calif.	Plugbords, Vectorbords, Springclip	Turret and push-in solder terminals; spring-loaded clips	6.25-25.00	Suitable for both semi-permanent wiring and breadboards; excellent design
Vero Electronics, Inc. 48 Allen Blvd. Farmingdale, N. Y.	Veroboard, Verorack	Copper foil strips	5.95-29.95	Etched circuits in breadboard form; special tool provided with kits to break etched strips
Vicon Instrument Company P. O. Box 2742 Colorado Springs, Colo.	Proto-Board		19.95-34.95	Suitable for finalizing a tested breadboard as a prototype circuit
The firms listed below also offer kits which include components and circuit diagrams.				
Allied Radio Corporation 100 N. Western Ave. Chicago, Ill.	Knight, Lincoln		14.95-26.95	Excellent for hobbyists with limited component stocks; Paromel kits handled as well
Herman H. Smith, Inc. Brooklyn 10, N. Y.	Norelco		9.95-19.95	Basic kit and "add-on" kit as well as advanced kit featured
International Rectifier Corporation 233 Kansas St. El Segundo, Calif.			14.95-44.95	Well-designed kits offered through toy stores and hobby shops as well as through parts distributors
Lafayette Radio Electronics Corp. 111 Jericho Turnpike Syosset, L.I., N.Y.	Lafayette, Argonne		16.95	Most standard breadboard kits listed above are offered
Radio Shack Corporation P. O. Box G Boston 17, Mass.			N.A.	Distributor of standard breadboard kits listed above

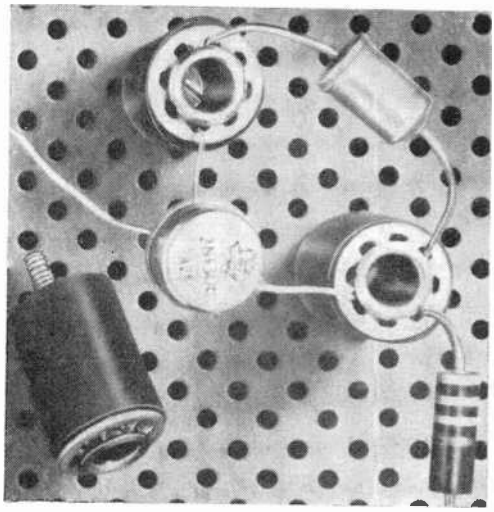


Fig. 7. Component leads are pressed into holes in top of ETA "Flexi-Klip" connectors.

and the leads are placed in the cups. Then the rubber tube is put back in, securing the leads in place. In Fig. 6(C), the terminal, put out by Photographic Instructions Co. (PIC), consists of a rubber grommet and matching tapered metal pin. Designed for use on perforated metal chassis, the grommet serves both to maintain a pressure contact between circuit leads and the pin, and to insulate circuit connections.

Figure 8 shows a popular combination terminal connector which is included with Vector's breadboard kits. Made of spring-like metal, the terminal is of the push-in type and is used with perforated circuit board. It has tapered, serrated slots that accommodate and hold component leads. For permanent assembly, the leads may be soldered into position after assembly and tests are completed.

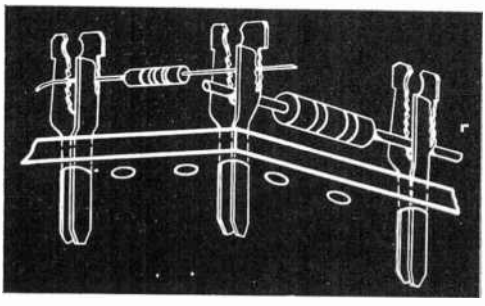


Fig. 8. These Vector connectors feature serrated slots for the component leads. Connectors can be soldered if desired.

Breadboards and Chassis. Practically all commercial breadboards fall into one of two categories: (1) perforated copper-clad board, and (2) perforated unclad boards. Some of the more popular types are described briefly in the following paragraphs.

Vero has come out with a special kit that can be used for laboratory development work as well as for experiments by the hobbyist. "Veroboard," as it is called, is made of synthetic resin bonded paper laminate with a number of copper strips bonded to it. The strips are pierced with a regular matrix of holes as shown in Fig. 9. A special tool is provided for cutting the copper strips where required. Components are soldered directly to the strips which are on one side of the board only.

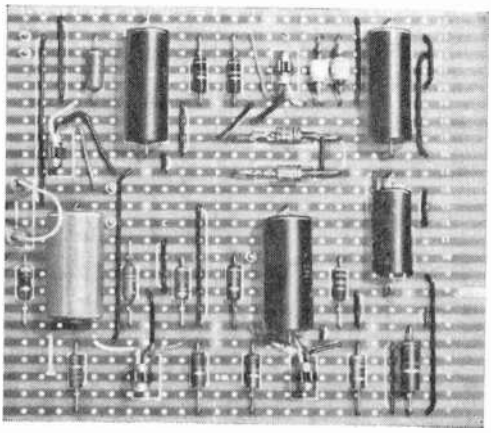


Fig. 9. Novel "Veroboard" has bonded copper strips pierced with a regular matrix of holes. Components leads are soldered directly to the strips.

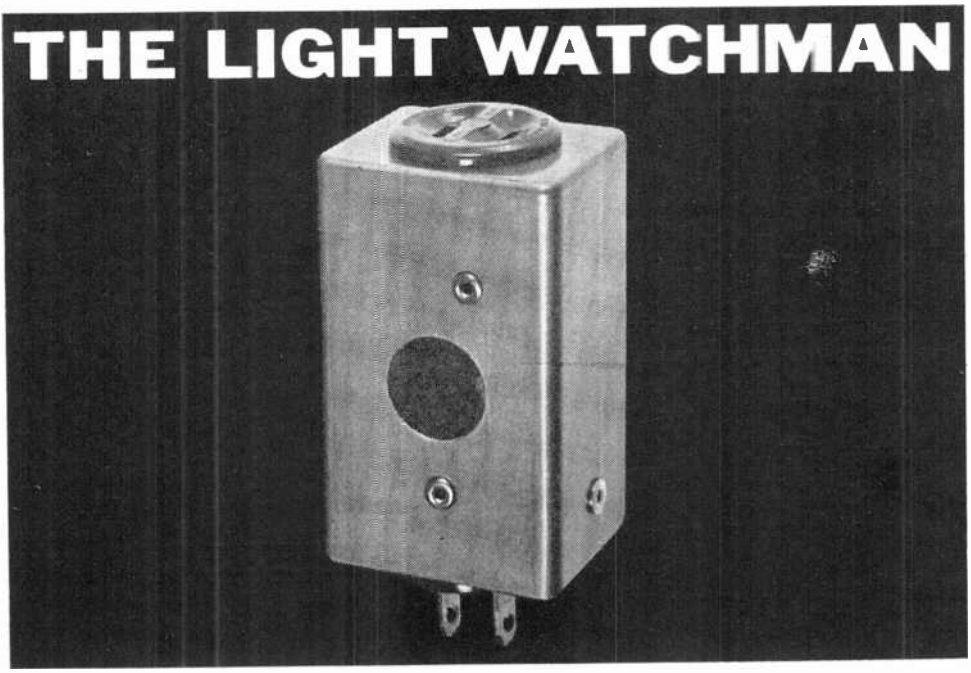
Darco's breadboard consists of a phenolic board with pre-mounted solder-filled eyelets, as shown in Fig. 3. The board fits on a rotating frame, permitting it to be wired from either side, or to be flipped over for tests.

The kits offered by Aladin, Alden, DeVry, Electronic Training Aids, Phillips-Advance, Sheatz and Vector all feature phenolic or plastic perforated boards. In some cases, these are mounted on an open metal chassis as shown in Figs. 10 and 11. The nearest approach to conventional metal chassis is found in

(*Continued on page* 96)

BUILD THE LI'L DUSKER

THE LIGHT WATCHMAN



This light sensor turns your lights on at dusk, and off at dawn, automatically—without a timer

By **DONALD E. LANCASTER**

HERE'S A CLEVER, useful, and economical photoelectric controller you will want to build. Li'l Dusker, the "light watchman," will earn its keep turning on lights for you in dark driveways, stairways, and halls at night, and then turning them off at dawn when they are no longer needed. And while you are away from home, Li'l Dusker will turn on that important "there's somebody home" light that will deter *all* but the most persistent intruder.

But Li'l Dusker has many more talents. It can serve as an automatic door opener, or a light-operated relay. And if you want an automatic flasher with adjustable frequency, or a low-cost touch control for a desk or table lamp, call on Li'l Dusker.

About the Circuit. Although Li'l Dusker acts like a magician, the circuit is really a simple one, as Fig. 1 shows. It is just a d.c. power supply (*R1*, *D1*, and *C1*), and a limiting resistor (*R2*), a cadmium sulfide photocell (*PC1*), and a d.c. relay (*K1*), all connected in series.

The cadmium sulfide photocell has a low resistance in the presence of light and a high resistance in darkness. This characteristic enables the Dusker to tell night from day. Therefore, as light increases with the break of dawn, the photocell resistance decreases, increasing the current in the relay coil, and causing the relay to pick up.

The relay sensitivity—the light intensity that will cause the relay to pick up —is established by the value chosen for the current-limiting resistor (*R2*). The circuit application determines which set of relay contacts is used. For dusk-to-dawn control, the *NC* (normally closed)

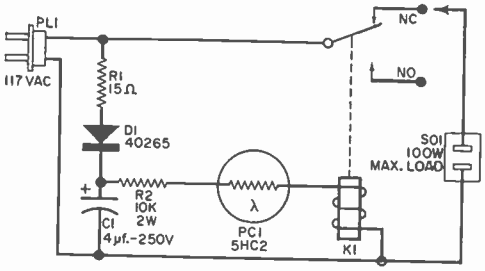


Fig. 1. For dusk-to-dawn control, connect load circuit to the NC relay contacts; for photocell relay application, connect load to the NO contacts.

PARTS LIST

C1—4-μf., 250-volt electrolytic capacitor
D1—130-ma., 400-PIV rectifier (RCA 40265 or equivalent)
K1—S.p.d.t. relay, 24 volts d.c., 1 amp contacts (Newark 60 F 1749 or equivalent)
PC1—Sigma 5HC2 photocell, 0.6 watt, 300 volts (Allied 9 E 307 or equivalent)
PL1—100-volt, 2-pole standard plug (Amphenol 61-M or equivalent)
R1—15-ohm, ½-watt resistor
R2—10,000-ohm, 2-watt resistor
SO1—110-volt, 2-pole universal receptacle (Amphenol 61-F or equivalent)
1—Case made from Millen 74400 octal base and shield (Newark 40 F 734)
Misc.—"Pop" rivets (4), 1¾"-square piece of 1/16" single-sided PC board, funnel eyelets for PC board (24), ½" x ⅞" aluminum sheet (2), 2" x 1½" plastic sheet or film, glue or sealant, wire, solder

contacts are used; for door-opening operation, the *NO* (normally open) contacts are employed instead.

Construction Pointers. Li'l Dusker can be encased for mounting on a windowsill or anywhere outdoors, and can be plugged into a standard wall receptacle or octal socket. In Fig. 2(A), the Dusker has its own line cord and is mounted on a windowsill where it can "look" outside. For general outdoor use, BX, ROMEX, or other approved wiring can be brought in through the top of the unit. To make the Dusker weatherproof, the outlet can be recessed and the entire unit mounted as shown in Fig. 2(B) in a sheltered area.

If Li'l Dusker is to serve as a door opener, the case is used as it comes, with only slight modification. You can then make a companion light source, perhaps with a 6.3-volt filament transformer and an automobile 6-volt lamp bulb and socket. You might want to add a low-cost

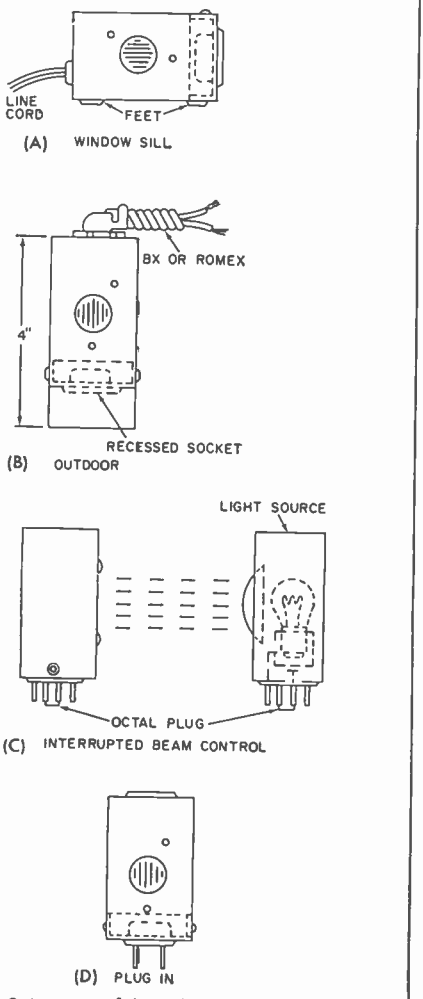


Fig. 2. Select one of these four case configurations for the Dusker. For table or desk lamp touch control applications, the outer casing is not used.

lens to focus the beam and thus provide for greater separation between the Dusker and the light source.

For touch control applications, you can omit the case altogether and mount the circuit directly inside the base of a table or desk lamp.

Construction Details. Using a Millen #74400 octal base and shield, cut the case for the plug-in configuration following the details given in Fig. 3. In addition, two mounting brackets will be required. These can be made out of a small strip of aluminum sheet cut as shown in Fig. 3(D). Drill the holes first, then

bend the bracket into shape using long-nose pliers, or a vise, if one is available.

You will also need a piece of tough plastic film to serve as a protective window for the photocell. Acetate, Mylar, or anything similar will do. Avoid using brittle material that will crack or break.

