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POPULAR ELECTRONICS

MARCH 1965

35 CENTS

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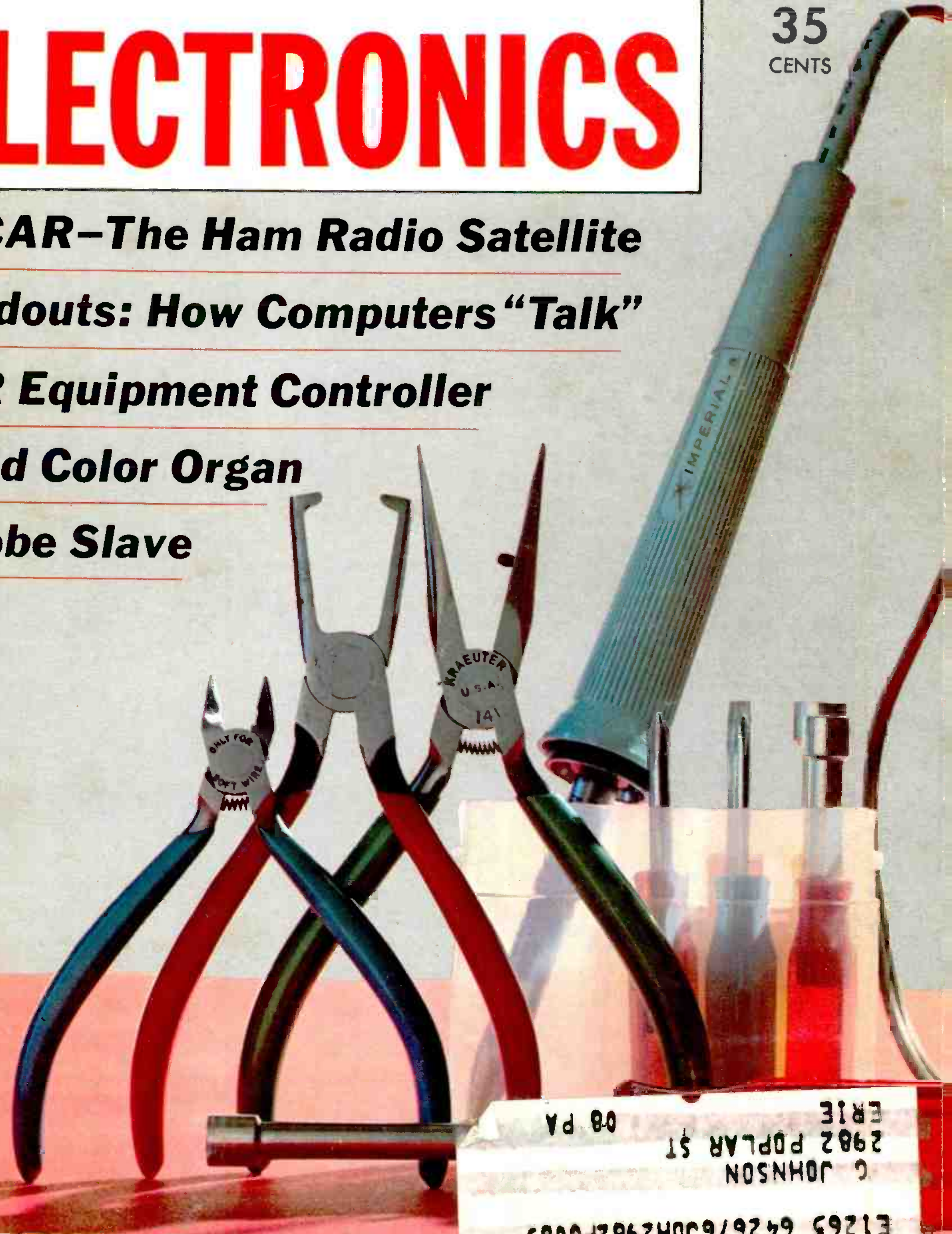
SCR Equipment Controller

Build Color Organ

Strobe Slave



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This month's cover photo by Bruce Pendleton
Equipment shown: Xcelite screwdrivers, Kraeuter pliers; Ungar soldering iron

VOLUME 22 MARCH, 1965 NUMBER 3

Special Feature

Special Tool Section

Construction Projects

Amateur, CB, and SWL

Electronic Features and New Developments

Departments

CIRCLE NO. 16 ON READER SERVICE PAGE

POPULAR ELECTRONICS

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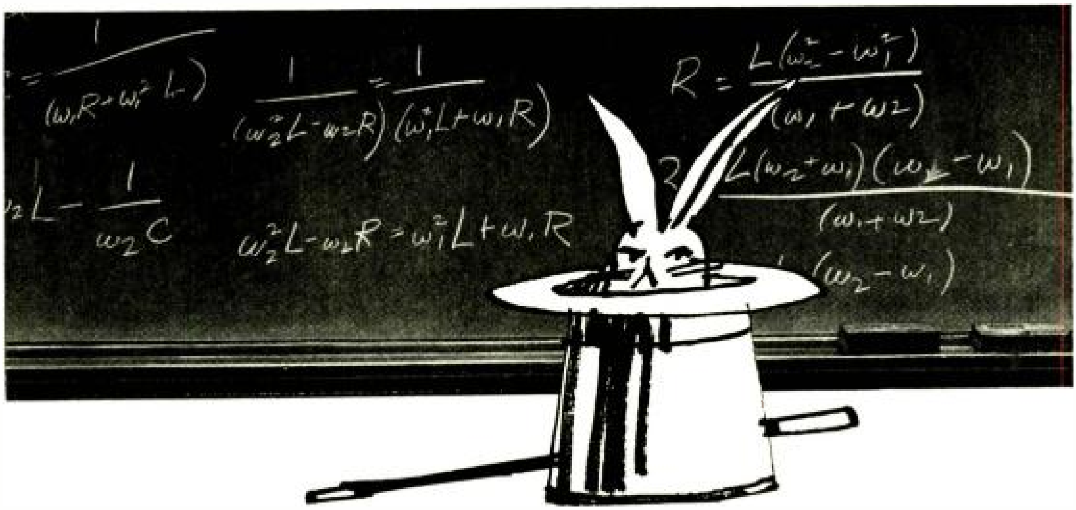

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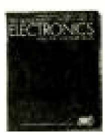

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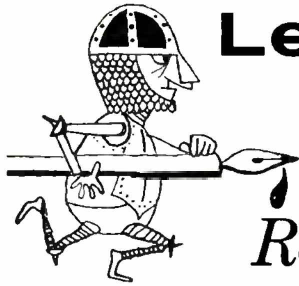
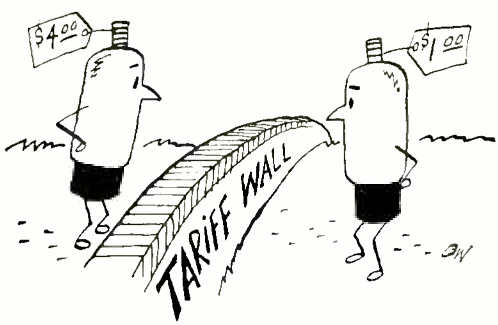


Letters from our Readers

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

Parts Cost $$$ in Canada

■ I wonder if your American readers are aware of the deplorable state of the electronics parts business in Canada? The majority of Canadians who construct even the simplest of projects have to resort to stripping old radios, etc., for parts because of the horrible prices we have to pay here. I, myself, and a lot of other guys I know look at a project and say, "Boy, wouldn't I like to build that!", and then pick up a Canadian catalogue and tearfully forget about it. Do American manufacturers and distributors really give a darn? How about the Canadian *wholesaler* who sells for 300 percent over the American *retailer?* What can be done about the retailer who jacks the price another 300 percent because "We don't sell many of these, so we've got to make a decent profit on it?" What can be done about that international boundary which takes a bite of 43 percent on all audio equipment and parts, radios, TV sets, etc., and an astounding 50 percent on all test equipment? What about it, fellow electronics enthusiasts? How about



raising a combined scream of protest to our respective powers that be? Perhaps if the moans are loud enough, the politicians will hear us above that clink in their gold-lined pockets. How about some comments on this situation from both sides of the "Fleecing Line?"

D. DAWSON, VE6PE4K
Penny, B. C.
Canada

It sounds as if you have a very legitimate gripe, reader Dawson, and that, to quote an old phrase, "there ought to be a law" (or a lot less of them). Perhaps other readers—both U.S. and Canadian—would like to comment.

More Humor Wanted

■ In the many years I have been a subscriber to POPULAR ELECTRONICS I have seldom had as good a laugh as I did over the "Odds 'N' Ends" column on

Turner's noise cancelling 333

TOPS FOR CB

Now you can get a deluxe professional communications microphone for use on CB — and at CB prices, too. The new Turner Model 333 CB Microphone is also ideal for amateur, marine and all other mobile communications.

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CIRCLE NO. 36 ON READER SERVICE PAGE

Letters

(Continued from page 6)

page 124 of the November, 1964, issue. I would like to see more of the same. Also, what happened to "Hobnobbing With Harbaugh" in the October and November issues?

DAN SEARLE
Antigua, British West Indies

Both the cartoons and "Odds 'N' Ends" are published on an irregular basis, Dan. We hope to have more of both in the near future, however.

Pico vs. Micromicro

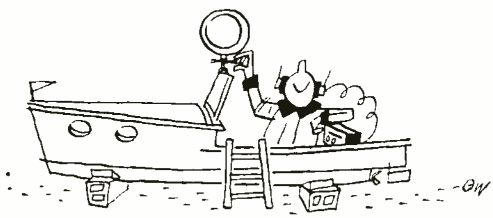
■ Please use standard symbols in your construction articles. In the "Wireless Re-Broadcaster," January, 1965, the symbol "pf." was used as well as "µf." I never saw "pf." used before, but I imagine it means "micromicrofarads."

DARREL BENDER
Camp Hill, Pa.

You're right, Darrel; "pf." means the same as "µµf." As we pointed out in the July, 1964, "Letters from our Readers" column, "pico" was one of the unit prefixes recently adopted by the International Committee on Weights and Measures. It means (as does "micro-micro") 10^{-12}.

Directional BCB DX Antennas

■ I enjoyed "Compact BCB DX Antennas" (January, 1965) very much, and must add that I've been using a directional antenna for years. Being an avid boating fan, I bought a Heathkit DF-3 direction finder, and have adapted the antenna for use with my HQ-100A



for BCB DX'ing. My suggestion to all who want an excellent, compact, directional BCB antenna would be to purchase the antenna from a marine direction finder.

PAUL F. ARUTT
Hewlett Harbor, N.Y.

P.E. Quizzes Applauded

■ I'd like to express my appreciation for Robert P. Balin's interesting and informative quizzes. To tell the truth, I enjoy them more than any of the other regular features in POPULAR ELECTRONICS. Each quiz is a challenge, and after making sure I'm thoroughly familiar with the answers, I put each one away in my permanent collection.

ROGER GANDET
Montreal, Quebec, Canada

"Wonderful World" Not So Wonderful

■ I was truly dismayed by "The Wonderful World of Lids" (December, 1964). The story certainly represents a very slanted view of amateur radio . . . It couldn't be as bad as pictured or it would never have gotten beyond the spark transmitter stage . . .

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CIRCLE NO. 27 ON READER SERVICE PAGE

Letters

(*Continued from page* 8)

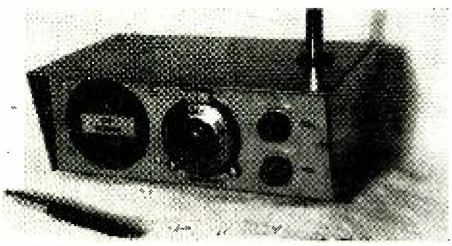
POPULAR ELECTRONICS is certainly capable of better articles than this one.

DICK EATON, WB2LKB
Dewitt, N.Y.

No offense intended, Dick. The point was to portray ham radio as it might appear to the naive outsider. The editorial staff members of P.E., all of whom have ham tickets or have worked within the amateur fraternity for many years, found the story funny.

Aircraft Receiver Lauded

■ Enclosed is a photo of the "VHF" Listener" (March, 1964) which I constructed a few months back. The little receiver has picked up commercial aircraft as far as 97 miles away at an altitude of 20,000 feet, and I have received radio checks up to 48 miles away at lower altitudes. I extended the frequency coverage of the "Listener," by substituting parts and doing a lot of experimenting, to include the 2-meter ham band. I've had many hours of pleasure and maybe a little frustration trying out different things, but it has been well worth it. Now, how about a UHF model?



MAX D. HENKE, USN
Brunswick, Me.

Thank you for the letter and photo, Max. Although we do not now have a UHF model in the works, we'll keep it in mind as a future possibility.

More On the CB Dilemma

■ Surely you jest! The "Communicator's License" (see the editorials in the November, 1964, and January, 1965, issues of POPULAR ELECTRONICS—Ed.) will not make a dent in the CB Dilemma. I doubt if many CB'ers or potential CB'ers would migrate to 2 meters. They have very fine equipment for 11 meters, and to use the "Communicator's License" they would have to spend an equal or greater amount of money for 2 meters . . . To clear up the CB Dilemma, I would recommend three things: (1) The FCC should institute a test for CB applicants on Part 19 of the Rules and Regulations; (2) The individual CB'er interested in DX'ing and rag-chewing should be encouraged to get an amateur license—it's no sweat; (3) Those who still want to have fun and have no incentive to become a ham should look into Part 15—There are six almost clear frequencies and 22 others which are not always in use.

JERRY HALEY, WA4TKI, WPE4FXI
Cookeville, Tenn.

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

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

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

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

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

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

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

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- PRINTED CIRCUITRY

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FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

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

Name...

Address...

....

PROGRESSIVE "EDU-KITS" INC.

(ATT: S. GOODMAN, M.S. in ED., PRES.)

1186 Broadway, Dept. 636D, Hewlett, N. Y.

CIRCLE NO. 26 ON READER SERVICE PAGE

Letters

(Continued from page 10)

to the final stage of the transmitter. Any U.S. citizen can obtain such a license after a short period of preparation. This apparently obscure service is known as ham radio . . .

STEVE ADAMS, WA4ODB
Cornelia, Ga.

■ I agree with your point of view on a "Communicator's License." It would give those of us interested in radio a chance to talk across town without interrupting CB communications. Such a license would keep the rag-chewers and hobbyists off the CB channels. All types of emission should be permitted—SSB, AM, NBFM, and CW. The license would serve to encourage a lot of would-be hams to get General Class tickets.

EUGENE NEUKIRK
Tacoma, Wash.

■ I have a few comments on the so-called "CB Dilemma." It seems that POPULAR ELECTRONICS wants to turn over one of the most interesting amateur bands to a group of blithering idiots so they will have more space to louse up. Projects like OSCAR and moonbounce efforts would have to bow to the chatter of "Communicators."

GEORGE MISIC, WA8LEM
Cleveland, Ohio

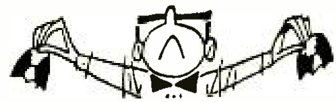
Newscast Directory Lauded

■ I feel that I owe you both a letter and a compliment. First, your directory of English-language newscasts to North America has been improved considerably, and I find it quite helpful. Second, I also enjoy the other articles, especially those on shortwave radio and radio construction projects.

DWIGHT CROSTREET, WPE9FII
Whitestown, Ind.

Thank you for both your letter and your compliment, Dwight. We hope you'll continue to find P.E.'s features and construction articles topflight.

Out of Tune



Christmas Lights Twinkle to Music (*December, 1964, page* 48). Resistor *R6* should be connected to the junction of *D2* and *D3* and to the other side of *SO1*. However, the circuit will work as shown.

Transformer Winding Quiz (*December,* 1964, *page* 97). The answer to question 4 should be 144.3 volts, not 134. 3 volts.

Wireless Re-Broadcaster (*January,* 1965, *page* 49). Diode *D1* is a 1N3254 or equivalent. A 3-ampere fuse (*F1*) is optional. Electrolytic capacitors *C1a* and *C1b* can be two separate units or in one container. Values of capacitance and voltage should be the same or higher. A 40-20 μf., 150-volts-per-section unit will do if you can't get the capacitor called for.

LOADED.

Except for the price.
That's a stripped-down $129.95

The Brand New CB-9 six channel CB transceiver

- Ideal for business and personal communication.
- Six crystal-controlled transmit and receive channels, plus full tuneable receiver with spotting switch.
- Accurate, easy-to-read "S" Meter built in.
- Complete, ready to operate either base or mobile, including all power cables and hardware.
- Hallicrafters "drop down" chassis for simple installation, instant crystal-changing or service.
- Accommodates all CB-3 Series accessories including HA-11 "Racket Buster" noise eliminator, HA-12 Selective Caller.
- Full 100% modulation capability, five watts input.
- Sensitivity 1 microvolt for 10 db. signal-to-noise ratio.

Write for complete specifications

"Quality through Craftsmanship"

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Export: International Div., Hallicrafters.
Canada: Gould Sales Company, Montreal, P. Q.

5th and Kostner Aves. Chicago, Ill. 60624

Dealer franchises available in selected territories. Write for information.

CIRCLE NO. 12 ON READER SERVICE PAGE

Tips and Techniques

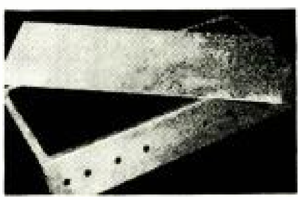
WATER STRAINER SPRAYS SOUND

An inexpensive rubber or plastic water strainer will double as a microphone holder. Most of the small microphone cartridges can be fitted into the center as shown here and secured with a plastic caulking compound or by any other convenient means. The outer casing serves as a scuff-proof shock absorber – protecting the microphone button – and will not mar any furniture it may contact. If the mike cord is threaded through a side opening in the strainer, which you can easily make, the entire assembly can be pressure-fitted over any holder or extension about the size of a water faucet to provide hands-free operation.

—Henry R. Rosenblatt

GET MORE MILEAGE OUT OF YOUR OLD CHASSIS

Chassis from equipment or projects no longer in use can be cleaned up and reconditioned to make them usable. Sometimes an old tube socket opening in the top of a chassis will be just where you want a solid surface, and sometimes there are more holes than chassis. In either event, a new top of proper dimensions can be cut and screwed onto the chassis frame. Cut out the old chassis top, making sure to leave enough of a rim on the chassis frame to support the new top. Use small nuts and bolts or self-tapping screws to hold the new top down. You might want to bond it to the



(*Continued on page* 20)

POPULAR ELECTRONICS
PRODUCT SERVICE PAGE

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

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

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VOID AFTER APRIL 30, 1965 3

No matter what job you have today CIE can help you move ahead ...fast!

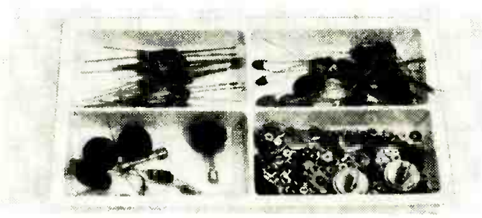
(*Continued from page* 14)

frame—with a spot of solder or a short grounding strap or busbar—to prevent hum and other ground loop problems.

—*Carleton A. Phillips*

SPEED UP KIT ASSEMBLY WITH A SEAFOOD PARTS TRAY

The next time you buy frozen seafood at the supermarket, look closely at the package. Some of this frozen food—notably fish cakes and patties, and such delicacies as



flounder stuffed with crab meat—are packed in plastic trays like the one shown in the photo. The trays have four compartments, each of which is just the right size for small components such as resistors, capacitors, nuts, bolts, etc. A couple of these trays can vastly speed up kit assembly—you simply sort parts into compartments before you begin. The tray illustrated here is used by National Food Marketers, Inc., Blue Anchor, N.J., and carries the "Home Spot" registered trademark.

—*W. B. Stevenson*

TWO-FACED TAPE STICKS BOTH SIDES

Tape developed for industrial use has tremendous holding power. Both sides of the $\frac{1}{2}$"-wide cloth or foam rubber tape are coated with adhesive. With either type, you can mount small accessories such as an S-meter to a receiver, flat batteries inside Minibox projects, new solid-state modules, etc., and some of this tape can also be used to keep a code key from shifting all over the place. The cloth type is available on 216" rolls and the foam tape on 75" rolls for about $1 a roll. Obtain it at your local department or hardware store, or write to Walter Drake and Sons, Inc., Drake Bldg., Colorado Springs, Colo. (for both types), or to Sunset House, 124 Sunset Bldg., Beverly Hills, Calif. (for the foam type).—*Fred Blechman, K6UGT/KFA7980*

for the critical recordist...
ANOTHER "FIRST" FROM UNIVERSITY

It's shock-mounted! It's a dynamic! It's a cardioid! And it's only $29.95
(It's also guaranteed for 5 years!)

Today...from the laboratories of University...an advanced technology has produced a great new microphone for the critical home recordist. It represents a clean and dramatic break with tradition—with outmoded notions. Considering its moderate price, you would expect it to be an ordinary crystal, carbon—or at the most, dynamic omni-directional. It isn't. The 8000 is a cardioid dynamic typical of the finest professional recording microphones. With its superb directional characteristics, it virtually eliminates background noise. You can work close or far—you will achieve a degree of clarity and definition you never thought possible before. Response: 70-13,000 cps. Sensitivity: −156 db (EIA). Output Level: −59 db/1mw/10 dynes/cm². Includes 15 ft. cable with *choice of high or low impedance* at the Cannon plug and receptacle! Includes desk stand adaptor. Only $29.95.

Model DS-10 desk stand —$6.95

LTV

Desk PE-3

Please send complete microphone information and specifications.

UNIVERSITY®
A DIVISION OF LING-TEMCO-VOUGHT, INC.
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U-75

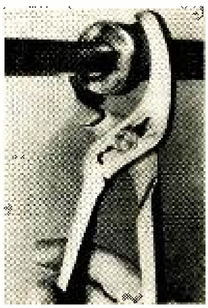
CIRCLE NO. 39 ON READER SERVICE PAGE

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 which appears on page 15.

SOFT-JAWED ADJUSTABLE WRENCH

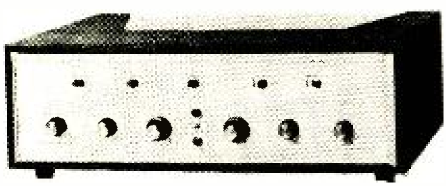
You can minimize the possibility of scarring or otherwise damaging the surface of an object with the "Protect-A-Grip" adjustable soft-jawed wrench being marketed by *Strauss Technical Services, Inc.* Suitable for use on polished metal, glass, or plastic, it comes in a regular adjustable wrench shape but with hard perma-plastic composition "gripping" jaws which provide a shield between the wrench and the object gripped. The "Protect-A-Grip" is 10" long, and has an adjustable jaw opening up to 4½". Price, $5.00.



Circle No. 75 on Reader Service Page 15

STEREO AMPLIFIER KIT

H. H. Scott, Inc., has introduced a 48-watt complete stereo amplifier kit. The LK-48B comes with a full-color instruction book for ease of assembly, each illustration being accompanied by its own Part-Chart. Features of the LK-48B include: an extruded aluminum front panel; speaker switch and front

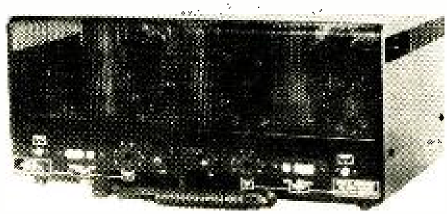


panel headphone outlet for private listening without loudspeakers; powered center channel output for an extension or center-channel speaker without any additional amplifiers; and heavy-duty output transformers for superior bass response even with inefficient speaker systems. Price, less than $130.00.

Circle No. 76 on Reader Service Page 15

"DISTORTIONLESS" STEREO AMPLIFIER

Distortion of the new Futterman H-3 vacuum-tube stereo amplifier introduced by *Harvard Electronics Co.* is said to be so minute as to be almost unmeasurable: intermodulation distortion is less than 0.05% at 50 watts, and harmonic distortion is less than 0.2% for any audio frequency at 50 watts r.m.s. output. The H-3 utilizes a new circuit configuration that eliminates all distortion-pro-



ducing driver and output transformers; speakers are coupled to the amplifier by large computer-grade electrolytic capacitors. Rated at 50 watts per channel with a 15- or 16-ohm load, the H-3 has a frequency response of +0, −0.5 db from 5 to 90,000 cycles, and a signal-to-noise level better than 90 db below 50 watts. Price, $288, including cage.

Circle No. 77 on Reader Service Page 15

SELF-POWERED VFO

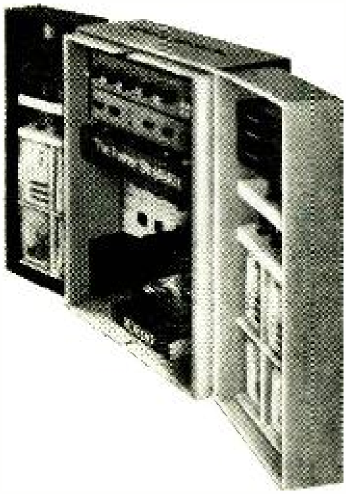
The new *Lafayette Radio* 99-2501 variable frequency oscillator, a self-powered unit covering the 80- through 10-meter amateur bands, uses a high-Q series-tuned Clapp oscillator. It incorporates a VR tube to eliminate frequency shift due to line voltage fluctuation, and the output is sufficient to drive most modern transmitters. Features include a large, easy-to-read illuminated slide-rule dial; smooth tuning drive; and a dual output-impedance silicon-diode power supply. Price, $34.50.

Circle No. 78 on Reader Service Page 15

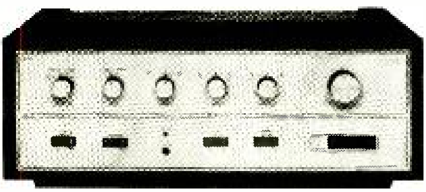
ELLIPTICAL-STYLUS STEREO CARTRIDGE

Specifically designed for the higher tracking pressures required by automatic record changers, the new ADC 660/E stereo cartridge developed by *Audio Dynamics Corp.* does not cause the damaging effects on records er-

Who makes the only great amplifier for $99.50?



You do... with the new Fisher KX-90 StrataKit.



Now, for the first time in high fidelity history, you can own a truly distinguished stereo control-amplifier for less than $100—if you are willing to build it yourself.

Fisher refuses to compromise quality. Therefore, even at $99.50*, the Fisher KX-90 StrataKit incorporates the same basic standard of fidelity as the most expensive Fisher components. Take away its price tag and it would still excite the admiration of the fastidious audiophile.

With 40 watts of clean power, the KX-90 can drive even inefficient speakers to their maximum performance level. Superior output transformers make certain this power will not fall off steeply at the frequency extremes. Advanced preamplier features, including rocker switches and complete phono/tape facilities, provide unlimited flexibility.

It's all yours if you follow directions. And that's no problem with the exclusive Fisher StrataKit method. No experience is necessary. Assembly takes place by simple, *errorproof* stages (Strata). Each stage corresponds to a *separate* fold-out 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 proceeding to the next stage.

The end result is a Fisher stereo control-amplifier that is fully equal in performance as well as reliability to its factory-wired prototype. Fisher guarantees this. And who should know better than Fisher?

FREE! $1.00 VALUE!
Send for The Kit Builder's Manual, an illustrated guide to high fidelity kit construction, complete with detailed specifications of all Fisher StrataKits.

Fisher Radio Corporation
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Long Island City, N. Y. 11101

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103

*WALNUT CABINET, $24.95

OVERSEAS RESIDENTS PLEASE WRITE TO FISHER RADIO INTERNATIONAL, INC., LONG ISLAND CITY, N. Y. 11101. CANADIAN RESIDENTS WRITE TO TRI-TEL ASSOCIATES, LTD., WILLOWDALE, ONT.

The Fisher

CIRCLE NO. 11 ON READER SERVICE PAGE

New Products

(*Continued from page* 22)

roneously ascribed to elliptical styli when used at any but the minimum tracking pressures. ADC research established that the design of the cartridge suspension, rather than tracking force, was the underlying cause of record wear. Their solution to the problem was a cartridge design which, while capable of perfect tracking at one gram, will still support the necessary weight of up to 3 grams required by many record changers.

Circle No. 79 on Reader Service Page 15

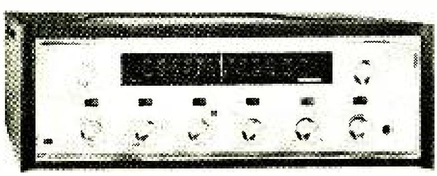
TELEPHONE "SECRETARY"

When your phone rings, and you're not there. the Model T-10 "Phone A Matic" will answer it for you. Manufactured by *American Research Laboratories*, the T-10 can greet the caller in your own voice, regret your missing the call, and advise the caller of your whereabouts and/or time of return. When you want to record a new message, you simply turn the switch and talk. The T-10 does not take messages from callers but it does record the number of calls received during your absence. Requiring no wire or induction coupling to the telephone, the unit can also be actuated by a doorbell. The T-10 cabinet is made of walnut and anodized aluminum. Price, $149.00.

Circle No. 80 on Reader Service Page 15

STEREO MULTIPLEX TUNER/AMPLIFIER

The Knight Model KN-370, available from *Allied Radio Corp.*, combines on a single compact chassis a 35-watt-per-channel stereo amplifier, individual FM and AM tuning sections, special multiplex circuitry that automatically switches to stereo, dual preamplifiers for records and tapes, and a full set of

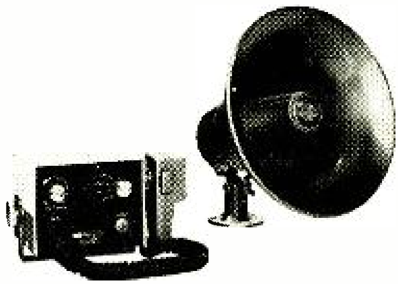


controls and inputs. In the FM section, IHF sensitivity is 2.5 μv. for 20 db of quieting; i.f. bandwidth, 300 kc. In the AM section, sensitivity is 4 μv. for 20 db of S/N ratio; selectivity, 8 kc. Frequency response is ± 1 db, 20—20,000 cycles, at full rated power; harmonic distortion is less than 0.6% at full rated power. Price, $279.95, less case; walnut wood case, $23.95; brown metal case, $12.95.

Circle No. 81 on Reader Service Page 15

FOG HORN/HAILER KIT

Three valuable boating functions are performed by the new *Heathkit* Model MD-24: fog horn, hailing, and boat horn. Featuring an all-transistor, 30-watt circuit, the unit has a 4-position switch for on/off and to select any one of the three functions. A push button actuates the boat horn when you're ma-

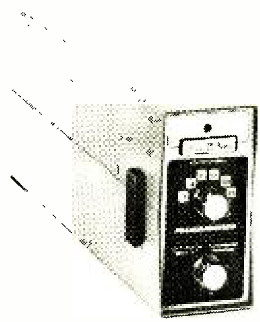


neuvering in crowded areas. When used as a fog horn, the MD-24 provides a powerful warning tone that penetrates the atmosphere for more than a mile. As a hailer, it will project your voice up to several hundred yards; a special gain control allows the volume to be adjusted. Easy to assemble, the kit uses just one simple circuit board.

Circle No. 82 on Reader Service Page 15

"SEA-B-MATE" MODULE

A self-contained CB module, *Pearce-Simpson*'s unique "Sea-B-Mate" converts the company's Catalina 68-watt marine radiotelephone to a dual-system marine/CB two-way radio. This provides skippers with an extra margin of safety at sea by essentially doubling the number of effective communications channels for immediate use—making a total of 11 channels (5 marine and 6 CB). Contact may be made to home, office, mobile units and marinas with CB facilities without the use of a marine operator. The Sea-B-Mate is salt- and fungus-proof, and is housed in an Iridited aluminum cabinet and chassis for maximum corrosion protection. Price, $89.90, complete with push-to-talk microphone and crystals.