The parts are mounted on a small (1¾-inch-square) printed circuit board laid out, drilled, and cut as shown in Fig. 4. Eyelets are used in the holes where shown to give the circuit board some extra ruggedness. The aluminum brackets are riveted to the circuit board

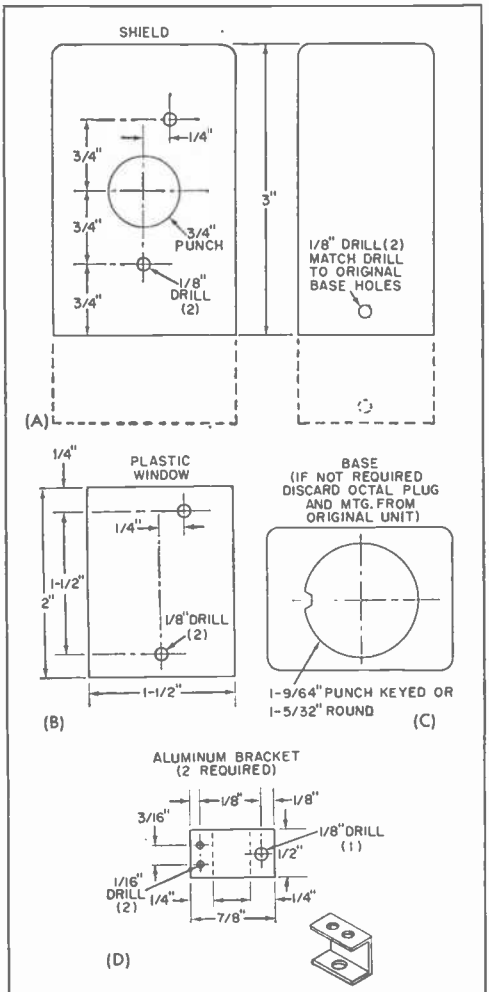


Fig. 3. The base and shield of case are cut and punched as shown. Then they are finished with lacquer or paint, or are anodized. The two brackets at bottom are made from 1/32-inch aluminum sheet. Window is made from heavy plastic film such as Mylar; avoid using brittle material.

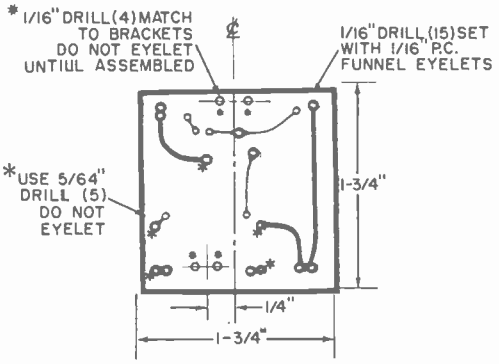


Fig. 4. This is foil side of printed circuit board. Numbers in parentheses indicate holes required.

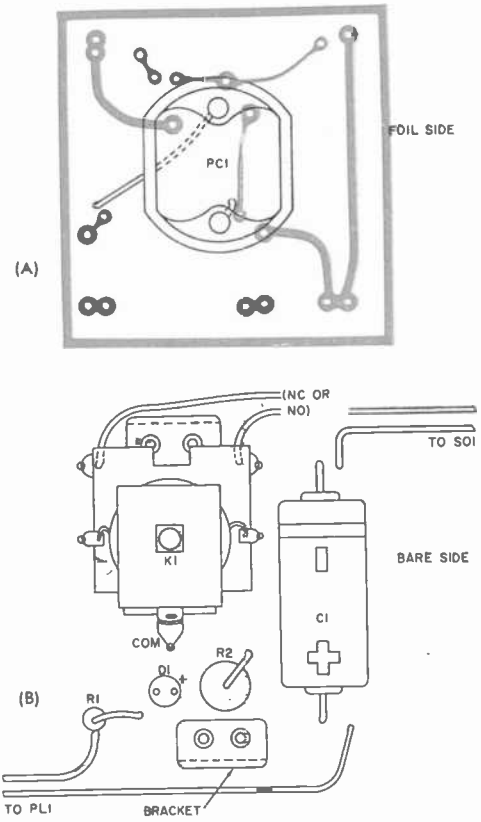


Fig. 5. Here's the component layout. Photocell PC1 is mounted on the foil side of the circuit board as shown in (A). All of the other parts are mounted on the bare side of the board as shown in (B).

in the locations indicated in Fig. 5, again using eyelets.

The photocell is glued to the back of the printed circuit board with silicone

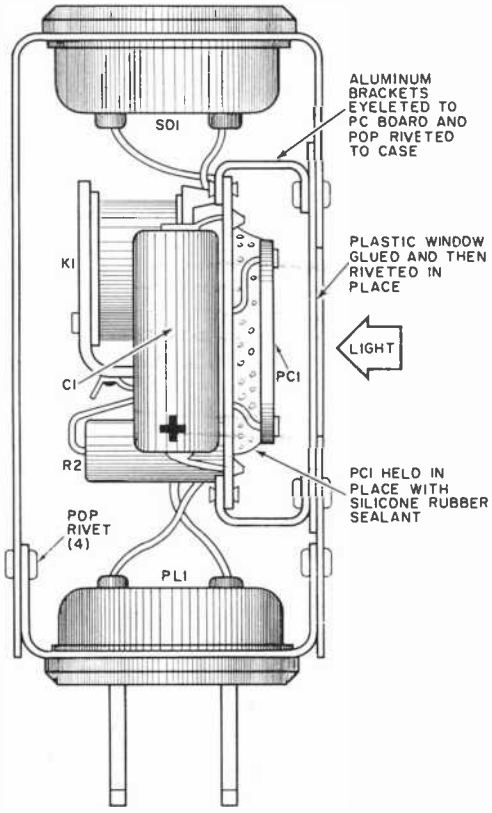


Fig. 6. After all the parts are preassembled on the circuit board, and the unit has been fully wired and tested, install the plastic window and pop-rivet the aluminum brackets to the case shield.

rubber sealant (Fig. 6). The plastic window is glued in place and allowed to dry before the aluminum brackets are riveted on.

Before making connections to the relay, refer to the Special Applications section at the end of this article to determine the proper relay terminals to employ. In general, the *NC* contacts are used when decreasing light must energize the load, and the *NO* contacts are used when increasing light is to energize the load.

Checkout and Final Assembly. Before final assembly, you will want to check out the circuit to make sure it works the way you want it to. For this you can use a flashlight or other suitable light source. If it becomes necessary to change the sensitivity of the unit, change the value of *R2* as necessary. But you can decrease the sensitivity by merely reducing the amount of light reaching the photocell. A filter made of colored cellophane, Polaroid material, or tinted acetate placed over the light window will work well.

Once you have obtained just the right sensitivity for the particular application, complete the assembly by "pop"-riveting the circuit board and bottom plate to the case. Once pop-riveted, the Dusker becomes tamperproof and there's no way to take the case apart without using an electric drill. If it becomes necessary to open the case again, use a ⅛" high-speed bit to drill out the rivets.

Once assembled, operation of the Dusker is a snap. Just plug it into a convenience outlet, plug the load or lamp into its receptacle, and away you go.

Special Applications. For operation as a light flasher, the Dusker must be wired as a dusk-to-dawn control. This makes it essentially an oscillator with negative feedback. The Dusker must be positioned

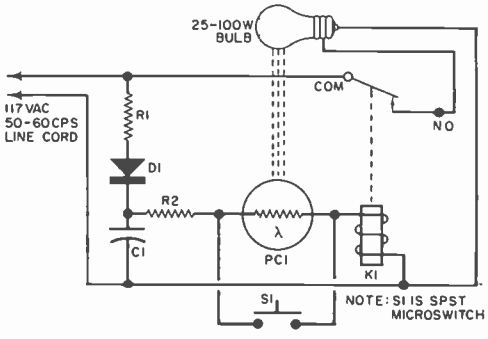


Fig. 7. This low-cost touch control circuit can easily be wired to any desk or table lamp by adding a microswitch across PC1. To turn on lamp, touch S1 gently. To turn off lamp, bring hand near PC1, shielding it from light. For proper operation, PC1 must be shielded from other strong light sources.

in such a way that the light shines in its "eyes." Initially, when the light is *off*, the photocell turns it *on*: the Dusker "sees" it and turns it *off* again. This cycle can go on as long as the unit is plugged in. To adjust the *on-off* rate (frequency), adjust the amount of light that gets fed back. Changing the bulb size will usually do the trick.

For "touch control" operation, mount the circuit board (less case) in the base of a lamp so that only the lamp light—

(*Continued on page* 99)

PREDICTED RADIO RECEIVING CONDITIONS

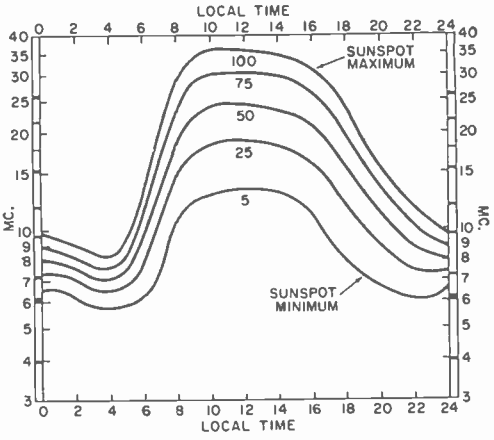
HOW THE SHORT-WAVE BANDS WILL BE IN SEPTEMBER AND OCTOBER PLUS SOME INFORMATION ON THE IMPROVED CONDITIONS EXPECTED

By STANLEY LEINWOLL, Radio Propagation Editor

THE sunspot numbers are climbing. Definite proof that the bottom of the sunspot cycle had been reached in 1964 was established this past summer. Short-wave listeners and radio amateurs were afforded a preview of what radio conditions will be like in several years. DX'ing conditions were noticeably better in the late spring and summer, as compared to the summers of 1963 and 1964. Sunspot numbers that had been hovering below 20 on occasion jumped —for short periods—up to 90 or 100.

During a few days of abnormally high sunspot activity, the British Broadcasting Corporation could be heard testing on the 21-mc. band. The BBC recently installed new 250-kw. transmitters for use in its international broadcast service. While SWL's were astounded to find the 21-mc. band open at 8 p.m. EST, the hams on 20 meters were working DX around the clock.

There is a major difference in the maximum usable frequency (MUF) that the ionosphere will reflect during periods of high and low sunspot activity. The accompanying graph shows the MUF over a distance of 1200 miles for the fall months in North America. Various smoothed lines represent average sunspot numbers, and it will be seen that during the daylight hours the MUF will range from 12 to 36 mc. as the sunspots increase. At night, the effect is not as pronounced, but it can be seen that the 31-, 41-, and 49-meter bands are open during the sunspot maximum, while only the 49-meter band is open at sunspot minimum.



Maximum usable frequencies that the ionosphere will reflect in the fall in North America over a distance of 1200 miles during periods of high and low sunspot activity. Black bars along the frequency scale indicate the international broadcasting bands.

Fall Band Conditions. In accordance with international agreement, short-wave broadcasting schedule changes for the fall season will be made on September 5. New schedules will then continue in effect until the change for the winter season on November 8.

11 Meters. It is possible that a few broadcasters will attempt to use this band during the coming winter. However, no significant broadcasting schedules in the 26-mc. band are anticipated until the very late fall and winter months of 1966-1967.

13 Meters. As the sunspot numbers increase, the improved propagation conditions will make DX possible in this band. Listeners should watch for Pakistan, on 21,590 kc., during the East Coast morning hours; this transmission may be difficult to catch as it is beamed to China, Japan, and the Philippines. The European transmission from Pakistan should be heard throughout most of North America—it goes on the air at 0830 EST. Norway will be on 21,730 kc. until 1300 EST, and *Radio Netherlands* has announced that it will be back this fall on 21,570 kc.

The *Voice of America* and the BBC intend to make extensive use of this band. The BBC relay station on Cyprus, 21,660 kc., will operate from 0400 to 0800 EST with transmissions beamed to Southeast Asia. This will probably be one of the most difficult DX catches of all the *VOA* and BBC transmissions in the band.

16 Meters. Improved DX is expected in this band during September and October. Congo will be on 17,720 kc. during the morning hours with best reception at 0900 EST. Generaly speaking, overall DX in this band will be possible from the early morning hours until early or mid-afternoon, local time.

19 Meters. This should be the optimum DX band for this period of the year. Most

(*Continued on page* 104)

SOLID STATE

By **LOU GARNER,** Semiconductor Editor

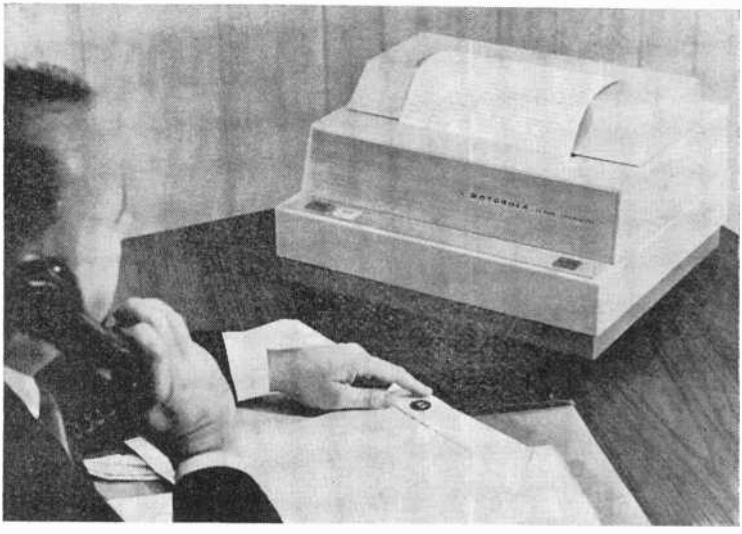
EVER SINCE WORLD WAR I, our armed forces, in their continuing and pressing need for the latest and most advanced electronic gear, have made substantial contributions in the research and development of new products. With virtually unlimited funds at their disposal, the services are able to acquire the latest designs in equipment built for their specific needs, and offering greater reliability than their commercial counterparts.

The giant radio industry which blossomed in the twenties and thirties, owes its success in part to the technical knowledge acquired during World War I. Similarly, the rapid expansion of our television industry in the late forties and early fifties, was due, in part, to the production techniques developed for military radar during World War II. Therefore, a peek today at new developments in the field of military electronics is tantamount to a glimpse of commercial off-the-shelf items that will be available to us all tomorrow.

New integrated circuits are now being used extensively in military communications equipment, surveillance and intelligence gear, and specially designed computers for navigaton and tactical applications. It can be presumed that low-cost integrated circuits which can be used by hobbyists and experimenters will be available before long as a by-product of military needs.

A new electronic teleprinter is now available from Motorola's Chicago Military Electronics Center. The Model TP-4000 features solid-state and integrated circuitry, and can produce printed copy at the rate of 3000 words per minute on special current-sensitive paper that requires no processing. Looking to the future, one wonders whether this new product may not herald the eventual development of all-electronic typewriters for home and office use.

The Army has begun tests on what is said to be the most powerful solid-state radio transmitter and receiver system ever built. Developed by Westrex Communications, a division of Litton Industries, Inc., the system is fully transistorized except for the final r.f. amplifier stage. Slightly less than half the size of comparable vacuum-tube types, the transmitter can deliver up to 300 kilowatts peak power, and 50 kilowatts average output power. Broadcasting from 2 to 30 megacycles, the equipment covers frequencies of interest to both commercial and amateur radio operators.



New desk-top silent electronic typewriter, developed by Motorola, can print 3000 words per min.

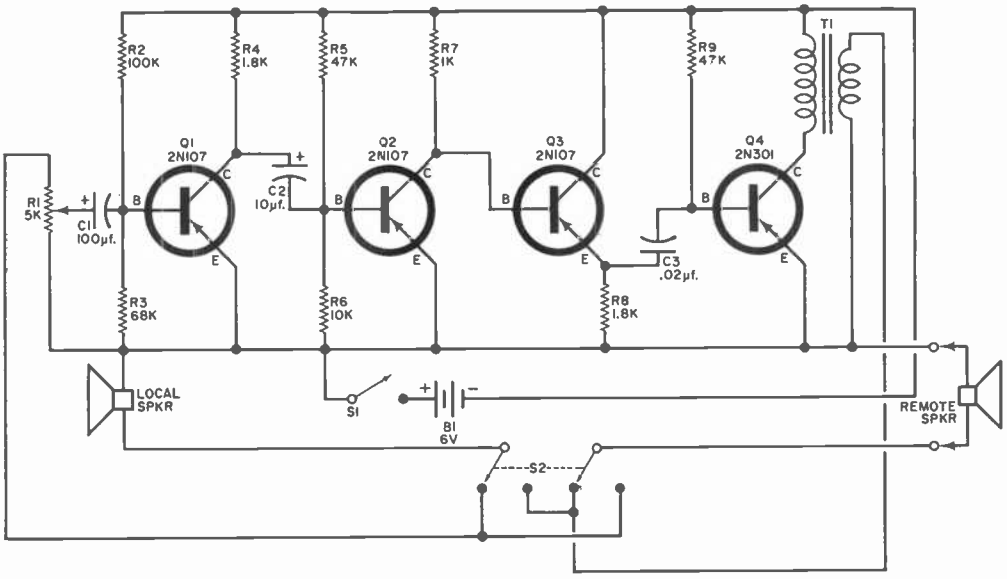


Fig. 1. Diagram of four-transistor intercom submitted by Bill Ruck. Circuit picks up a whisper 10 feet away. With S2 as shown, local speaker becomes a mike; with S2 flipped, remote speaker operates as mike.

Reader's Circuit. Our prize-winning circuit for this month was submitted by reader Bill Ruck (2450 - 18th Ave., San Francisco, Calif.). Bill's circuit, a four-transistor intercom (Fig. 1), differs from more conventional designs in many respects. First, it has exceptonally high gain. Bill writes that it *can pick up a whisper* in a relatively quiet room at distances of up to 10 feet or more (probably depending on the condition of the battery). Second, the unit uses standard 8-ohm speakers. Third, an emitter follower, *Q3,* is used to drive the power amplifier instead of the usual interstage transformer.

Either of the speakers can serve as a microphone. The input audio signal is coupled to the base of *Q1* through coupling capacitor *C1*. Signal level is determined by adjustment of gain control potentiometer *R1*. Base bias voltage for *Q1* is developed by voltage divider *R2-R3*. The amplified output signal developed across load resistor *R4* is applied through *C2* to the base of *Q2*, which is biased by voltage divider *R5-R6*.

The output of *Q2* is developed across load resistor *R7*, and is applied directly to the base of *Q3* operating as an emitter-follower. The output of *Q3*, developed across *R8*, is applied to the base of power amplifier *Q4* through coupling capacitor *C3*. Base bias for *Q4* is provided by the drop across resistor *R9*. The amplified output at the collector of *Q4* is coupled to either speaker (depending on position of *S1*) by impedance matching transformer *T1*.

Bill used standard components in his design. Transistors *Q1*, *Q2*, and *Q3* are 2N107's, while *Q4* is a 2N301. Except for the volume control, *R1*, all resistors are half-watters. Capacitors *C1* and *C2* are 10-volt electrolytics, while *C3* is a small disc ceramic capacitor. For *T1*, Bill tried several different standard output transformers, finally choosing one having a 5000-ohm primary and an 8-ohm secondary. The on-off switch, *S1*, is an s.p.s.t. type, and can be either a slide or rotary unit; if preferred, it can be mounted on the volume control.

The *Talk-Listen* switch, *S2*, is a d.p.d.t. lever, slide, rotary, or toggle type. The speakers are 8-ohm PM types; any convenient size from 2 to 6 inches will do. The larger the speaker the more efficient it will be. For the power supply, *B1*, you can use a 6-volt lantern battery, or four penlight or flashlight cells connected in series.

Keep signal leads as short as possible, and maintain ample separation between the input (*Q1*) and output (*Q2*) stages. Either a metal chassis or a circuit board can be used for mounting the components. Banana jacks, insulated binding posts, or a screw-type terminal strip can serve as connectors to the remote speaker. Neither parts arrangement nor wiring is critical, but good wiring practices to maintain the high-gain characteristics of the equipment should be observed.

The amplifier, battery, and local speaker can be housed in any suitable case. The remote speaker should be mounted in a

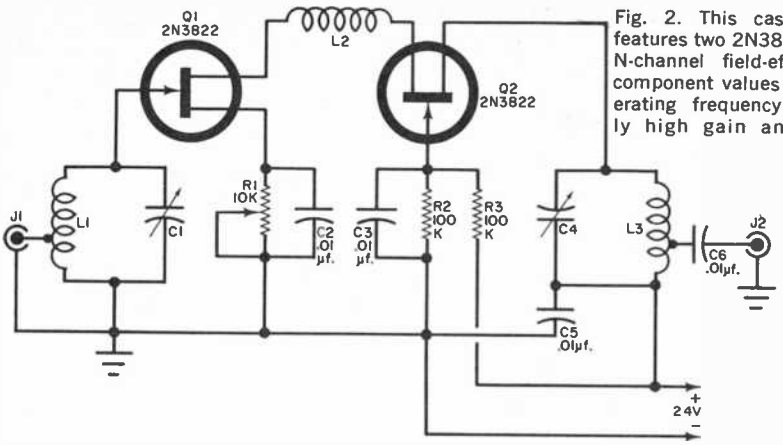


Fig. 2. This cascode amplifier circuit features two 2N3822 (Texas Instruments) N-channel field-effect transistors. With component values chosen for desired operating frequency, circuit has relatively high gain and low noise figure.

standard speaker enclosure, and connected to the amplifier by a two-conductor "zip cord" or other hookup wire. Shielded cable may be preferable in areas having an excessive amount of electrical noise.

Manufacturer's Circuit. Field-effect transistors (FET's) are generally used in audio preamplifiers having extremely high input impedances. However, some types of FET's are ideally suited for use in r.f. amplifier circuits. Figure 2 shows a pair of 2N3822 N-channel FET's in a cascode amplifier circuit. Developed by Texas Instruments, the circuit can be used as a field strength meter preamplifier, as a line amplifier, as a booster for receivers, or as a predriver for a small transmitter.

Component values for tuned circuits *L1-C1* and *L3-C4,* as well as collector choke coil *L2,* are chosen for the specific frequencies to be handled. Except for bias potentiometer *R1,* all resistors are half-watters, and bypass capacitors *C2, C3,* and *C5,* and output coupling capacitor *C6* are ceramic or mica types. To facilitate matching input and output transmission line impedances, taps are provided on *L1* and *L3.* Operating power for the circuit is provided either by batteries or by a suitable line-operated power supply.

Amplifier performance is determined by a number of factors, including the adjustment of *R1* and the *Q*'s of the tuned circuits. However, in a typical application at 200 mc., the circuit provided a gain of approximately 12 db, and a noise figure of 2.5 db. The combining of a 1000-microvolt, 200-mc. signal with a 200,000-microvolt, 150-mc. signal produced a cross modulation of less than 1%.

Even though this circuit is of a relatively simple design, only experienced experimenters who can design their own coils, and who are familiar with high-frequency equipment layout and wiring techniques, should attempt to build it.

Transitips. Oscillator circuits have been in use for quite a while in superhet receivers, transmitters, various types of test and control equipment, electronic musical instruments, code-practice sets, capacity-operated relays, and so on. If we get down to basics, we find that an oscillator is simply an amplifier with regenerative (in phase) feedback, and that oscillators differ mainly in the types of feedback networks used.

As a general rule, vacuum-tube oscillators are essentially Class C amplifiers with a feedback loop. Transistorized oscillators, on the other hand, are operated Class A or Class AB. Since Class C amplifiers are inherently nonlinear, they are quite suitable for use as modulated r.f. amplifiers, but unsuitable as modulators. Class A amplifiers, however, work well as modulators but not as modulated r.f. amplifiers. This fact alone accounts for many of the difficulties experienced by hobbyists in assembling wireless phonographs, home broadcast units, and wireless intercoms.

For example, a wireless mike may seem to radiate a very strong signal, but the voice may come over very weak or indistinct. This condition may be due primarily to low-percent modulation. The "trick," then, is to get the oscillator to operate as a nonlinear amplifier by reducing its transistor base bias to near cutoff, i.e., shifting towards Class AB operation.

Another important factor that has a direct bearing on how well an oscillator circuit operates, is the use of optimum feedback. If too little feedback is used, the circuit may become unstable, may not

(*Continued on page* 104)

AMATEUR RADIO

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

WORKING DX ON 21 MEGACYCLES

TRADITIONALLY, the beginning of September signals the opening of another DX season. On the 1.8-, 3.5- and 7-mc. bands, static starts decreasing, and increasing hours of darkness produce stronger signals from greater distances for longer periods. At the same time, equally important changes take place on the higher frequency amateur bands. The 21-mc. band, for example, should be opening up quite often for distances over 1500 miles during daylight hours.

Two factors combine to improve 21-mc. DX prospects for this season. The maximum usable frequency (MUF) for daytime DX work normally increases as winter approaches; also, ionospheric propagation conditions are now taking their first steps upward from the trough of the current sunspot cycle. The latter factor, plus the surprisingly good 21-mc. DX conditions of last spring, indicates that conditions will be better than they were last fall—and there were many good days even then.

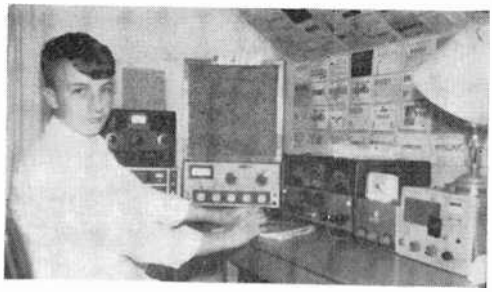
The prospect of favorable 21-mc. conditions at this time should be encouraging to both Novice and General Class operators. The 21.1- to 21.25-mc. Novice band gives Novices their best chance to work foreign DX; and an open 21-mc. band provides many General Class phone and CW operators with improved opportunities to work DX, because competition is normally less severe here than it is on 14 mc., where kilowatts and big beams are so plentiful.

Fortunately, the vast majority of the amateur transmitters on the market today work well on 21 mc. But receiver requirements are slightly more rigorous than on the lower frequencies, resulting in some inexpensive communications receivers that are satisfactory on 3.5 and 7 mc. becoming marginal in both sensitivity and selectivity on 21 mc.

The ideal 21-mc. band antenna is a good beam. But good results can also be obtained with simple antennas—either horizontal or vertical. Most 7-mc. antennas work at least fairly well on 21 mc., and a ½-wave antenna is short enough (22′ 2″ for 21.2 mc.) to permit a separate 21-mc. antenna to be erected in many locations. If you're going to use a

AMATEUR STATION OF THE MONTH

Mrs. Carrie C. Lynch, WA4BVD/NØRCA, of Savannah, Ga., became a Novice in 1961 and a General the following year. She is active on c.w. and radioteletype and in Navy MARS. Among Carrie's 21 awards are a Public Service certificate for assisting during Hurricane Cleo, 20-wpm code, and WAS and WAC certificates. She uses a Heathkit DX-60 transmitter on c.w. and a Heathkit "Marauder" on RTTY. The receiver is a Heathkit "Mohawk." Carrie will receive a one-year subscription for submitting this winning photo in our Amateur Station of the Month contest. If you would like to enter the contest, send us a clear picture of your station, preferably showing you at the controls, accompanied by some details on your ham career and on the equipment you use. Mail your entry to Amateur Photo Contest, c/o Herb S. Brier, P. O. Box 678, Gary, Ind. 46401.



Forty-nine states and 11 countries is the fine Novice record of Joseph Hill, WN4VGG, in Louisville, Ky. His efficient layout contains Heathkit DX-60 and Johnson "Adventurer" transmitters, a Heathkit "Sixer," and a Hallicrafters SX-99 receiver.

Shawn Mateson, WA5JXL, and Stu Gilman, WA5FBQ, are treasurer and president of the East Jefferson High School Amateur Radio Club in Metairie, La. They're shown operating the club station, WA5LYP.

horizontal antenna, the most important single factor to consider besides proper length is height. Strive for a height of at least 30 feet. Greater height is desirable for best DX results, while a lower height will do the job over shorter distances. If you use a vertical antenna, the most important consideration is installing it in the clear.