Circle No. 83 on Reader Service Page 15

'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.

KLH

KLH RESEARCH AND DEVELOPMENT CORPORATION
30 CROSS STREET, CAMBRIDGE 39, MASSACHUSETTS

CIRCLE NO. 17 ON READER SERVICE PAGE

LAFAYETTE RADIO ELECTRONICS

FREE!

1965 CATALOG No. 650

Over 500 Pages! *Featuring Everything in Electronics for*

HOME • INDUSTRY • LABORATORY

from the "World's Hi-Fi & Electronics Center"

- Stereo Hi-Fi—All Famous Brands Plus Lafayette's Own Top-Rated Components
- Citizens Band—Transceivers, Walkie-Talkies and Accessories
- Tape Recorders • Ham Gear
- Test Equipment
- Radios, TV's, and Accessories
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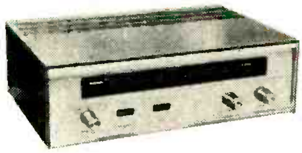
BUY ON TIME— *Use Lafayette's famous Easy-Pay Credit plan . . . up to 24 Months to Pay*

See the Largest Selection in Our 44-Year History

199.50

New LR-800 70-Watt Complete AM-FM Stereo Multiplex Receiver features a tuned nuvistor "front-end" and an FM "Stereo-Search" multiplex indicator. Excellent sensitivity, frequency response, and low distortion specs. Imported, **99-0005WX.**



93.95

New LT-325 AM/FM Multiplex Tuner combines simplicity, flexibility, and superb styling. 20-Tube performance provides a great variety of features, including a new audible tone "Stereo Search System." Imported, **99-0001WX.**

59.95

Model RK-142 Deluxe Portable Tape Recorder perfect for the home, school, or office. Records and plays ½ track monaural at two speeds. With dynamic microphone, connecting cables and empty 7" reel. Imported.
99-1512WX.

HEADQUARTERS FOR THE HI-FI ENTHUSIAST

THE WIDELY ACCLAIMED LAFAYETTE RK-137A TAPE RECORDER

FEATURING 4 —TRACK STEREO PLAYBACK* —TRACK MONAURAL RECORD PLAYBACK

TAKES REELS UP TO 7"

89.50
99-1511WX

With Electronic Track Selector Switch, VU Recording Level Meter and Pause Switch For Instant Editing

Includes lightweight carrying case, dynamic microphone, output cable, 7 inch empty tape reel.

• Two Speeds—3¾ & 7½ ips • Pause Lever Provides Instant Stop for Editing • Record—Erase Safety Switch • Fast, Rugged Shift Lever Control • Extension Speaker Jack • High Impedance Monitoring Jack • VU Meter Recording Level Indicator • Electronic Track Selector Switch • Specially Designed Heavy-Duty 6x4" PM Speaker • Separate Erase and Record Heads. Imported.

* adaptable to stereo playback

FREE! ***Lafayette 516—Pg. 1965 Catalog No. 650. Write: Lafayette Radio Electronics Corp., Dept. IC-5, P.O. Box 10, Syosset, L. I., N. Y. 11791***

LAFAYETTE ...Headquarters For Citizens Band Equipment

NEW! LAFAYETTE 23-CHANNEL CRYSTAL-CONTROLLED DUAL CONVERSION 5-WATT CB TRANSCEIVER *WITH ADVANCED "RANGE-BOOST" CIRCUIT*

- **13 Tubes, 8 Diodes**
- **Low Noise Nuvistor RF & Mixer**
- **5 Double-tuned IF Transformers**

Model HB-400
Stock No. 99-3001WX Only 169^{50}

■ Frequency Synthesis For 23 Channel Crystal Controlled Transmit & Receive ■ No Extra Crystals Needed ■ Dual Conversion Receiver with 3/10 uv Sensitivity ■ Delta Tuning ■ Variable Squelch, Variable Noise Limiter ■ Illuminated "S" and RF Output Meter ■ Push-to-Talk Ceramic Mike ■ "Range-Boost" provides high average Modulation—increases Effective Range ■ Built-in Dual Power Supply, 117VAC, 12VDC ■ "Vari-Tilt" Mobile Bracket For Easy Installation ■ Plug-in Facilities for Lafayette Selective Call Unit ■ Compact, 12"Wx10"Dx5"H

NEW! LAFAYETTE ALL-TRANSISTOR DUAL CONVERSION 5-WATT CB TRANSCEIVER *FEATURING AUTHENTIC MECHANICAL FILTER*

The Perfect Unit For Mobile!

- Only 3" high—fits easily in any car
- Special multi-stage noise-limiting circuit ends problem of mobile noise
- The same output as the most powerful tube unit—yet uses only 2½ per cent of the battery power required by a tube unit.

MODEL HB-500
Stock No. 99-3027WX Only 139^{50}

■ 12 Crystal-Controlled Transmit & Receive Positions ■ 23 Channel Tunable Receiver with Spotting Switch ■ 15 Transistors, 5 diodes ■ Dual Conversion Receiver with 5/10 µV Sensitivity ■ Exclusive Quality Mechanical Filter For Razor-Sharp Selectivity ■ Variable Squelch, "S" meter ■ Dependable Sealed Relay Switching ■ Compact 3"Hx11⅞"Wx6¹⁵⁄₁₆"D ■ For 12VDC (optional 117VAC Solid State power Supply available) ■ Supplied With Crystals for Channel 12, easy-mount Mobile bracket, Push-to-Talk Dynamic Mike.

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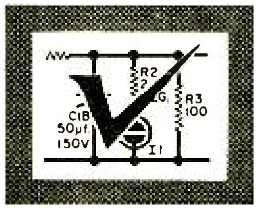
CIRCLE NO. 20 ON READER SERVICE PAGE

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* readers. Here's how it works: Check over 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 post card direct to OPERATION ASSIST, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print or type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts etc. Remember, *use a post card;* we can handle them much faster than letters. Don't send a return envelope; your response will come from fellow readers. Because we get so many inquiries, none can be acknowledged, and POPULAR ELECTRONICS reserves the right to publish only those requests that normal sources of technical information have failed to satisfy.

Schematic Diagrams

Egert Engineering signal generator, model unknown. Battery-operated, a.f. and r.f. frequency outputs on 7 ranges. Has 2 tubes; one is 30, other unknown. (David A. Dawson, Box 125, Port Crane, N.Y. 13833)

Atwater Kent Model 20 receiver. Has 5 01A's. (Allen R Boldrey, 756 Washington, Bridgeport, Ill. 62417)

Philco Model 39-116 receiver, circa 1939. Tunes 3 bands. (Timothy Cutforth, 941 S. Irving, Denver 19, Colo.)

Philharmonic Model RT-285 A/URC-11 receiver-transmitter. Tunes 243 mc. (Ramon Gonzalez, Montezuma Seminary, Montezuma, N. Mex.)

E. H. Scott "Philharmonic" receiver, ser. LL-375, circa 1936. (George D. Heath, 69 Woodland Ave., Fords, N.J.)

Osborne "Duo-Com 100" walkie-talkie. Has 10 transistors. (F. H. Heberling, Box 23, Bakerstown, Pa. 15007)

Weston Model 669 VTVM, type 1, ser. 114. Meter range, 1.2-16 volts. (Clary, K1ZBZ, 1Q2762, 240 Weston St., Waltham, Mass. 02154)

Atwater Kent Model 44 receiver, year unknown. **Atwater Kent** Model 75 receiver and phono combo. (John Carter, Box 257, Rochester, Ind.)

Motorola Model FMRU-16 30D FM receiver, circa 1947. (James H. Weber, 9336 Washington Blvd., Culver City, Calif.)

E. H. Scott Model RBO-2 receiver, ser. 1CZC-46225, circa 1940. Tunes BC and s.w. Has 3 bands. Made for Navy Dept -BuShips. (Stanley Coutant, 666 E. Sierra Madre Blvd., Sierra Madre, Calif. 91024)

Philco Model 42-395 receiver, circa 1945. Tunes FM, BC, and s.w. Has 9 tubes. (Dan Driscoll, 3660 Cole Port, Pontiac, Mich. 48055)

RCA Model 10D/1128 receiver, type 6, circa 1942. Made for Royal Canadian Air Force. Tunes 0.14-21 mc. Has 10 tubes. (John Kirchner, 142 Halliwell Dr., Pittsburgh, Pa. 15233)

Silvertone Model 4586A receiver, circa 1942. Tunes BC and s.w. bands. Has 10 tubes. (Douglas Zagrodnick, 604 Iolite Ave., Johnstown, Pa. 15902)

Sargent-Raymont Model SR51 AM-FM tuner. (Ray S. Hanson, Box 365, Galt, Calif.)

Special Data or Parts

Meissner Model 9-1085 receiver; tunes BC and s.w. bands; has 6 tubes. Coils marked M56 and EZ29 needed. (Horace C. Dolph, 2001 Godwin Ave., Grand Rapids 7, Mich.)

Webster Chicago Model 81-1 wire recorder. Wire needed. (John Charis, 248 Park St., Lawrence, Mass.)

Zenith Model 770B receiver, ser. 501162. Tube source and schematic needed. (Steve Colton, 276 Peace Ave., N.W., Cedar Rapids, Iowa 52405)

Ultratone Model PT-9 tape recorder radio-phono combination. Capstan assembly part 27-1054 needed. (Leonard Powell, 2414 Ashland Ave., Baltimore, Md. 21205)

National Model NC 156 receiver, circa 1940; tunes 200 kc. to 17 mc. Alignment data and diagram needed. (Richard Petersen, 1719 A Ave. N.E., Cedar Rapids, Iowa 52402)

Zephyr 9 Model 930 pocket receiver, made in Japan. Variable capacitor drive pulley replacement needed. (R.O. Kroeger, 3335 Eastern, Davenport, Iowa)

Zenith Model 98262 receiver, ser. R567895; tunes 3 bands. Schematic and original knobs wanted. (Robert J. Poirier, 1733 Piute St., Barstow, Calif. 92311)

Radiomarine Model DAF-1 direction finder and CRM-46153 receiver, W.W. II vintage. Operating and technical data wanted. (Steven Benham, Rt. 1, Box 1526, Bremerton, Wash. 98313)

Radio City Products Model 447 multitester. Battery information and schematic needed. (Donald Fuchik, 2206 N. Palm Dr., Victoria, Tex.)

Atwater Kent Model 40 receiver. Power supply needed. (Jack D. Paslay, 1507 East Bowie, Beeville, Tex.)

Radio City Products Model 324 tube tester. Tube test data and schematic needed. (F. Waltemath, 4541 S. Lacrosse Ave., Chicago, Ill. 60638)

RCA "Radiola 3" receiver, circa 1924. WD-11 tube needed. (Bertrand L. Lavoie, 17 Stone St., Brunswick, Maine)

Collins Model RT-91/ARC-2 transceiver; tunes 2 to 9 mc., AM, c.w., m.c.w. Technical manual wanted. (Glenn Wiebe, Box 354, Thompson, Manitoba, Canada)

Farnsworth Model BC-191-N transmitter; tunes 200-18,000 kc.; has 100-watt output, AM, c.w., m.c.w. Technical data and schematic wanted. (David Creek, 2280 Ponte VeDra Ct., Decatur, Ga.)

Lear Aviation automatic direction finder receiver, model unknown; has 18 tubes. Technical manual and schematic needed. (Alexander Strychar, 6224 Horatio, Detroit, Mich. 48210)

Automation Electronics "Pierson" KE-93 vibrator power supply, ser. 3310. Schematic needed, and any other available info. (Dennis R. Tunis, #4 Autumn Dr., Pekin, Ill. 61554)

Kogyo K.K. Model 302 tape recorder, #30900, made in Japan; a.c.-powered. Source for parts and schematic needed. (Melvin H. Long, Box 65, Hapeville, Ga. 30054)

Heath Model V-5 VTVM kit, circa 1950. Construction manual and/or calibration data needed. (Fred Moller, 150 W. Eckerson Rd., Spring Valley, N.Y. 10977)

Link Model 250UFS transmitter, ser. 1317; tunes FM. Crystal data and schematic wanted. (J. White, 50 N. Greenwood Ave., Hopewell, N.J.)

RCA Model TDQ transmitter. Manual needed. (H. R. McCoy, 14 Foster Rd., Staten Island, N.Y. 10309)

Sparton TV set, ser. 033605. Tube data and schematic wanted, plus specs on tube type KY 3612. (Michael J. Krebs, 1200 Ruxton Rd., York, Pa.)

Freed-Eisemann Model FE-15N0660CC receiver; has 5 tubes. Operating instructions, source for parts, and schematic wanted. (Larry K. Walker, 1020 Barlington Ave., Casper, Wyo. 82601)

Dumont Model 294A oscilloscope. Operating manual, technical info and schematic needed. (Willard G. Preussel, Jr., 2202 Ardsley St., Winston-Salem, N.C. 27103)

Sonora Model 600SE electronic organ. Schematic needed and any other available info. (Kenneth D. Shirk, 246-16 Alameda Ave., Douglaston 62, N.Y.)

—30—

POP'tronics Bookshelf

ELECTRONIC GADGETS FOR YOUR CAR

by Len Buckwalter

Unquestionably, the subject of automotive electronics is a popular one. Given the facts that the number of persons who enjoy tinkering with the family car is enormous and that a sizable segment of that number has some savvy in the field of electronics, it's easy to understand why. In this book, Len Buckwalter has outlined ten projects for the automotive-electronics hobbyist ranging from the simple addition of a d.c. ammeter on the auto dashboard to the construction of a tachometer for measuring engine r.p.m. Although some of the projects seem of marginal interest, there is enough good material in this volume—such as the tachometer and dwell indicator projects—to make it a worthwhile investment.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Soft cover. 128 pages. $2.95.

ADVANCED SERVICING TECHNIQUES
Volume 1, Color and Black-and-White Television

by Paul B. Zbar and Peter W. Orne
Prepared under the sponsorship of the Electronics Industries Association

Advances in the design and manufacturing processes of TV receivers and in the techniques of servicing demand that service technicians acquire new knowledge and ability in both theory and skill. This text is designed to make it possible for the TV technician to efficiently service both color and black-and-white receivers, including transistorized TV receivers. Emphasized throughout is a systematic, industry-approved, logical trouble-shooting procedure, utilizing the latest test instruments. Paul Zbar, head of the Electronics Department, Voorhees Technical Institute, and Peter

Orne, supervisory engineer at Emerson Radio and Phonograph Corp., have a first-hand, practical knowledge of the problems in the field and are eminently qualified authors. A completely new text, this edition is written in simple, easy-to-understand language. Symptoms of troubles arising from defects in each section of the receiver are presented, and procedures to find these troubles are detailed. Bench servicing and home servicing techniques are given. Profusely illustrated, the book includes full color plates to show important details of color TV servicing. A must book for the student as well as for the advanced TV technician.

Published by John F. Rider Publisher, Inc., 116 West 14 St., New York 11, N.Y. Hard cover. 298 (8½" x 11") pages. $8.25.

TAPE RECORDERS: HOW THEY WORK

by Charles G. Westcott and Richard F. Dubbe

Devoted to the history, theory, and construction of modern tape recorders, this book is now in its second edition after having been enlarged and updated by its authors. Both service technicians and hobbyists will benefit from perusing it, since easily understood details on tape recorder functioning as well as more technical information—along with circuit diagrams—are included. Beginning with a short history of magnetic recording, the volume takes the reader through a theory section, the motor-board—tape-transport mechanism and drive motors, volume indicators, bias oscillators, amplifiers, magnetic heads, and recording tape.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Soft cover. 224 pages. $3.95.

STANDARD ELECTRONICS QUESTIONS AND ANSWERS

Volume I: Basic Electronics; Volume II: Industrial Applications

by Steve Elonka and Julian L. Bernstein

These two books are all-purpose educational texts designed "to help the enterprising technician prepare himself for rapid advancement in his chosen field." In compiling the material, the authors had in mind the large number of fields that require personnel skilled in basic electronics, and the resulting shortage of such personnel. Volume I introduces the basic concepts of electronics and includes chapters on direct current, magnetism, inductance, capacitance, alternating current, vacuum tubes,

Bookshelf

(*Continued from page* 31)

semiconductors and transistors, voltage amplifiers, and power supplies. Volume II deals with basic industrial circuits in their simplest form. Chapter subjects include oscillators, special circuits, transducers and sensors, control systems, closed-circuit and color TV, industrial processes and devices, and test equipment. Both books pack a tremendous amount of information into the question and answer format, requiring the close attention of the reader. They should make excellent study material for those willing to invest some time and effort.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Volume I, 232 pages; Volume II, 220 pages. Hard covers. Price, $8.50 each, or $15.95 per set.

CLOSED-CIRCUIT TELEVISION HANDBOOK

by Leon A. Wortman

The second "TV revolution" is under way. Just as television broadcasting swept the country in the late 40's and early 50's, closed-circuit TV (CCTV) is now beginning to saturate many fields—including education, industry, research, medicine, and commerce. Mr. Wortman's text is essentially a treatment for the potential user of CCTV rather than for the technician or engineer. Covered are such topics as cameras, monitors, video recording, lenses, lighting, wiring, microwave relays, and the use of CCTV in the fields mentioned above. The text is easy to read and profusely illustrated.

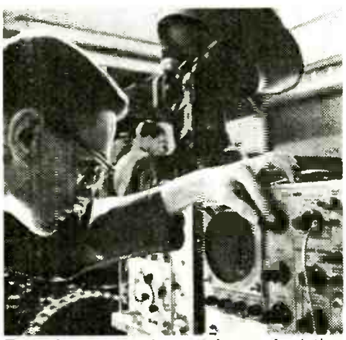
Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Hard cover. 286 pages. $6.95.

Free Literature

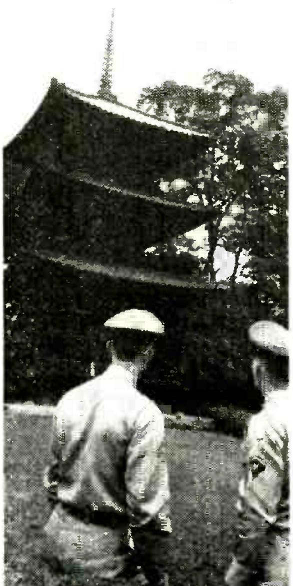
Two "envelope-stuffers" are available from Amprobe Instrument Corp. (Dept. Full-Line, 630 Merrick Rd., Lynbrook, N.Y. 11563), the manufacturer of "AMPROBE" snap-around volt-amp-ohmmeter and miniature strip chart recorders. The REE-16 is a condensed catalog of the most popular recorder models, while the AAE-14 contains information on their full line of snap-around instruments and accessories . . . You'll find lots of semiconductor bargains in the 1965 Poly Pak eight-page flyer. Poly Paks (P.O. Box 942E, S. Lynnfield, Mass.) is offering new integrated circuits, "pancake" transistors, etc., plus a free "double bonus" to mail order customers. —30—

Share great moments with other great guys

Get a new set of wheels in the Army. Ten feet across or scooter size, there are more wheels in the Army than in any other organization in the Free World. Some are an adventure to drive, others take you to adventure—and, if you want, you can learn what makes each one roll.



Experts are made, not born. And the Army makes the best. Army schools teach hundreds of different specialties. If you qualify, you can sign up for the one you want before you enlist.



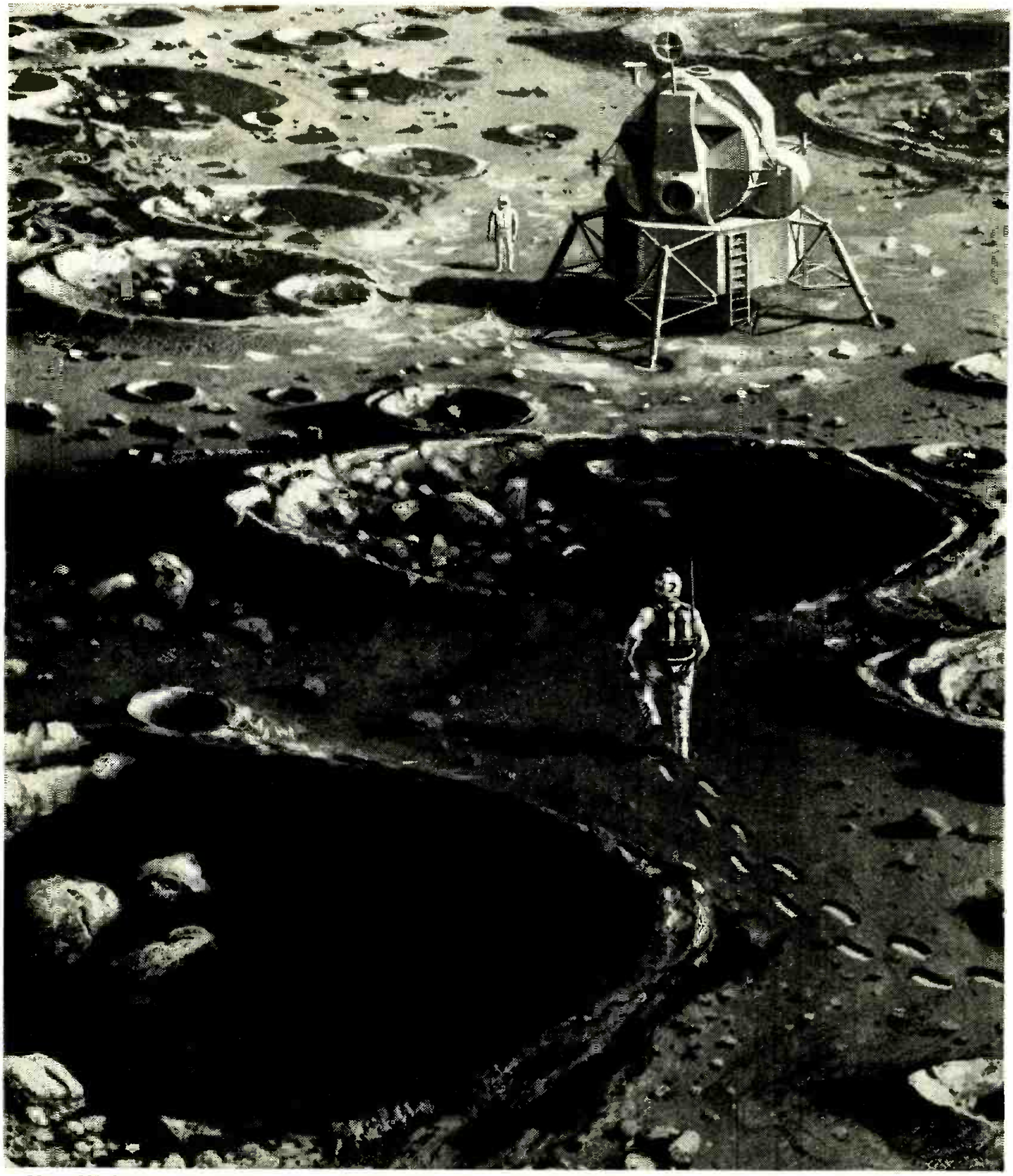
It's different from your home town. And who wouldn't expect it to be? After all, one of the reasons you join the Army is to see the world of differences.

You're not alone in today's action Army. Every experience you have is shared with other great guys. Regular guys who are learning, earning, growing, going, serving our Country, developing themselves. Just as you are.

But the wonder of these experiences is yours alone. No one can tell you how great it feels to master a difficult specialty like computer programming, missile repair, electronics, or construction. No one can live the excitement of landing in a foreign country for you. No one can know what *your* great moments in the Army will be. But you can be sure your life in today's Army will be full of great moments. Enough to add up to a great life.

Talk to your local Army recruiter. Let him tell you what the Army can do for you... and what you can do for the Army. Let him help you to that great moment, the moment you realize that... if you're good enough to get in, a proud future can be yours in today's *action* **Army**

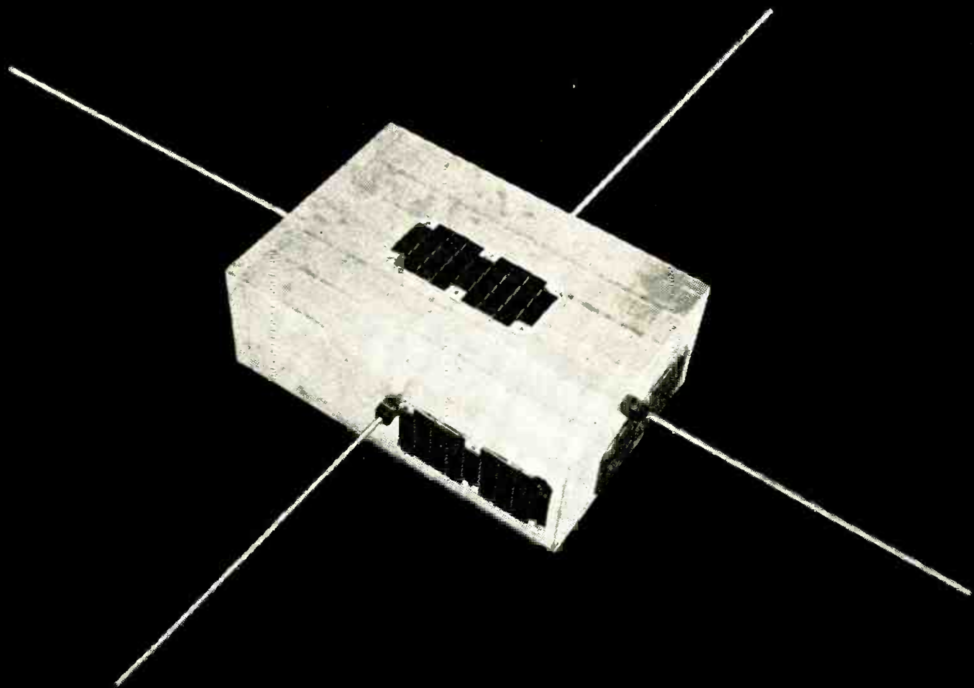
CIRCLE NO. 40 ON READER SERVICE PAGE



It will take thousands of electronics technicians to put man on the moon

will you be one of them?

To put men on the moon requires an army of electronics technicians working behind the scenes. These technicians will be men who, like yourself, started their careers with a healthy interest in electronics, and the foresight to realize what a major role electronics will play in the future. Many of them will have taken their first step in this exciting field by sending for the free book from RCA Institutes. This book, more than any other, shows you how much more you get with RCA Institutes Home Training, and how thousands of men, like yourself, have built, and are building the most rewarding careers the field of electronics has to offer. Read how right this minute, you can do the same!



OSCAR III: Ham Radio's New 2-Meter Space Station

The latest in a series of amateur-designed and amateur-built satellites is expected to provide unparalleled DX thrills

By ROBERT N. TELLEFSEN, W7SMC/6, **and HARLEY C. GABRIELSON,** W6HEK

OF THE SCORES of satellites placed in orbit around the earth during the past seven years, two were unique. They were built by radio amateurs, they transmitted their signals in the 2-meter (144-mc.) ham band, and they were observed by a worldwide amateur tracking network. These first two amateur satellites were named OSCAR I and OSCAR II from the initial letters of *O*rbiting *S*atellite *C*arrying *A*mateur *R*adio. Soon, possibly by the time you read this, OSCAR III will be in orbit. And, unlike the first two OSCARS which carried only beacon transmitters, OSCAR III will be a complete 2-meter ham station capable of receiving and relaying back to earth amateur 2-meter signals!

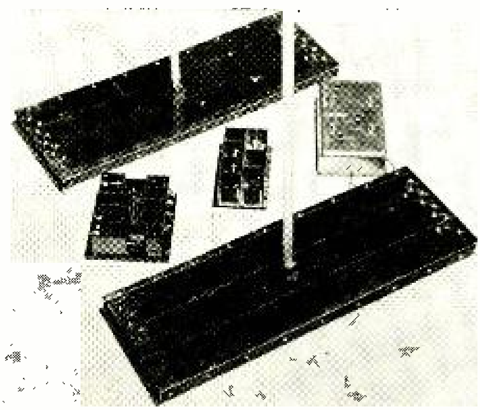
Origins of Project OSCAR. The idea of an amateur satellite was put forth by Don Stoner, W6TNS, in 1959, who pointed out that hams could probably build a satellite "if someone only had a vehicle" to put it in orbit. Stoner, Fred Hicks, W6EJU, and others developed the idea and formed the Project OSCAR Association which later became Project OSCAR, Inc. Typical of the reactions of their fellow San Francisco area hams was a comment by "Chuck" Towns, K6LFH: "You're crazy. When can we start?"

The first problem facing the amateurs was what form an amateur satellite should take. The initial OSCAR concept was a simple beacon transmitting an unmodulated carrier in the 2-meter ham band. Later, a keying unit was designed to enable the beacon to transmit the word "HI" in c.w. (.... ..), and a telemetry channel was added to monitor the internal temperature of the satellite. "HI" is a friendly greeting between hams, and has the same meaning in many languages. The "HI" identifier and telemetry channel were used in both OSCAR I and II.

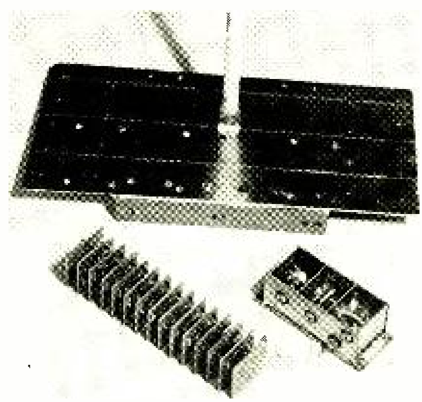
Construction and Launching. When construction of the first satellite began, many manufacturers in the space and electronics industries donated hard-to-obtain components that make the difference between success and failure in a satellite. Other manufacturers loaned test equipment and gave advice and information. The actual design and construction, however, were done by hams working in their basements.

One reason for the simplicity of OSCAR I's design was that, although the U.S. Air Force had indicated a willingness to launch an amateur satellite on a space-available basis, a final commitment would not be made until the hardware had been built and tested. A simple design is more reliable, a matter of some importance in a field where Murphy's Law works overtime. Finally, despite its lack of sophistication, the satellite would provide tracking experience for future efforts.

When the satellite was tested and a launch date established with the help of the ARRL, one question still remained. Could amateur tracking stations acquire and track the 100-milliwatt OSCAR signal? On December 12, 1961, an Atlas-Agena rocket carried OSCAR I aloft, and the friendly "HI" from orbit dis-



OSCAR III translator with input, output antennas. Three units of translator (l. to r.) are front end and 30-mc. i.f. strip, up-converter, power amplifier.



Stack of wafers is telemetry keying unit, while the three-chambered unit is telemetry transmitter. End-panel antenna at back radiates telemetry signal.

pelled all doubts. Rare indeed was the OSCAR observer who did not track OSCAR I from one horizon to the other with signals loud and clear.

Tracking reports continued to come into OSCAR headquarters even after the satellite battery voltage had dropped to the point where the "HI" keyer had ceased to function. At this point, it is estimated that the output power was approximately one milliwatt!

When a second ride into orbit became available, OSCAR II was launched on June 2, 1962. It was identical to OSCAR I except for minor improvements such as the addition of more batteries.