Normally, no matter what hour of the day or night you listen in on the 3.5- and 7-mc. amateur bands, you can hear signals from somewhere. This is not true of 21 mc. During this part of the sunspot cycle, the band usually works best in full daylight. Broadly speaking, DX signals are normally best from a generally easterly direction in the morning and from a generally westerly direction in the afternoon. The further north you try to work, the fewer hours of the day you are likely to be able to do so; conversely, it is often possible to work stations from the south when stations from no other direction can be heard.

Now that you have the general picture, the best way to enjoy 21 mc. is to get on the band and use it. Don't just listen in on your receiver for a moment or two without turning on your transmitter if you don't hear a lot of signals. Fire up the transmitter and call CQ a few times. You may be pleasantly surprised to get calls from other hams who were "just listening."

On-The-Air Code Practice. The ARRL Station W1AW has added 20- and 25-wpm practice material to its 9:30 p.m. (EST in winter, EDT in summer) code practice transmissions on Sunday, Tuesday, Thursday, and Saturday—the slow nights. To refresh your memory, the frequencies are 1805, 3555, 7080, and 14,100 kc., 50.7 and 145.6 mc.

On the west coast, the San Francisco Section *Courier* reports that W6PMK, of the North Peninsula Electronics Club, sends code practice on 1976, 3590, and 7135 kc., Monday through Friday, starting at 7 p.m., local time. Speeds are 8, 11, 14, 17, 20, and 30 wpm.

In the Los Angeles area, Ron, W6ODX, sends code practice every Saturday at 1:30 p.m., local time, on 3805 kc.

FCC and Other News. Would *your* station pass an unexpected FCC inspection? Two hundred U.S. hams faced this test recently when the FCC made "sudden" inspections. According to Frank M. Kratokvil, W3BA, Chief, Field Engineering Bureau, FCC, 76% of them passed with flying colors, 20% got a passing grade, and 4% didn't meet minimum standards. A total of 14 citations were issued as a result of these inspections. W3BA considers these figures very flattering to the amateur service; sudden inspections in other services frequently result in a citation rate of over 50%.

Have you worked TI2MAG—portable USA? Mrs. Grace Ruiz Castro Glorioso, TI2MAG, who arrived in the U.S. in the spring, was the first foreign amateur authorized to operate in the United States under Public Law 88-313. It is fitting that she received this honor, since Costa Rica was the first government to effect an agreement with the U.S. under the new reciprocal operations law.

The 1965 Special Convention of the International Amateur Radio Club will be held in Geneva on Saturday and Sunday, September 18 and 19. There will be technical sessions on Saturday and a banquet in the evening. On Sunday the six IARC stations, 4U1ITU through 4U6ITU, will be operated by visiting amateurs, and the program will include a visit to Montreux, the seat of the ITU Plenipotentiary Conference, where IARC station HB3ITU will also be in operation. For more details on this international radio convention, and the IARC, write to: International Amateur Radio Club, Box 6, 1112 Geneva 20, Switzerland.

Simple Lightning Arrestor. In the April issue of *Radiogram*, put out by the Carolina Radio Monitors League, W. E. Sladky, W1CTZ, says that a discarded but clean automobile spark plug makes an excellent

(*Continued on page* 104)

SHORT-WAVE LISTENING

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

NEWS FROM AROUND THE WORLD

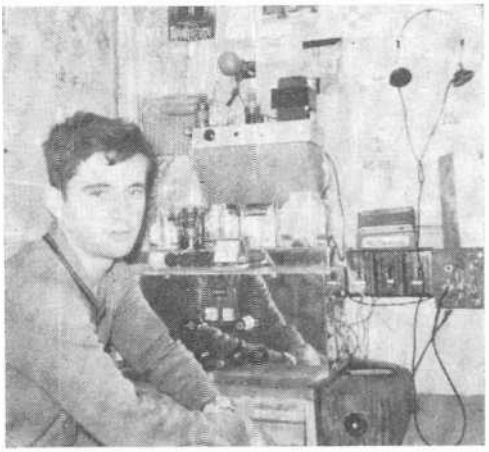
ANOTHER short-wave station popularity poll has been conducted under the auspices of *DX Allianses* of Stockholm, Sweden. Only Scandinavian area DX'ers were eligible to take part in the voting, and the poll was based on the short-wave stations that carry regular Swedish programming. The top five winners and the number of votes they received are: HCJB, Quito, Ecuador (994), *Radio Prague* (722), *R. Japan* (394), *Polish Radio* (307) and Rome (255).

Runners-up included *Radio Berlin International* (East Germany), *Radio Riga* (U.S.S.R.), *R. Finland, R. Moscow, R. Tallinn* (U.S.S.R.), *Vatican Radio* and *R. Brazzaville.* It's interesting to note that *Radio Brazzaville* appeared in the listing despite the fact that its monthly program in Swedish has not been heard for well over a year.

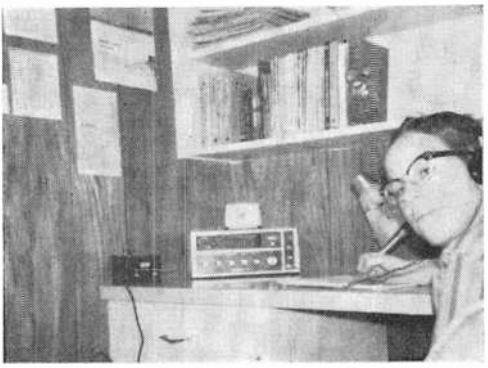
East Germany. *Freedom Radio 904,* previously mentioned in the February 1965 issue, and *Deutscher Soldatessender* (German Forces Broadcasting Service) both operate from a small town near Magdeburg in the Soviet Zone. *Freedom Radio 904* is currently on 908 kc. with 500,000 watts power, which provides considerable interference to the broadcasts from London on the same channel. The station transmits daily at 1300-1400, 1500-1640, and 2230-0000, announcing as "the single broadcasting service in the Federal Republic of Germany which is not controlled by the government of Western Germany." An excellent musical format makes it popular among teen-agers, but the station also features propaganda talks and messages for undercover agents.

Deutscher Soldatessender operates on 935 kc., the channel used by the American Armed Forces Network in Berlin. Broadcasts are at 0015-0115, 1200-1245, 1415-1445, and 1730-2030, with western dance music and propaganda talks beamed primarily to armed forces in Western Germany. DX'ers with sharp broadcast-band receivers should try for either or both of these stations during their late evening transmissions.

West Indies. This area now has a club of its own: the West Indian DX'ers Association. They recently published their first



One of our Canadian monitors is Carl Robertson, VE1PE9A, of Wolfville, Nova Scotia (above). Carl's receiver is a McMurdo Silver "Masterpiece II" and his antenna is 100 feet long, 60 feet high. His record: 16 countries verified out of 26 logged.



A newcomer to the SWL'ing hobby, Bruce Hancey of North Logan, Utah, has just assembled a Knight-Kit "Star Roamer." He uses a 50-foot long-wire antenna and a vertical whip for Citizens Band reception.

English-Language Newscasts to North America

All of the stations below specifically beam English-language newscasts to the U.S.A. The times may vary a few minutes from day to day.

COUNTRY	STATION	FREQUENCY *(kc.)*	TIMES *(EST)*
Argentina	Buenos Aires	11,780, 9690, 6090	2200, 0100 (Mon.-Fri.)
Australia	Melbourne	17,780, 15,220	2030, 2130, 2230
		9580	0745
Bulgaria	Sofia	9700	1900, 2300
Canada	Montreal	15,190, 11,760, 9625	1800 (E. Coast)
		9625, 5970	0230 (W. Coast)
Congo (East)	Leopoldville	11,755	1630
Congo (West)	Brazzaville	15,370, 11,930	1430
Czechoslovakia	Prague	11,990, 9795, 7345, 7120, 5930	2000, 2230
Denmark	Copenhagen	15,165	0730
		9520	2100
West Germany	Cologne	11,925, 11,795, 9735	1010
		9640, 6075	2040
		9735, 6145	0000
Hungary	Budapest	9833, 9540, 7305, 6234	1930, 2030
		9833, 7305, 7215, 6234	2200, 2330
Italy	Rome	11,905, 9630	1930, 2205
Japan	Tokyo	15,135, 11,780	1900
Jordan	Amman	9560	2000
Lebanon	Beirut	9710	2130
Netherlands	Hilversum	15,425, 11,950	1235 (Tues., Fri.)
		15,425, 11,730	1535 (Tues., Fri.)
Netherlands Antilles	Bonaire	9590	2030
Portugal	Lisbon	6185, 6025	2100, 2245
Rumania	Bucharest	11,940, 11,810, 9590, 9510, 6190, 6150	2330, 2200, 2030
Spain	Madrid	11,715, 9615, 6140	2200, 2100, 2000
Sweden	Stockholm	15,195	0900
		11,805	2215, 2045
Switzerland	Berne	9665, 9535, 6120	2015
		9665, 9535	2315
Turkey	Ankara	15,165	1700
United Kingdom	London	15,300, 11,860	1100
		9610, 6195	1700, 1800, 1900, 2100
U.S.S.R.	Moscow	15,180, 15,140, 9730, 9660, 9640, 9630, 9570, 9540, 7360, 7330, 7320, 7310, 7290, 7250, 7240, 7230, 7200, 7150, 7130, 6070 (all channels not in use at any one time)	1730, 1900, 2000, 2100, 2300, 0045
Vatican City	Vatican City	9645, 7250, 5985	1950

bulletin. Membership is primarily intended for any DX'er living anywhere from Bermuda in the north down to Trinidad in the south, including the Netherlands Antilles and the mainland countries of Venezuela, British Guiana, and British Honduras. For further information, write directly to the club at 21 Richmond St., Port-of-Spain, Trinidad.

Some Town, U.S.A. Rebroadcasting of police calls by unqualified persons has long been frowned upon by federal authorities. Such an operation was investigated recently and found to be conducted by members of a local broadcast-band station who were "experimenting" with an old station transmitter. No criminal intent was found and no charges filed. However, the guilty persons were given a severe reprimand.

Swan Island. The liberation of Swan Island was the noble aim of a group of young men in a large southern city. Headed by a 15-year-old high school dropout, the group boasted their own medical corps, an air force of two Piper Cubs, an arsenal

(Continued on page 110)

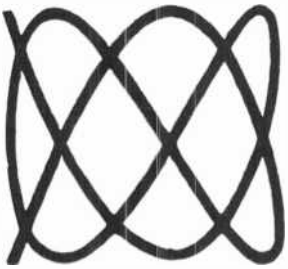
UNKNOWN FREQUENCY QUIZ

By ROBERT P. BALIN

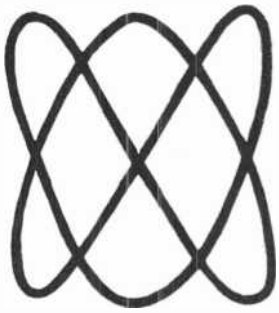
An unknown frequency can be accurately determined by analyzing the Lissajous pattern it forms when combined with a known frequency. Lissajous patterns can quickly tell you the ratio of the frequencies applied to the vertical and horizontal inputs of an oscilloscope. See if you can do problems 1-10. Ratios and unknown frequencies are given on page 95.

(Hint)

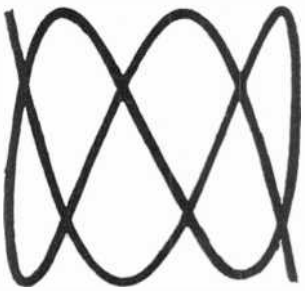
In problem 1, for example, there are three-and-one-half vertical cycles as indicated by the peaks at the top and bottom of the pattern, and two horizontal cycles as indicated by the peaks on either side. This combination or vertical-to-horizontal frequency ratio is 3.5 to 2, or 7 to 4. Therefore, if the vertical frequency is 2800 cycles, the unknown horizontal frequency must be 1600 cycles to produce the pattern shown.



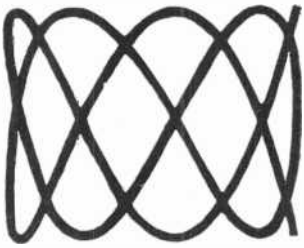
1 V = 2800 cycles; H = ____



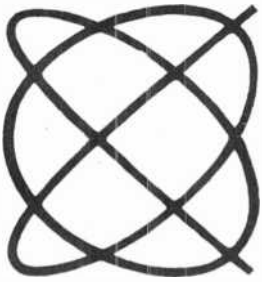
2 H = 500 cycles; V = ____



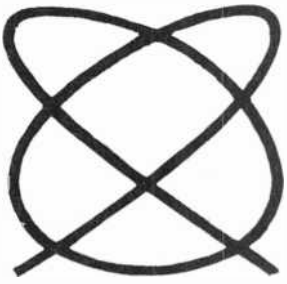
3 V = 1400 cycles; H = ____



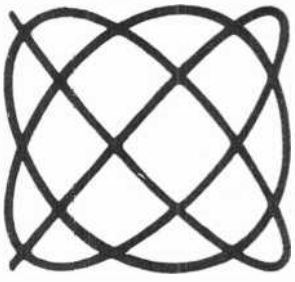
4 H = 240 cycles; V = ____



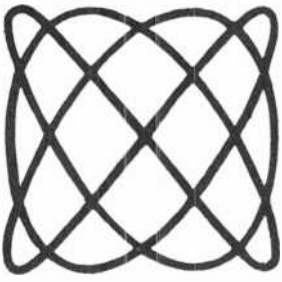
5 V = 1000 cycles; H = ____



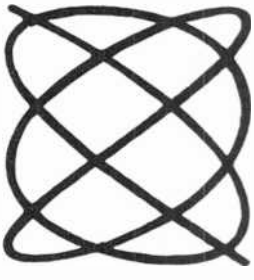
6 H = 60 cycles; V = ____



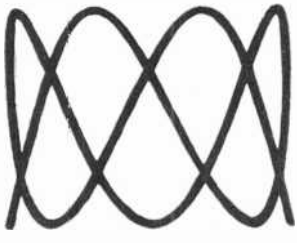
7 V = 4200 cycles; H = ____



8 H = 120 cycles; V = ____



9 V = 3500 cycles; H = ____



10 H = 900 cycles; V = ____

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Automation Electronics. Gets you ready to be an Automation Electronics Technician; Manufacturer's Representative; Industrial Electronics Technician.