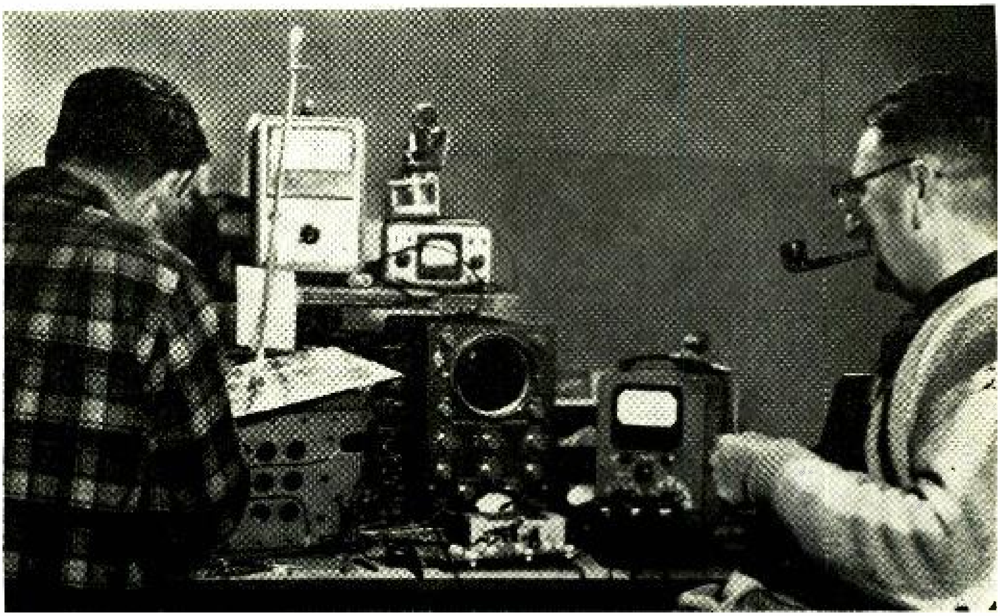
The Verdict: Success. These first OSCAR operations were unqualified successes. Nearly 1000 stations in 27 countries submitted some 10,000 tracking reports to OSCAR headquarters, ranging from simple reception reports to comprehensive and highly competent technical reports. Considering the limited resources of most of these amateur stations, . . . quality of the reports was remarkable.

What was achieved? Much practical experience was gained which could not have been obtained in any other way. Many participants designed complete tracking stations, built and operated them, and wrote down their observations. Others became skilled at generating orbit predictions from a minimum of information. Valuable data was collected on propagation in the 2-meter band at orbital altitudes, as well as on the performance of space communications hardware.

This amateur satellite activity also had international effects. The International Telecommunications Union designated 144 to 146 mc. as an International Amateur Radio Space Communications Band, thus providing radio amateurs all over the world with their own window in the sky.

On To OSCAR III. The third OSCAR satellite will be capable of relaying signals to ranges not normally possible in the 2-meter ham band. It contains a translator, a telemetry system, and a coherent beacon transmitter, all using transistors. OSCAR III is about the size of a small suitcase, 7" x 12" x 17", and weighs about 30 pounds.

The translator is not a repeater in the sense of a receiver and transmitter connected together, as there is no demodulation of received signals within the satellite. Signals received at 144.1 mc. are



Ed Hilton, W6VKP (left), and Don Norgaard, W6VMH, at work on the OSCAR III package in Hilton's garage. In addition to designing much of the satellite electronics, they also designed equipment for testing the units.

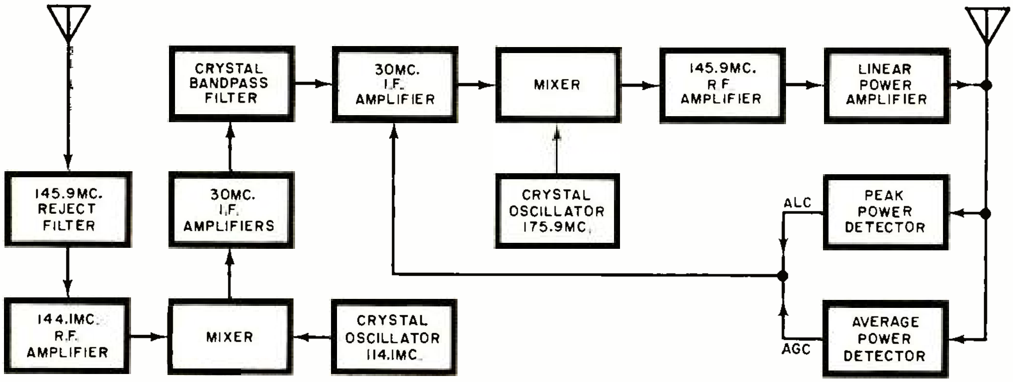


Fig. 1. As shown in this block diagram, the OSCAR III translator receives signals at 144.1 mc., converts them to the 30-mc. i.f. frequency, then to 145.9 mc. for retransmission. The satellite, which will relay signals in excess of 2000 miles, can handle amateur AM, c.w., NBFM, RTTY and slow-scan TV signals.

converted to 30 mc. for amplification, and then reconverted to 145.9 mc. for further amplification and retransmission. Figure 1 shows the functions within the translator.

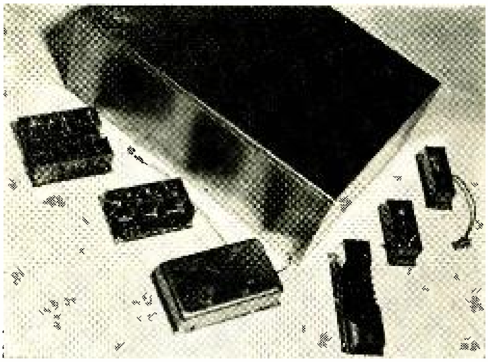
The translator will retransmit a single signal with a power of one watt. However, if two or more signals are in the translator pass-band simultaneously, they will share the watt in proportion to their strengths at the translator input. When no signals are present in the pass-band, the output is noise only, due to the 130 db system gain.

The telemetry system in OSCAR III (see Fig. 2) has three channels monitoring the main battery voltage, the average internal temperature (which is the main battery temperature since it is the largest thermal mass), and the highest internal temperature (the case temperature of the translator output amplifier transistors). The telemetry system transmits "HI" as an identifier, and the battery voltage channel is obtained by varying the rate at which "HI" is sent. The other two channels are interspersed between "HI's" in bursts of pulse-width telemetry modulation.

The coherent beacon transmitter (Fig. 2) is very close to the original OSCAR concept. Its output is unmodulated, but its power is somewhat less than that of the OSCAR I and II transmitters.

Four quarter-wave antennas are mounted on the sides of the OSCAR III package, one for the translator input and one for the output, one for the telemetry transmitter, and one for the coherent beacon. These antennas are made from a steel tape measure, and are silver-plated. During launch, they will fold against the OSCAR III package, but when OSCAR III separates from the launch vehicle to go its own way in orbit, each antenna will snap erect.

(*Continued on page* 92)



Shown here are the electronic components of OSCAR III grouped around the case. Small unit at the extreme right is the low-power coherent beacon unit.

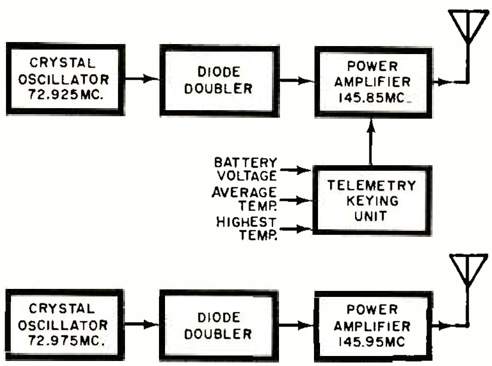
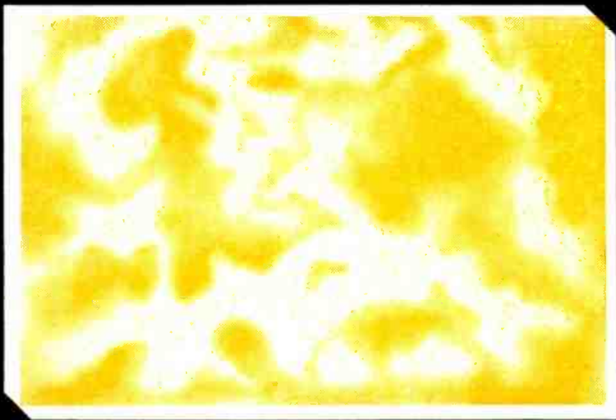


Fig. 2. Block diagrams detail functioning of telemetry (which transmits "HI" as an identifier), coherent beacon for making Doppler shift measurements.



LOW-CO$T HI-FI COLOR ORGAN

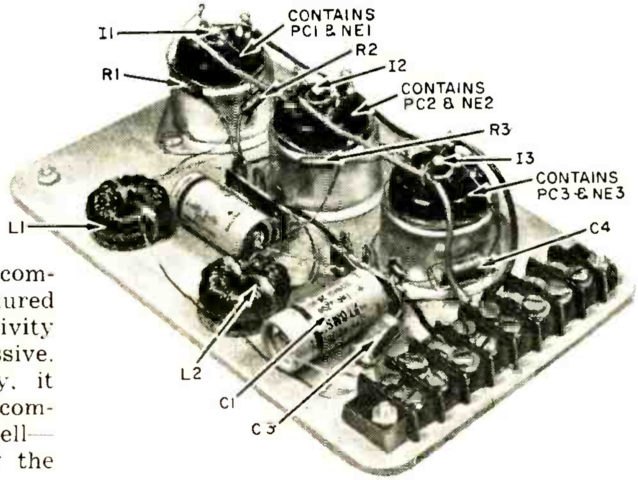
Bring hi-fi music to life with a light display that follows the sound. This unique circuit gives you 75 watts of light for less than $9.00

By DON LANCASTER

HOW WOULD you like to add the intricate patterns of dancing, colored light to your hi-fi setup? Now you can do so without spending a fortune thanks to POPULAR ELECTRONICS' low-cost color organ. To start at the beginning, a color organ is a device that sorts out the highs, the middles, and the lows from music and uses these notes to modulate (control) three colored light sources. You literally watch the music. By reflecting the light onto a broken display surface, the lights grow and dance with the changing pitch and volume of the music. By diffusing the light, the entire rainbow of colors can be produced.

To date, color organs have been expensive, complex devices, using SCR's, Biswitches, Triacs, or transistors as light modulators preceded by fancy tone filters. A simple control chassis meant a pitifully small display, perhaps one or two watts of light at most, while a larger one meant great cost and complexity. POPULAR ELECTRONICS' color organ, on the other hand, is very easily built, and should cost you less than $9 even if you have to buy everything brand-new. And the payoff is that the unit, operating from the speaker terminals of your hi-fi set, will control 75 to 90 watts of colored light!

Fig 1. The photo (right) indicates the approximate location of parts on the ¼" x 4¼" x 7" piece of aluminum. The photocells are mounted under the shells (see text), which act as light shields. Wind L1 and L2 as described in text; mount them on a layer of tape or of other insulating material.



How It Works. To get away from complex design problems, the unit featured here has a fairly low input sensitivity so that considerable, but not excessive, audio drive is required. Secondly, it uses a fairly recent semiconductor component—the Delco LDR-25 photocell—and an unusual circuit to simplify the control chassis but retain a high power control capability.

Basically, the principle behind the color organ is use of the input audio to drive three pilot lamps and then *amplify the light to the display power level!* An inductance in series with one of the bulbs acts as a low-pass filter; a capacitor in series with a second acts as a high-pass filter; a third pilot lamp is made series resonant in the middle of the audio spectrum with an *LC* series filter.

The next step is to "amplify" the light output of the pilot lamps by "watching" each bulb with an LDR-25 photocell. These photocells control the power flow-

Fig. 3 (below) shows wired shield-socket unit with neon, pilot lamps in place. Fig. 4 (the mechanical drawing below the photo) shows how wound toroid is secured to base with lacing twine; ¾" disc insulates it from heat sink. Fig. 5 (bottom drawing) indicates how leads are connected to terminal strip using "Y" lugs. Spaghetti sleeve must be employed.

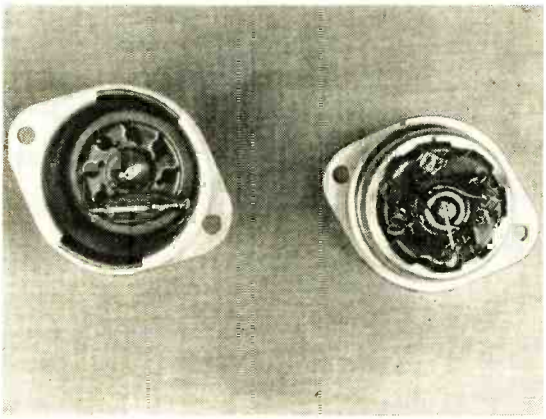
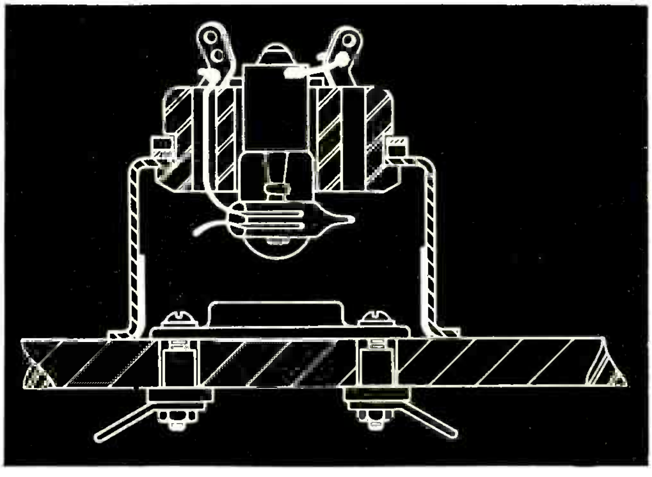
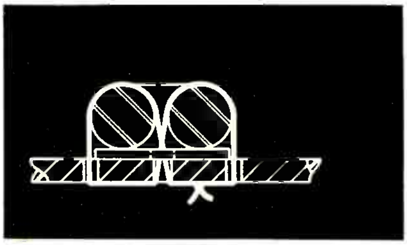
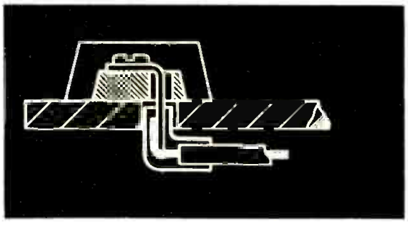


Fig. 2. Modify octal socket by drilling out center to 13/32"; remove odd pins 1, 3, 5, and 7, and wire as shown. The photocell must be centered under shield assembly; mounting hardware comes with cell.







ing to the big display bulbs. A little light *in* (a fraction of a watt) produces a lot of light *out* (25 watts).

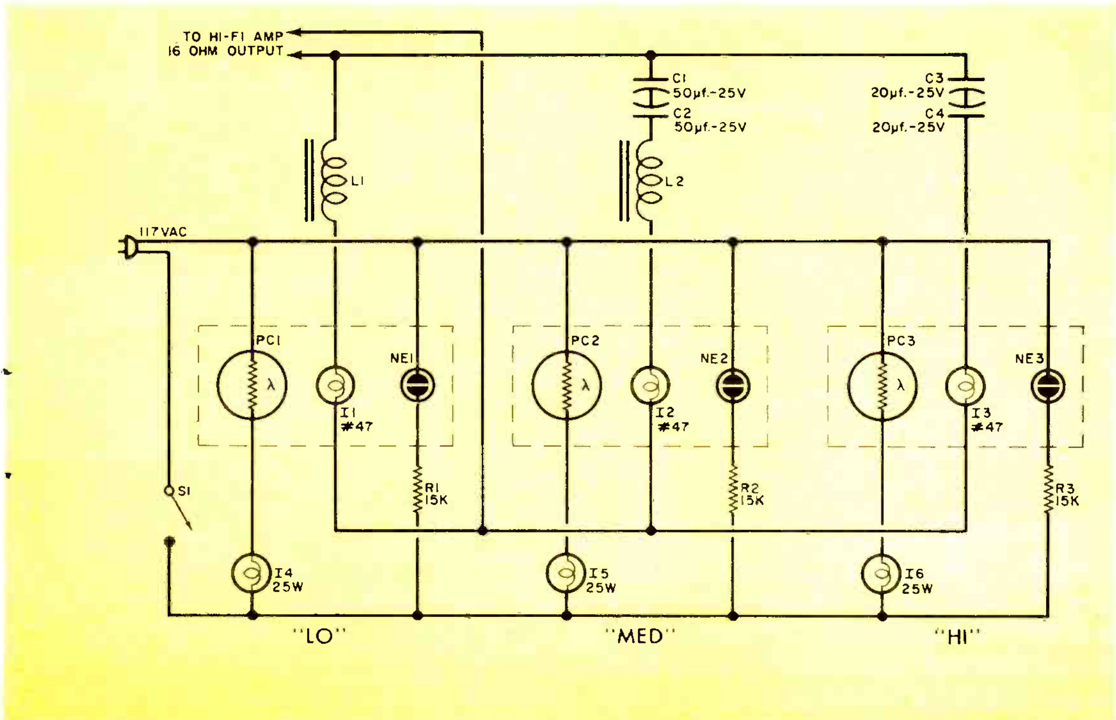
Practical Details. The LDR-25 photocells will easily handle the display power if the mounting and illuminating instructions are followed. A large slab of aluminum is used as a heat sink for the photocells (*PC1*, *PC2*, and *PC3*). If If you care to add a fan to cool the heat sink, you can run 50 watts per channel instead of just 25. Even without a fan, the photocells can handle a total of 75 watts continuously, or up to 90 watts if you stick to a 20-minute-or-less operating cycle.

Two refinements complete the color organ. Light shields must be provided for the photocells to prevent the display and room lights from locking the photocells on. These are simply recessed shell tube socket mounts, ready to go at 11 cents each. If the color organ was operated with only the music lights (*I1 I2, I3*) shining on each photocell, the bulbs would remain off for low musical passages, giving a choppy appearance.

By shining a small amount of light on the photocells *all the time,* the display remains barely lit, permitting the lights to follow the music smoothly. This feature increases display sensitivity of input audio, and prevents the display bulbs from cooling off (insuring that high

PARTS LIST

C1, C2—50-µf., 25-volt electrolytic capacitor
C3, C4—20-µf., 25-volt electrolytic capacitor
I1, I2, I3—#47 pilot lamp
I4, I5, I6—117-volt, 25-watt light bulb (one red, one blue, one green)
*L1—Approx. 3-mh., 0.6-ohm coil; made with Arnold A4-800-250-HA-P core filled with #24 enamel wire**
*L2—Approx. 1.2-mh., 0.3-ohm coil; made with same core as L1 but filled with #22 enamel wire**
NE1, NE2, NE3—NE-2 neon bulb
PC1, PC2, PC3—Delco LDR-25 photocell
R1, R2, R3—15,000-ohm, ½-watt resistor
3—Retainer ring octal socket (Amphenol Type "S")
3—Mounting shell for light shield (Amphenol Type 61-61 or equivalent)
1—8-conductor barrier terminal strip (Cinch-Jones Type 8-140 or equivalent)
4—"Y" lugs for use with above
1—¼" x 4½" x 7" aluminum plate
3—Cleat socket to take 117-volt a.c. display lamp
Misc.—3-lug tie points, line cord, silicone grease, lacing twine, chassis feet, 6-32 hardware, spaghetti, wire, solder, display materials
*Available from Arnold Electric Company, Marengo, Ill., @ 25 cents each



current surges through a cold display bulb will not destroy the photocells). The "bias" light is provided by small neon lamps (*NE1*, *NE2*, *NE3*) inside each light shield. Each lamp is connected to the power line with a series resistor. The value of this resistor determines the display background level.

Two electrolytic capacitors back-to-back are used in the middle and high range audio filters (*C1* and *C2*, and *C3* and *C4* respectively). They are cheaper than large bipolar capacitors and do the same job. The coils are simply enameled magnet wire wound on two low-cost powdered iron toroids. Fill the toroids as full as possible with wire. Counting turns is unnecesary; exact inductances are not critical. The circuit values were experimentally determined to give a good and lively separation and balance to each channel.

The circuit was left "stripped" to conserve costs. Switches, a cabinet, a fuse, and the fan may be added at any time. Background potentiometers could also be included to set the "out" display brightness and balance colors.

Construction. Start with a 1/4" x 4" x 7 1/2" slab of soft aluminum (you may be able to purchase this at the local junkyard). Break all sharp edges with a file and use steel wool on the aluminum to get a good finish. Drill holes for mounting the recessed shell tube socket mounts, the photocells, the barrier terminal strip, the two tie strips, the two toroids, and the chassis feet (see Fig. 1 on page 44 to get an idea of layout).

Be sure to follow the mounting instructions supplied with the photocells. Use silicone grease between each one and the chassis; do not overtighten the mounting nuts.

Drill out the centers of the tube sockets to clear the #47 pilot lamps and remove all odd pins from the sockets. Complete the connections between the pilot lamps and the neon bulbs by using the remaining socket pins. Add two small pieces of good electrical tape to the inside of the shields where they might possibly contact the electrically hot tops of the photocells. Next, mount the octal sockets on their shields, bulbs in, terminals out. The shields may now be mounted on the chassis. Three-lug solder tie points are mounted with the

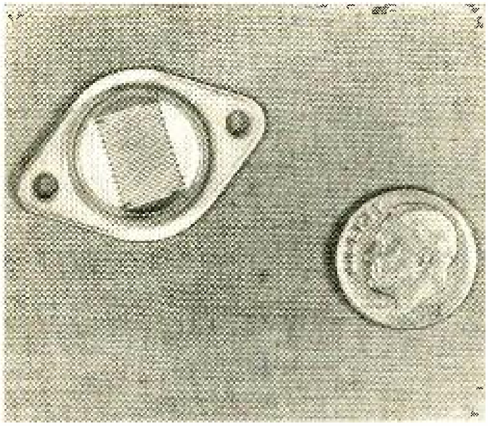


Fig. 6. LDR-25 photocell is small as comparison with dime shows, but can handle considerable power.

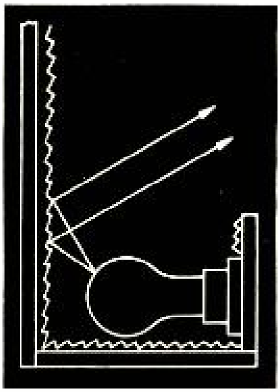


Fig. 7. Display using crumpled aluminum foil can be a simple adaptation of that shown in Fig. 10. Reflected light is more pleasing to watch.

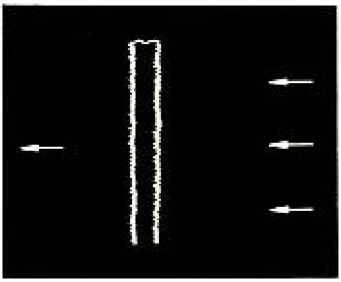


Fig. 8. For color mix, diffuser can be made with a piece of sandpapered plastic or frosted ground glass.

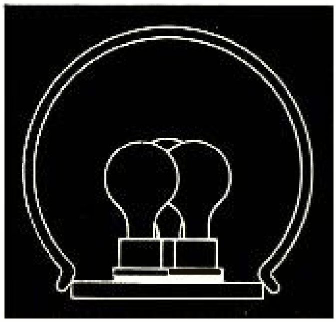


Fig. 9. Fish bowl frosted with lye or sandblasted will create a wide-angle display unit.

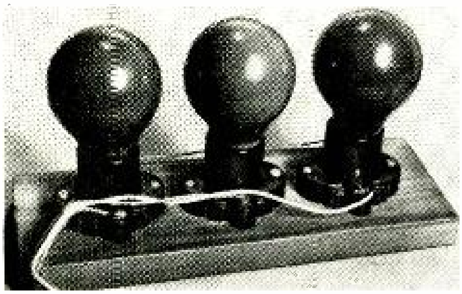


Fig. 10. Build this simple display for testing your color organ. Simply mount cleat sockets on wood base and install three 25-watt bulbs. Display can later serve as light source for a more elaborate setup.

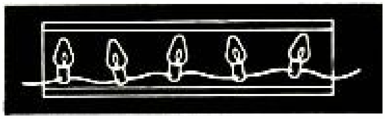


Fig. 11. Another way of making a display is to use series strings of Christmas lights (one five-bulb string per channel). To diffuse the light, run each of the strings through a piece of frosted plastic tubing (below). Remember, when using this type of display, that you must keep within the 25-watt per channel limit of the photocells. Interesting color mix is possible by using lamps of different hues.

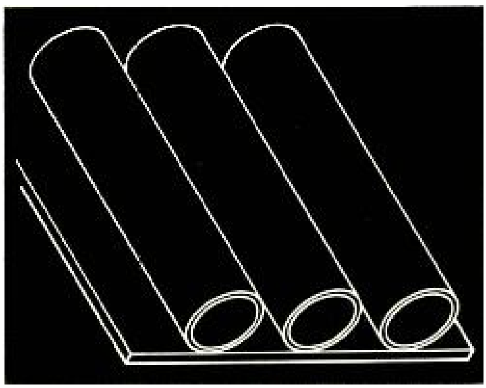
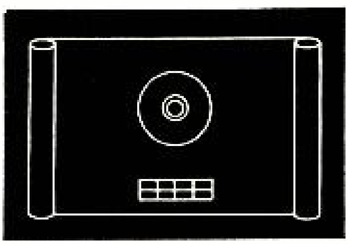


Fig. 12. An adaptation of the idea above, this one makes use of frosted plastic tubes—again with Christmas lights—attached to the front of the speaker enclosure in a manner similar to organ pipes.



first two shields (as illustrated in Fig. 1 on page 44).

Wind the coils using enameled (but otherwise uninsulated) magnet wire. Fill one toroid with #24 wire, the other with #22. Do not substitute wire sizes. Work your way circularly around the core, adding layer after layer, until there is no more open space left in the core center. Mount the coils on an insulator (tape, fish paper, etc.) and sew them to the chassis with string or lacing twine as detailed in Fig. 4.

Wire in the resistors and capacitors as shown in the schematic and Fig. 1. (Note that the electrolytics are connected back-to-back.) Add the remaining wiring, completing the circuit. The high-level a.c. connections to the barrier terminal strip are made from the bottom using "Y" type connectors. Be sure to slip a length of spaghetti over each connection as shown in Fig. 5.

Wiring and Testing. Double-check the wiring of your color organ before placing it in operation: A mistake can ruin your hi-fi. Also check to make sure that no connection exists between the 117-volt a.c. circuit and the leads to the audio amplifier.

The simple display shown in Fig. 10 should be built for initial tests. It is simply a piece of pine, three cleat sockets, and red, blue, and green 25-watt light bulbs. To test display operation, connect it up and plug it in. All the display bulbs should light dimly. If necessary, adjust *R1*, *R2*, and *R3* to get the desired background level and balance.

Make the connections to the audio amplifier speaker terminals and slowly turn up the volume. The color organ should be "on the air." Since speaker volume will be too loud when color organ operation is optimum, you may want to either mismatch the speaker or add an L-pad to quiet it down.

Displays. A number of display ideas are shown in Figs. 7 through 12. Although the simple three-bulb display in Fig. 10 will work, the display will be much prettier if you scatter the light on crumpled aluminum foil (Fig. 7), diffuse it (Figs. 8 and 9), or work out any of several other possibilities.

Regardless of the type of display you select, your color organ will add new fascination to your hi-fi listening. -30-

Simple Simon Voltage Calibrators

By FRED CHAPMAN

INTERESTED in a versatile voltage-step calibrator that has, literally, hundreds of uses? While designing a wide-range VTVM the author found a need for some means of feeding calibrated millivolt signals to the meter. The answer was a simple voltage divider, whipped up around a handful of 10% resistors as shown in Fig. 1.

Jacks *J1* through *J15* are banana jacks, and the resistors are ½-watt units unless otherwise specified. A separate pair of jacks (*J3* and *J4*) accommodates the meter, while the voltage output is taken between the bottom jack (*J15*) and the jack at the desired percentage level. If you want to work with higher voltage levels, it will be necessary to increase the wattage rating of most of the components.

Figure 2 shows a grown-up version of the calibrator that you might want to put together. Note the provision for a.c. or d.c. voltages from 0.1 mv. to 1 volt with a 1-volt input; for a 6-volt input, the steps will range from 0.6 mv. to 6 volts. You simply multiply the input voltage by the percentage indication at the desired position of switch *S2*.

Transformer *T1* is a 6.3-volt filament

(*Continued on page* 95)

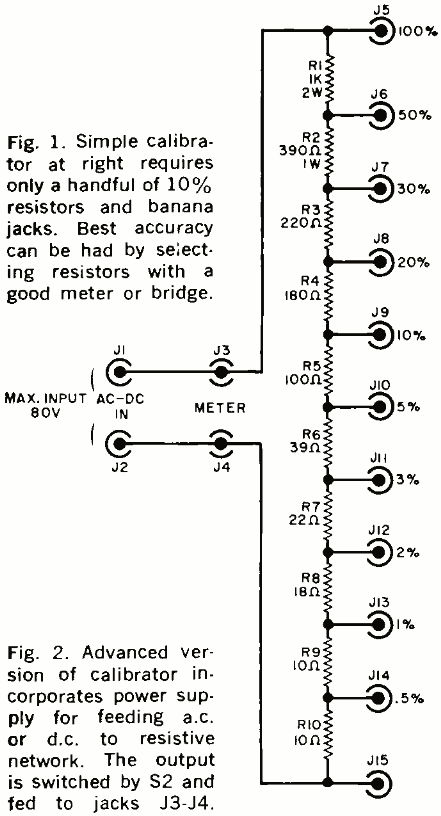


Fig. 1. Simple calibrator at right requires only a handful of 10% resistors and banana jacks. Best accuracy can be had by selecting resistors with a good meter or bridge.

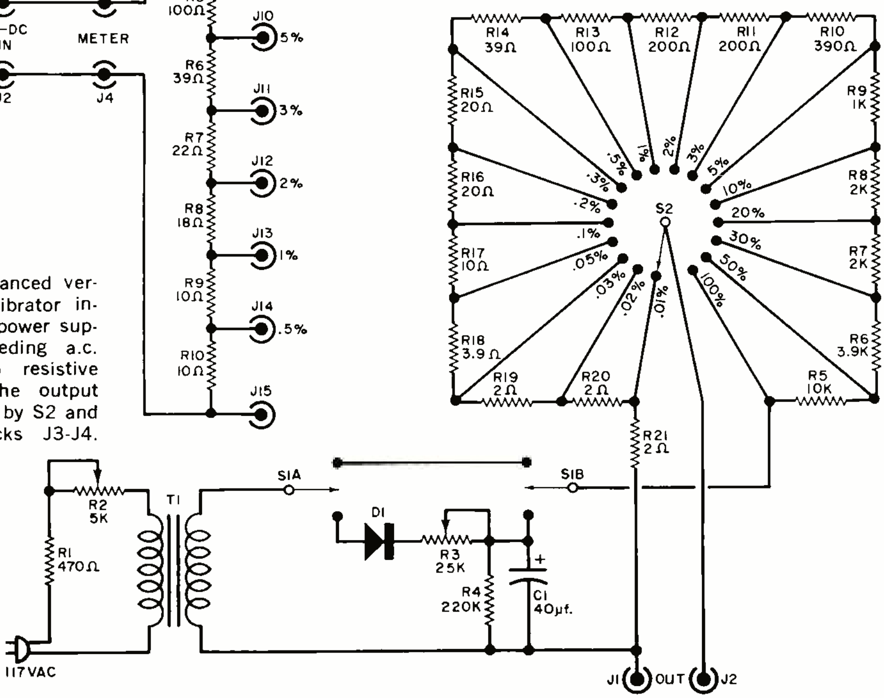


Fig. 2. Advanced version of calibrator incorporates power supply for feeding a.c. or d.c. to resistive network. The output is switched by S2 and fed to jacks J3-J4.

READOUT INDICATORS FOR SOLID-STATE COMPUTERS

Here's how neon lamps are made to work in low-voltage transistor flip-flop and trigger circuits

By ED BUCKSTEIN

THOSE WHO RECALL the "first generation" of electronic computers are continually amazed by the reduction of physical size achieved in later generations. With good reason the computers of the late 40's and early 50's were called *giant* brains: So immense were some of these machines that separate buildings or special additions to existing buildings were required to house them. A typical installation required several large motor-generator sets to feed the power-hungry giant, and huge air conditioners to provide cooling for the many ceiling-high cabinets which housed the electronic circuitry. With some computers, the heat generated by the tens of thousands of vacuum tubes heated an entire building through the cold winters of the North.

Computers had become so large that, for a time, it seemed that further improvements in capability and speed would be prevented by heat and reliability problems. Some people believed that computer technology had already reached the point of diminishing returns. At about the same time, however, the transistor began to live up to its promise. Improved manufacturing techniques produced transistors that were relatively uniform and quite reliable. No longer was it necessary to search through a box full of semiconductors to find two with nearly identical characteristics. The *enfant terrible* of the industry had reached maturity in the form of the stable, reliable, predictable transistor.

From Tubes to Transistors. Computer engineers now hopefully focused their attention on transistors. These new components eventually proved to be even better than the engineers had hoped for, and the solid-state computer took over where its vacuum-tube predecessor left off.

Because the transistor generated far less heat than the vacuum tube, the air conditioner lost its standing as a necessary computer accessory. The smaller size and lower power demands of the transistor permitted a reduction of physical size concurrent with an increase of computer capability. Today, the desk-size computer is no longer a novelty, and some special-purpose computers, designed to solve a specific type of problem, have reached the less-than-a-cubic-foot status.

Interestingly enough, the transition from tubes to transistors created a new problem: the voltage level in a transistor circuit is not high enough to ionize a neon indicator lamp. Such indicators are employed in a computer to provide a front-panel display: of the *data* stored in registers; of the *instruction* being performed by the computer; and of the *address* of the data in the memory unit. Typical neon indicators require about 70 to 90 volts for ionization. In a vacuum-tube computer the neon lights could, therefore, be connected in the plate circuits.

An example of this type of connection is the flip-flop circuit shown in Fig. 1. When the tube to which the neon lamp is connected is conducting, the voltage across the plate load resistor is sufficient to light the lamp. When the tube is cut off, the voltage across the plate load resistor is less than the holding voltage of the neon lamp, and the light goes out. The indicator therefore shows the state of the flip-flop. Transistor circuits, however, generally employ power supplies of 20 volts or less—not enough to ionize a neon lamp.

High-Voltage Transistors. One solution to this problem involves the use of special high-voltage transistors. These units can operate at a hundred volts or more and can therefore drive neon indicators directly. Because of their slow switching speed, however, high-voltage transistors cannot be used in the computer circuits proper, but only to drive indicators. The neon lamp, the transistor, and associated resistors are manufactured as a single package designed for panel mounting.

A typical unit is shown in Fig. 2, and Fig. 3 shows a typical circuit configuration. The neon lamp and its current limiting resistor are connected across the collector load resistor. Only when the driver transistor conducts is the voltage across the load sufficient to light the lamp. The transistor is initially biased off, but turns on when it receives a negative input from the circuit being monitored.

It is sometimes desirable to have the neon indicator on when the neon-driver transistor is off and vice versa. A circuit of this type is shown in Fig. 4. When the transistor is conducting, its collector voltage is too low to light the lamp. When the transistor is cut off, however, its collector voltage is high enough to light the lamp.

Low-Voltage Driver. As indicated in Figs. 3 and 4, the neon driver requires a power supply of approximately 100 volts. Figure 5 shows a circuit that can be used in equipment which does not have a 100-volt supply. This circuit requires only −15 to −19 volts, and generates over a hundred volts for the neon lamp. Initially, the transistor is biased off by the voltage divider consisting of the

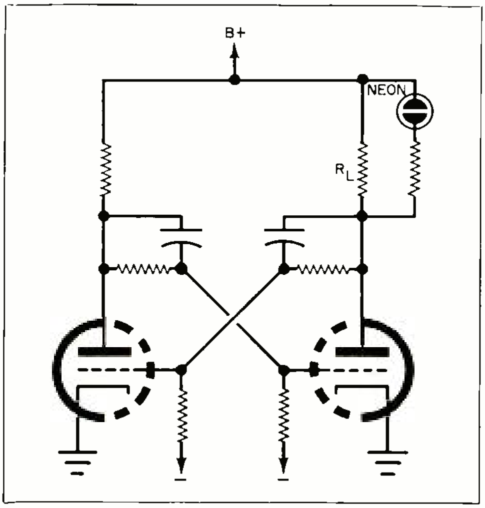


Fig. 1. As the circuit flip-flops from conduction of one tube to conduction of the other, the lamp glows only when tube on the right is conducting.

Fig. 2. Plug-in lamp indicator package contains a high-voltage transistor driver which can be triggered by a low voltage from a transistor circuit.

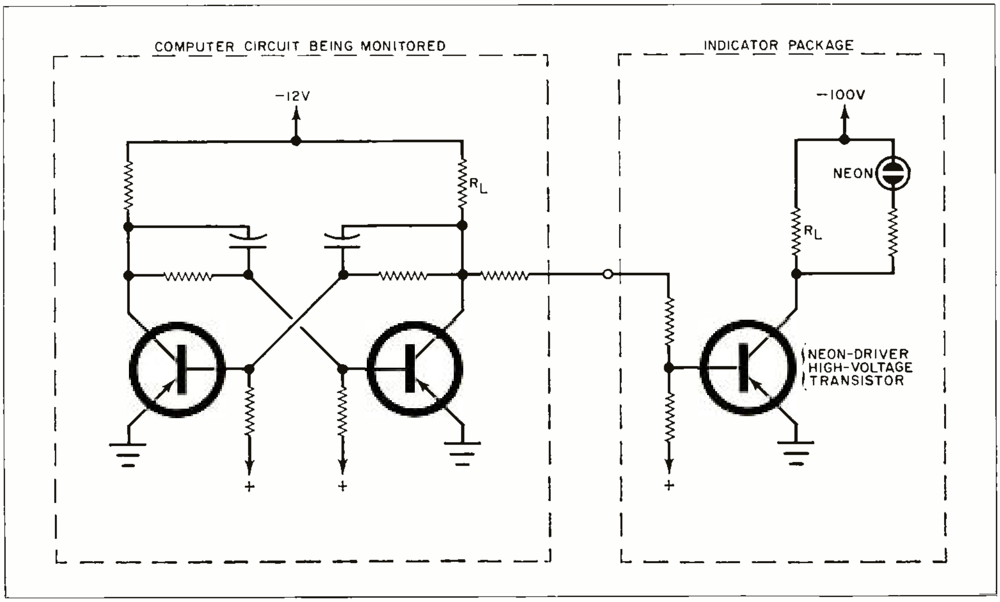


Fig. 3. Driver transistor in indicator package acts like a relay. It is triggered by the low voltage from the basic computer circuit, and in turn applies high voltage to fire the neon lamp.

5100-ohm and the 1000-ohm resistors.

The neon lamp in Fig. 5 turns on when a negative input of −5 to −10 volts is applied to the base of the transistor. This input (from the computer circuit being monitored) forward-biases the base-emitter junction, allowing the transistor to conduct. The circuit now oscillates as a result of the feedback from the collector coil to the emitter coil. An additional winding provides step-up transformer action, increasing the oscillator signal to approximately one hundred volts for the neon lamp.

The 10,000-ohm resistor in the input lead provides isolation to reduce the loading effect on the computer circuit being monitored. If direct input to the

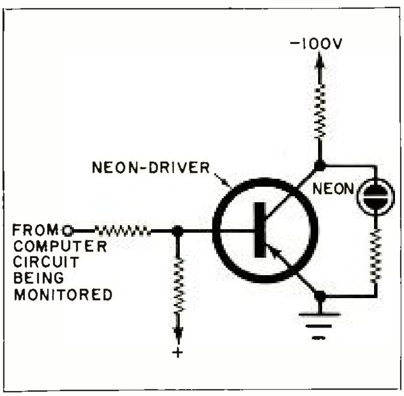


Fig. 4. There are times when it is desired to have the neon lamp on when the transistor is off. As shown in this circuit, the collector-emitter resistance is low during conduction and so is the voltage drop. During off time, the resistance increases and lets the voltage rise enough to fire the lamp.

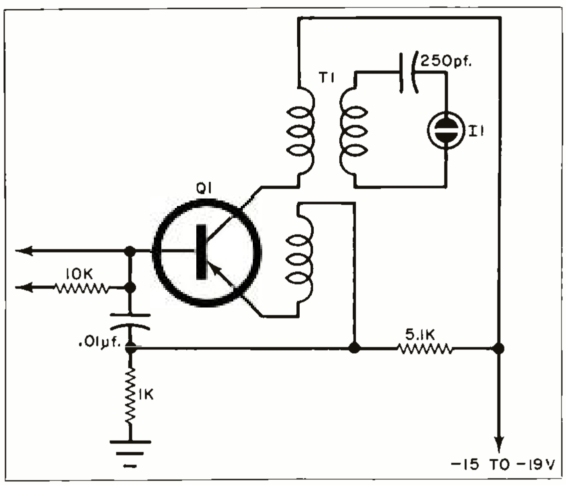


Fig. 5. Only 15 to 19 volts is needed for this indicator circuit. Current flow through the transformer, when a signal is applied to Q1, steps up the voltage to ignite the lamp.

base is employed, an external resistor is required.

Incandescent Lamps. When greater brightness is required, filament type lamps are used instead of neon lamps. The incandescent lamp is connected in series with the driver transistor as shown in Fig. 6, and turns on when the transistor is driven from cutoff to conduction. The lamp is pre-biased by current flow through the resistor shunted across the transistor. This pre-bias current heats the filament slightly but not enough to light the lamp.

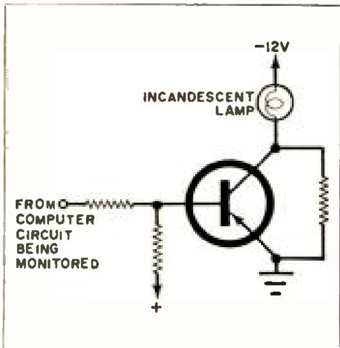
Pre-biasing extends the life of the lamp by reducing the thermal shock to the "cold" filament when the transistor conducts. It also reduces the current requirement of the transistor.

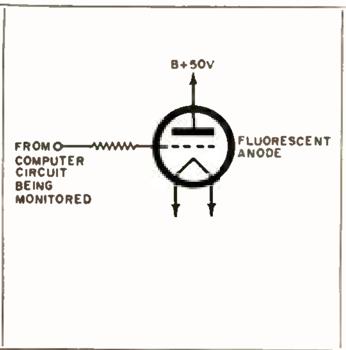
Indicator Triode. The indicator triode is a subminiature vacuum tube having a fluorescent anode. A fluorescent glow is therefore produced whenever the tube is conducting. The Tung-Sol 6977 tube (Fig. 7) is designed especially for transistor circuits in computers and data processing equipment. Full light output is obtained with zero voltage on the grid, and complete light cutoff is achieved at −3 volts grid bias. The grid of the indicator can therefore be connected to the transistor circuit to be monitored. The 6977 tube requires a 1-volt, 0.03-ampere filament supply. It operates from a 50-volt B supply, and draws approximately 0.5 ma. of plate current at maximum light output.

Glow Discharge Indicator. Thyratrons and glow discharge tubes have also been designed for indicator service. One such tube is the TG121A (Fujitsu Limited, Tokyo, Japan). This glow discharge tube has two cold cathodes, one of which is visible through a viewing window.

Normally, the glow is on the holding

(*Continued on page* 91)





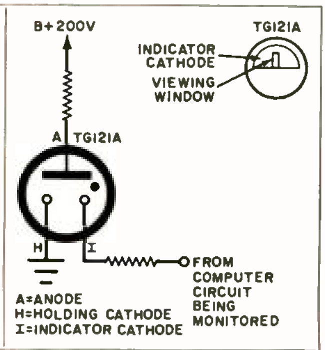


Fig. 6 (above). Incandescent lamp provides a brighter light when needed. Resistor across the cathode-emitter allows just enough current to flow through the lamp to keep it warm, but not enough to light the lamp.

Fig. 7 (above, center). Fluorescent indicator triode glows when the tube conducts. Grid requires only 0 to −3 volts to go from full on to cutoff, well within operating voltage levels of transistor computer circuits.

Fig. 8 (Above, right). Of the two cathodes in this glow discharge tube, only the indicator cathode (I) is visible. A negative signal voltage transfers the glow from the holding (H) to the indicator cathode.

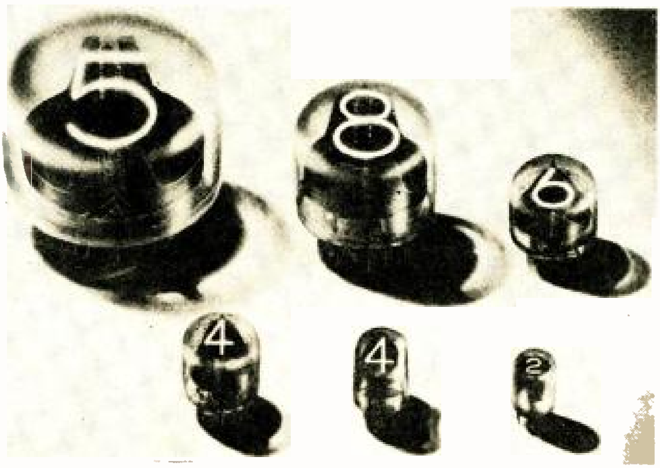


Fig. 9. Nixie numerical indicator produces a glow in the shape of the cathodes. See Fig. 10 (p. 91) for circuit. Photo courtesy of Burroughs Corp.

BUILD THE MASTER CONTROL SCR SWITCHING CENTER

You can control equipment from a remote or local position with automatic or manual go—no-go type switch, photocell, or sensor

By HAROLD REED

THE silicon-controlled rectifier (SCR) is one of the most recently introduced types of semiconductors presently performing electronic miracles. It works like a high-current on/off switch, yet has no moving parts. Many devices, such as electric light dimmers and motor speed controllers, are already taking advantage of the SCR. As the demand for new semiconductors builds up, prices come down. They have already done so to a considerable extent. The SCR used in the Switching Center is a 2N2323 and costs less than $3.50, which is below the cost of many vacuum tubes.

The Switching Center can be used as the heart of burglar alarms, fire alarms, photographic control equipment, door openers, motor driven controls, etc. Control can be automatic or manual, local or remote, and can be triggered by Microswitches, magnetic reed or thermal switches, photocells, etc. The switches can be used in combination, say a magnetic reed switch to close the controller and a Microswitch to open it.

The controller is extremely sensitive; a photoconductive cell connected directly to its binding posts can actuate the relay just by "seeing" a lit match 12 inches away.

How It Works. Like a thyratron, the SCR (*Q1*) conducts when the anode is sufficiently positive with respect to the cathode. Under normal operating conditions the anode voltage is not high enough to start conduction, but is high enough to maintain current flow once it starts. The gate on the SCR performs the same function as the grid of the thyratron. When a small positive voltage is applied to the gate, the SCR fires (provided that the correct anode-to-cathode voltage is also present).

Thereafter, the gate has no control and cannot stop current flow. The only way to extinguish the SCR is to remove or reduce the anode-to-cathode voltage below the holding point. When current flow is stopped and plate voltage is restored, the gate once again is in a position to exercise control.

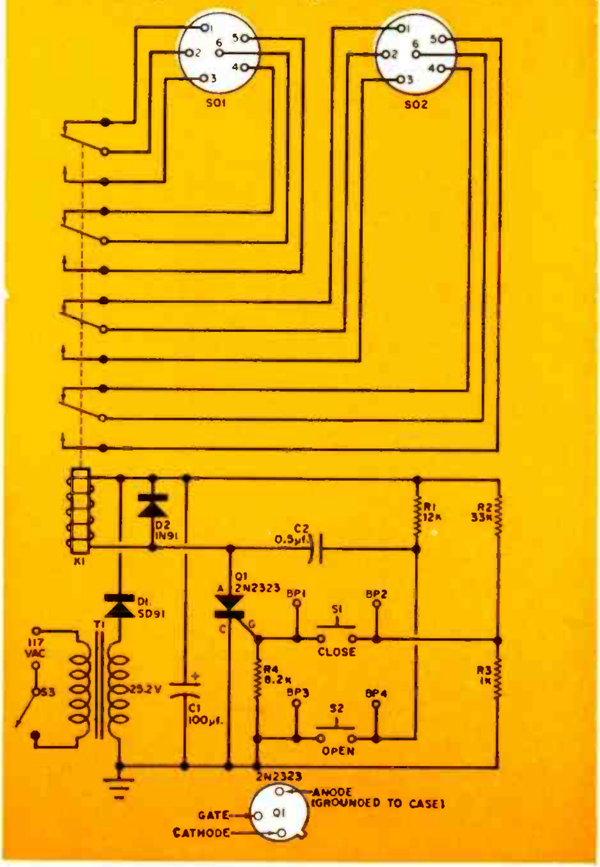
Relay *K1* has a four-pole, double-throw switch to provide numerous control applications. If desired, a s.p.d.t. relay can be used and is noted in the Parts List for your convenience. Both relays have a 2500-ohm coil.

The relay is energized when d.c. flows through the circuit consisting of *T1*, *D1*, *K1* and *Q1*. About 25 volts a.c. from *T1* is rectified by *D1*, filtered by *C1* and applied to *K1* and *Q1*. The d.c. control voltage applied to *Q1*'s gate is developed by the voltage divider action of *R2* and *R3*. Diode *D2* stabilizes relay action and cuts down the high inductive kick from the relay coil when the unit is switched off. Excessive voltage peaks could damage *Q1*.

In the nonconducting state, *Q1* exhibits a very high internal resistance and only a very small leakage current flows; thus, *Q1*'s anode voltage is approximately equal to the d.c. supply voltage. Since this voltage is below the rated peak forward voltage of *Q1*, it will not trigger.

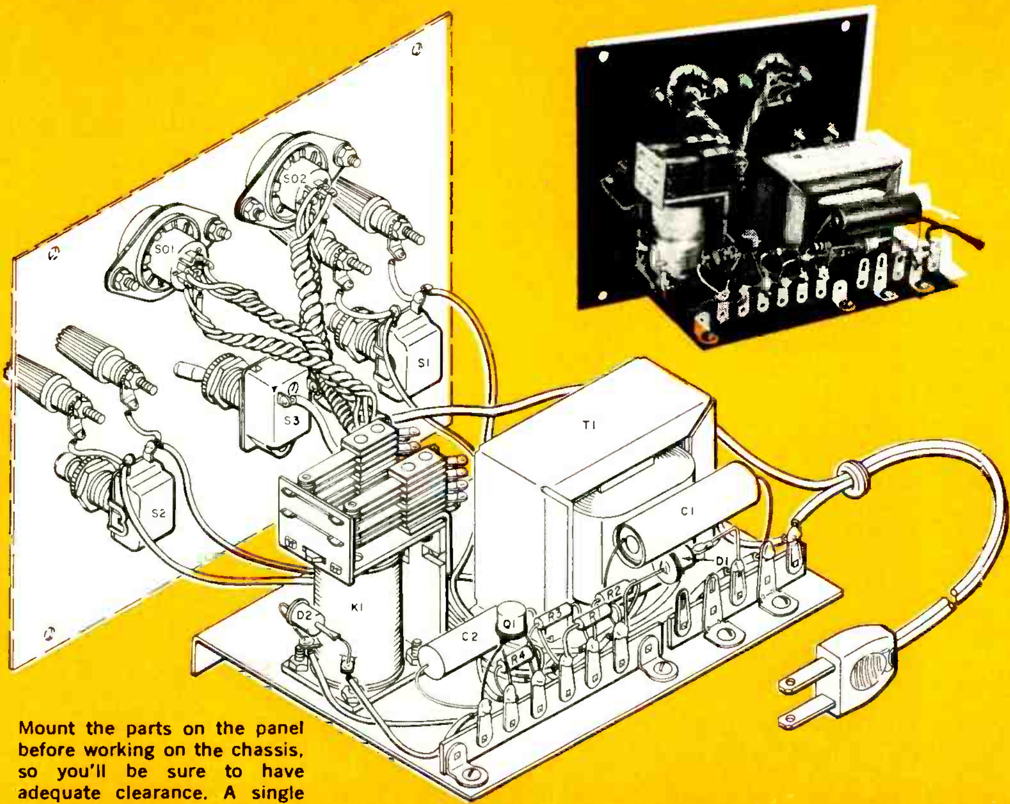
Under this circumstance, all it takes to fire *Q1* is a small positive d.c. pulse applied to *Q1*'s gate. As mentioned before, this comes from the junction of *R2* and *R3* via *S1*. Switch *S1* may be manually controlled or paralleled by any external switching devices attached to *BP1* and *BP2*. Internal resistance of *Q1*

A positive voltage at the gate of the SCR causes it to conduct and close the relay; to stop conduction, a negative pulse is applied to the anode.



PARTS LIST

BP1 to BP4—5-way binding post (Lafayette 32 G 6430C or equivalent)
C1—100-µf., 50-volt capacitor
C2—0.5-µf., 200-volt capacitor
D1—Silicon diode (International Rectifier SD91 or equivalent)
D2—Germanium diode (General Electric 1N91)



Mount the parts on the panel before working on the chassis, so you'll be sure to have adequate clearance. A single terminal strip can be substituted for sockets SO1 and SO2.

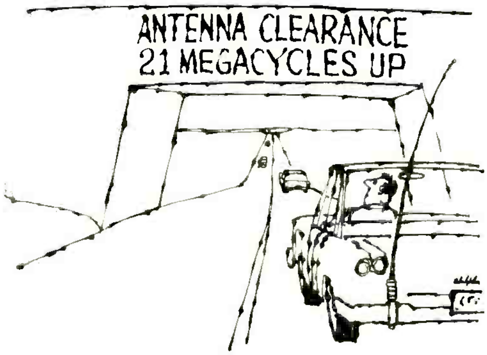
K1—Relay, 4-p.d.t. or s.p.d.t., 2500-ohm coil (Potter & Brumfield GB17D or GB5D or equivalent)
Q1—2N2323 silicon-controlled rectifier
R1—12,000 ohms
R2—33,000 ohms
R3—1000 ohms
R4—8200 ohms
(R1–R4: ½-watt resistors)
S1, S2—S.p.s.t. push-button switch (Lafayette 99 G 6218 or equivalent)
S3—S.p.s.t. on-off switch
SO1, SO2—6-pin miniature socket
T1—Power transformer: primary, 117 volts; secondary, 25.2 volts (Stancor P-6469 or equivalent)
1—4" x 5" x 6" steel cabinet (Bud C-1797)

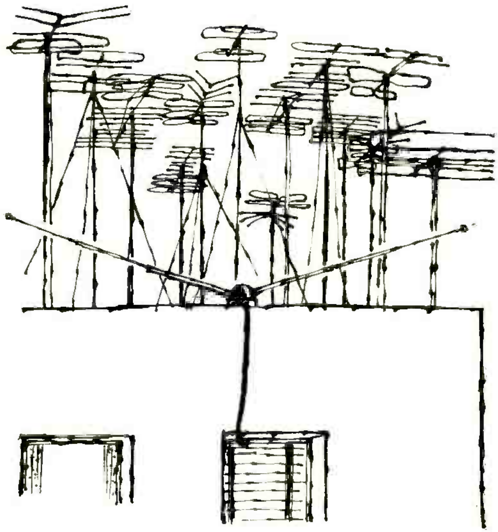
becomes extremely low when it conducts and practically all of the d.c. supply voltage appears across *K1*. The relay closes and works any appropriate device plugged into *SO1* or *SO2*.

Once *Q1* fires, it remains in this condition, keeping *K1* closed regardless of any further switching attempts by the gate. To extinguish *Q1* and open the relay, the voltage developed across *C2* through *R1* is discharged across *Q1* by closing *S2* or by a bridging action of an external control switch. The charge on *C2* momentarily counteracts the voltage across *Q1* enough to stop conduction.

Construction. The unit shown in the photos is built in a 4" x 5" x 6" box which has a self-contained chassis attached to the front panel. All parts are easy to obtain and inexpensive. Transformer *T1* and relay *K1* are mounted on the chassis; smaller parts are soldered to terminal strips. Switches *S1* and *S2*, the binding posts, and power switch *S3* are attached to the front panel.

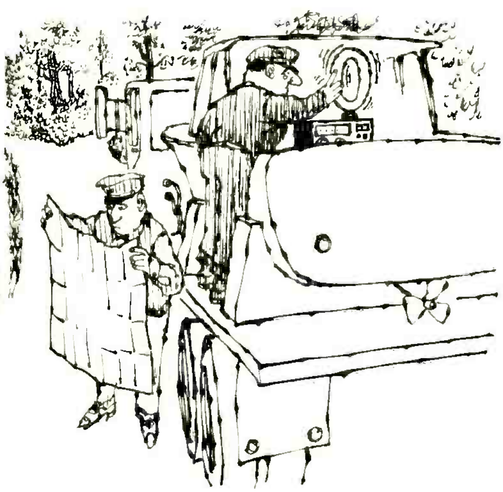
Two 6-contact sockets to extend the relay contactors to a convenient outlet are also mounted on the front panel. Any type of connector or terminal strip could be used for this purpose. —30—

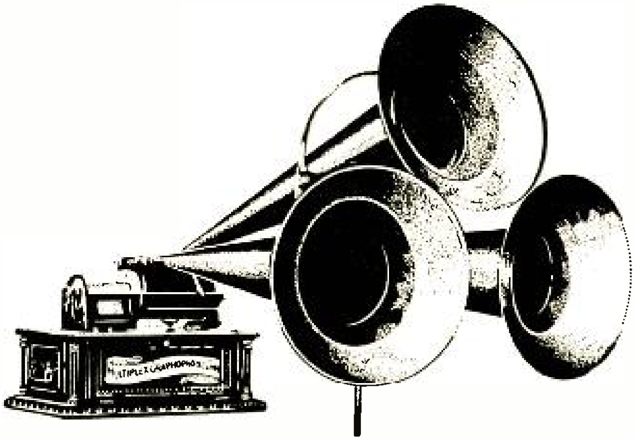




ANTENNA ORIENTATION

By RODRIGUES





By H. H. FANTEL

updating your stereo system

Why does a 1965 stereo system sound better than your 1963 model? There's a good reason—just look at the cartridge!

IF your stereo system is more than two years old, chances are that you can dramatically upgrade its performance just by changing the cartridge. Cartridge design has recently become much more sophisticated, and nearly all of today's cartridges offer a level of performance unknown only a short time ago.

The best news for stereo fans with a tight budget is that the performance gap between the top and the bottom of the price scale is rapidly narrowing. POPULAR ELECTRONICS has tested a representative group of high-quality cartridges and discovered that the sound of a good phono cartridge selling for about $20 comes surprisingly close to the sound of cartridges selling for more than twice that amount. In updating a middle-aged stereo set, installing a new moderate-cost cartridge therefore offers the biggest possible improvement per dollar invested.

Test Results. The results of the P.E. test are reported in the table on the next page. Besides measuring frequency response, distortion, stereo separation, output, and required tracking pressure, each cartridge was given a subjective listening test. These tests revealed that the surprising similarities between low-priced and high-priced cartridges were far more striking than the differences.

All cartridges tested had clean highs and the ability to "ride out" even the loudest passages without "breaking up" or "shattering." Granted, the higher priced models were "silkier" in the highs, and in the loudest passages they had a slight margin in clarity; even in a *triple forte,* they didn't blur and all the instruments stood out clearly. However, these differences are small and they show up only with top-rank amplifiers and loudspeakers. (In these tests a Knight KG-870 stereo amplifier and a pair of KLH Model 6 speakers were used.)

Tonal Coloration. The listening tests also showed certain differences in the tonal coloration of different cartridges. These factors are hard to pin down in the manufacturers' specifications. Like loudspeakers, cartridges have individual quirks that cannot be fully expressed in figures. Their individual tone coloration can best be described in subjective

CARTRIDGE TEST RESULTS

(Cartridges are listed in order of increasing price)

Make and Model	Type	Test Tracking Force (grams)	Frequency Response (cps)	Inter-modulation Distortion (percent)	Vertical & Horizontal Compliance* (dyne/cm)	Stylus Shape* and Tip Diameter (1/1000 inch)	Stereo Separation at 10,000 cps (db)	Price (audiophile net)
Empire 880p	Magnetic (moving magnet)	2	20-15,000 ± 3 db	1.4	15×10^{-6}	round, 0.6	20	$19.95
Pickering V-15	Magnetic (moving iron)	2	20-16,000 ± 2.5 db	2		round, 0.7	17	19.95
Shure M44-7	Magnetic (moving magnet)	2	20-18,000±3 db	1	20×10^{-6}	round, 0.7	21	19.95
Sonotone[1] Mark IV	Ceramic	2.0	20-19,000 ± 2.5 db	2.5	15×10^{-6}	round, 0.7[1]	11	20.25
Shure M44-5	Magnetic (moving magnet)	1.5	20-19,000 ± 2.5 db	1	25×10^{-6}	round, 0.5	18	21.95
ADC 770	Magnetic (moving iron)	2.0	20-17,500 ± 2.5 db	2.4	15×10^{-6}	round, 0.7	19	29.50
Stanton 500 AT	Magnetic (moving iron)	3.0	20-16,000 ± 2.5 db	2		round, 0.7	14	29.85
ADC Point Four	Magnetic (moving iron)	1.0	20-18,000 ± 2.5 db	1.3	30×10^{-6}	round, 0.4	24	50.00
ADC Point Four/E	Magnetic (moving iron)	1.0	20-18,000 ∓ 2.0 db	1.3	30×10^{-6}	elliptical	22	60.00
Shure V-15	Magnetic (moving magnet)	1.0	20-17,000 ± 2.5 db	2	25×10^{-6}	elliptical	24	62.50
Ortofon SPE/T	Magnetic (moving coil)	2.0	20-20,000 ± 2.5 db	2	10×10^{-6}	elliptical	24	75.00

*Data supplied by manufacturer.

[1] Turnover design, also plays 78-rpm records with 3-mil stylus tip.

terms, such as "bright" and "brilliant" as contrasted with "warm" and "round." In this respect, too, there's far less variation between different models today than a few years ago. Nevertheless, most listeners agreed that the various ADC models and Ortofon SPE/T seemed to be on the *bright* side while the Shure and Pickering cartridges tended toward a somewhat *warmer* sound. All other models occupied a middle ground.

Whether you prefer a bright-sounding cartridge or a warm-sounding one is largely a matter of personal taste. If at concerts you like to sit up front and hear the instruments at close range, a bright-sounding cartridge would be your logical choice. If you prefer a smoother kind of tonal blend—as from a seat maybe ten rows back—a warm-sounding cartridge may be more to your liking.

You can also pick your cartridge to compensate for deficiencies in your speakers. A dull-sounding speaker, weak in treble, can be pepped up by pairing it with a bright cartridge. Conversely, if your speaker sounds brassy and strident, you can tame it down by hitching it up with a more mellow cartridge.