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.

Industrial Electronics. For jobs as Industrial Electronics Technicians; Field Engineers; Maintenance Technicians; Industrial Laboratory Technicians.

Nuclear Instrumentation. For those who want careers as Nuclear Instrumentation Electronics Technicians; Industrial Laboratory Technicians; Industrial Electronics Technicians.

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ON THE CITIZENS BAND

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

IN the February edition of this column, we reported that several statewide Citizens Band Radio clubs across the country had formulated plans for organizing a National Congress of Citizens Band Associations. Their ultimate goal is to unite statewide CB Councils which will eventually represent CB'ers on a national scale through a National Congress organized *by* CB'ers and *for* CB'ers.

The groups promoting the association feel that when a representative number of state organizations have exchanged ideas and chosen their representatives, a session can be held to discuss the formation of the National Congress along the guidelines of a proposed set of bylaws. Since the initial proposal was announced, nearly a hundred clubs have exchanged correspondence and ideas. It is hoped that a divisional meeting can be held before the end of the year.

PROGRESS ON NATIONAL CONGRESS FOR CB'ERS

The objectives and functions of such an association have been summed up in a letter we received from Bruce B. McMahon, chairman of the National Congress Committee, Washington State CB Association, Incorporated. Excerpts from this letter follow.

". . . Because of your article we have been contacted by numerous clubs throughout the United States who are interested in forming such an organization but did not know how to go about it.

"We of the Washington State CB Association, Inc., believe that the only way . . . CB'ers will be able to achieve true representation at a national level is through local, state, and national organizations. It is true that several national organizations are already in existence but it is felt that they are not representing the CB'ers at large. A chain of command does not exist through which the ideas or requests of individuals or local clubs can be presented. . . . It is also becoming more and more apparent that these organizations are leaning toward commercialism and individual profit rather than the interest of the CB'ers.

"To be of any help to the individual CB'er, a national organization must be able to work . . . at the local level in order to recognize and alleviate problem areas before they have a chance to get out of hand or become cause for alarm. . . . A national organization can accomplish this through its membership states, down to the clubs and to the individual.

"In forming a National Congress it is essential that clubs within each state band together into a State Association, as membership in the National Congress shall be limited to states so organized. It must also be realized and understood that there can be only one association representing each state as any more would defeat the sovereignty of the state association.

"The Washington State Association has formed a committee to help other interested states become organized. . . . It is our intent and purpose to give all assistance available to those states whose clubs are interested in forming an association. As soon as enough states have become organized, we are then prepared to proceed with the formation of the National Congress of Citizens Band Associations. . ."

The Washington association has published individual sets of the proposed national bylaws, the Washington state bylaws, and a model set of bylaws prepared for local clubs so that the overall structure of the complete organization can be studied. If your club is interested, write to: Bruce B. McMahan, Chairman, National Congress Committee, Washington State CB Association, Inc., P. O. Box 1066, Olympia, Washington 98501.

Flood in Minnesota. Dick Mann reports that CB radio played an important role during recent flooding in Winona, Minnesota, caused by the rising of the Mississippi River. A 24-hour 'round-the-clock CB radio network was established on channel 9 at the local Civil Defense Center in city hall, and all communications during the emergency were directed by CD Communications Chief Roy Evett.

More than 20 mobile CB units were sta-

tioned along an 8-9 mile dike area. All work on the dikes, as well as dispatching of men, sandbags, bulldozers and supplies, was done under the control of CB radio. Once completed, the dikes were patrolled by mobile units until the flood threat cleared.

Also on hand at CD headquarters were amateur radio operators who handled communications between Winona and other cities up and down the Mississippi. Local radio station KWNO also participated with a 24-hour programming setup to relay CD information to the general public. By utilizing CB radio at the emergency site, with relays passed to CD headquarters, and then spread to local and area communities via amateur and AM radio, the three unrelated services established a complete communications warning and alerting system.

CD Communications Chief Roy Evett, 16W3320, is shown manning his CB unit at Civil Defense Headquarters during recent flood emergency at Winona, Minnesota. Roy was on the air more than 400 hours dispatching men and trucks where they were needed.

CB Lifeline. To Tom Finn, Citizens Band radio is far from a nutty pastime. It's an essential communications lifeline. Tom has been a quadriplegic for almost ten years. His spine was severed in an auto accident when he was 19. In his CB conversations Tom fails to mention that he cannot move the lower part of his body or that he is unable to sit up.

Via CB, Tom has established many friendships, none warmer than with a group of CB'ers who call themselves the "Durty Dozen," "even though," comments Tom, "they're neither dirty nor are they limited to only a dozen since they have more than 100 members. The members of this club learned of Tom's disability, and when his first CB set began to malfunction, they decided to get him a new one. At CB coffee breaks each member contributed 50 cents to a kitty that eventually presented Tom with a new transceiver.

Tom has only limited use of his fingers and even the seemingly simple task of turning knobs is difficult for him. So, Don Keever, a fellow CB'er, equipped Tom's new Regency rig with levers to replace the knobs. Bob Jacobs, another CB friend, made a switch box control for the microphone which Tom lays on his chest and works with ease. Bob also mounted the microphone on a flexible tube so Tom would not have to hold it.

In addition, members of the "Durty Doz-

Presenting a new Regency CB radio to quadriplegic Tom Finn are three members of a club called the "Durty Dozen." They are (l. to r.): Clinton Ginn, W. L. Rittenberry, and Charles Arieon. Tom's rig differs from the usual CB set in several ways—see text.

en" learned that Tom had been out of his home only seven times in nine years and that he had to be transported in a prone position. They decided to buy a used ambulance. To earn money they leased an automobile service station and manned it with CB'ers. They soon had their ambulance.

"They're making a regular gadabout out of me," says Tom. "They took me to a coffee break, a Globe-trotter basketball game, and four wheelchair basketball games this year."

Tom's mother, Mrs. Earl Finn, sums up her feelings for Citizens Band operators: "They're wonderful people."

Blue Baby in Massachusetts. A recent press release from the Mount Greylock (North Adams, Mass.) Mobil-Ears indicates that this group has been highly active in REACT emergency assists. One assist involved the relaying of messages from Westfield, Mass., via Plainfield, to North Adams in search of ambulance driver Pete Blohm, KKB2442, who was using his personal auto to deliver a patient, locally.

Pete was not aware that he was expected at Westfield Hospital to transport a blue-baby oxygen case to a Boston hospital. Through the assistance of Ruth Stimson, KBC9990, of Plainfield, and George Trottier, KKA3188, of North Adams, he was finally located and informed of his mission. It would be a close one! Pete was expected at the hospital at 3 p.m.; it was now 1:55 p.m, with a normal two-hour drive ahead from North Adams to Westfield.

Assisting George Trottier on the local scene were Ann Hartman, KKA8380, and Mike and Mary LaVersa, KKA4462. Mrs. LaVersa alerted the State Police that Pete was on his way, "in a hurry." A Sgt. Bowen informed all police and other authorities along the route. Pete was given the go-ahead to "step on the gas, but drive carefully." He evidently set a new record by making the two-hour trip in a little over an hour. He arrived at the hospital in Westfield at 3:07 p.m.

The next day, those who had assisted Pete received QSL's that read: "Picked up baby at 3:07 p.m., OK." Three weeks later, Pete sent another: "The baby is still alive. Thanks, 73's. Pete."

Tornado in Wisconsin. More news has been received regarding assists by CB'ers after the tornado in the Northern Illinois/Southern Wisconsin area on April 11. Members of the Waukesha County CB Club, Inc., Oconomowoc, Wis., were called out at 5:30 p.m. on that fateful Sunday and told to report to Unit 1, Civil Defense of Jefferson County.

Several members were first confronted with the removal of trees that had fallen across county roads, blocking all traffic. While they worked with county highway men, sawing and dragging tree limbs and trunks to the side of the road, other club members relieved highway police officers to enable them to enter the more seriously hit areas.

Under the command of CD officials, CB mobiles directed traffic and set up road blocks, as required. A first aid station was also set up by two YL's. Several of the volunteers assisted until noon the following day.

1965 OTCB Club Roster. The following are clubs that have reported to "On the Citizens Band" for the first time. If your club has not been listed in these pages, forward all pertinent information to: 1965 OTCB Club Roster, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

Hartford, Connecticut: Citizens Communication Service. Group is unit of Connecticut Civil Defense authority. Present officers: Donald Boulanger, KBC2291, president; H. W. Little, Jr., KBD3641, vice president; Carl E. Blass, KBD2273, secretary; Orville LaFerriere, KBC7200, treasurer; Charles Lawrence, KBA3756, communications officer. Unit operates weekly communications net.

Fort Lauderdale, Florida: 11-Meters Citizens Radio Club. Club call is KKP5331. Their excellent newspaper is informative and well-written. Club officers are: Lafeyette Hart, 7Q0913, president; Deb Gaddy, KKP2901, vice president; Les Vaughn, KKP3933, treasurer; Betty Gaddy, KKP2901, secretary; Irene Hart, KDH0209, recording secretary. Newspaper editor Tom P. Towsley, KKP4600, has nine assistants!

Miami Beach, Florida: Dade County REACT, Inc. Group operates Dade County REACT motorists aid program on U.S. Highway #41 (Tamiami Trail) on weekends. George Williams, KKP5213, is director of program. Officers are: John Hendry, chairman; Fred Muller, KDH1404, Tomas B. Magnano, KKP4430, deputy director; Sara Muller, KDH1404, secretary; Jerry Escobar, KDH3098, treasurer. The board of directors is made up of Messrs. Dickert, Ditmars, Flaksa, Hendry, and Wood.

Portland, Oregon: The Oregon Grapevine, Inc. Organized five years ago, this club handles communications for a variety of civic functions: Delta Park Rose Cup Race, Ocean Lake Go-cart races; traffic and crowd control for Pacific International Parade; dispatching and operation of CB-equipped

vehicles for TV marathon fund drives. Group monitors channel 9 nearly 24 hours a day. Officers include: Dave Beadle, president; Bob Wilkinson, vice president; Cricket Jones, secretary; Jo Rasmussen, treasurer; Curt Fenney, Alan Erickson and Martin DeBois, board members; and H. K. Oberg, publicity.

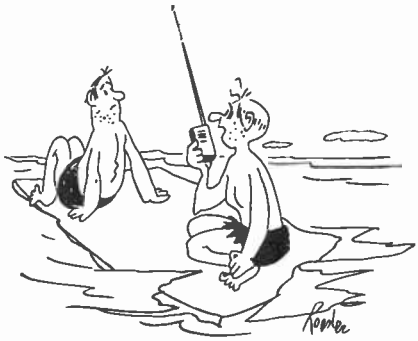
Winston, Oregon: Douglas CB Radio, Inc. The club call is KFG1572. Unit covers Douglas County, is equipped with a mobile CB bus, and is on stand-by for local and/or area emergency assistance. Search and rescue work is under supervision of Roy Fisher, commander of local CD unit; Art McGuire, president of club; and Loren Costello, secretary and communications director, area CD.

Other clubs reporting: In *Russellville, Alabama,* Franklin County CB Club; in *Chicago, Illinois,* The Four Points Radio Organization; in *Battleground, Indiana,* Hoosier Micro-Watts CB Club, Inc.; in *Fitchburg, Massachusetts,* "23" CB Radio Club; in *Cohoes, New York,* Cohoes Area CB Rebels, Incorporated; in *Clearfield, Pennsylvania,* Clearfield Citizens Band Club; in *San Antonio, Texas,* American Civil Emergency Police; and in *Montreal, Quebec, Canada,* De La Province De Quebec CB Club.

FCC Clarification. The Federal Communications Commission has clarified an important element of the rules regarding CB transmitters that can be switched to reduce power from 5 watts to 100 milliwatts. Use of a power reduction switch is not only permissible, it is encouraged. But a transmitter capable of input power higher than 100 mw. does *not* comply with the requirements of the Part 15 Rules, and must *not* be operated without a license even if the user intends to utilize the equipment for 100-mw. operation only.

I'll CB'ing you,

—Matt, KHC2060

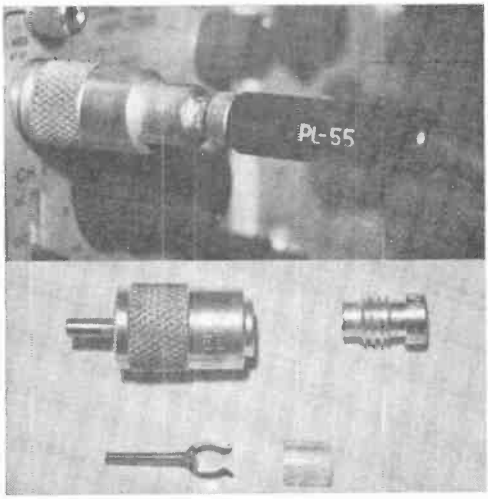


"They're sending aid! What's our zip code?"

TIPS (*Continued from page* 20)

PHONE-PLUG-TO-COAXIAL-CONNECTOR ADAPTER

This adapter is useful for mating ordinary PL-55 type phone plugs to coaxial connectors on many types of electronic equipment. Obtain a standard PL-259 coax plug and a UG-176 cable reducer, and cut off ¼" from the shank of the reducer. Solder a short length of 3/16"-wide spring brass or bronze strip to the tip of a No. 4 or 5 flathead screw, ¾" to 1" long. Bend this strip into



a stirrup shape to conform to the standard phone plug as shown, then cover with a 5/16"-i.d. plastic sleeve. Now insert the assembly in the PL-259 so that it is firmly seated and the screw protrudes through the hollow tip of the plug. Trim and solder the screw. Next, take the shortened reducer and screw it part way into the PL-259. Insert the phone plug as far as possible and rotate the reducer until the tip of the phone plug snaps into place and touches the bottom of the stirrup. After checking final results for continuity, solder the reducer to prevent further turning. —*F. W. Chesson*

FREQUENCY QUIZ ANSWERS

(*Quiz appears on page* 85)

1	7:4, 1600 cycles	6	4:5, 48 cycles
2	3:2, 750 cycles	7	7:6, 3600 cycles
3	7:3, 600 cycles	8	4:3, 160 cycles
4	9:4, 540 cycles	9	5:7, 4900 cycles
5	5:6, 1200 cycles	10	8:3, 2400 cycles

GRANDMA'S BREADBOARD

(*Continued from page 72*)

PIC's "Pin-Up" kit (Fig. 12). The chassis is made of heavy perforated metal. Of the currently available breadboards, this one is probably the best suited for mounting heavy components such as power transformers, filter chokes, etc.