Advantages of the New Cartridges. In addition to offering strikingly better sound, the new breed of stereo cartridges also pays off in another way. Because the stylus lever in all the new models is extremely light and mounted in a highly flexible suspension, these cartridges can track records at very light stylus pressures. Some cartridges work at less than a gram downward pressure (so light that a gentle puff can blow the tone arm off the disc) and two grams is about tops. This makes record wear a thing of the past. At such featherweight pressures, the stylus does not permanently deform the groove walls. Assuming that you brush the dust off your discs before every play (to prevent abrasion in the grooves), the new cartridges will make your records last almost indefinitely.

Most of the new cartridges also have the advantage of a standardized stylus angle, that is, the vertical angle by which the stylus leans backward in the groove. In older cartridges this angle varied anywhere from 0 to 40 degrees.

What the Tests Tell You

TEST TRACKING FORCE

The test tracking force is that used by our laboratory to obtain the frequency response figures. This does not denote the minimum tracking force possible with any particular cartridge. During the tests all cartridges were mounted in a Shure SME 3012 tone arm. In all cases the cartridge would track at a slightly lower figure than that given. Records used included the HiFi/Stereo Review Test Record 211, Columbia CBS STR-100 Test Record, and RCA Test Record 12-5-39.

FREQUENCY RESPONSE

The overall range of a cartridge (i.e., the top and bottom notes it will reproduce) is less important than the UNIFORMITY of response within these extremes. Uniform response—often called "flat" response—assures that every note gets its due, no more and no less. That is why the frequency figures are followed by a plus-or-minus (±) figure, which tells the maximum deviation (in db) from flat response. As any deviation up to 3 db is virtually undetectable by human ears, 3 db has been chosen as the maximum permissible deviation for these ratings. The frequency figures indicate the range over which the cartridge maintains response with 3 db deviation or less.

INTERMODULATION DISTORTION

This test measures the amount of distortion produced by the interaction of two frequencies played simultaneously through the cartridge. The percentage indicates the amount of distorted signal relative to the total output. Any figure up to 3% may be considered excellent.

COMPLIANCE

Compliance is the ease with which the stylus follows the shape of the record grooves. (See explanation in text.)

STEREO SEPARATION

This test indicates how well the cartridge separates left and right, preventing the signal for the left channel from leaking over into the right, and vice versa. The amount of separation varies at different points in the frequency scale, diminishing toward the highs. Any cartridge that maintains 15 db or more separation at 10,000 cycles is considered very good.

These discrepancies sometimes caused distortion of the vertical signal and loss of stereo separation, especially on discs in which wide separation between left and right channels produced fairly high vertical amplitudes in the groove. Ideally, the angle of the playback stylus should be the same as the angle of the cutting used in making the master disc at the recording studio. This angle has recently been standardized at 15 degrees. Most new cartridge designs have adopted this standard, resulting in cleaner sound and better stereo separation.

What makes the new cartridges so good and gentle? It's basically a combination of two factors: low dynamic mass and high compliance. In plain language, this means a lightweight stylus with plenty of "give."

Dynamic Mass and Compliance. To understand the importance of these two factors, visualize what goes on in the groove as you play a record. Suppose you have Al Hirt spinning on the turntable. What you hear as a smooth, shiny trumpet note is for the stylus a wild ride on a bumpy road. There are some 20,000 hairpin turns every second—each being one frequency cycle of the trumpet's overtones. And, in stereo, the stylus is not just swinging from side to side—the frantic motion goes up and down as well.

All along this fast and furious ride, the stylus must really "hug the road." The lighter the stylus, and the lower its inertia, the more accurately it can follow the tricky turns of music's complicated waveforms—just as a sport car corners more easily than a truck.

Recent progress in micro-assembly techniques has made it possible to cut down the dynamic mass—that's the weight of the moving parts—in the best cartridges to less than a milligram (about 3/100,000 of an ounce), which means better tracking, cleaner highs, and less distortion.

This low mass in modern cartridges has still another advantage. As mass goes down, the natural resonance of the moving parts goes up—way above the audible range. Harsh-sounding response peaks get pushed up into a frequency region where only bats can hear them. The clean, silky sound of many new cartridges is largely the result of this upward resonance shift.

Next to shrinking the dynamic mass, the other most important engineering advance in cartridge design is increased compliance. Basically, compliance tells you how readily the stylus yields to guidance from the record groove. If the stylus follows the grooves easily, it doesn't have to be pushed down so hard into the grooves and will track at much lower downward pressure.

The specs might tell you, for example, that a certain cartridge has a compliance of 15×10^{-6} cm/dyne. The fancy figures look extremely technical, but they simply mean that if a force of 1 dyne (about 0.000002 pound) pushes on the stylus, the stylus has enough "give" to move a distance of 15 millionths of a centimeter.

Yet these fine physical measurements need not concern you as such. What really matters for purposes of comparison is just the first figure—in this case, the 15. The higher the figure, the greater the compliance. Today's better cartridge designs range roughly from about 12×10^{-6} to 30×10^{-6} cm/dyne.

The greater the compliance, the more easily the stylus follows the twists and turns of the record groove. But there's

(*Continued on page* 94)

INSTALLATION HINTS

When you mount your new cartridge in the tone arm—

- Keep the stylus guard on while you are working. Without it you might accidentally bend the stylus.
- Don't solder the lead wires directly to the terminal pins—the heat would damage the cartridge. Instead, use the pin jacks that are usually packed with the cartridge.
- Make sure the pin jacks grip the cartridge terminals tightly. Loose cartridge connections are a common cause of signal loss or open-ground hum. Also check to make sure that the grounding shields of the cartridge cable pin plugs fit tight around the input jacks of the amplifier.
- Check recommended tracking pressure carefully with a stylus pressure gage. Inexpensive models cost about $1. A gage is indispensable—so get one.

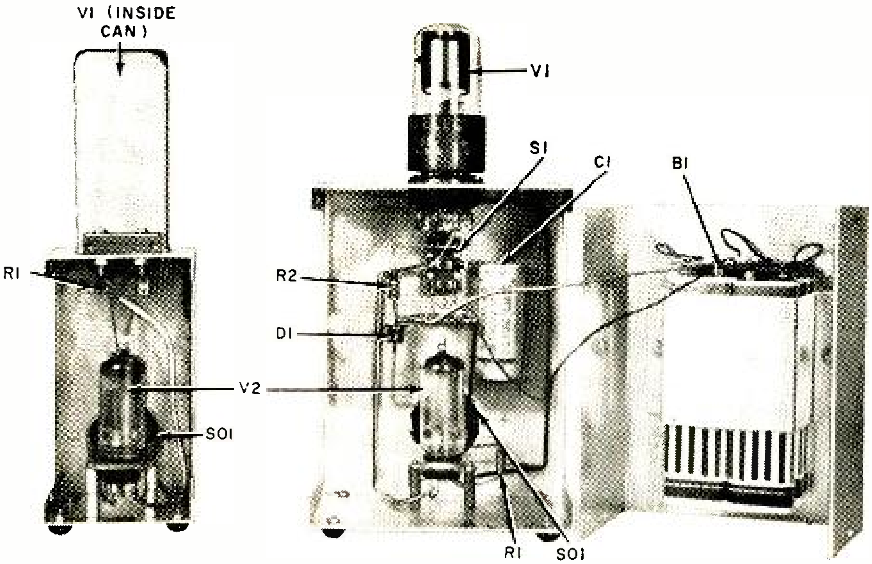
After a few weeks, check stylus pressure again. Keep the stylus tip free of accumulated dust and dirt by cleaning it periodically with a soft brush; make the brush strokes from back to front—not side to side. Be careful not to bend the stylus. Every six months, check stylus pressure.

STROBELIGHT SLAVE

By W. F. GEPHART

Convert any electronic flash unit to a cordless, reliable, light-actuated slave with an easy-to-build adapter

HOW OFTEN have you wished you had more convenient and better flash units to provide fill-in light for photographs of large groups, sports events, or in other critical spots where the light is unfavorable? When you talk about "better," chances are you mean electronic strobe units with their reliability, quick recycling time, and (in recent years) relatively low cost. When it comes to convenience, a prime requisite is the elimination of awkward, hazardous, unreliable cables.



PARTS LIST

B1—180 volts (four Burgess U-30 45-volt batteries or equivalent)
C1—20-µf., 250-volt electrolytic capacitor
D1—1N530 silicon diode or equivalent
*R1—10-megohm, ½-watt resistor**
R2—680,000-ohm, ½-watt resistor
S1—D.p.d.t. slide switch
*SO1—Panel-mounting female receptacle, a.c. type (Amphenol 61-F or equivalent)**
*V1—929 phototube**
*V2—5823 gas triode**
*1—Octal socket**
*1—7-pin miniature socket**
1—2¼" x 2¼" x 4" aluminum box for basic unit, or 3" x 4" x 5" box for booster unit*
Misc.—Shield can for V1, 1" spacers* for mounting V2, 6-32 hardware*, terminal strip, scrap aluminum for battery retainer, battery terminals, rubber feet*, wire*, solder*.*
*Only the parts marked with an asterisk are used in the basic Strobelight Slave.

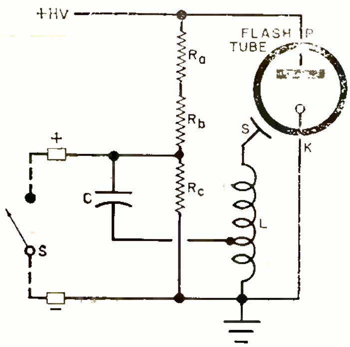


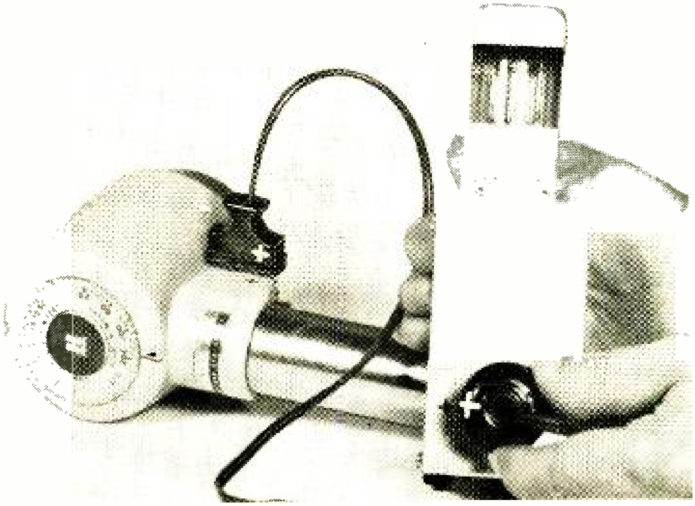
Fig. 1. Shutter discharges capacitor through coil to fire typical strobe.

In addition to the inherent problems cables present, different strobe units cannot always be wired together—in some cases damage may result. Even if the units are similar and designed for parallel operation, polarities must be carefully observed.

What the foregoing list of factors adds up to is the "Strobelight Slave," a simple adapter, described here in two versions, which can be used to convert any electronic flash into a light-operated slave unit. With the slave, the strobelight can be remotely located, responding instantly to the flash from the master strobe fired by the camera shutter.

Typical Strobe Operation. Figure 1 shows the firing arrangement used in most electronic flash units. High voltage is applied to the flash tube between its plate and cathode, while the starter anode is connected to ignition coil *L*. Capacitor *C* is charged to a certain percentage of the high voltage through the voltage divider consisting of *Ra*, *Rb*, and *Rc*. When the shutter contacts (*S*) close, the capacitor discharges through the lower part of the coil, inducing a very high voltage in the upper part, and causing the flash tube to fire.

Basic Slave Circuit. A look at the Strobelight Slave Circuit shown in Fig. 2 reveals how it works. The 5823 (*V2*), a gas-filled triode, operates as a switch. At least 150 volts must be applied between the plate (pin 1) and the cathode (pin 7 or pin 3). No conduction occurs until a certain voltage appears on *V1*'s



Basic Strobelight Slave is shown connected to strobe with a cord terminating in plugs on both ends. Both plugs and the sockets on the strobe unit and either slave unit should be marked with plus signs to avoid damage from cross-polarizing units.

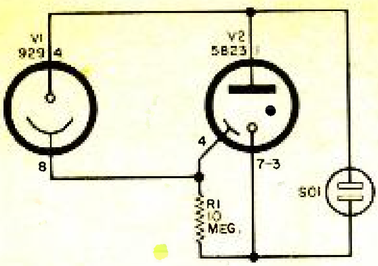


Fig. 2. Basic Strobelight Slave is self-powered, can be used if charging voltage is 150 volts or more.

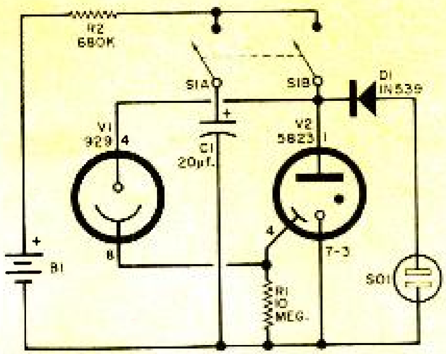


Fig. 3. Booster slave uses batteries to fire V2 with low-voltage type strobes.

starter anode (pin 4). When this happens, the tube then fires, and conducts to such an extent that the plate and cathode are literally shorted. Of course, this condition causes the remote strobe unit plugged into *SO1* to flash.

The trigger voltage for *V2* is generated by *V1*, a 929 phototube, in response to the light from the master strobelight. The basic Strobelight Slave shown in Fig. 2 is, therefore, completely self-powered, and may be used with any strobe having a shutter capacitor charging voltage of at least 150 volts.

Booster Slave. The second version of the Strobelight Slave shown in Fig. 3 provides supplemental voltage for the slave trigger tube when the capacitor charging voltage of the strobe is less than 150 volts. Here, *B1* is used to charge *C1* through *R2*. This insures that the full battery voltage is available to fire *V2* when light strikes *V1*, since, when fully charged, *C1* bolsters the current capacity of *B1*. Diode *D1* isolates the internal slave voltage from the strobe unit, but permits current to flow in a forward direction when *V2* fires, firing the strobe connected to *SO1*.

The second version of the Strobelight Slave also includes switch *S1* to cut *B1* out of the circuit when the slave is used with units having high shutter contact charging voltages—normally *S1* is on only when used with units having low charging voltages. However, when a strobe unit has a charging voltage over

(*Continued on page* 106)

H.E.L.P.

CB radio to rescue stranded motorists

A PLAN to encourage establishment of a nationwide communications network to aid motorists in distress has been announced by the Automobile Manufacturers Association. The system, to be known as H.E.L.P., for Highway Emergency Locating Plan, calls for the use of Citizens Band two-way radio equipment in private passenger cars. Motorists requiring aid would make their needs known on CB Channel 9, where the calls for help would be picked up by a round-the-clock monitoring station within the 10- to 20-mile range of the equipment. Monitors would include volunteer citizens teams, police agencies, road service stations, and hospital emergency rooms.

The plan grew out of a growing concern by government agencies and highway safety groups over the lack of emergency communications facilities for motorists. In seeking a solution to the problem, various states and areas have experimented with systems of roadside telephones, solar-powered emergency signal systems, roadside radio transmitters, and emergency road patrols. Such systems, while commendable, may not be the most practical or economically feasible in attempting to cover the nation's entire road system.

A special AMA engineering task force has been working on H.E.L.P. for more than a year in cooperation with the well-established REACT program and its 600 teams. Design engineers are developing specialized auto radio equipment to expand the highway emergency communications concept. A number of volunteer groups are successfully operating smaller programs in various parts of the country, and would be urged to join H.E.L.P. to effect a coordinated system throughout the nation.

The auto industry is petitioning the FCC to study a proposal for the assignment of two "clear channels" to encourage optimum utilization of H.E.L.P. installations and reduce mutual interference stemming from shared channels. Because the range of CB equipment covers local areas and will be used by individual motorists only for short periods of time, the "unused message capacity" will allow police and highway authorities to transmit messages to motorists regarding highway conditions and other safety information.

Present aims of the program are to encourage motorists to install equipment, to establish a nationwide monitoring system, and to gain support for H.E.L.P. from groups interested in promoting highway safety. —30—

TOOLS FOR THE ELECTRONIC HOBBYIST

A wide variety of tools are available to help you do the job right

By DON LANCASTER

THE success or failure of every piece of electronic equipment you build depends on the tools you have and how you use them. Beginner or old-timer, professional technician or experimenter, you need certain tools, each of which requires an investment. An unused tool is a waste of money. A missing tool means lost time and occasionally a botched-up job.

What are the essential tools for electronics work? Who makes them and how much do they cost? There are four categories of tools we should consider: (1) basic tools absolutely essential for the beginner; (2) "luxury" tools for the beginner, but otherwise generally useful and convenient; (3) special tools required for serious home-brew work, magazine construction projects, equipment modifications, custom audio work, etc.; and (4) the "there must be an easier way" tools that greatly simplify work and improve results, but are not really necessary.

Suppose you're just getting started in electronics. Table 1 on page 68 lists the essential tools you will need. This selection of tools will ultimately become the set around which your whole collection is built.

Soldering Tools. Foremost is something to solder with. Solder is the glue of electronics. Without it, you'd be as bad off as if you tried to build a house without nails. You must choose between an iron or a gun. A soldering iron is low in cost, holds a fairly uniform temperature, and in general enables you to do neater work, particularly on connectors and printed circuits. On the other hand, a gun is much more convenient. It heats and cools quickly and needs no stand. It lights its way into dark corners. Some models provide dual heat. The gun is much better suited for installation work, to get inside speaker enclosures and television sets that can be serviced in the living room.

Eventually you'll want both a gun and at least one iron (two if you do heavy work). The rule on the initial choice is this: If you are going to do most of your work on a bench, or if you are somewhat restricted financially, get an iron. If you are going to work on a kitchen table, get a gun.

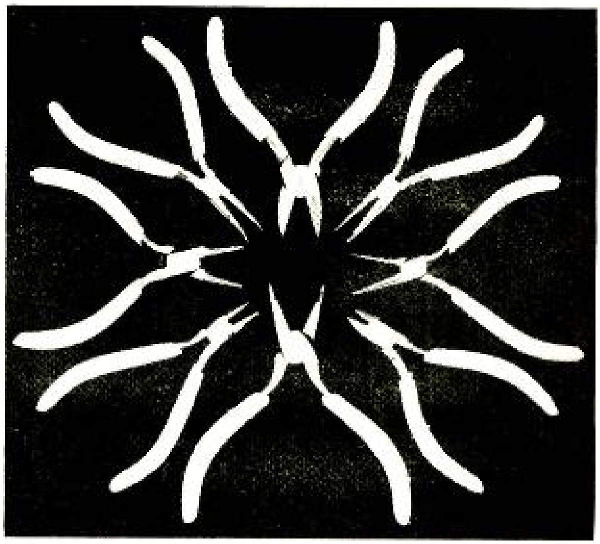
A good choice to start out with in a gun is something in the 100-watt range such as the Weller Model 8200 which offers a dual-heat capacity of 100/140 watts. The best choice in an iron is a handle and cord assembly with a removable tip. Tips with heats of 37½ watts and 47½ watts are available (among others) and will prove eminently practical for general-purpose work. Less wattage is needed in an iron for the same soldering job because the thermal mass of the tip stores heat better than the small gun tip.

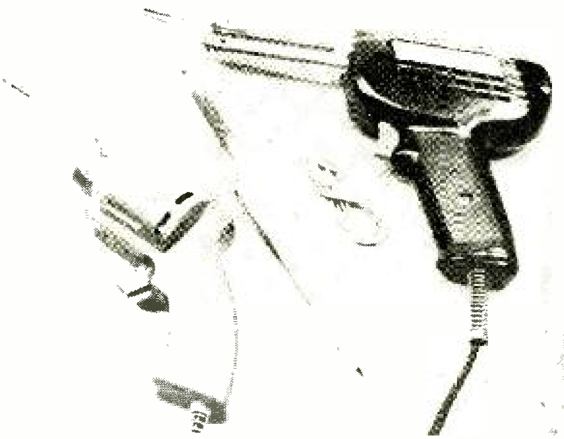
Dikes, Pliers, and Screwdrivers. You'll need a pair of diagonal cutters ("dikes"), and a pair of needle-nose pliers. Dikes are used for cutting component leads and wire, and for stripping wire. Needle-nose pliers are used for bending and positioning component leads and wires prior to soldering. Watch the quality of the tools you buy. The 88-cent variety just doesn't cut properly or hold up well. A very good choice is the so-called "jeweler's pliers (4½″ size, Kraeuter #81, #83, Crescent 942, etc.) instead of the larger, more cumbersome "electronic" pliers.

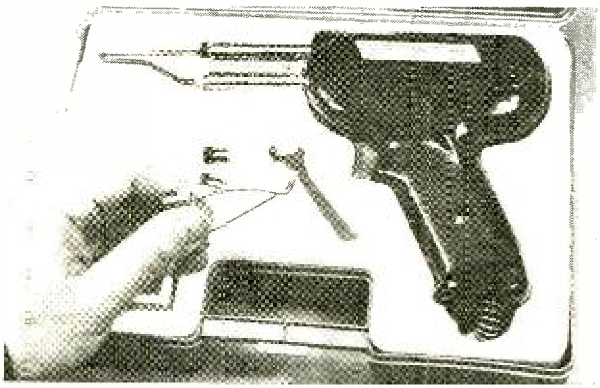
The jeweler's pliers are cheaper, have soft cushion-grip vinyl handles, and are easier to use, especially in tight areas and on printed circuits. Of course, you can't bend ⅛″ steel or cut bolts with this size tool, but the small size is otherwise perfect for all electronic work.

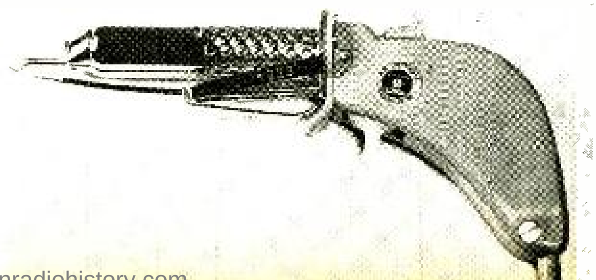
You'll need two screwdrivers, a large one with a 3/16″ blade for general assembly work, and a small one with a ⅛″ blade for knobs and smaller hardware. Two types of screwdriver blades are the cabinet tip (straight) and keystone tip (keystone shaped). The cabinet tip is much better suited for electronic work, and is a bit less common than the keystone tip. Watch for it when you buy.

Again, avoid the bargain basement screwdrivers. There is a definite relationship between the quality of your tools and the quality of the work you do. Further, cheap screwdrivers tend to slip and mar cabinets and finished panels,









Top, left: Various specialized types of cutters and pliers are available as well as straight "dikes" and needle-nose pliers as Crescent Tool Co. photo shows.

Second photo: Soldering options include gun, iron, or soldering pistol. See text for discussion of merits.

Third photo: Weller D550PK kit includes dual-heat gun and specially shaped tips for hard-to-reach work.

Bottom: Brand-new is Blixt automatic iron sold by Curin Electronics. Squeezing trigger advances solder.

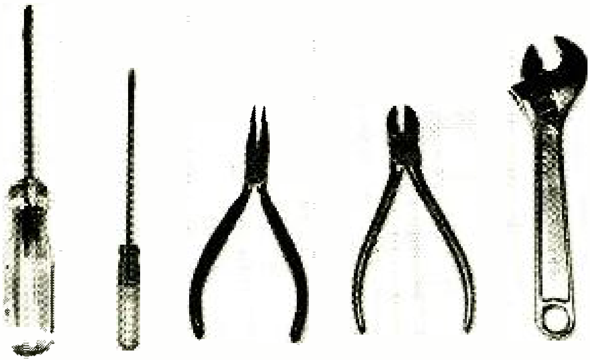
Top, right: Basic tools include large and small screwdrivers, diagonal cutters, and needle-nose pliers. A 6″ adjustable wrench helps handle control nuts, etc.

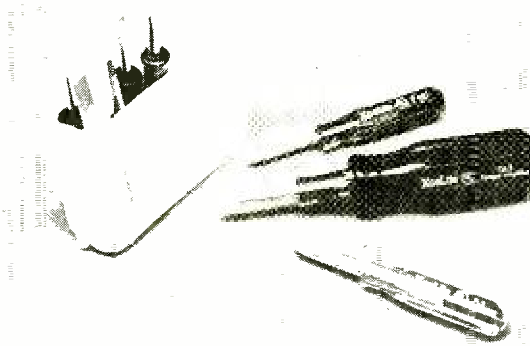
Second photo, right: Worthwhile is an assortment of screwdrivers with regular and Phillips head blades.

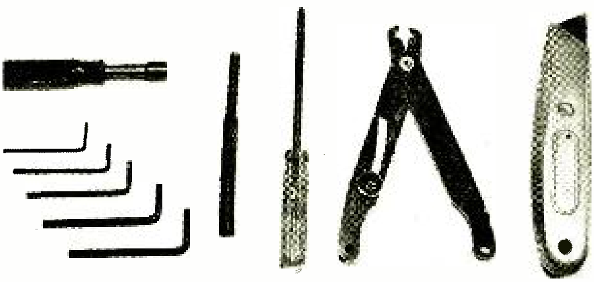
Third photo, right: Add to your basic tools a ¼″ nut-driver, a set of Allen wrenches, a nut starter, Phillips screwdriver, wire stripper, and a shop knife.

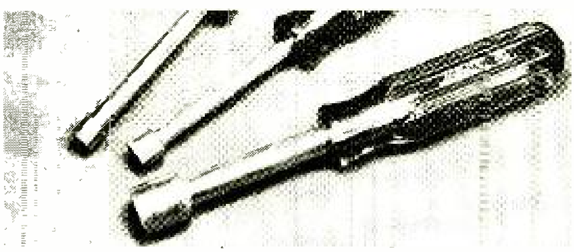
Fourth photo, right: Several sizes of nut-drivers or a set will add much to working convenience.

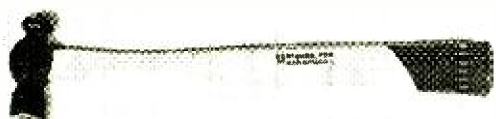
Bottom, right: Basic tools for chassis layout include a ball peen hammer, a scriber, a center punch, and a combination square. Good tools are an asset here.

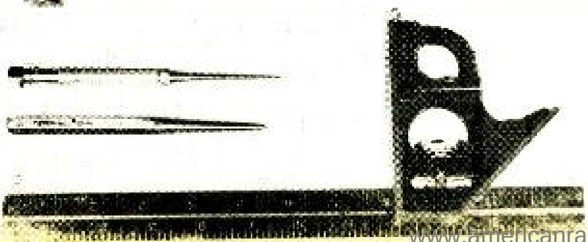












and have caused more than one gouged finger. A quality screwdriver costs 88 cents (Proto, Xcelite, Craftsman, etc.) and is well worth it.

The final basic tool is a 6″ adjustable wrench. This tool enables you to remove and fasten everything from a sheet metal screw to a volume control nut. You get a lead and bracket bending tool, a small vise, and a changer mechanism repair tool free in the bargain. Make sure your wrench is drop-forged; any other type just won't last. The chrome-colored variety is a bit more expensive than a black wrench, but has a better "feel."

This minimum collection will get you started. If you only do occasional electronic work, it may be all you will ever need. But if you're like most electronic "types," you'll start adding "luxury" tools to your basic collection. These tools are not absolutely necessary, but are extremely helpful. Some of them are listed in Table 2 (on page 70). Tables 1 and 2 together will give you a good, well-rounded, basic electronic tool set.

Additional Tools. The first addition should be a ¼″ nut-driver, either a pocket- or full-sized one. Virtually every radio, television set, and phonograph is held together with sheet metal screws that have a ¼″ head. Also, all of the #4 hardware and almost all of the #6 hardware use nuts that are ¼″ across the flats. As these are the two most common electronic hardware sizes, the ¼″ nut-driver is a most useful tool. You can buy nut-drivers individually or in sets (Xcelite PS120, etc.).

You may want a wire stripper of the low-cost variety. They do neater stripping than dikes and there is much less of a tendency to nick the wire. They are also much easier on the hands than dikes. The strippers with vinyl handles are a better choice at twice the cost of the inexpensive variety. There are also "automatic" strippers available which may be a good investment if you do considerable work in electronics.

A soldering aid and a heavy-duty shop knife are two tools that everybody has his own special uses for and are generally well worth their price.

A nut starter is usually provided free with your first kit from at least one kit manufacturer (Heath). This 25-cent piece of plastic tubing can save you hours of frustration trying to get nuts on elusive #4 and #6 screws in tight locations.

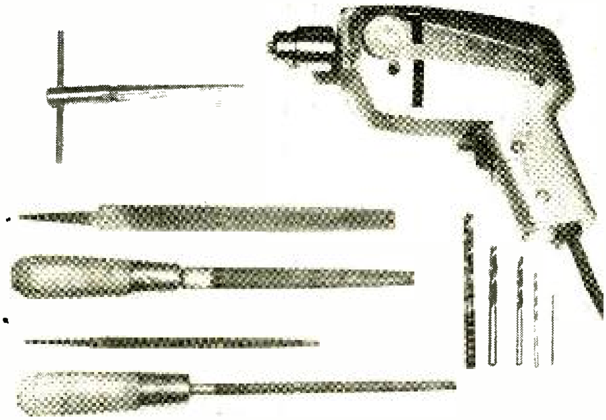
A Phillips screwdriver should be bought when you need it. A #2 or #3 tip is best suited for the screws occasionally found on some consumer electronic items and certain car radios. These screws are not too common, but when encountered, a Phillips driver must be used.

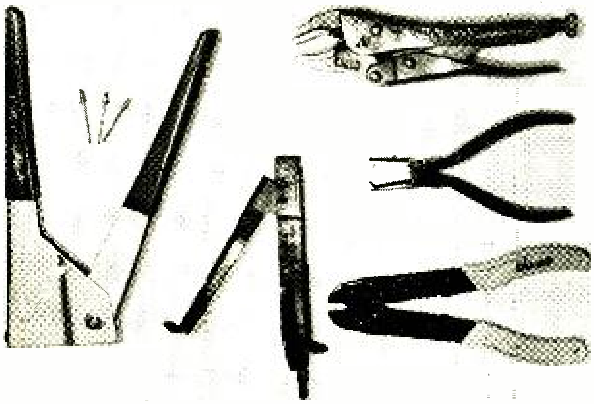
A pair of pliers of either the low-cost slip-joint "gas" plier variety or else the multiple slip-joint "water pump" variety makes a good addition. These are used for positioning, holding, bending, and clamping. They also will do heavy cutting (busbar, appliance wire, etc.). The water pump variety (Channellock, etc.) at $2.60 or so is much more expensive than the 69-cent pair of gas pliers, but is more useful in some instances.