Vari-L's "Develoboard" consists of an open metal chassis equipped with a front panel and a phenolic board on which are mounted 35 wedge-type terminals. Volume controls, switches, pilot lamps, and similar components can be mounted on

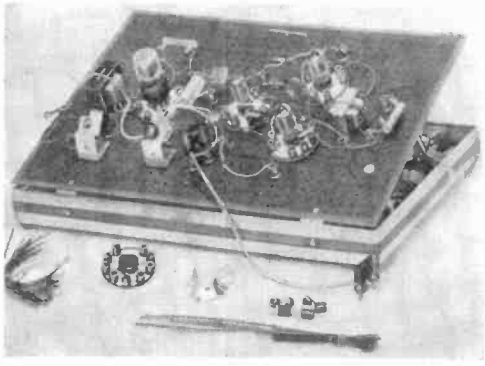


Fig. 10. Experimental vacuum-type circuit wired with an ETA Model K-100F breadboard kit.

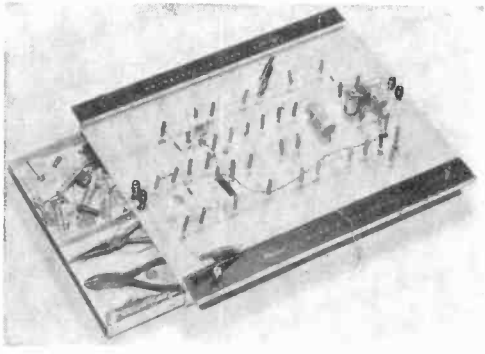


Fig. 11. Control circuit assembled using a Phillips-Advance breadboard.

the chassis or on the front panel. Buckeye breadboards are especially designed for transistor circuits. The kit features both electrically connected and electrically isolated spring-clip connectors. Component leads snap firmly into the connectors.

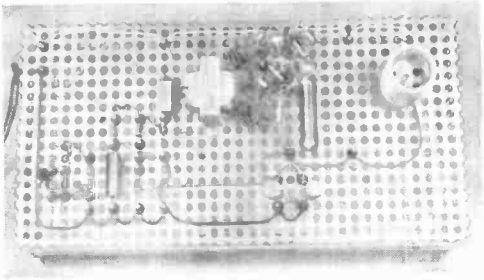
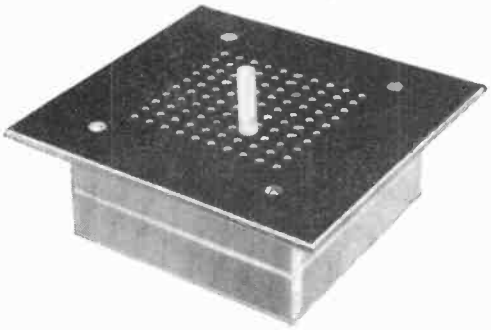


Fig. 12. Solid-state voltage regulator circuit constructed on a PIC "Pin-Up" breadboard chassis.



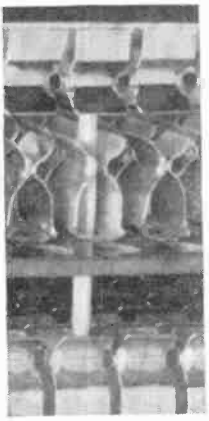


Fig. 13. Sealectro's three-deck "Selectoboard" —a basic breadboard kit for switching and programming circuits.

Sealectro's "Selectoboard" (Fig. 13), is designed to simplify breadboard tests of switching and crossbar matrixes. Shorting plugs are used for interconnections, although special plugs, including partially insulated types, are available.

Vicon's kit is somewhat unusual in that the "chassis" is a base made of soft, plastic-like material. Circuit leads are simply inserted into the base as shown in Fig. 14. The circuit is wired using lap-solder connections. After a circuit has been completely wired and tested,

a special frame equipped with an output connector is put over the breadboard, and a mixture of epoxy resin potting cement is spread over the circuit and frame, as shown in Fig. 15. Once the

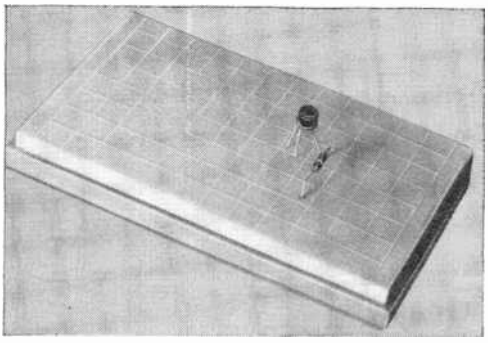


Fig. 14. Components are assembled on Vicon "Proto-Board" by inserting their leads into the soft material comprising the plastic base.

resin has hardened, the entire circuit board is lifted from the base, and the projecting leads are clipped off.

Choosing a Kit. At this point, you'll probably want to ask, "Which is the *best* breadboard kit?" Unfortunately, there

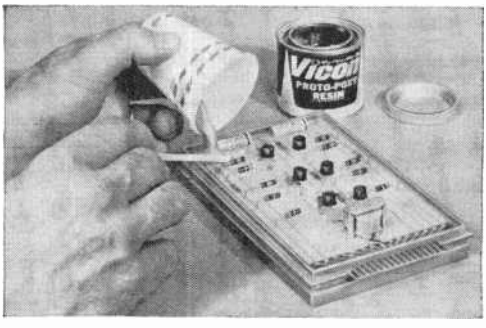


Fig. 15. This "Proto-Board" circuit can be fitted with a frame as shown and covered with a special epoxy resin compound.

is no final answer to this question. Each kit offers some advantage over other designs for some applications, and disadvantages for other applications. For example, kits using coil spring terminals eliminate soldering, reduce the chances of heat damage to sensitive components, and are easy to use, but are not well suited for assembly of critical VHF or UHF circuits.

However, with such a variety of breadboard kits to choose from, the hobbyist or engineer can afford to pick

DO'S AND DON'TS IN BREADBOARDING

DO watch for exposed terminals and leads, especially when working with vacuum-tube circuits which may carry very high voltages.

DO avoid accidental shorts. These can easily occur between exposed component leads. Before applying power, check to see that bare leads are not touching each other.

DO use rubber-covered alligator clips on all test lead connections to avoid short-circuiting components.

DON'T make circuit changes at random just to see what happens. You may damage an expensive part.

DON'T leave parts dangling loose. Mount all parts securely on the board, unless you are merely "jumping" the part for test purposes.

and choose to his heart's content to meet individual tastes or needs.

Many experimenters may prefer to obtain two or three different kits to handle a variety of projects. Where cost is a factor, one can budget the smallest kit offered of the type desired, and later purchase additional components and terminals as needed. Refer to the table on page 71, which lists the kits currently available from the various manufacturers, for pricing information and other details. -30-

LI'L DUSKER

(*Continued from page* 76)

and no other room light—shines on it. Add a microswitch across the photocell, and connect the relay so that increasing light energizes the load (Fig. 7). The microswitch will short out the photocell when pressed.

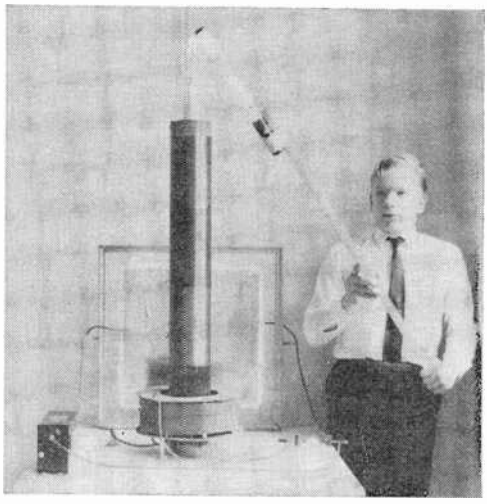
Here's how the touch control works: While the light is out, the photocell "sees" no light and the relay is not activated. A gentle touch of the switch energizes the relay and the light goes on. The photocell "sees" the light and holds the relay energized. The light stays on. Now, how do you turn the light back off? Just pass your hand between the bulb and the photocell to create a shadow. Presto! The lamp goes out and stays out. -30-

LETTERS

(*Continued from page 12*)

"Big TC" Wins First Prize Twice

■ My son, Joseph, built "Big TC" (July, 1964) for his seventh grade science fair. Here he is shown exciting a fluorescent tube. His "Big TC" used a 12,000-volt neon sign transformer; a 12" 15-turn primary coil; a linoleum shipping tube for the secondary coil form; aluminum foil on the capacitor; and plastic popsicle freezer forms for the spark gap mounts. No awards are given in St. Joseph schools, but Joe's project attracted



much attention and caused considerable interest among visitors. Joe is 13 years old, and is attending Bliss Junior High. He has been seriously interested in electronics since he was seven years old. Just thought you might like to hear about another young boy growing up in the field of science.

D. E. ANDORFER
St. Joseph, Mo.

■ I built "Big TC" and entered it in our science fair. Much to my surprise I found a First Prize dangling on my capacitor and got my picture in the newspaper. I used a 9000-volt transformer which someone gave me, and made an oversized capacitor as described in your October, 1964, issue, page 12. The project cost me about $8 and was a lot of work, but it was worth it.

GLENN RICHARDS
Yonkers, N.Y.

OUT OF TUNE

Annual Report on CB Equipment (August, 1965, page 69). The mysterious second unit "to be announced shortly" by Browning Laboratories, Inc., in addition to the "Raven" was mistakenly identified as CB equipment. It will be a public address amplifier. —30—

ASSIST (*Continued from page 38*)

National Radio Model HRO-60 receiver. Coil sets needed. (William P. Stiles, 2201 Linden Ave., Middletown, Ohio 45042)

Precision Apparatus Model 612 tube tester. Operating manual and special instructions wanted. (L. Vaksman, 5855 Drexel Rd., Phila., Pa. 19131)

Philco Model 39-4791 TRF receiver; tunes 550 kc. to 18 mc. Schematic and servicing information needed. (Earl W. Rapp, 25469 Pennie Rd., Dearborn Heights, Mich. 48125)

Collins Model 32RA transmitter, series 8, circa 1942. Instruction manual and three plug-in tuning units needed. (William N. Meppen, Nassau, N. Y. 12123)

RCA Model CRV-46147 receiver, circa 1954; tunes 0.5 to 4.0 mc. Navy technical manual needed. (Bob Troller, 44509 Fern Ave., Lancaster, Calif.)

EICO Model 400 oscilloscope. Power transformer needed. (H. E. Lange, 1043 E. 70 St., Long Beach, Calif. 90805)

Supreme Instruments Model 563 audio oscillator, ser. 1845. Schematic and alignment instructions needed. (T. E. McLaughlin, R. D. 2, Nassau, N. Y. 12123)

Dumont A/R "Range Scope," type 256-B, ser. 772. Schematic & operating manual needed. (Orville H. Huish, 479 Chestnut Ridge Rd., Hubbard, Ohio 44425)

Rider Perpetual Trouble Shooters Manuals Volumes 1 to 5. (Gerald C. Bowen, Route 3, Box 211, Shelby, N. C.)

Westinghouse "Aerolia Sr." receiver and "Aerolia" two-stage amplifier. Schematic and WP11 tube needed. (James Doughty, 1½ Ulebber Pl., Texarkana, Ark.)

Federal Mfg. & Engrg. Model LP-5 r.f. oscillator, type CFD-60006-A, circa 1945. Schematic, power cord and operating manual needed. (E. Duree, Box 267, Laytonville, Calif. 95454)

RCA Victor Model 220 receiver; tunes 540-3500 kc. Schematic, speaker data, and year of manufacture wanted. (Terry Zirney, Box 86, Roberts, Ill. 60962)

Hickok Model 560 (SPL) tube tester. Roll chart, schematic, and information to test current tube types needed. (Harry E. Kraus, 147 W. Beamer, Woodland, Calif. 95695)

Silvertone Model 1830 receiver, circa 1934. Variable capacitor needed. (John Uhl, 176 W. Main St., Rochester, N. Y.)

Truetone Model 147 receiver, ser. 398038, circa 1942; tunes BC and s.w. from 1.8 mc. to 15.7 mc. Schematic and list of parts needed. (Steven Jeske, Route 3, Box 173, Buffalo, Minn. 55313)

Hallicrafters Model 540-A receiver; tunes 0.54-44 mc. on 4 bands. Schematic and operating manual wanted. (Charles J. Beaumont, 439 Central Ave., Brooklyn, N. Y. 11221)

Crosley Model 51 receiver, ser. 31889E; has 2 tubes; tunes s.w.; is battery-operated. Diagram and tubes needed. (Stanley Bazylar, 8477 11 Mile Rd., Warren, Mich. 48093)

Philco Model 87 receiver, circa 1928; tunes 550-1500 kc.

Supreme Model 546 oscilloscope. Schematics or service information needed. (Thomas A. Berry, Box 338, Lot 38, Niceville, Fla. 32578)

Grunow Model 1541 receiver; has 15 tubes; tunes 55 kc. to 70 mc. on 4 bands. Schematic and operating instructions needed. (Fred Fischer, 2406 W. Lapham St., Milwaukee, Wis. 53204)

BC-342 receiver, circa 1943. Case needed. (Claude Hodge, Box 202, Holcomb, Mo.)

Packard Bell Model 166641 receiver, ser. 48A16334; has 8 tubes. Tube numbers, schematic, and tube layout needed. (George T. Wiser, 123 E. 3rd N. St., Anthony, Idaho 83445)

Tubes (6K7, 6N7, 6L7, 6B8, 6F6, 6J5) needed. (Rick Patterson, 1547 Indianola Ave., Akron, Ohio 44305)

Bendix Model 0636BA receiver; has 6 tubes. 14A7GT and 35A5GT tubes needed. (Gerald Georgopolis, 75 Cross St., Lawrence, Mass. 01841)

World Radio Labs. "Globe Scout" receiver; tunes 80 to 10 meters. Schematic, plug-in coil, and crystal data needed. (Mike Webster, RD 2, Central Square, N. Y. 13036)

PHASING SPEAKER SYSTEMS

(*Continued from page* 66)

Repeat this process with speakers *C* and *D* in the other cabinet. If there are more than two speakers in the second enclosure, compare them, one at a time, with speaker *C*.