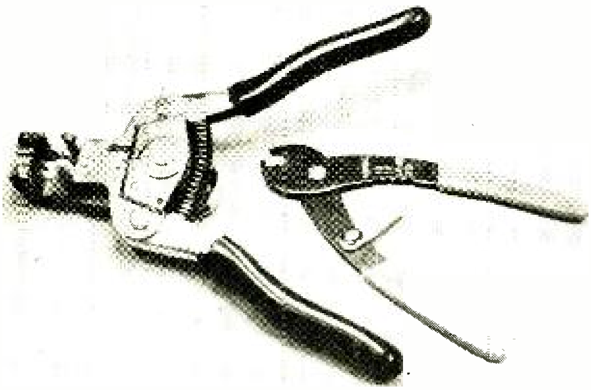
You will probably never run across an Allen head screw until you try to take apart your first piece of military surplus gear or do an industrial service job. Then you will find dozens of the little monsters staring at you. At this point there is only one answer—go buy a quality set of Allen wrenches. Contrary to popular belief, a file tang just won't work! The bargain basement Allen wrench sets are worthless on three counts: They are not hardened, they are not small enough, and the sloppy plating job makes them murder on the screw heads themselves. Be

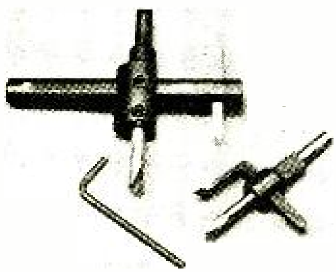
TABLE 1: Essential Tools for the Beginner

Tool	Typical Brands	Use	Approximate Cost
Adjustable open-end wrench, 6"	Craftsman Industro Utica	Volume control nuts, sheet metal screws, bending, tightening	$2.75
Diagonal cutting pliers, 4½"	Channellock Craftsman Crescent M. Klein Knight Kraeuter Lafayette	Cutting wire and component leads stripping wire and cutting insulation	2.75
Needle-nose pliers, 4½"	(See list for diagonal cutting pliers)	Parts positioning, wire bending, and lead forming	2.50
Neon test light 55-600 volt, a.c.-d.c.	—	Measuring voltage and polarity; testing for "hot" circuits and chassis	.35
Resin core solder	Ersin Kester	Soldering	2.00 per lb.
Screwdriver, 3/16" blade 6" long, cabinet tip	Knight Lafayette Proto Vaco Xcelite	Mounting hardware, positioning parts, general mechanical assembly	.60
Screwdriver, 1/8" blade 3" long	(See list for 3/16" screwdriver)	Mounting small parts, particularly knobs; also for tight work and probing circuits	.40
Soldering gun 100 watts or dual capability	Weller Wen	Soldering	5.00 up
Soldering Iron, 30-40 watts or multiple capability	American Beauty Ungar Wall Weller	Soldering	1.00 up









sure your set is hardened or tempered steel, and not the plated variety.

Tools for Home-Brew Work. You now have a rather complete collection of electronic tools, well suited to most experimental work, almost all service work, and certainly all kit building. But you still can't build anything of your own! You have no way of cutting and laying out chassis and panels, or of handling cases and cabinets. Table 3 (on page 88) shows the tools you'll need if you decide to do serious home-brew work or try to duplicate magazine construction projects. Here the cost of your tool collection will go up considerably. The best rule to follow before you buy is to wait until you have a definite need for each item and are certain that you will need the same tool again in the future.

A basic set of layout tools consists of a combination square, a scriber, a ball peen hammer, and a center punch. A bit of common sense at this point may save you some money. If you are only occasionally going to be doing construction work, then by all means get the low-cost tools. But if you're going to do any serious work, get the best-quality tools you possibly can.

To cut your brackets, panels, and chassis, you will need two more tools, a 12" hacksaw with a fine-tooth blade, and a pair of shears. You have a choice between conventional "tin snips" or the more expensive double-action aircraft shears.

Now to put the holes in. You *must* have an electric drill if you are at all

Top: If you plan to do much home-brew work, an electric drill is a must. Also essential are a reamer, and rattail, half-round, triangular, and round files.

Second photo: "Easier way" tools include a riveting tool, vise grip pliers, traverse cutting pliers, a terminal crimping tool, and a chassis nibbling tool.

Third photo: Wire strippers are handy to have. Unit at left is "automatic" type—good if you do a lot of wiring. Inexpensive stripper (right) will also serve.

Bottom, left: Circle cutter is also essential if you do much metal work. It's used with carpenter's brace for cutting out round holes for meters, dials, etc.

Bottom, right: Two chassis punches are a good investment. Common sizes—1 5/32" and 5/8"—take care of most socket and capacitor mounting problems.

TABLE 2: "Luxury" Tools for the Beginner

Tool	Typical Brands	Use	Approximate Cost
Allen wrench set	Craftsman Lafayette Walsco	Disassembly of military surplus electronics and some knobs; also for some industrial electronics equipment	$1.00
Nut-driver, ¼" x 6", hollow shaft	Craftsman Knight Lafayette Xcelite	Tightening and removing sheet metal screws and all #4 and #6 nuts; needed for disassembly of most radio, TV sets	1.00
Screwdriver, Phillips #2 or #3, 6" long	Craftsman Knight Lafayette Proto Vaco Xcelite	Removing and replacing Phillips screws	.60
Shop knife, heavy-duty	X-acto	Cutting insulation and lacing twine, removal of insulation, scraping	.35 up
Slip joint or "gas" pliers	Craftsman Crescent M. Klein Knight Kraeuter	Holding and positioning heavy cutting (busbar, etc.), bending	.60
Soldering aids	Beauchaine & Sons Clauss GC Electronics Ungar	Bending and positioning leads prior to soldering, removing unsoldered components	1.00
Wire stripper	GC Electronics Miller Walsco	Stripping insulation off wires, cutting component leads	1.00

serious. Otherwise you'll be wasting your time. At least a ¼"—or better yet—a ⅜" chuck should be chosen. The only difference between a $15 and a $30 drill is the quality of the bearings (bushings vs. ball bearings) and the ruggedness and "burn-out-proofness" of the motor. For occasional work, choose the cheaper models. For professional or production work, get the finest drill you can buy (Skil, Black and Decker, etc.). It will pay for itself many times over.

A drill index with some drills is next. Here there should be no compromise. Even if you are only going to drill one hole, get a quality drill. The bargain basement drills dull quickly, cut a ragged hole, and walk all over the place.

The same goes for files. Stick to the quality brands (Nicholson, etc.). You'll need these for enlarging holes, cutting square holes for sockets and transformers, and finishing panel edges. A basic set consists of a ¼" "rat-tail" file, a small triangular one, a large half round, and a large flat file. Another important rule: When a file gets dull (not clogged, but just plain *dull*), do one of two things with it—either use it as a paint stirrer, or throw it away. But don't try to file with it. You'll be wasting your time.

Two cold chisels and a taper reamer for enlarging holes complete the basic construction tools you'll need. The chisels are fine for transformer holes. The reamer is required to get a ¼" hole large enough to accommodate a volume control or a pilot light.

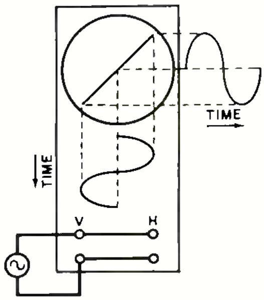
"Easier Way" Tools. Maybe you already have most of the tools listed in Tables 1, 2, and 3, and are considering getting the rest. But Table 4 lists a new breed of tools. They are the "there must be an easier way" tools that make child's play

(*Continued on page* 88)

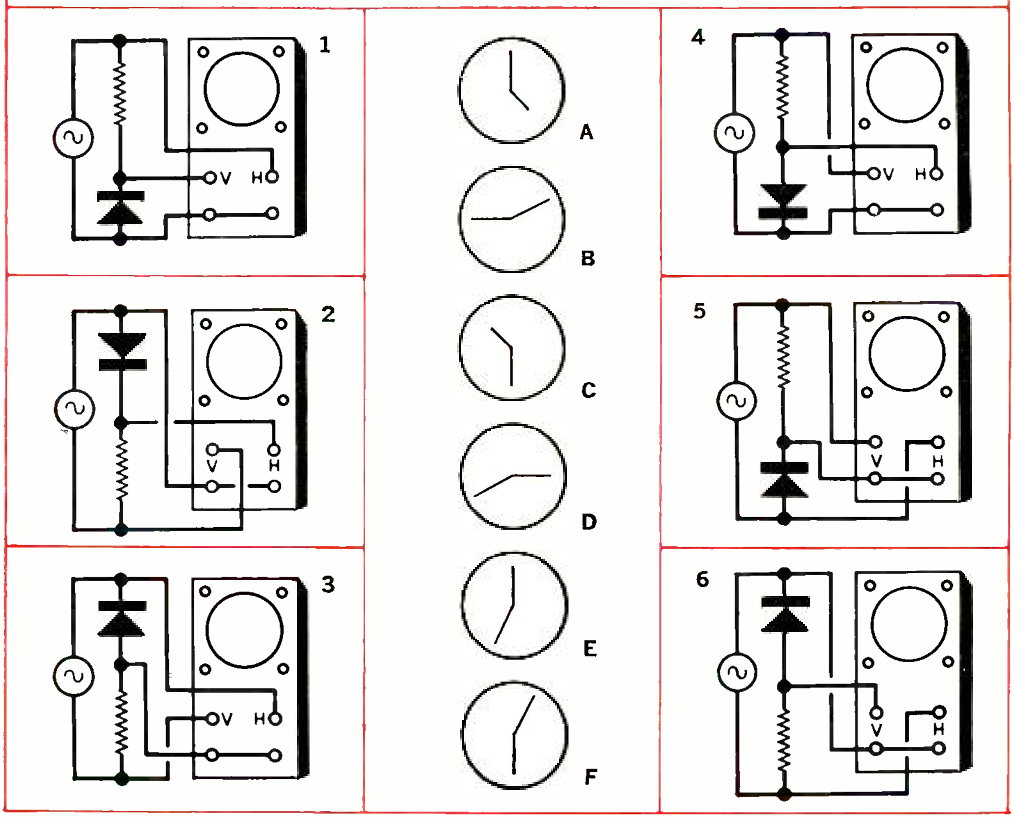
SCOPE-TRACE QUIZ

By ROBERT P. BALIN

How are you at vectors? Here's a chance to get some practice and test your scope sense. The vertical and horizontal input signals to an oscilloscope combine to form Lissajous patterns whose appearance depends on the waveform, frequency, and relative phase of the two signals. Knowing how these patterns are formed will help you to interpret waveforms and to have a better understanding of the scope. Test your ability to project (vectorially) the forces at work on the electron beam in the CRT. Six different oscilloscope traces are shown in A—F. Can you match them with circuits 1—6 below?



The resistor used in each circuit has a value equal to the reverse resistance of the diode. Forward resistance of the diode is negligible. The circuits shown do not load or distort the signal source. Both the vertical and horizontal gain controls have been set to provide equal gain. Positive-going signals cause the beam to be deflected upward for the vertical input and to the right for the horizontal input. The example at left shows the resultant trace derived from the same signal applied to both the vertical and horizontal scope inputs. Tips on how to solve this quiz appear with the answers.



(Answers on page 97)

Transistor Topics

By LOU GARNER, Semiconductor Editor

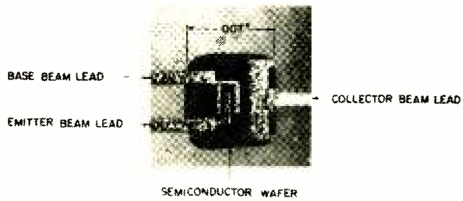
AN IMPORTANT ADVANCE in semiconductor technology eliminates a number of electrical and mechanical production problems and promises to simplify fabrication and assembly procedures for most types of semiconductor devices and circuits, including transistors, diodes and integrated circuits. Invented by M. P. Lepselter of the Bell Telephone Laboratories, the new technique involves the use of electroformed cantilever-type beam leads both as mechanical supports and as electrical connections. The beam leads are made of gold and are approximately 10 microns (4/10,000 of an inch) thick—relatively massive in terms of transistor dimensions.

The cross-sectional view of a typical silicon planar transistor produced using the beam-lead method is shown in Fig. 1. A photomicrograph of an actual transistor is also shown. Conventional planar techniques (see "Transistors—Types and Techniques," November 1962) are used to form the transistor active regions. The strong electrical beam leads are then deposited over the silicon oxide to connect to the base, emitter and collector.

One of the main features of beam-lead integrated circuits is the simple way in which electrical isolation of components is accomplished: all unwanted material between components is removed at the same time that individual circuits are being separated. Unlike other techniques in use today, no additional diffusion or processing steps are required to isolate components.

Another feature of beam-lead construction is that semiconductor wafers or chips, which may contain either single devices or entire circuits, can now be connected directly to headers by the beam-leads. Previously, semiconductor wafers were first bonded to the header to keep them in place and then extremely fine wires were individually connected to the circuit elements on the wafer.

These experimental beam-lead devices and circuits have shown their physical ruggedness by successfully passing tests which included thermal aging in 360°C steam and centrifuging to greater than 100,000 times the force of gravity. Looking to the future, the beam-lead technique, when adopted by semiconductor manufacturers, should lead to better and more rugged transistors and diodes at lower prices. And it may even permit the production of low-cost integrated circuits for hobbyist applications.



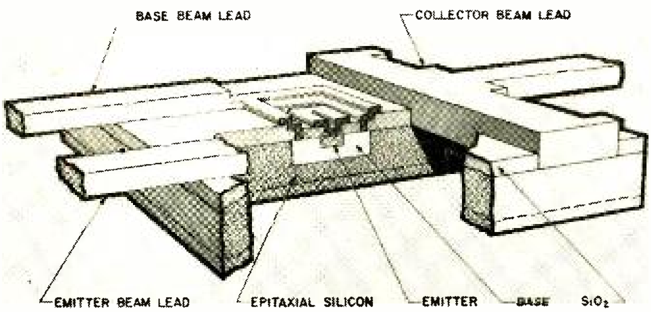


Fig. 1. Strong electroformed beam leads, made of gold, serve as mechanical supports as well as electrical connections in the new construction technique developed at Bell Labs for use in solid-state components and integrated circuits. The photomicrograph of an actual transistor, above, shows the microminiature size. More than 20,000 transistors can be placed in a 1" square area.

Manufacturer's Circuit. A 100-kc. crystal-controlled oscillator is a useful addition to an experimenter's laboratory or to a ham shack. Providing harmonic signals at 100-kc. intervals, such an instrument can be used to check the calibration and alignment of multiband receivers, transmitters, tuned signal tracers, h.f. frequency meters and signal generators. The schematic diagram of an easily built 100-kc. oscillator is shown in Fig. 2. Suggested by Texas Crystals (1000 Crystal Drive, Fort Myers, Fla.), the circuit uses a crystal, an *npn* transistor (2N332), and a minimum of additional components.

The 2N332 is used in a modified grounded-base oscillator arrangement. Base bias is provided through voltage-divider *R1* and *R2*, with the base at a.c. ground because of the bypassing action of *C2*. Inductance *L1* serves as the collector load. Capacitor *C3* and the crystal provide the collector-emitter feedback needed to maintain and control oscillation. Resistor *R3* serves as a stabilizer and prevents runaway action on the part of the transistor. The output signal is obtained through *C5*. A 20-volt source, controlled by *S1* and decoupled by *C1*, furnishes power to the circuit.

Readily available components are used. All resistors are half-watt types, while *L1* is a standard 2.2-mh. r.f. choke (typically, a Miller 924-712). Capacitors *C1*, *C2* and *C4* are ceramic disc types and *C3* and *C5* are either ceramic or silver-mica units. Control switch *S1* can be any standard s.p.s.t. switch. Finally, the power source can be either series-connected batteries or a line-operated supply, as preferred.

The instrument can be assembled in a small Minibox, in a sloping panel meter case, or on a small chassis. In use, it provides harmonic signals at 100-kc. intervals. Loosely coupled to a receiver's antenna, it will provide signal check points across the band (using the set's BFO), permitting dial calibration checks. When used to check a signal generator's calibration, a separate detector, such as a receiver, must be employed. Again, beat notes are obtained at 100-kc. intervals.

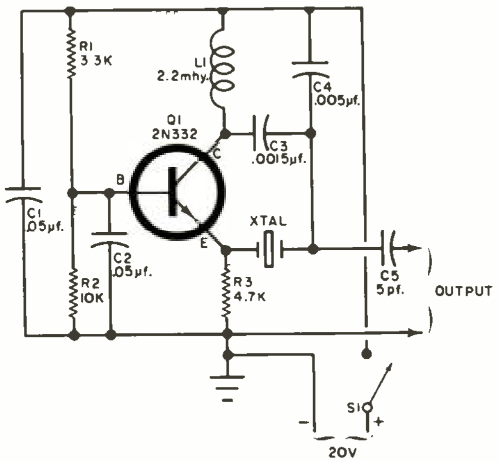


Fig. 2. Texas Crystal's 100-kc. crystal-controlled oscillator is rich in harmonic output and can be used to calibrate and check alignment of multi-band receivers and transmitters, and signal generators.

Reader's Circuit. Delivering a maximum of five watts output, depending on the B-plus voltage (6-22 volts), the interesting audio amplifier circuit illustrated in Fig. 3 was submitted by Professor Raoul J. Fajardo of the Electronics Department, Pasadena City College (1570 E. Colorado Blvd., Pasadena, Calif. 91106).

Transformerless amplifiers have become popular for transistor circuits, but unless the builder has had sufficient experience with transistors he is likely to run into biasing difficulties and distortions arising from poorly matched transistors. Those difficulties can be greatly minimized with this circuit, which eliminates the driver transformer, but retains the output transformer.

One-watt output can be obtained with a 9-volt supply and up to five watts with a 22-volt supply. A simple adjustment of only one potentiometer is all that is needed to handle any of the voltages within these limits. This versatility is achieved by a novel differential biasing arrangement.

The circuit is a push-pull class AB amplifier, in which phase inversion for push-pull operation is obtained by *Q1*. The signals developed across *R5* and *R1* are 180° out of phase. This stage is also known as a *paraphase* driver stage. It operates class A at a low power level and current drain is low. The outputs are then coupled to the final drivers, *Q2* and *Q3*, each of which amplifies one-half of the signal. These transistors are directly coupled to the power transistors (*Q4* and *Q5*), thus providing a very efficient design.

Output transformer *T1* is used to integrate the two halves of the signal into a complete signal for the speaker. Diodes *D2* and *D3* are used to decrease the effect of leakage current and to obtain a certain amount of thermal stabilization in the output stage. The result is good frequency response and good damping ratio to provide tonal quality expected of hi-fi performance.

The manner in which *Q1* is coupled to *Q2* and *Q3* by resistor-capacitor combinations is a novel feature of this circuit, and deserves a word of comment. When a paraphase amplifier drives a transistor class B stage in push-pull, the coupling capacitor accumulates a d.c. charge that unbalances

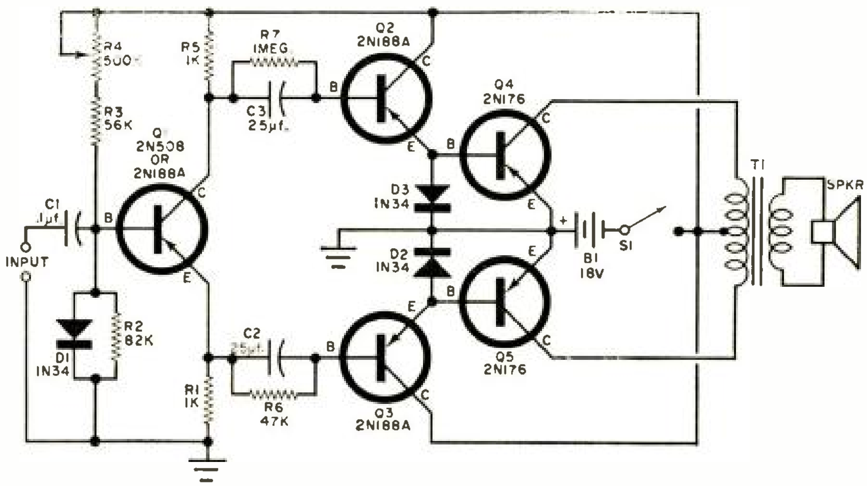


Fig. 3. In Professor Raoul J. Fajardo's audio amplifier circuit, the usual driver transformer is eliminated and problems of bias and distortion due to mismatched transistors are overcome through the use of a differential biasing technique. A single control adjusts for minimum distortion at various operating voltages. Up to 5 watts output can be obtained from this circuit.

the pair. This is the main reason why this type of circuit is not tried by audio designers and experimenters. The professor has found, however, that by connecting *R7* and *R6* across the coupling capacitors three things are achieved: (1) d.c. accumulation in the capacitors is eliminated; (2) push-pull drivers *Q2* and *Q3* are simply biased by these resistors and require no additional bias network; and (3) the biasing of the output stage is differentially accomplished (when one goes up, the other goes down), so that by adjustment of *R4* the operating point for distortionless performance is easily obtained for any given supply voltage from 6 to 22 volts.

Diode *D1* provides a highly effective thermal stabilization for the paraphase driver stage—and since this stage also controls the bias of the following transistors, thermal stabilization is important here. The amplifier will operate perfectly without this diode, but temperature variations would require a slight readjustment of *R4* if operation at minimum distortion is desired. With the use of the diode, as shown, once the bias is adjusted it will remain so through the range of temperature variations that a home may normally undergo. In place of this diode, a 47,000-ohm thermistor could be used, but the diode may be easier to obtain.

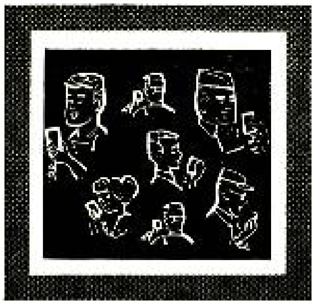
To get hi-fi performance with this circuit, the preamplifier must contain a treble control and an adequate bass boost. The "Phono-Tape Preamplifier" which appears as Fig. 9-1 in the Sixth Edition of the *GE Transistor Manual* is ideally suited for this purpose.

For music in the home, a voltage of 12 to 18 volts is recommended. If you use separate voltage sources for the preamp and the amplifier, be sure to have a common ground between the two. To adjust the bias by means of *R4*, play some orchestral music with which you are familiar; set the volume control high enough so that some distortion is audible and then, starting at the highest value of *R4*, turn this resistance down until distortion disappears. If you have an audio signal generator and an oscilloscope, a more precise adjustment can be made as follows: feed in a 250-cycle signal and monitor the output with a scope. Adjust *R4* until a clean symmetrical sine wave is obtained.

Standard components are used in this circuit. Except for *R4*, all resistors are half-watt units. Input coupling capacitor *C1* is a small ceramic or paper capacitor, while *C2* and *C3* are 25-μf., 6-volt (or higher) electrolytics. All diodes are 1N34's (or 1N34A's). Transistor *Q1* is a 2N188A or 2N508, *Q2* and *Q3* are 2N188A's and *Q4* and *Q5* are 2N176's. *T1* is a Thordarson TR-61 output transformer (or equivalent). The on-off switch (*S1*) can be any s.p.s.t. type. Power supply *B1* can be made up of one or more series-connected lantern batteries, or a line-operated d.c. power supply can be used. Insulated heat sinks should be provided for *Q4* and *Q5*.

Spies, Beware! Counterespionage operators need no longer rely on a disguised "tail" to shadow suspected enemy agents.

(*Continued on page* 100)



On the Citizens Band

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

PERHAPS our efforts to kick the new year off in the right direction should have been a plea to all the communications services combined: sort of a "let's quit verbally abusing one another and tend to our own problems."

Of course, the situation isn't as bleak as it may appear to an outsider who happens upon a CB'er and an amateur fencing with their mobile antennas! There are thousands of CB'ers involved in rescue communications, emergency assists and community service; and their totality is pretty much duplicated by the amateur ranks with their network of services. But there are obvious problems created by some operators in both the CB and amateur services.

THE OUT-OF-TUNE OPERATOR

The latest quarrel behind the shack involves a triangle of attitudes. Hams are still using the excuse (now six years old) that CB'ers "stole" 11 meters from them, a band which was never allocated to them exclusively. (See "CB Dilemma—Revisited," January issue.) Some CB'ers argue that FCC clampdowns are *unjust* while they continue to contact skip stations, take their "25," and philosophize on the air as to how they feel the rules should be changed. The third group now receiving the pointed finger is made up of teen-agers who have gone gung-ho for the hobby kick, with five watts, unfortunately!

How can we resolve the standstill negativism of all involved? Let's try!

● Hams interested in solving the problems of the Citizens Band could help immeasurably by working with CB club officers, trading suggestions, hashing out misunderstandings, and preparing for emergencies where *both* services could unite their communications know-how.

● In an attempt to warn CB'ers to be sure they are "on the right bandwagon before beating a national drum," we prophesied last month that it will be the Citizens Band clubs which will truly unite CB'ers in a national cause; and it would seem logical that these organizations can go a long way in curbing misuse in their own areas.

● If we are to consider the use of the Citizens Band by the younger set as the "teen-age problem," then we must also consider that the spark was ignited by adults. If teen-agers seem to be taking over the band with misconduct, we, as adults, cannot overlook the fact that we set the example—starting September, 1958! There are thousands of Boy Scouts legally using CB equipment properly while camping, hiking, etc. There are just as many teen-agers who are a part of many of the country's CB rescue teams, and they've proven as helpful and as diligent in their assists as adults. We can't wish them away merely because one of them gets a chuckle out of ringing his alarm clock over the air, or because another has become the "phantom crooner." The Dads should make it unnecessary for the FCC to issue THEM citations before a few junior G-men get sent 10-7—permanently.

● There's even a solution for the commercial operator who has been joining hands with other users to claim that overcrowded channels have ruined his investment. Even without chit-chatters, 11 meters would be the "busy band." But for the commercial user who needs short-distance communications, the addition of tone-signaling devices eliminates reception of all superfluous calls in the monitoring position (which seems to be the greatest complaint) at still far less expense per system than long-range business band equipment.

This single editorial is certainly not expected to change the attitudes of all "out-of-tune" operators overnight—in fact, it will take us a lot longer to win the graces of the authorities than it took us to get into this verbal war with one another.

CB Fleet User. One of the most important areas in which two-way radio has long been depended upon involves the safety of life and limb and the ability of trained per-

Six ambulances and two base stations are kept in communication on a 24-hour basis via CB radio by the Hastings Ambulance Service, Aurora, Ill. Here, ambulance driver Fred Dalton, KHC7965, goes over emergency procedures with your OTCB Editor.

sonnel to act quickly and precisely in the handling of communications reports, relays and verbal orders, where minutes may determine the fate of the accident victim or the person felled by a heart attack.

Hastings Ambulance Service, Aurora, Ill., has successfully employed the Citizens Band frequencies for the past four years between two base stations and six ambulances. And as far as Gail Hastings (CB owner of the service) is concerned, CB plays a twofold role in his business that isn't available in other services. The two base stations, serving Aurora and Hazel Crest, about 40 miles apart, feed and receive calls to and from the ambulances while they are en route on any call. And as a private service, Hastings finds that CB radio has also been highly effective on long trips where transporting a patient might involve a thousand or more miles. There's always someone along the way who is more than willing to offer assistance whether the need is due to mechanical failure, lack of directions, or an immediate emergency. Whatever the assignment, Gail is sure of a communications link regardless of how far away his ambulances travel.

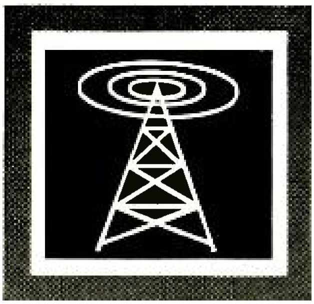
During a visit to the ambulance service, your CB Editor was taken on tour of an immaculate, well-organized system of operation. We were almost afraid to sit down anywhere in the Aurora base station for fear of contaminating the area, but finally chose a wheelchair! During our chat over the well-known coffee cup (who ever heard of CB'ers without coffee in one hand—mike in the other?) we discovered that the crew is made up of individually licensed CB'ers—all members of the Aurora Five Watters CB Club. Gail's call is KHA3365, and some of his drivers and attendants are Fred Dalton, KHC7965; Rich Janko, KLJ3254; and Victor Burson, KHC5406. The "coffee club" was finally broken up by club president Marion Scott, KHD6015, who stopped by for a chat and to fill us in on his predicaments with communications equipment of "the old days!"

Coffeed up to here, we then inspected the mobile rigs. The six ambulances use either Hallicrafters or Polytronics tranceivers. (Both base stations employ International Executive 100's.) We had to admit we had never seen the inside of an ambulance's control system up close and appreciated the opportunity—as long as it was as an observer and not as a passenger. A special control panel for all lights and the siren takes up most of the dashboard. Individual switching arrangements control four flashing red lights on the front and rear of the ambulance, a 360° revolving red beacon, and two flashing spotlights. The siren can be activated by a panel switch or transferred to control through the horn button.

For long hauls, Gail has built in an inhalator/resuscitator (his own idea) behind the front seat, capable of delivering oxygen for ten hours. All other equipment is standard, neatly and efficiently prepared for any emergency. As a topper, we learned that Gail also has seven planes available for air ambulance service. So if you're ever in the area—and in need—there's a 24-hour monitor on channels 11 and 17, standing by as KHA3365.

Emergency Action. Upon receiving a report indicating that two hunters were lost in the wooded area of Mt. Tabor, members of the Otter Valley CB Club, Rutland, Vt., relayed the information to other CB'ers. In short order, these CB'ers prepared food and coffee, and with first-aid equipment and walkie-talkies were ready to comb the area when the two hunters walked out of the woods on their own after spending the night within. Although not put into action, four-

(*Continued on page* 98)



Monthly Short-Wave Report

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

WHAT MAKES A QSL A QSL?

MORE AND MORE complaints are being received from SWL's in all parts of the world that short-wave stations are becoming increasingly lax in their methods of verifying. It would seem that some stations now send out verification cards to acknowledge anything from an honest reception report to a musical request! We have dealt with this subject in previous columns (most recently in the September, 1964, issue), but in the past few months a great number of SWL's have become sorely disgusted with the verifying methods and policies of certain broadcasters.

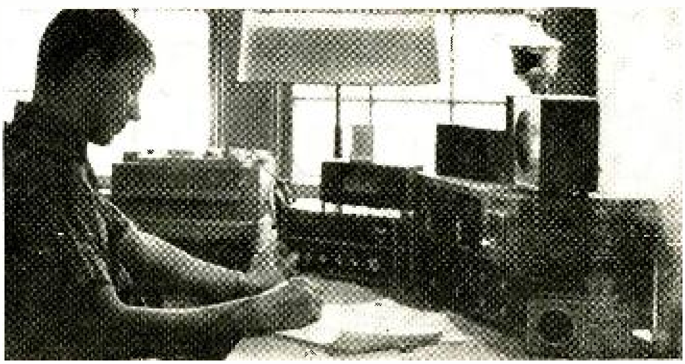
The International Short Wave Club (100, Adams Gardens Estate, London, S.E. 16, England) is one of the prime movers in a suggested program to attempt to point out that a QSL card, to be honestly regarded as a QSL, should contain at least the date, time, and frequency of reception. Your Short-Wave Editor would be in favor of adding the name of the listener or his WPE identification as a "must" item.

Several stations have made it known from time to time that they have their own paid monitors located in strategic target areas. These monitors forward complete reception reports at regular intervals to the home stations which are more thorough and of more value to the station than a report from the average short-wave listener. On the other hand, there are many stations that literally beg for reception reports. In return for these reports, it would seem to us that the very least the stations could do would be to send "legitimate" QSL cards.

In all fairness to the stations, we must admit that many reports are not worthy of verification. Some listeners will go to almost any extreme to obtain a QSL. For example, we know of a case where a DX'er "lifted" information from this column, and sent it in to a station. On the particular day he reported reception, the station was not even on the air!

The ISWC has made it known that one of its members, who is considered a highly experienced DX'er, has compiled a list of stations from which he has received "improper QSL's" or no QSL at all. His definition of an "improper QSL" is one that did not contain the date, time, or frequency. Some of you may have had better luck with these stations.

Radio Nacional de Espana, *Radio Congo*, *Radio Abidjan*, and *Radio Kabul* sent what the DX'er lists as "useless pieces of paper" after he fired a total of 34 cards and 12 letters at them. *Moroccan Radio*, the Nigerian Broadcasting Service, *Radio Iran*, *Radio Baghdad*, *Radio Lebanon*, *Radio Pakistan*, Cairo, and *Radio Havana* are all listed as having sent improper QSL's after



The SWL'ing equipment used by Paul Silver, Providence, R.I., includes a Knight-Kit R-100A and "Star Roamer" receiver, a code oscillator, a signal generator and a crystal calibrator which is built into the R-100A. To date, Paul has 25 countries and 13 states logged.