Phasing the Enclosures. Once all the speakers have been phased in each enclosure, phase one enclosure with another in the same manner. It is important that you be located where you normally listen to your system, and that the enclosures be positioned in their normal setup. Reverse leads 7 and 12, as shown in the diagram, and listen for the louder sound. As before, the louder sound indicates an in-phase condition.

One word of caution: know your amplifier before you attempt to disconnect or short out the speakers. On some amplifiers you can turn down a level control or adjust a balance control to quiet a string of speakers; on other amplifiers you can short out one or more speakers with a jumper; and in some cases you can disconnect the speakers. The safest course to follow is to substitute a proper resistor for the speakers to act as a dummy load. Avoid running an amplifier with no load, or with a shorted load.

A quick dummy load can be improvised from a 1000-watt or a 1300-watt heating element; resistance will be on the order of 10 to 14 ohms. Such elements can handle all the power output from your amplifier. A toaster, iron, or broiler will do nicely. -30-

"Have you tried speaking to this neighbor who plays the 1812 Overture at full volume all night?"

PARTS PROFILES

(*Continued from page* 58)

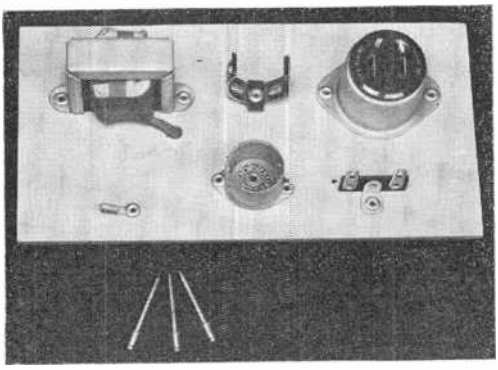
nuts and bolts. "Pop" rivets can be set blind (from one side of the work) and require no bucking or backup. They can be removed by drilling.

By now, you've probably seen "Pop" rivets in most of the hardware stores and some of the electronic distributors, under trade names of United, Rivetall, and one or two others. Perhaps you have wondered just what good they would be for electronics work. Well, there are some nut locations that even a plastic nut starter can't get to, particularly if you are doing some replacement work deep inside an already wired chassis. This is a snap for "Pop" rivets.

They look like an eyelet with a nail stuck through it. You insert the eyelet end into the work from the finish side after drilling a #30 or an 1/8" hole (a #30 drill is recommended). A riveting tool is used to grab and pull the nail end to set the rivet. When the eyelet is properly clinched, the nail portion snaps off with a loud pop, completing the operation.

You can use these rivets to hold down parts or assemblies that won't be taken apart too often, such as transformers, tube sockets, terminal strips, chassis brackets, mounting clips, ground lugs, etc. Even more important, the rivets make equipment "child-proof" if covers are riveted in place. Back-up plates are available to reinforce, if necessary, a riveted section of thin sheets of aluminum, or other soft metal. Metal washers (1/8" i.d.) serve the same purpose, and are less expensive. Long rivets are available for fastening parts to heat sinks, or riveting wood or fiberglass panels.

The riveting tool is a one-time purchase. **("Pop" rivets, 25 for 49 cents. Rivet tool, $4 to $6 at distributors or hardware stores.)**



SOLID STATE

(*Continued from page 80*)

work with some transistors, and may even stop oscillating altogether if the supply voltage deteriorates even slightly. If there is too much feedback, the transistor may be damaged, or the circuit may "block" at periodic intervals, superimposing an ultrasonic or audio tone on its output.

In the design of r.f. circuits, precautions must be taken to maintain frequency stability under varying conditions. If this is not done, the interelectrode capacity of the transistor will vary with modulation, changes in ambient temperature, or variations in the supply voltage, resulting in a shift in oscillator frequency. To overcome this condition, two techniques can be employed: (1) the use of a circuit in which the internal capacitance of the transistor can be "swamped" by an external fixed capacitor, and (2) "tapping down" on the coil to limit the effects of the transistor on circuit *Q*.

In circuits using relaxation oscillators, the oscillator frequency is determined by the time constant of an *RC* network rather than by an *LC* tuned circuit. In the design of these circuits, the internal resistance of a transistor must be considered, for the resistances may approximate the values of the resistors in the *RC* network.

We've reached our closing point for this month, fellows, so we'll "30" until next month.

—Lou

PREDICTED CONDITIONS

(*Continued from page 77*)

broadcasters in the international service are aware that the number of short-wave receivers capable of tuning 19 meters is much greater than those capable of tuning either the 16- or 13-meter bands. Broadcasters interested in reaching the largest possible audience will schedule their transmissions so that this band will be heavily populated.

From sunrise until shortly after noon, most of the broadcasting channels in the 19-meter band will be occupied—some by more than one transmitter. The *VOA* relay station in Liberia will be using 15,445, 15,360, and 15,270 kc. during the early afternoon and should be audible in North America on one of these frequencies; these transmitters have an output of 250 kw. Rumania will be

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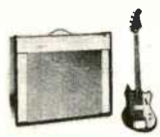
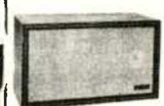


New! 25-Channel, Solid-State C.B. Transceiver Model HB-600

New! Criterion Hi-Fi Bookshelf Speakers



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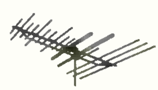

Do A Friend A Favor . . .

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one of the most difficult broadcasters to observe; however, this country will be operating briefly on 15,380 and 15,250 kc. at about 1000 EST. The transmitter on 15,380 kc. will be beamed to Africa and the transmitter on 15,250 kc. will be beamed to India.

25 Meters. Best reception in this band will take place during the afternoon hours, local time, from Europe, Africa, and Asia. The Latins will start pouring in during the early afternoon and will continue to be heard until the evening hours. Ghana, using one of its new high-powered transmitters, should be easily heard on 11,800 kc. with its late-afternoon African-language service. Among the Latins, the Argentine station on 11,710 kc. with a 10-kw. transmitter should be the easiest to find. Haiti will be on 11,835 kc. and Brazil will be on 11,865 kc. with low-powered equipment.

31 Meters. This band will be good for DX from mid-afternoon until the evening hours. Jordan, on 9503 kc., will be a good catch for most SWL's because of its low power. Both West Germany and the Soviet Union have announced possible use of this channel, so you'll probably have to do some digging to catch Jordan under their QRM.

41 and 49 Meters. Both of these bands will continue to produce good DX from sunset to a few hours after sunrise. Tremendous QRM and interchannel interference is to be expected. Practically all international broadcasters have scheduled transmissions in one or both of these bands. By 1966-1967, sunspot activity will have risen to the point where the higher frequency bands will be more useful during the evening hours and crowding on these bands will abate.

Broadcast and Long-Wave Bands. With the seasonal decrease in nighttime static levels, and the increase in nighttime hours, there will be a gradual pickup in the number of DX openings on these bands. As the fall season progresses into late October, some transatlantic and transpacific openings are possible. -30-

AMATEUR RADIO

(*Continued from page 82*)

lightning arrestor for a "long-wire" antenna. Set the plug gap to about the thickness of a sheet of paper for a receiver and to about 1/16" for a transmitter. The gap should be just large enough for normal line voltages not to arc over. Connect the top of the plug to the antenna, and connect the plug base to a

good earth ground through a heavy conductor. (A piece of one-inch pipe at least six feet long driven into the earth will serve as a satisfactory ground. Make the connection to it as short and direct as possible.)

Reading Matter. A small booklet (24 pages) with a long title is *A Condensed Manual of Radiotelegraph Operating Procedure and Technique for the Amateur Service*, compiled and published by The Aeronautical Center Amateur Radio Club, Inc., Postal Station 18, Oklahoma City, Okla. 73169. It's hard to imagine any amateur CW operator who couldn't benefit from reading this little booklet. Not every experienced CW operator will agree 100% with everything said in it, but none would deny that if all hams followed the procedures recommended CW operations in the ham bands would improve greatly. Copies are available from the Aeronautical Center ARC for 25 cents each.

If you can read either French or German, you will probably enjoy the colorful bulletin *Der Old Man* published by the Swiss Union of Short Wave Amateurs (USKA). To obtain a copy, send two International Postal Reply Coupons to Public Relations, USKA, Postfach 21, 6020 Emmenbrucke 2, Switzerland.

News and Views

Dan Shames, WB6JYL, reports that the QRP (Low Power) Club has modified its rules to permit high-power stations (over 100 watts) to join as "booster members." Such members will receive the QRP Club *News Letter* and enjoy most of the other advantages of belonging to the club. Full details on regular and booster memberships are available from: K8DZR, 2146 Chesterland Ave., Cleveland, Ohio . . . **Barry Kneabone, WN1CCZ,** RFD #2, Wrentham, Mass., worked 11 states on 80 meters, running less than 80 watts of power his first three months on the air. Then Barry switched over to a 30-watt, home-brew transmitter and quickly ran the total up to 32 states and a "mess" of Canadians. A long-wire antenna and a Lafayette HE-30 completed his Novice setup. A Lafayette HA-90 VFO for the transmitter awaits the arrival of his General Class license, which is expected momentarily . . . Reading between the lines, **Steve Lustgarten, WNØJES,** 4417 N. 78th Ave., Omaha, Nebr., worked close to 45 states in his first nine months on the air, but he has been able to get QSL cards from only 32 of them. When you work him on 40 or 15 meters, you can ask him what he has in the way of equipment; he didn't say in his note.

Roy Moore, WN4YKA, 307 Nunn St., Hazard, Ky., started his radio career as an SWL, holding the P.E. Monitor Registration of WPE4FWH. In two months as a Novice, Roy has worked 20 states with his Heathkit DX-60A transmitter and Knight-Kit R-55A receiver. An 80-meter dipole antenna did most of the radiating . . . Commenting on our remark in the May column about adding a

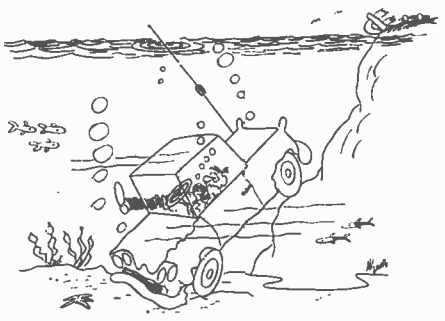
GMT hand to a 24-hour clock, **Earl Henson, W3ZNF,** R.D., Camden, Del., suggests setting the clock to Greenwich time and adding an extra local-time hand to it. Earl points out that GMT is a must for MARS members and is advisable for all amateurs . . . **Leonard Quimby, WN7COB,** Route 1, Halsey, Ore., is organizing an 80-meter traffic net for Oregon and Washington hams . . . And **Allan C. Shepler, K3WKJ,** 325 S. Liberty St., Orwigsburg, Pa. 17961, has organized the "Eastern Atlantic Teen Amateur Radio Association," which meets on 3840 kc. at 8 a.m., each Saturday . . . **Dennis R. Vernacchia, WB2JDW,** 33 Davenport Ave., Newark, N.J., worked 30 states and three countries—mostly on 40 meters—during his nine-month Novice career. His record is now 49 states and 25 countries. The missing state is Hawaii. Dennis uses a Johnson Viking-1 transmitter to feed an 80-through-10 meter "fan" dipole antenna and receives on a Hammarlund HQ-110A.

Joe Larson, WA9NDV, 410 Lawrence Ave., Rothschild, Wis., made three contacts in his first six months on the air. He then changed antennas and quickly worked 24 states. Now, two days after the arrival of his Conditional license, Joe is looking for a VFO for his Knight-Kit T-60 transmitter. He still receives on a "vintage" Hallicrafters S-53. . . . If you haven't yet sent in data on your high school radio club to the Elkhart High School ARC, Elkhart, Ind. 46514, why not do so now? If you include a stamped return envelope with the data, you'll receive a list of the school radio clubs tabulated so far. **Stan, W9FQN,** the Elkhart High School ARC adviser, has submitted an objection to the FCC's proposal to eliminate 2-meter phone privileges for new Novices in return for a two-year Novice license. He says that combining 2-meter phone operation with the club code and theory classes has resulted in the club graduating several General operators this year. In previous years, when 2-meter phone was not used, an average of only one student a year got his General Class license. Incidentally, one of the new Generals is a YL.

Did you ever hear of a DX man who didn't emphasize the necessity of listening? Here's another one. **Bill Crawley, K1NIT/MM,** *USS Mount Baker (AE-4),* Fleet Post Office, San Francisco, Calif., writing from the South China Sea, reports that while in the Tonkin Gulf—rated by the U.S. Navy as one of the world's poorest listening areas—he heard two W6's on SSB working each other across town, running full power, and griping about DX conditions. A VU (India) tried to "break" them eight times before he gave up. Also, a W3 on CW called "CQ DX," and raised a JT1, which is in Zone 23, Outer Mongolia, but the W3 never knew it. He was calling "CQ DX" again before the JT1 stood by! Bill has some advice for QSL'ing Navy "Maritime-Mobile" stations. First, be patient. It often takes over a month for an airmail letter to reach the ship. As for boat mail—just forget it. Second, keep in mind that a sailor usually has a very limited income; so return postage is most appreciated . . . VHF operators in California should be interested in the California State FM Association's Frequency Directory, which lists the frequencies of 50-, 144-, and 420-mc. FM and AM nets in California. To get a copy, send a postpaid return envelope with your request to **Douglas E. Decker, WA6TAD,** 5901 Streamview, Apt. 3, San Diego, Calif. 92115.

Letters, pictures, and club bulletins, as well as your "News and Views" are a big help in preparing *your* column. We are also interested in learning of your club's plans for code and theory classes for the next year. Send all communications to: Herb Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana 46401.

73, *Herb, W9EGQ*



"You're coming in a little garbled, WA2HDQ . . . Over."