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.

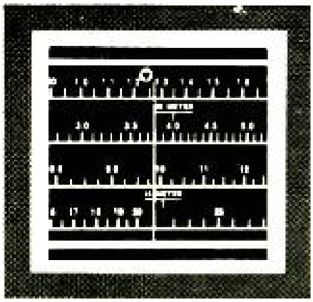
COUNTRY	STATION	FREQUENCY *(kc.)*	TIMES *(EST)*
Argentina	Buenos Aires	11,780, 9690, 6090	2200, 0100 (Mon.-Fri.)
Australia	Melbourne	17,840, 15,220	2030, 2130, 2230
		9580	0745
Bulgaria	Sofia	9700	1900, 2000, 2300
		7290	1630
Canada	Montreal	15,190, 11,760, 9625	1800 (Caribbean)
		9625, 5970	0215, 0300 (W. Coast)
		5970	0800
Congo (East)	Leopoldville	11,755	1630
Congo (West)	Brazzaville	15,190	1430
Czechoslovakia	Prague	11,990, 9795, 7345, 7115, 5930	2000, 2230
Denmark	Copenhagen	15,165	0730
		9520	2100
West Germany	Cologne	11,795, 9640, 9545	1010
		9640, 6160	2040
		9735, 9575, 6160, 6145	0000
Hungary	Budapest	9833, 9540, 6234	1930, 2030
		9833, 7305,7215, 6234	2200, 2330
Italy	Rome	9575, 5960	1930, 2205
Japan	Tokyo	15,135, 11,780	1900
Jordan	Amman	9555	2015
Lebanon	Beirut	9625	2130
Netherlands	Hilversum	11,730, 9590	1600
		15,425, 15,220	1130 (Tues., Fri.)
		15,425, 11,730	1535 (Tues., Fri.)
Netherlands Antilles	Bonaire	9685	2300
Portugal	Lisbon	6185, 6025	2105, 2245
Romania	Bucharest	9590, 9570, 5910, 7225, 6190, 5990 (9570 not used at 2030)	2330, 2200, 2030
Spain	Madrid	11,715, 9615, 6140	2200, 2100, 2000
Sweden	Stockholm	15,300	0900
		5990	2215, 2045
Switzerland	Berne	9535, 6120, 6080	2015
		15,305	2315
Turkey	Ankara	15,165	1700
United Kingdom	London	15,300, 11,860	1100
		9510, 6195	1700, 1800, 1900, 2100
U.S.S.R.	Moscow	9700, 9680, 9660, 9650, 9640, 9620, 9570, 7440, 7360, 7310, 7290, 7240, 7170, 7150 (may not all be in use at any one time)	1730, 1900, 2000, 2100, 2300, 0040
Vatican City	Vatican City	9645, 7250, 5985	1950

receiving a total of 110 cards and 42 letters. Station RTF, Algeria, *Radio Leopoldville, Radio Conakry, Radio Katanga,* the Hashemite Jordan Broadcasting Service, Syria, and *Radio Nacional Brasilia* all failed to reply to 50 cards and 19 letters, and, in some instances, tape recordings.

Many of our readers are members of various radio clubs represented in the Association of North American Radio Clubs (ANARC). We urge that the participating clubs request, through their appointed representatives, that the ANARC be empowered to start a campaign to determine which stations are the worst offenders, and to contact the stations asking that they seriously review their verifying methods and policies. Such a request, coming from the association, either with or without the cooperation of the ISWC and "DX Alliansen" (the European counterpart of the ANARC) would, we believe, have far more effect than individual monitors could ever hope to achieve.

Next month we'll present the other side

(*Continued on page* 108)



Across the Ham Bands

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

OSCILLOSCOPES AND BROAD PHONE SIGNALS

ABOUT two weeks ago, I called CQ on 20-meter SSB phone and raised a W1 who gave me a "30 db over 9" signal report. My smile of satisfaction turned slightly sour, however, when he added, "but your signal is kinda rough—sounds like you're 'flat-topping!' "

"Flat-topping," or nonlinear reproduction of signal peaks, in an SSB signal is positive proof of improper transmitter operation. It is usually due to the transmitter's audio gain control being advanced too far, which causes the signal to occupy excessive space in the phone bands. "Flat-topping" can also make the received signal sound rough and distorted. But when a signal is flat-topping enough to sound distorted, it is really broad and splattery.

I watched the pattern on the cathode-ray oscilloscope connected to the output of my transmitter while I talked, but it showed no trace of flattening of the signal peaks. When I told this to the W1, he replied, "I'm sorry for the report. I didn't have you tuned in right."

On the other side of the coin, a day or two later, another operator reported that my signal seemed a little broad. This time, the scope confirmed that my signal *was* actually flat-topping on high voice peaks. I had forgotten to reset the transmitter audio gain control when I shifted frequency to keep a schedule. Backing off the gain control slightly cleaned up the scope pattern, and I thanked the other operator for calling the fault to my attention.

These examples show the usefulness of a scope in a phone station. A glance at the scope pattern immediately revealed which of the two reports was true and told more about the signal emitted by the transmitter than could have been learned in an hour of checking with conventional meters. Going a step further, it is virtually impossible to tune up an SSB transmitter properly without the aid of an oscilloscope, unless the meter readings and the different adjustments have been previously calibrated with the aid of a scope. But the tune-up job is child's play with a scope.

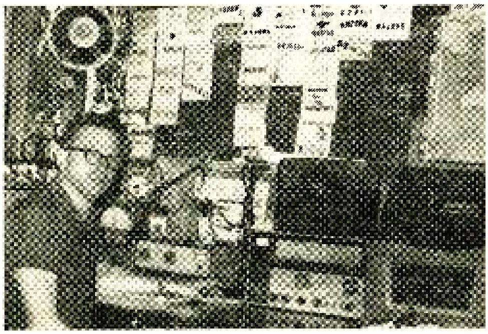
Unfortunately, there are too many broad signals to be heard in all the amateur phone bands, and somebody has to tell the owners of these signals about them for self protection. But one fact complicates doing so: practically all communications receivers in use today overload on very strong signals, causing the signals to appear excessively broad when they are actually perfectly

Amateur Station of the Month

One of the best-known hams in Canada, and certainly the most popular, is Leo Meyer, VE5LM, Saskatoon, Saskatchewan. Stricken by polio in 1942, Leo operates with the aid of mouth sticks. An excellent operator, he finances his hobby entirely on the $10 a month he previously spent on smoking. VE5LM gets over 5000 QSL cards a year; the only ones he can answer, however, are those which are accompanied by a self-addressed return envelope and either a dime or an International Postal Reply Coupon. Leo will receive a one-year subscription to POPULAR ELECTRONICS for submitting the winning photo for March 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—together with some data about your ham career. All entries should go to: Herb S. Brier, Amateur Radio Editor, P. O. Box 678, Gary, Indiana 46401.

Tex Miller, WN8KLD, of Taylor, Mich., has made 425 contacts in 38 states logged, mostly on 80 meters.

Don McCoy, WAØHKC, Wheat Ridge, Colo., was born in Brooklyn—the one place that he can't seem to work.



clean. Therefore, it saves embarrassment to find out at what signal level your receiver overloads and to refrain from accusing signals above this level of being excessively broad.

Here at W9EGQ, I have two antennas, an 80-40-15-meter dipole and a 20-meter beam, and whenever I am in doubt about whether a signal is broad or just overloading my receiver, I flip over to the antenna not designed for the band I am operating on. This knocks down the strength of the signal several "S" units and quickly reveals whether the signal is broad or not.

Contrary to the reports of some other hams, I have found that a courteous report of a broad signal is almost always received with thanks—if not with pleasure—when the report is true, and it almost always is if the transmitted signal is not being monitored with a scope. It is not impossible to radiate a clean phone signal without a scope, but your Amateur Radio Editor can testify from long experience that it isn't easy.

Amateur Regulations in England. It is always interesting to compare amateur radio in the U.S. with conditions in other countries. In England, an applicant for an amateur license takes the written test first and the code test later—just the opposite of the system in the United States. The written examination is about as difficult as the standard U.S. General exam. However, the English exam is of the essay type, rather than multiple choice. The written exams are given only once or (sometimes) twice a year; and each test is different from the last one.

After the written exam is hurdled, an appointment for taking the code test can be made—without any time limit. Amateur operator G3TGB, for example, passed the written exam in 1950 and passed the code test in 1964, 14 years later.

There are three types of amateur licenses issued in England. Amateur (Sound) License A grants all amateur privileges to applicants who pass both the code and theory examinations. Amateur (Sound) License B permits operation on the amateur frequencies above 420 mc., without the code test. There is also an Amateur TV License for use above 425 mc.

In most ways, amateur regulations are much stricter in England than in the United States. Maximum permissible power is 150 watts on c.w. and AM phone. On SSB, however, the maximum instantaneous peak envelope power (PEP) may equal the instantaneous peak power input of a 150-watt AM phone signal modulated 100%. As the instantaneous peak power input of a conventional AM phone transmitter is four times the average d.c. input on 100% modulation peaks, this sets the maximum PEP SSB input at 600 watts.

In England, only a licensed amateur may operate or talk over an English ham station. And even a licensed amateur may talk over another amateur's station only under the personal and direct supervision of the licensed owner of the station. Logs must be kept in GMT, all entries made immediately, and the frequency used—not just the band—must be logged. It is recommended, but it is not mandatory, that the International Phonetic Alphabet (see "Across the Ham Bands," November, 1964) be used for identifying difficult letters.

More News from England. Browsing through *Short Wave Magazine* and the *RSGB Bulletin* while researching the English licensing picture, we came across the

(*Continued on page* 96)

Predicted Radio Receiving Conditions

How the short-wave bands will be in March and April plus some information on the poor conditions expected

By STANLEY LEINWOLL, Radio Propagation Editor

MAJOR international short-wave broadcasting schedule changes will become effective Saturday, March 6, at 2000 EST. Here is a summary of expected conditions in the high-frequency bands for March and April.

11 Meters. Because of the low level of sunspot activity, 11-meter signals cannot be propagated via sky wave during the spring season. None of the short-wave broadcasters have scheduled transmissions in this band.

13 Meters. Activity in this band is expected to be below winter levels. Principal users will be the *Voice of America* and the *BBC* between the hours of 1000 and 1800 GMT (0500-1300 EST). Interesting DX possibilities in this band include Ghana on 21,530 kc. between 0900 and 1100 EST, Australia on 21,540 kc. from about 2000 EST, and Pakistan on 21,590 kc. between 0500 and 0900 EST.

16 Meters. Fairly good DX'ing should be possible throughout much of the day. Considerable use of this band will be made by the Europeans from early morning to shortly after noon, EST. Ecuador, on 17,890 kc., is about the only Latin-American country scheduled to broadcast in this band, and the best time for reception is around 1500 EST. Congo, on 17,720 kc., during the period from 0800 to 1000 EST, is another attractive possibility.

19 Meters. This band will be most productive for DX during the daylight hours, from very early morning to evening, with reception from all parts of the world possible at some time during the period when the band is open. During the morning hours until mid-afternoon (EST), for example, reception should be good from Europe, Africa, the Near East, and Latin America. During the late afternoon and evening, reception will improve from Asia and Australia, and continue from Latin America.

25 Meters. Conditions in this band will improve over those observed during the winter, when DX to many parts of the world was relatively poor. In the spring, the ionosphere begins to stabilize—usable nighttime frequencies get higher, while optimum daytime frequencies get lower. This seasonal trend makes the 25-meter band useful for longer periods of time. In general, reception from Europe, the Middle East, and Africa should be possible during middle to late afternoon, local time. During the evening hours, the Latins will be predominant, while best DX possibilities from the Pacific should exist during the morning hours.

31 Meters. The seasonal trend toward higher usable nighttime frequencies will result in improved conditions in this band. Reception from Europe, Asia, and Africa should be possible from mid-afternoon into the evening hours, when South and Central American stations will dominate. During the mid-morning hours, reception of stations to the west will be best. Among the better DX possibilities in this band are Kuwait on 9520 kc., Guinea on 9650 kc., Senegal on 9720 kc., and Israel on 9725 kc., all during the afternoon hours, EST.

41 and 49 Meters. These bands will open up for DX reception during the late afternoon hours, local time, and will remain open from one area of the world or another throughout the night. Although interference levels will not be quite as bad as they were during the past winter, they will nevertheless be serious enough to hamper many of the better DX catches. Some stations, however, should be exceptionally strong during the late evening hours. In general, DX reception should begin during the afternoon from stations in Europe, the Middle East, Asia, and Africa. The distant Latins will start coming in shortly afterward. For the late night DX'ers, signals from the east will start going out several hours before dawn. Stations from the Pacific should be heard at this time, and should continue to be heard until several hours after sunrise.

60 and 90 Meters. Conditions will deteriorate in the spring. During the past winter, the combination of low sunspot activity and a record number of users made DX reception in these bands the best in history. With the approach of summer, static levels will increase and signals will grow weaker. However, there will still be a few good DX openings during the hours of darkness.

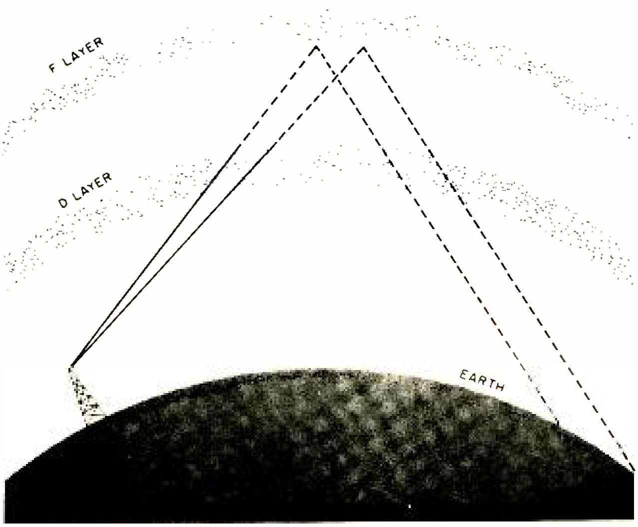
Standard Broadcast Band. The record-breaking DX conditions observed during the winter months have come to an end. Signals in the standard broadcast band are growing weaker, and noise levels are increasing. This trend should continue as the season progresses, nights grow shorter, and maximum usable frequencies increase. Good DX will still be possible, but for shorter periods of time, and not nearly to the extent observed in December and January.

Long-Wave Band. Some interest has been expressed in reception of signals in the long-wave band, between 150 and 285 kc. The Geneva Radio Regulations of 1959 allocate this band to AM broadcasting in Europe, Africa, and part of Asia. Long-wave broadcasting is fairly popular in Europe, although not as popular as medium-wave (or what we call "standard") broadcasts.

In general, long-wave propagation is similar to medium-wave propagation: conditions at night are much better than during the day, and propagation in winter months is better than in the summer. One problem with reception of long-wave broadcasts that is more serious than in any other part of the spectrum is the type of antenna required. Wavelengths in the kilocycle range are extremely long, being on the order of about *one mile* at 180 kc. This means that a simple half-wave dipole antenna would have to be half a mile long at this frequency to be effective. Listeners cannot be expected to erect such antennas, so a fairly long wire must do, which means a loss of signal strength. This fact—coupled with the fact that as we go down in frequency, static levels and absorption in the ionosphere increase—results in reception that is generally inferior to that in the medium-wave broadcast band.

Ionospheric Storms. From time to time disturbances occur in the upper atmosphere which tend to disrupt long-distance communications by severely upsetting the stability of the ionosphere. Such disturbances are most likely to occur during the spring and fall equinox—March and April, and September and October—when the earth passes through the plane of the sun's equator. They fall into two general categories: the ionospheric storm and the sudden ionospheric disturbance (SID). Ionospheric storms usually develop gradually and continue from several days to almost a week. The SID, on the other hand, commences suddenly, and seldom lasts more than an hour.

Although they are different in nature,



During ionospheric storms the normal day-to-day structure of the reflecting layers undergoes immense changes. Particles from the sunspots are caught in the earth's magnetic field and find their way into the ionosphere. The F layer (responsible for most long-distance radio communication) is weakened. Signals either pass through this layer into space or are weakly reflected. The D layer absorbs an abnormal number of radio signals passing through this region, further reducing signal strengths.

both disturbances have the same effect on communications: during storms, signal levels fall off sharply, fading becomes severe, and the general quality of DX reception deteriorates. During extreme conditions, a radio blackout may occur during which it becomes impossible to maintain high-frequency communication with many areas of the world.

During the early days of radio (the 1920's), it was not unusual for SWL's and amateurs to rip their receivers apart during radio blackouts because they thought something had gone wrong with the sets. Nowadays, we know better. Ionospheric storms are caused by bursts of radiation from the sun. This radiation, composed of either extremely intense ultraviolet radiation, or subatomic particles from an explosion on the sun, or both, saturated the ionosphere, resulting in a tremendous increase in radiowave absorption, which in turn results in a sharp decrease in signal levels.

WWV Propagation Forecasts. To enable users of the ionosphere, SWL's included, to keep track of the latest radio conditions, the Central Radio Propagation Laboratory of the National Bureau of Standards issues short-term propagation forecasts four times daily, at 0000, 0700, 1200, and 1800 EST. These forecasts give estimates of radio quality over North Atlantic transmission paths, such as between London and the eastern United States. However, the forecasts are generally applicable to other paths, particularly during good propagation conditions.

Although these forecasts are revised every five to seven hours, they are repeated every five minutes by NBS Station WWV, in International Morse Code, on 2.5, 5, 10, 15, 20, and 25 mc. Each forecast is broadcast unchanged until the regularly scheduled revision comes on.

The forecasts consist of a letter and number; the number is the forecast, while the letter identifies the quality of radio-propagation conditions prevailing at the time the forecast is issued. The numbers used have the following meanings: *1*—useless; *2*—very poor; *3*—poor; *4*—poor to fair; *5*—fair; *6*—fair to good; *7*—good; *8*—very good; *9*—excellent.

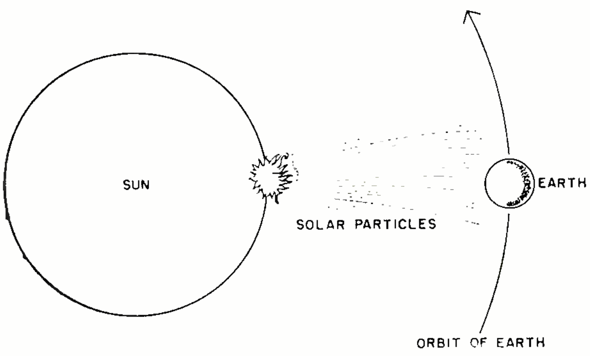
The radio quality at the time the forecast is issued, based on the average quality of conditions in the two hours preceding its issue, is identified as follows:

W—Warning. Disturbed conditions (quality *1*, *2*, *3*, or *4*) exist.

U—Unsettled. Quality *5*.

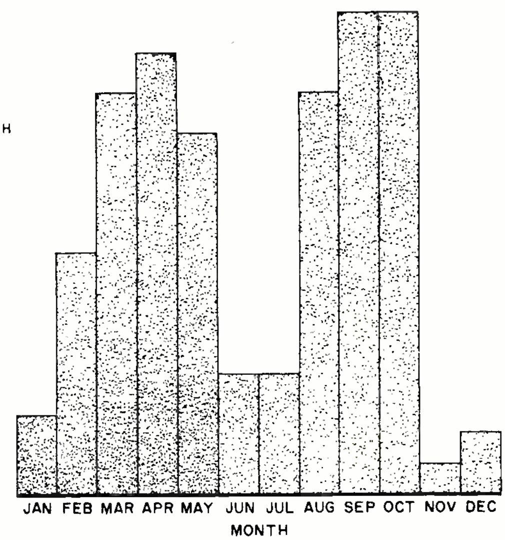
N—Normal. Quality *6*, *7*, *8*, or *9*.

A typical forecast statement would be "U-6," which means that propagation conditions are *now* unsettled but radio quality is *expected* to improve to "fair to good" (6) during the period covered by the forecast. —30—



Sunspots, or explosions on the surface of the sun, are caused by factors unknown to us at this time. These explosions release a shower of particles that have been recorded by satellites launched specifically for this purpose. The particles do not travel with the speed of light and seemingly take 20-30 hours to reach the earth. Scientists refer to the spreading out of particle streams as a "garden hose" effect. Severe ionospheric storms will occur in March.

The relative number of ionospheric storms varies according to the month, or season of the year. It also varies with sunspot activity—more sunspots mean more ionospheric storms. Ionospheric disturbances are more frequent during the equinox due to the position of the earth in its orbital plane.



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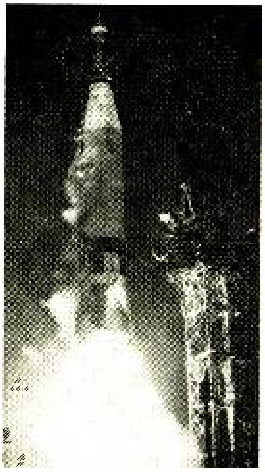

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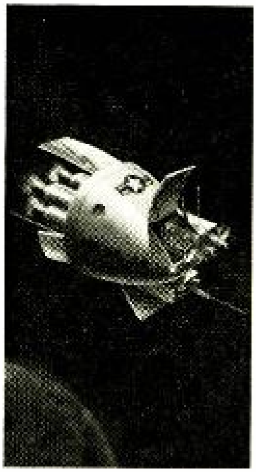

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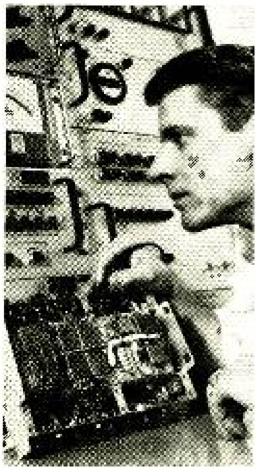

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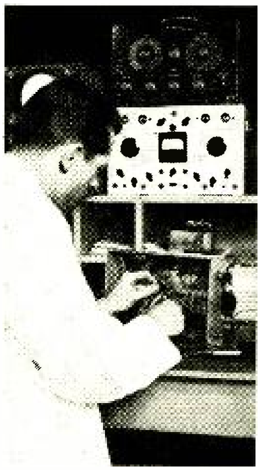

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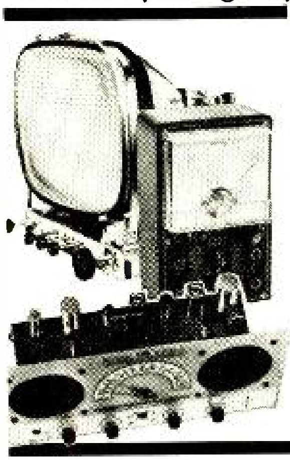

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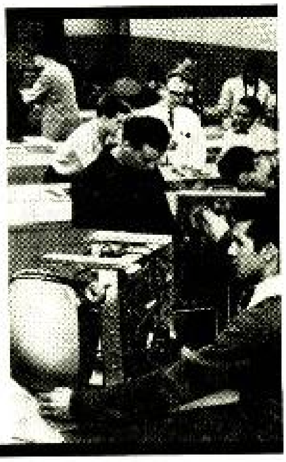

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Tools for the Hobbyist

(*Continued from page* 70)

out of some rather boring and hard jobs, or else improve results and quality considerably. Or maybe they just make life easier. You may want to add some of these nonessential tools to your collection.

Foremost on this list is a pair of locking (vise grip) pliers. This tool is just plain wonderful. It serves as a third hand, a vise, cuts bolts, wire, and rod, positions parts, and holds small parts for soldering. Next is a crimping ("Champ") tool. Outside of its obvious use for crimping solderless connectors and terminals, it makes a fine wire stripper, and a bolt cutter *that does not damage the threads while cutting.* It also cuts wire along with its other functions.

TABLE 3: Special Tools for Home-Brew Work

Tool	Typical Brands	Use	Approximate Cost
Bits: 1/16" to 1/4" by 32nds; 5/16"; 3/8"	Century Champion Craftsman Lafayette	Drilling holes, enlarging holes	$ .25 up
Center punch	Craftsman General Hardware Stanley	Locating holes for drilling and setting eyelets and rivets	.60
Cold chisels; 1/4", 1/2"	Craftsman Veeco	Cutting large holes, transformer mounts, etc.	1.00
Electric drill 1/4" or 3/8"	Black & Decker Disston Electro Lafayette Millers Falls Ram Rockwell Skil SpeedWay Stanley Thor Wen	Drilling holes, cutting circles, polishing, etc.	8.00 up
Files: Small triangular Small rat tail Medium half round Medium mill flat	Lafayette Nicholson Simonds Vaco	Enlarging and shaping holes for sockets, transformers, etc.; also for deburring	.20 up
Hacksaw, 12"	Craftsman Forsberg Lafayette Stanley	Cutting chassis, brackets and panels	3.00
Hammer, ball peen	Craftsman Stanley	Layout and cutting	3.00
Scriber	General Hardware Lufkin Moody Starret	Marking hole centers, punch locations, etc.	.50
Square, combination, 12"	Craftsman Stanley	Layout of all panels, chassis, etc.	4.00
Taper reamer, 1/8" to 1/2"	General Hardware Henry Hanson	Enlarging holes for volume controls, etc.	1.50
Tin snips or shop shears	Wiss	Cutting metal panels, insulation and brackets	3.00

TABLE 4: "There Must Be an Easier Way" Tools

Tool	Typical Brands	Use	Approximate Cost
Chassis punches: 1 5/32" and 5/8"	Greenlee	Cutting tube socket and capacitor holes in chassis	$2.50
Circle Cutter	General Hardware Stanley Wyco	Cutting large, round holes for meters, dials, etc.	2.00 up
Crimping tool	Klein-Amp Lafayette Super-Champ Vaco Waldom	Setting stake-on terminals, neatly cutting bolts, wire stripping, cutting	4.00 up
Nibbling tool	Adel	Neatly cutting large holes in panels and sheet metal chassis	4.00
Nut driver set, 3/16" to 9/16"	Craftsman Knight Lafayette Xcelite	Mounting hardware, tightening and removing nuts and components	6.50
Riveting tool	"POP" Rivetool (United Shoe) or Rivet-All (Lafayette)	Cheaper, quicker, better way of mounting semi-permanent components, sockets, brackets, etc.	5.00
Socket and ratchet set (automotive)	Proto	Tightening volume control and switch nuts, etc.	3.00 up
Traverse cutting pliers, 5"	M. Klein Kraeuter	For close cutting of leads in tight corners; perfect for printed circuit work	3.00
"Vise Grip" pliers, 7"	Vise Grip	Holding and clamping, positioning large parts prior to soldering, heavy cutting	1.60

A nibbling tool has to be seen to be appreciated. This little known tool neatly chomps its way through a chassis to provide a smooth-edged hole. It takes a small bite each time. The little bites all line up to give any size hole you want in any shape—rectangular, round, or free form. Nibbling one power transformer hole will pay for the tool.

One or two chassis punches in the common 1 5/32" and 5/8" sizes makes tube socket and capacitor mounting hole punching a snap.

Another little known tool is the traverse cutting plier. This is a cutting plier that looks like a pair of "needle noses," but *cuts clear out at the tip* (as a dog would bite, not on the side as the cutters on some needle-nose combinations). There is nothing like this tool for close cropping of printed circuit leads, and tight, "down under" cutting of any type. The cutting plier neatly cuts off leads that a pair of dikes can't get near.

A final special tool is a relatively new item. Five dollars will get you a "POP" Rivetool that will enable you to rivet electronic assemblies together. This is done from one side at the squeeze of a handle. The cost is less than that of standard hardware. You can use a Rivetool in blind or nearly blind locations where a nut cannot be backed up. The rivets will not shake loose, but they can be drilled out easily if you have to remove them. And you can fasten two thin sheets of metal together where a sheet metal screw will not hold. The resulting appearance is "professional."

Of course there are other tools that could be mentioned, but they are not too widely used. What we have listed here should represent a good setup for anyone in electronics. —30—

Readout Indicators

(*Continued from page* 52)

cathode which cannot be seen. An input of −5 volts to the indicator cathode will cause the glow to transfer to this cathode, and the glow will then be visible in the window. When the negative signal is removed, the glow returns to the holding cathode.

As indicated in Fig. 8, the negative input for the indicator cathode is obtained from the computer circuit to be monitored.

Numerical Indicator Tube. Numerical indicator tubes such as the Nixie (trademark of Burroughs Corp.) provide visual display of numerical data. The Nixie tube has ten cold cathodes and a common anode. The cathodes are shaped like the numerals 0, 1, 2, 3, 4, 5, 6........9. When a B supply is connected between the anode and one of the cathodes, the neon gas ionizes and the glow surrounds the selected cathode. The characteristic orange glow of ionized neon therefore takes the shape of a numeral as shown in Fig. 9. As illustrated in Fig. 10, ten transistors are employed as switches, one for each cathode lead of the Nixie tube. Initially, all transistors are biased off and the Nixie tube is not ionized. When a positive voltage is applied to one of the input terminals, the corresponding transistor will conduct. As a result, the gas will ionize and the glow will surround the selected cathode.

(*Continued on page* 92)

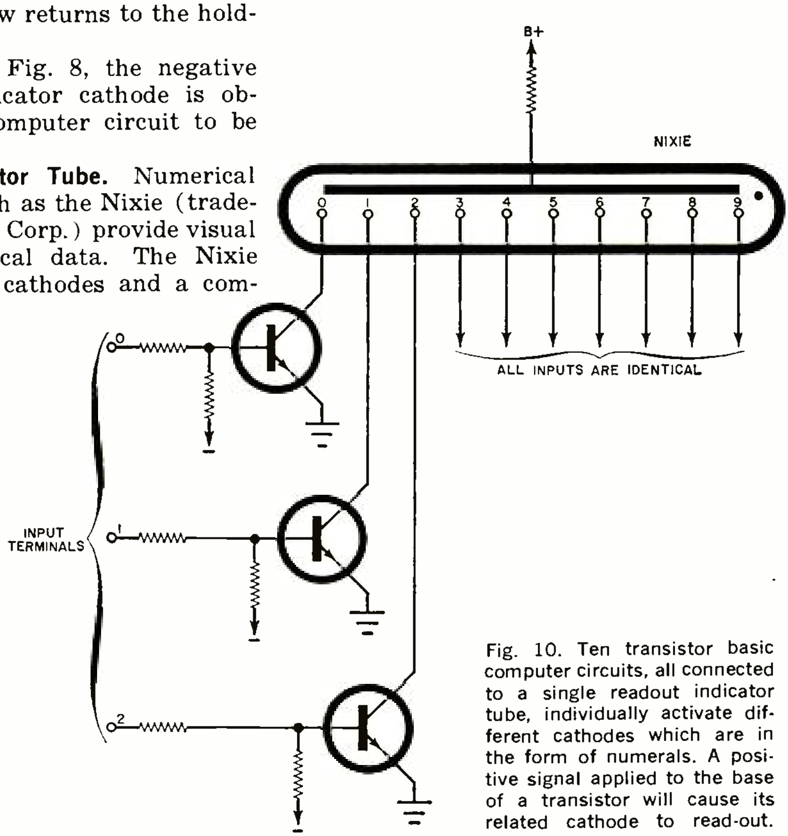


Fig. 10. Ten transistor basic computer circuits, all connected to a single readout indicator tube, individually activate different cathodes which are in the form of numerals. A positive signal applied to the base of a transistor will cause its related cathode to read-out.