SHORT-WAVE LISTENING

(*Continued from page 84*)

consisting of a .22 pistol, a jungle knife, and a Molotov cocktail (one apiece), and plans for a prisoner of war compound, barracks, and heavily fortified islands. When given the information, an official of the Federal Aviation Agency on Swan Island quipped, "I didn't know that we wanted to be liberated." We wonder if the station personnel of *Radio Americas* also realized that they could have been "liberated."

The World. The Foreign Broadcast Information Service's up-to-date *Broadcasting Stations of the World* is now available. For complete information and price, write to the U. S. Government Printing Office, Washington, D. C. 20402.

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 identification, and the make and model number of your receiver.

Angola—Station CR6RS, *R. Clube de Lobito*, 4908 kc., opens on Sundays around 0100 with an anthem and ID in Portuguese. Music usually follows, fading around 0120.

Brazil—Rarely reported is PRL3, a government station operated on 11,950 kc. by the *Ministerio da Educacao e Cultura* in Rio de Janeiro. It has been logged with good signals from 2155 to 2203 s/off.

Bulgaria—*R. Sofia* can be heard at 2100 s/on on 9500 kc. in Spanish to South America. Signals are best when *R. Santo Domingo* is off the air. The N.A. xmsn is now aired only on 9700 kc. at 1900 and 2300.

Canada—Recent frequency and time changes: to Australasia in Eng. at 0230-0330 on 9625 and 5970 kc.; to Africa in Eng. and French at 1330-1500 on 17.820, 15,320 and 11,720 kc.; and to Europe in Eng. for the Canadian Armed Forces at 0100-0130 on 9625 kc. English to N.A. is currently scheduled at 1800-1830 on 15,190, 11,720, and 9625 kc.

Station CBUX, 6160 kc., a relay station of CBU, Vancouver, has changed its call-sign to CKZU. It operates 24 hours daily.

Congo (East)—*R. Leopoldville*, 4741 kc. (but drifting to as low as 4730 kc.) was noted at 2300 s/on on a Saturday with newscasts in Eng., French and native language. Fading took over around 0130. This xmsn represents a move from 4880 kc.

Cuba—Havana's current schedule shows French at 1400-1510 and Eng. at 1510-1640 to Europe on 15,155 kc.; Eng. to N.A. at 2200-2330 and 0000-0100 and French at 2330-0000 on 11,865 kc.; Eng. to South America at 1550-1650 on 15,135 kc.; Arabic at 1530-1610 and French at 1610-1640 to Mediterranean areas on 15,300 kc.; Portuguese to South America at 1800-1900 on 15,340 kc.; and Creole to the Caribbean at 0600-0700 and 2100-2200 on 6060 kc. Other xmsns noted include French to N.A. at 2335-0010 on unlisted 6226 kc.

Ecuador—Station HCAH3, *R. Trebol,* Zaruma, 4916 kc., is audible during the week from 2200 to 2230 s/off (Saturdays to 2300) with a good signal but usually poor modulation.

Formosa—*Voice of Free China,* Taipei, has been observed using a new frequency of 15,125 kc. at 1135 with Arabic and at 1145 with an Eng. ID.

France—A Parisian newspaper gave this complete schedule: to Latin America on 9755 and 11,845 kc. in Portuguese beamed toward Brazil at 1815-1900, in French to 1930, French lessons to 1945, and Spanish to 2145; to Bulgaria in Bulgarian on 9755 and 7160 kc. at 1400-1445; to Canada in French on 17,850 and 15,130 kc. at 1230-1245 (except Saturdays and Sundays, Fridays to 1255); to Spain in Spanish on medium-wave 944 kc. at 1700-1800; to Germany in German on medium-wave 1277 kc. at 1300-1400 (except Sundays), on Sundays at 1340-1430 with French lessons at 1345-1400; to Hungary in Hungarian on 5955 and 9570 kc. at 1315-1400; to Middle East in French on 11,845 and 15,130 kc. at 1030-1045; to Poland in Polish on 9560 kc. at 0500-0600, and Dominical Mass in the Polish Church of Paris on 1376 kc. at 1230-1300 (except Sundays), and on 6145 and 7160 kc. at 1400-1500; to Portugal in Portuguese on 9620 and 7280 kc. at 1400-1430; to Rumania in Rumanian on 7240 and 9755 kc. at 1315-1400 (French lessons on Mondays, Tuesdays, Thursdays and Fridays at 1345-1400); to S. E. Asia on 15,245, 17,720, 17,850, and 21,580 kc. at 0800-0830 in Eng. and to 0900 in French, also at 0830-0900 on 13.95 meters (about 21,500 kc.); to Czechoslovakia in Czech and Slovak on 5955 kc. at 1400-1500; to U.S.S.R. in Russian on 7160, 9620, 11,885, and 15,160 kc. at 1100-1200 with French lessons from 1145 to 1200; to Israel in Yiddish on 9620 and 11,845 kc. at 1615-1635 (except Sundays); to Yugoslavia in Serbo-Croatian on 6145 and 7160 kc. at 1400-1445. The French course is broadcast separately to Great Britain at 1500, to Portugal at 1515, and to Spain at 1530, all on 6175 kc. An listed xmsn has Eng. news on 9700 kc. with s/off at 0030.

Germany (East)—*R. Berlin International* now quotes 9770 and 11,920 kc. to West Coast N.A. at 2245 and 2345, and 9560 and 11,880 kc. to East Coast areas at 2000 and 2130.

Germany (West)—Cologne's current Eng. schedule: 0000-0040 on 6145 and 9745 kc.; 0105-0135 on 11,785, 15,275, and 17,845 kc.; 0345-0440 on 11,925, 15,275, and 17,845 kc.; 1010-1050 on 9735, 11,795, and 11,925 kc.; 1050-1120 on 15,295 and 17,875 kc.; 1115-1210 on 15,275 and 17,845 kc.; 1520-1550 on 9605 and 11,785 kc.; 1610-1700 on 5980 and 9530 kc.; 2030-2150 on 6075 and 9640 kc.; and 2200-2240 on 9530 and 11,795 kc.

Gilbert and Ellice Islands—Station VTW3 is said to operate on 3215 kc. with 300 watts (not 3000 watts as given by some sources), but to date there has been no sign of this station on that frequency or any other.

Three Hallicrafters receivers—an SX-110 plus a standby S-120 and SX-25—are part of the good-looking shack of Paul Slater, WPE1FRT, Medford, Mass. Paul has veries from 42 countries, 21 states.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	R.—Radio
ID—Identification	s/off—Sign-off
IS—Interval signal	s/on—Sign-on
kc.—Kilocycles	xmsn—Transmission
N.A.—North America	xmtr—Transmitter

Greece—A letter from the Hellenic National Broadcasting Institute, 16 Mouroysi St., Athens, states that the Foreign Service has been discontinued. Another recent letter from the station gives this schedule: Greek only to England and France at 1230-1300 and to N.W. Europe at 1430-1600, all on 11,720 and 15,345 kc.

Greenland—*The Voice of Greenland* operates two 1000-watt xmtrs at Kook Island, according to a letter from the station. One is on 5980 kc. beamed towards Agmagssalik, and the other on 3993 kc. beamed north-south. The station will be pleased to receive reception reports, which will be answered by personal letters or verification cards.

Iceland—Reykjavik has discontinued operations on the short waves due to technical difficulties.

Iran—Teheran has moved up to 11,750 kc. where it is noted with pop records until Eng. closes at 1530. The station is asking for reports, and continues to give the frequencies as 7125 and 11,730 kc.

Italy—Rome operates to N.A. at 1930 and 2205 on 11,905 and 9630 kc. A new channel in use is 9540 kc., heard from 2035 to 2115 in Italian and beamed to Central and South America.

Lebanon—Beirut has again changed frequency, this time to 9710 kc. We don't have the official new schedule, but monitor reports indicate that the

SHORT-WAVE CONTRIBUTORS

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Andre Maurice, Astoria, N. Y.
Michael McElhatton, Willow Grove, Pa.
Wolfgang Schafer, Hamburg, Germany
R. Nederland, Hilversum, Netherlands
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

SHORT-WAVE MONITOR CERTIFICATE APPLICATION

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

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

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N.A. programs are aired now in French at 2030-2100, in Arabic to 2130, in Eng. to 2200, in Arabic (to West Coast N.A.) to 2330, and in Spanish to 2300. Omnidirectional xmsns are at 2330-0230 and 0915-1320 on 5980 kc. and at 0430-0900 on 9545 kc.

Malagasy Republic—*R. Malgache,* 15.270 kc., is heard from 1101 to 1142/fade with a female in French and a male in English, with rock-and-roll music and frequent ID's given in both languages.

Netherland Antilles—Station PJB, *Trans World Radio,* Bonaire, has been heard on 9555 kc. at 2330 in Russian; on 9590 kc. at 2030-2120 relaying the programs of *R. Nederland,* and from 2130 in Dutch ("The Happy Station Program" on Sundays); on 11,785 kc. from 2200 with Eng. in the usual format; on 11,855 kc. at 1000 s/off, at 1940 with "Song Time," and also from 2215; and on 15,220 kc. at 1455-1550 (replacing 15,290 kc.) to West Africa with news, talks, music and variety shows. Send reception reports to *R. Nederland,* Hilversum.

Netherlands—*R. Nederland,* 11,950 kc., Hilversum, transmits at 1455-1550 (replacing 11,970 kc.) in Eng. to Africa with world and home news, music, and a mailbag. The second N.A. xmsn is now being relayed via Bonaire on 9590 kc. at 2030-2120.

Nigeria—*The Voice of Nigeria,* Lagos, has extended its broadcast day by two hours. The new schedule reads: French at 0800-0900 and 1400-1600, Hausa at 0900-1000, Eng. at 1000-1100, 1200-1400 and 1600-1700, and Arabic at 1100-1200. Frequencies: 11,900 kc. at 0800-1100 and 1200-1700, and 15,255 kc. at 1100-1700.

Peru—Station OAX6E, *R. Continental,* Arequipa, is heard on 5930 kc. with native music; s/off weekdays is at 0000. Station OAX7L, *R. Altiplano,* Puno, 5850 kc., was logged from 2020 to 2030 s/off with a theme from Bizet; it is assigned 5809 kc. Station OCX4W, *R. Inca,* Lima, 4763 kc., has returned to the air and is noted after 0100 with Latin American pop tunes, commercials, and frequent ID's. Station OAZ4T, *R. Chanchamayo,* La Merced, listed for 4895 kc., presently is on 4861 kc. with commercials at 2250 and s/off at 2302, using the same musical number as *R. Victoria,* Lima, 6012 kc. Station OBX7C, *R. Onda Azul,* Puno, 4801 kc., features much Peruvian folkloristic music. This channel is normally blocked by a strong teletype station.

Philippines—The daily schedule (Monday to Friday) of the Far East Broadcasting Co. reads: to Australia, Malaysia, Japan, and Indonesia on 15,300 kc. until 1830, on 15,380 and 17,810 kc. until 2000, on 15,380 kc. until 2200, and from 2100 to 2200 on 9710, 11,740, and 17,810 kc.; to Thailand, Malaysia, Indonesia, and Japan on 15,430 kc. until 0745, on 15,300 kc. until 0400 and at 0645-1030, on 17,810 kc. until 0645, on 11,920 kc. until 0400 and at 0645-0745, on 9710 kc. until 0400, and on 9500 kc. at 0745-1130. The Sunday schedule is essentially the same.

Poland—Warsaw still broadcasts in Eng. to Europe at 1330-1400 and 1430-1500 on 6135 and 7125 kc. as well as at 1530-1600 on 5950 and 7145 kc. The music programs can be heard at 1830-2000 on 7125 and 7270 kc.

Spain—*Radio Nacional de Espana,* Madrid, was noted on 15,425 kc. with IS and s/on at 0615, then news in Spanish to 0630.

Switzerland—Berne's schedule to N.A. is in effect until November 6 and reads as follows: at 2015-2145 (East Coast) on 9655, 9535, and 6120 kc.; and at 2315-0015 (West Coast) on 9655 and 9535 kc.

Syria—Damascus is noted on 15,190 kc. at 1730 s/on, with an ID in Spanish, and then recordings. The signal faded after 1800.

Togo—Lome, 7175 kc., was logged at 0020-0045 s/off with French rock-and-roll; news in French is given at 0030.

Uruguay—An unlisted station is being heard in Spanish on 11,845 kc. around 1930. Anmts indicate that the location is Montevideo. Do not confuse this one with Paraguay on 11,850 kc.

U.S.S.R.—*R. Kiev* is scheduled to Western Europe at 1400-1430 on 9760 and 7210 kc., and to N.A. at 1930-2000 on 11,790, 9810, 9680, 9660, and 7180 kc., and at 2330-0000 on 9680, 9660, 9610, and 7180 kc. This schedule is in effect on Mondays and Thursdays only. The 11,790-kc. outlet is noted around 1800 when *R. Kiev* operates as a regional station.

Windward Islands—St. Georges is using a new frequency of 15,100 kc. at 1800-1930, with news, request music, time checks, and features. —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.

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Tom Spurlin (WPE9DKT), Vandalia, Ill.
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Don Eggert (WPE9FMV), South Bend, Ind.
Joel Cesnick (WPE2LMZ), New York, N. Y.
Mike Shannon (WPE9HDX), Appleton, Wis.
Richard Clinard (WPE4GNV), Madison, Tenn.
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Thirty States Verified

Dick Schier (WPE4HIO), Chattanooga, Tenn.
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James Peshock (WPE5HQD), Richardson, Texas
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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.

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FREE GIANT BARGAIN CATALOG! silicon mesas, planars, duals, darlingtons, medium and high power transistors; integrated circuits; 250mw to 10W zeners, references; top hat, epoxy, stud rectifiers, diodes; silicon control rectifiers, switches; prepacked **"POLY PAK"** $1 parts specials. Poly Packs, Inc. P.O. Box 942, Lynnfield, Mass.

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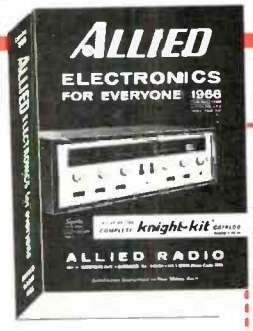

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