Nixie indicators are particularly useful for readout of decade counters, but they are also available with alphabetic characters, math symbols, etc. The Nixie tube, ten switching transistors, and associated resistors are available as a package known as a Trixie module (Burroughs Corp.).

Projection Type Readout. A popular type of readout indicator employs optical projection as illustrated in Fig. 11. Twelve incandescent lamps are mounted at the rear of the unit, and these lamps can be controlled by relays or by lamp drivers such as those previously described. When one of the lamps is lighted, it projects the corresponding digit on

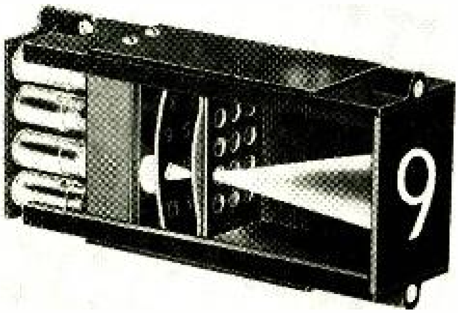


Fig. 11. Optical projection readout indicator has 12 incandescent lamps mounted in the rear. Photo courtesy of Industrial Electronic Engineers, Inc.

the condensing lens through the projection lens onto the viewing screen at the front of the unit. According to which lamp is turned on, any of the 12 characters can be projected onto the viewing screen. Typically, the characters are the digits from 0 through 9, and right-hand or left-hand decimal points.

Character size of the unit in Fig. 11 is 5/8 inch, but other models provide characters greater than 3 inches high. Also, colored digits are available for special environmental lighting.

Another type of readout indicator employing incandescent lamps is shown in Fig. 12. Each lamp is mounted so that its light enters the edge of a plastic strip whose display surface has a pattern of "dimples" in the shape of a numeral. The light travels through the plastic strip and emerges from the dimples, producing a pattern of bright spots in the form of a numeral. A stack of ten of

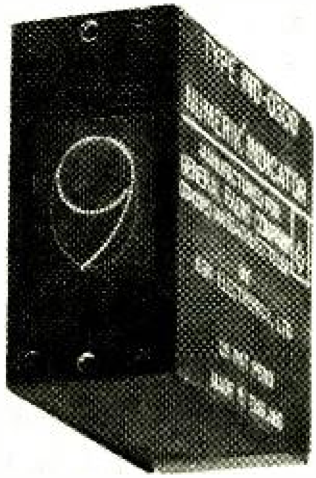


Fig. 12. Each edge-lit plastic strip in the sandwich has a numeral-shaped pattern of dimples on its surface. Photo courtesy of General Radio Co.

these plastic light-conductors provides readout of the numerals from 0 through 9. Clear plastic is used so that even the rear-most numeral can be easily seen through the stack. A 12-lamp model is also available to provide a decimal point and a comma.

Developments in readout indicators have kept pace with other developments in the computer field, and the "pilot light" of yesteryear has taken on new and important duties. —30—

Oscar III

(*Continued from page* 42)

The satellite package is made of magnesium-lithium alloy, the lightest commercially available material obtainable, and covered with shiny aluminum foil tape to reflect the heat of the sun. Black stripes are painted over the shiny aluminum to radiate heat away from the package while it is in the shadow of the earth.

Power to operate the satellite is obtained from a large 18-volt battery. When it is exhausted, the coherent beacon will begin to operate on power supplied by solar cells (see Fig. 2) and a rechargeable battery.

Performance of OSCAR III. This, then, is OSCAR III. What can be done with it once it is in orbit? As a communications relay satellite it should be able to relay signals in excess of 2000 miles. This estimate is based on observations of the OSCAR I and OSCAR II satellites. The translator will relay amateur AM, c.w., NBFM, RTTY, and slow-scan TV signals equally well, and, because of this versatility, OSCAR III has been called an amateur Telstar.

Besides its use as an orbiting relay station, many experiments can be performed with OSCAR III. They can be divided into three categories—those requiring only a 2-meter receiver and antenna, those requiring some test equipment in addition, and those requiring an amateur radio operator's license.

Experiments in the first category can easily be performed by any SWL with a 2-meter receiver. These experiments are to determine how long the satellite can be received on a given orbital pass, to determine the battery voltage by measuring the time necessary to send "HI" ten times, to write down any satellite-repeated amateur call-signs heard for later identification, and to monitor the satellite frequencies when no signals are expected in order to discover any unexpected propagation phenomena. These amateur satellite experiments open up a whole new field for SWL's; reports could be of real value here.

The second experiment category requires an oscilloscope, a tape recorder, and a calibrated audio oscillator. The experiments include obtaining data from the two temperature telemetry channels, measuring Doppler shift, tape-recording slow-scan TV, high-speed RTTY or c.w. signals, and making range measurements.

The third category of experiments requires a General Class amateur radio operator's license. A few of the many possible experiments here are establishing scheduled communications using the predictable reappearance of the satellite, making active range measurements, and originating specialized communications signals, such as slow-scan TV, high-speed RTTY, or high-speed c.w.

Future OSCAR's. Future OSCAR operations will depend somewhat on the results obtained from OSCAR III, and on the degree of participation. Many ideas are currently being discussed for possible inclusion in future satellites, such as a wider pass-band, more telemetry channels, operation on other bands, and the use of solar cells to increase satellite life.

More advanced ideas include communication between two satellites to increase the range of relayed signals, an ionospheric penetration sounder operating in the 80-meter ham band, and some means for detecting whistlers, naturally-occurring very-low-frequency signals that are not completely understood.

Whether you intend to take an active part in one of the experiments outlined in the preceding paragraphs, or just listen, a report of your observations would be appreciated. Project OSCAR headquarters is located at Foothill College, Los Altos Hills, Calif. The Project OSCAR program is the only space effort in which direct participation by amateur and many professional scientists, both here and abroad, will be possible for some time to come. We hope you will make use of it. —30—

Updating Your Stereo System

(Continued from page 60)

one hitch. High-compliance cartridges won't work in the ordinary type of tone arm used on inexpensive changers and record players. The frictional drag of such arms and their high downward pressure bend the very flexible stylus out of its normal position. Vertical response is washed out. At worst, the cartridge might be permanently damaged. To get the benefit of the new cartridges, you must use them in a high-quality tone arm with low-friction pivots and precise stylus pressure adjustment. (Some companies, notably Pickering and Shure, offer a whole range of different stylus assemblies with their new cartridge designs to make them adaptable to record changers and manual tone arms with different drag factors. However, the least tone arm drag is always best because it permits maximum stylus compliance.)

Ceramic or Magnetic. In picking the right cartridge for your sound system, you have to choose between two basic types: (1) ceramic cartridges or (2) magnetic cartridges. Because of their high output, ceramics are mostly used in simpler sound systems and record playing systems that lack the preamplifier stage needed to boost the signal of a magnetic cartridge. The high output impedance (about 1 megohm) of ceramic cartridges matches the phono inputs marked "CER" or "XTAL" on many amplifiers, but special adapters are available so that these ceramic cartridges can also be plugged into amplifier inputs intended for magnetic ("MAG") cartridges.

Ceramic cartridges are very simple in principle. Two ceramic slabs (one for each channel) are linked to the stylus. Because of the so-called piezoelectric effect, these slabs generate a voltage proportional to the stylus motion, thus producing the audio signal. Though most ceramic cartridges are not designed for critical high-fidelity applications, some recent models—notably the Sonotone "Mark IV"— approximate the performance of the better magnetic cartridges.

Most stereo cartridges, however, operate on the magnetic principle and the inputs of all hi-fi amplifiers are designed for this type of cartridge. These cartridges work like miniature power plants. In some designs, small magnets linked to the stylus move inside tiny coils, generating voltages proportional to stylus motion; they are known as moving-magnet cartridges. In other designs, the process is reversed—the coils move and the magnet remains fixed; quite logically, they are known as moving-coil cartridges. A third type, utilizing the motion of a neutral iron shank in a magnetic field, is called a moving-iron cartridge. All these magnetic types are basically similar in performance and differ only in their mechanical structure.

The Stylus Tip. After deciding which type of cartridge (magnetic or ceramic) is required for your rig, you have one more basic choice to make. Most cartridge manufacturers offer two types of stylus: either with a tip radius of 0.7 mil (7/10,000 inch), or with a tip radius of 0.5 mil.

The 0.5-mil stylus has a slight advantage in tracing the inner grooves of a stereo disc where the waveforms get quite crowded in the tighter circles near the label of the record. But it can produce fairly high distortion when playing mono records only. The 0.7-mil stylus plays both mono and stereo records with very good results. So if you still have many mono records, the 0.7 mil is your best bet. If you play only stereo records, get the 0.5-mil model.

The latest option in stylus tips is the oval-shaped stylus recently introduced in several de luxe cartridges. Its rather complicated geometry helps it reduce distortion at the inner record grooves. Shaping and polishing a diamond tip to a precise oval contour is quite a tricky job, and the price of such cartridges shows it. The improvement in performance is noticeable, but slight. To inveterate perfectionists, it's worth the added cost.

Make Your Own Listening Test. The best way to choose between different cartridges is simply to listen to them.

Take a good symphonic recording with many passages scored for full orchestra to your hi-fi dealer and ask him to play it for you with various cartridges. As you listen, ask yourself these questions: Can you "see through" the orchestra? Are the instruments clearly defined even when they are playing together? Are the strings silky and without harshness? Does the percussion sound crisp and snappy? And does the sound of the cellos and basses have depth and warmth? By watching for these factors, you can train your ears to be the best of all test instruments. —30—

Simple Voltage Calibrators

(*Continued from page* 48)

type rated at 0.6 ampere. *D1* is a silicon diode rated at 50 PIV, 100 ma., or better, *S1* is a d.p.d.t. unit, and *S2* is a single-pole, 17-position rotary switch. Potentiometer *R2* serves both as an a.c. and a d.c. voltage adjuster, while *R3* controls only the applied d.c. voltage. Resistor *R1* insures a certain amount of minimum resistance in the circuit to protect the diode against current surge. Electrolytic capacitor *C1* can have a working voltage rating of 150 volts or as low as 20 volts.

A voltmeter at the output jacks can be used to set up the desired input voltage on the 100% range. All the other positions will, without further adjustment, provide the indicated voltage steps; accuracy is limited only by the initial meter reading and the variations in values of the resistors. Both the meter reading and output voltage are taken from *J1* and *J2*.

One precaution to observe when taking voltage readings is to avoid the loading effect of a low ohms-per-volt meter. A simple check on the accuracy of your reading on the 100% level is to measure the voltage on the next lower step, which is the 50% level, and then multiply your reading by 2. If the answer is the same, you are on firm ground; otherwise, you should accept the reading on the lower scale as being the more accurate one. —30—

Across the Ham Bands

(*Continued from page* 80)

following items in *Short Wave Magazine*.

After years of effort through every possible channel, the English Amateur Radio Mobile Society was granted special permission to allow licensed U.S. amateurs to operate G3NMA/A during the society's annual Mobile Rally held at Barford last July 4. Bill Snedigar, K4RUT, was the first U.S. operator on this historic occasion, and he created about the same stir among the G's as if a Japanese ham had suddenly appeared in the middle of the 75-meter phone band on a Sunday afternoon.

In another item, G6NU reported that his first valve (tube) was a Ford double-filament motor lamp. One filament was used as the heater-cathode, the other one as the control grid. A piece of silver paper wrapped around the glass envelope was the plate, which operated with 90 volts, d.c., applied. The valve performed as well as a good crystal detector—and also lit the room.

Annual S.S.B.A.R.A. Dinner. On March 23 the Single Sideband Amateur Radio Association will hold its annual "Sideband Dinner" at the Statler-Hilton Hotel in New York City. This affair is attended by hams from all over the world. For details, contact Dorothy M. Strauber, K2MGE, 12 Elm St., Lynbrook, N.Y.

News and Views

Gary Steinbaugh, WN8MZD, 564 North Warpole St., Upper Sandusky, Ohio, really had faith in Santa Claus. He had a 5-element, 2-meter beam all ready to connect to the Heathkit "Twoer" on his Christmas list. On the lower frequencies, Gary uses a Johnson "Adventurer" transmitter and a Heathkit "Mohawk" receiver in conjunction with a home-brew, multiband doublet . . . **John Miller, WA8MAT,** 3933 9th Ave., Parkersburg, W.Va., continues to make West Virginia a little easier to work than it used to be. Separate antennas for 80 and 40 meters and a Mosley TA-33 rotary beam for 80, 40, and 15 meters spread the good word. A Johnson "Challenger" transmitter does the pushing and a Hallicrafters SX-140 receiver processes the incoming signals. As a Novice, John worked 40 states and 5 countries with this combination. Watch his totals grow now that his General Class ticket allows him to plug in his VFO . . . **John J. Yurek, K3PGP,** R.D. #6, Irwin, Pa., won a first at the Pennsylvania State Science Fair with his 2-meter ham station. The transmitter is home-brew and runs 475 watts to a 4X500 as the final amplifier, which feeds a 10-element. rotary beam. John's next stop is 432 mc. And to prove that he doesn't neglect the "d.c. bands," he has WAC, WAS, RCC. and other assorted certificates on his shack wall.

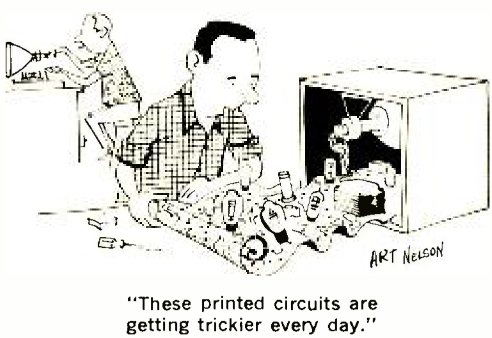
Howard Lester, WB2KPO, 245 Rumsey Rd, Yonkers, N.Y., proves that you don't need a beam to work DX on 20-meter phone. His evidence is a dipole antenna, a Heathkit HW-32 20-meter SSB transceiver, and 28 countries and 46 states worked. A Hammarlund HQ-110C receiver picks up the DX that lurks outside the U.S. phone band . . . **Jeff Leep, WN6JGT,** 1795 Bay Laurel Drive, Menlo Park, Calif., uses an electronic T-R (transmit-receive) switch to shift his Hy-Gain 14-AVS antenna from his receiver to his transmitter automatically when he presses the key. The transmitter is a Heathkit DX-60, and the receiver is a Drake 2B. His record: 15 states and Canada worked in a few weeks on the air . . . **Jerry R. Sheldon, WN9MET,** 311 Broadway, Wausau. Wis., uses a Johnson "Valiant" transmitter cranked down to 75 watts input and a Hallicrafters SX-43 receiver. Working 80, 40, and 15 meters with two dipole antennas, Jerry has 29 states and three Canadian provinces logged . . . **Barry Rupp, WA3AJU,** 852 W. Martin St., Ephrata. Pa., closed out his Novice career with 25 states and three Canadian provinces worked—all on 40 meters. Barry transmits with a Johnson "Adventurer" and receives on a Lafayette HE-80; a 40-meter, inverted-V antenna is the go-between.

Wayne Riddle, WA4TFC, 1812 N. Armistead Ave., Hampton, Va., boasts a record of sorts. Although he has worked 36 states and 9 countries, he has never worked anyone in the seventh call area! How about some of you boys in Wyoming, Utah, Arizona, Nevada, Washington, Idaho, and Oregon coming to his rescue? With Johnson "Valiant" and "Challenger" transmitters, a Hammarlund HQ-160 receiver, a 136' long-wire and a Hy-Gain 14-AVS vertical antenna, Wayne can cover most of the lower frequency bands. But he prefers 15 and 40 meters . . . **Leonard L. Gumport, WB2OKN,** 244 East 68 St., New York, N.Y., went from Novice to General in two months to the day. During that time, he worked 23 states and a handful of Canadians using an EICO 723 transmitter feeding a "modified Windom" antenna through a Johnson "Matchbox" antenna coupler; he receives with a Hallicrafters SX-111. You'll find Len on 40. 20. and 15 meters . . . If you haven't already picked up a supply of the 50th Anniversary Amateur Radio Commemorative Stamp from the post office, you may still be able to do so. They are especially appropriate for mailing QSL cards overseas . . . And the next time you visit an amateur radio supply house, see if you can "promote" a copy of the new Hallicrafters DX Log. If you have any interest in working DX, you'll be glad you did.

Mike Griffin, WA3AZI, 715 Webb St., Aberdeen, Md., was a busy man during his Novice days. Besides working 29 states and three Canadian provinces, he built a preamp for his receiver (P.E., October, 1961) and added a "spotting switch" to his Knight-Kit T-60 transmitter. Operating as a General, Mike has added just one state to his total, but he is building a VFO and an antenna coupler, both of which were described in P.E.

Will *your* "News and Views," pictures, or club bulletins be featured in our next column? Mail them to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana 46401. 73,

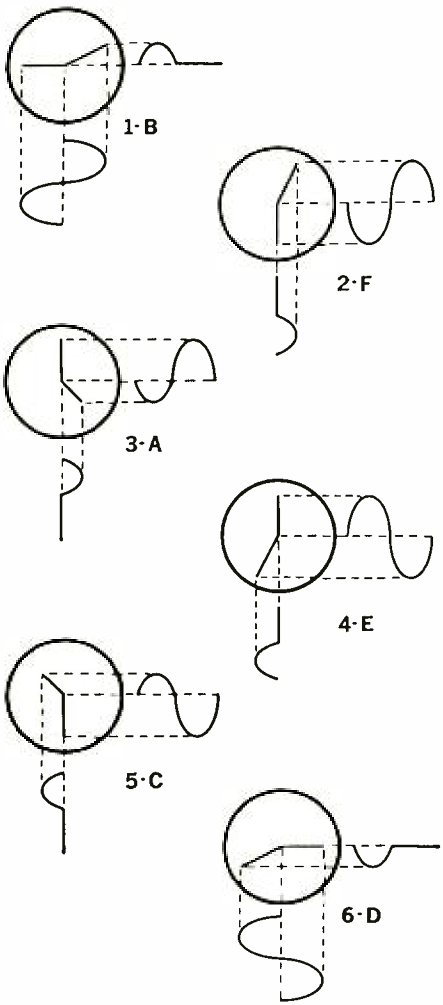
Herb, W9EGQ



"These printed circuits are getting trickier every day."

Scope-Trace Quiz Answers

(*Quiz on page* 71)



If you had trouble solving this quiz, consider the following facts:

(1) Output across the complete resistor and diode circuit is the same amplitude as the input signal.

(2) Output across the resistor only varies between 50% and 100% (100% when the diode is working in the forward direction).

(3) Output across the diode varies between 50% and 0% (0% when the diode is working in the forward direction).

On the Citizens Band

(*Continued from page* 76)

teen CB'ers were commended for their quick response to the call, and willingness to help.

Members of the Lake County Five Watters, Willoughby, Ohio, were again asked to assist the Lake County Sheriff's Department on Halloween last year, the third year in a row. The "Spook" patrol was activated on October 29, 30 and 31, with two club members per vehicle and three (including one executive member) at the control center. A special projects register was initiated so each participant could enter pertinent information while on duty, giving the club an accurate record of the proceedings for reference at any time. Thirty-three mobile units traveled 3,064.7 miles during the three-day period, consuming an estimated 204.3 gallons of gasoline at an average 15 miles per gallon. Among other things, the patrollers found and removed numerous obstacles from highways, and used a fire extinguisher after goblins had upset some construction flares. They also removed a lighted red flare from a railroad track minutes before a train was due, sparing all involved the necessity of a false emergency stop.

In a letter from the Broward County Chapter of the American Red Cross, members of the Broward Citizens Radio Club, Ft. Lauderdale, Fla., were lauded for their cooperation and fine work during the threat from hurricane "Isbell" last year. Red Cross chapter manager Don Roberts stated that he had not been familiar with CB operators until their recent association, and hoped that the county residents would become equally familiar with and understand the important role played by the dedicated operators. A Disaster Committee meeting was scheduled for a later date, with an invitation to Kenn Nordine, chairman of the volunteer group, to attend.

Finger Lakes CB Club, Geneva, N.Y., received two letters of commendation for their assistance during Halloween week—one from the Police Department, and another from the chief of the Auxiliary Police. The group had donated their mobiles, equipment, gasoline, and time to the cause. The chief of the Auxiliary Police informed FLCB club president Wm. Snyder that "without your help it would have been impossible for the Auxiliary Police to cover the city so completely and efficiently!"

New OTCB Additions. Wm. C. Holt Jr. reports that the Utah Citizens Band Association, Salt Lake City, Utah, was organized two-and-a-half years ago. Present club officers include: Jim Velotis, KGC0885, president; Roger Frost, KHA4980, vice president; JoAnne Steele, KLE0399, secretary; and Norman Steele, KLE0399, treasurer. The club monitoring channel is 9, with 15 as an alternate. A recent project by the club was the placement of road signs on four highways leading into Salt Lake City. These useful reminders to traveling CB'ers that "help is at hand if needed" contain a bright yellow beehive and black lettering, and are in the shape of the state —Utah! This group also publishes a neatly organized and well-written UCBA monthly, *The Newsletter*.

Another REACT unit checks in with the OTCB column this month. The Fort Wayne, Ind., squad was started in 1960: its present membership consists of 35 highly skilled two-way radio operators who incorporated the group in January, 1964. Captain Jack Forbing, KHC2683, reports that the squad guarantees 24-hour monitoring on the REACT National Monitoring Channel, and that as the official REACT squad in Fort Wayne, the group is affiliated with police, fire and sheriff organizations in the area. Other officers include Dee Northcutt, KLJ-2814, lieutenant; and Jerry Mowrey, KLJ-2909, treasurer. REACT (Radio Emergency Associated Citizens Teams) is sponsored nationally by the Hallicrafters Company, Chicago, Ill.

Three more additions to this month's OTCB CB Club Roster include the Lake City CB Club and McDowell County Rescue Squad, both of Marion, N. C., and the Denver Metro Radio Club, Denver, Colo.

Club Chatter. New officers of the Lapeer County CB'ers, Lapeer, Mich., include Rex Bauder, KHG3173, president; Duane Stevens, KHC6694, vice president; Robert Gould, KLM6964, secretary; and Basil Watz, KHJ9409, treasurer. The staff of the club monthly, *The Monitor,* is directed by Jack Arms, KHG6276, editor.

The Greater Dallas Citizens Band Club, Dallas, Tex., has also installed new officers. Past president and editor of the *CB Broadcaster,* Bill Brown, KEG1363, remains as president, with Vince Aloi, KEH7179, now handling the duties of editor. Other officers: Paul Corcoran, KEH5254, vice president; Elizabeth Lambert, 10W4031, treasurer; Betty Norvell, KEG2497, recording secretary; and Elaine Utay, KEG3788, corresponding secretary. The board of directors has four members.

Planning a national, area, or local CB Jamboree for the spring, summer or fall? Ship us all the information *now* so we can inform CB'ers from Maine to Mexico, Canada to California, and Alaska to Atlanta! Obviously, we can only print information on those arriving in time to meet publishing deadlines.

If your club has not been listed on our OTCB Club Roster, shake your publicity director or secretary loose and fill us in on total membership, activities, info on rescue teams and planned projects. Got a new communications bus, special CB installation at the police department, or anything unusual in CB applications that 450,000 other readers might like to see? Why not include a good, clear photograph? No murals please!

Be sure to send all information and photographs to Matt P. Spinello, CB Editor, Popular Electronics, One Park Avenue, New York, N. Y., 10016.

Incidentally, the revised 1965 edition of the Communications Handbook will be on the newsstands the last week in February. Watch for it! Your CB Editor once again had the privilege of writing the Citizens Radio Service chapter.

I'll CB'ing you.

—Matt, KHC2060

Transistor Topics

(*Continued from page* 74)

Instead, the suspect is fed (unwittingly) a tiny plastic-covered "radio pill" similar to those used in medical research work (see "Transistor Topics," October, 1963). For 48 hours or so thereafter, the suspect emits a radio signal which can be picked up by sensitive direction-finding receivers hundreds of feet away. The counter-agents, comfortably seated in a nearby car or closed van, can tell when the suspect is in his room, or slipping down the back stairs.

Essentially little more than a subminiaturized r.f. oscillator, powered by a built-in power supply, a "spy-finder" pill can be made not much larger than a grape seed by using an uncased transistor. When covered with soft plastic, it can be introduced into a suspect's food. Or it can be slipped into a seam or cuff of wearing apparel.

Once planted, the radio pill can be monitored by means of vehicular-based receivers or a pocket-sized receiver carried by a counter-agent on foot. Since each pill can be preset to a specific frequency, more than one suspect can be tracked at the same time, each one having his own "signature."

According to a story by Chapman Pincher of the *London Express Service*, radio pills are being used not only by the FBI but (probably) by Iron Curtain countries and by some American "private eyes."

Transitips. Like resistors, capacitors and other components, transistors can be stacked to produce increased or decreased impedance, increased output, etc. They can be placed in series, in parallel, in push-pull or in push-push combinations. Two or more transistors can be used in a single stage, if circuit power requirements are greater than can be supplied by a single unit. Three basic arrangements are shown in Fig. 4. These circuits illustrate typical configurations and are not intended as construction guides.

Series-connected transistors, as shown in Fig. 4(a), can be used if a relatively high supply voltage is available. In operation, the base bias of *Q1* and *Q2* is furnished through *R1* and *R2* respectively; and *C1* and *C2* serve as coupling capacitors (in all three arrangements). The collector load is common to both transistors. Their combined output impedance is now approximately twice that of a single unit. In-phase signals are applied to the base-emitter circuits.

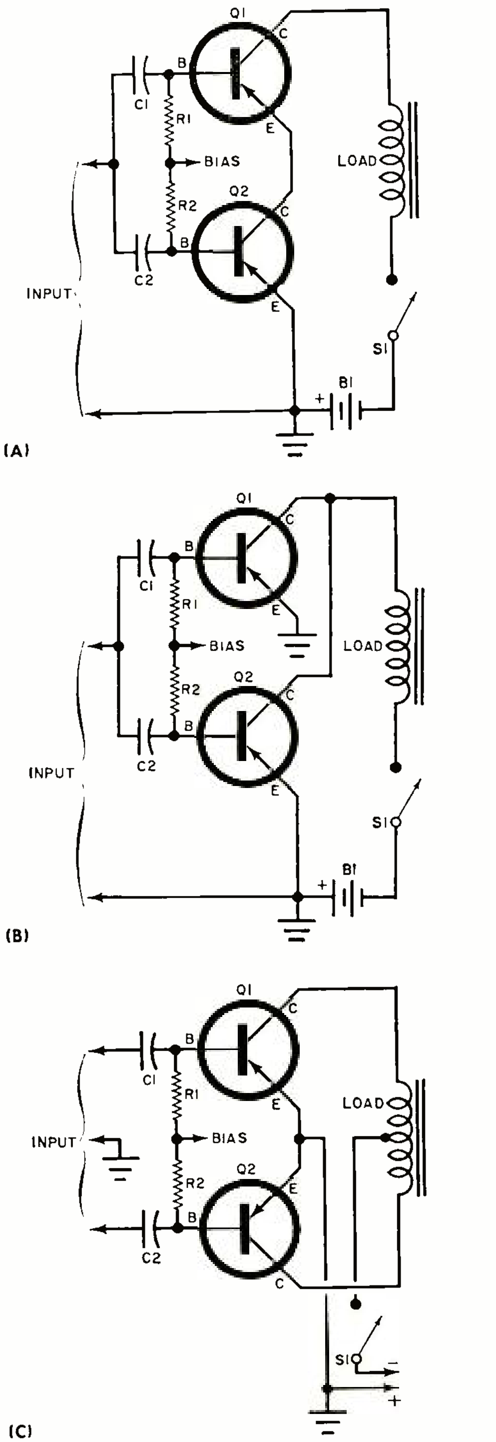


Fig. 4. Transistors connected in series (A) raise output impedance; parallel hookup (B) increases current output, but decreases impedance; and push-pull circuit (C) permits Class AB, or B operation.

"I checked the whole audio circuit, boss, and the plate voltages still are too low, so I thought I'd get your opinion . . . you listening, boss? . . . boss?"

Parallel-connected transistors shown in Fig. 4(b), are used where larger load currents are required than can be handled by a single transistor. In-phase drive signals are applied to *Q1* and *Q2*, while their combined output impedance is approximately half that of a single transistor.

The *push-pull* arrangement in Fig. 4(c) is one of the most popular. A center-tapped load is needed and 180° out-of-phase input signals are required for proper drive. In Class A operation, both *Q1* and *Q2* amplify the entire input signal, but in Class AB and B operation each transistor essentially amplifies a different part of the signal.

Properly matched transistors are required for best performance in all three circuits. In the series arrangement, *Q1* and *Q2* must have similar gain and voltage drops to prevent excessive voltage build-up across one or the other unit. Collector currents must be matched in the parallel arrangement. Finally, both gain and current must be matched in the push-pull arrangement to insure distortion-free amplification.

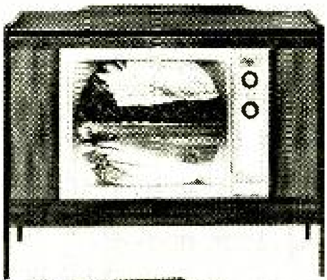
Any of the three basic circuits can be modified to meet special requirements. For example, if a center-tapped power supply is used in the push-pull circuit, the load need not be center-tapped. In another application, a push-pull drive signal can be used, with the collectors connected in parallel. The latter arrangement, sometimes called a *push-push* circuit, is commonly used for r.f. frequency doublers.

Where needed, two or more of the basic circuits can be combined. Typically, two transistors can be parallel-connected and used in pairs in a push-pull four-transistor configuration. Identified as a *parallel-push-pull* circuit, this arrangement is used where very high power outputs are needed.

That's it . . . for now.

—*Lou*

13 HEATHKIT® VALUES... SEE THE



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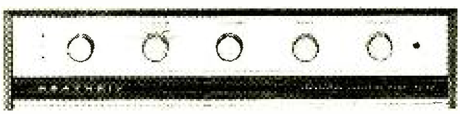

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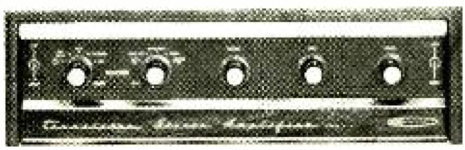

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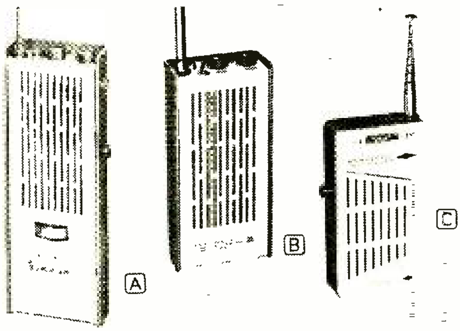

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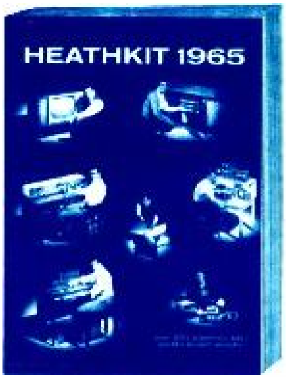

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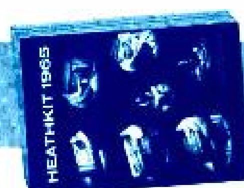

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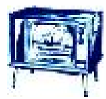

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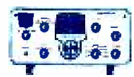

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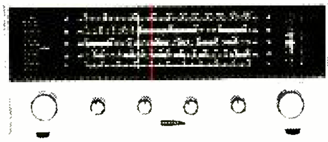

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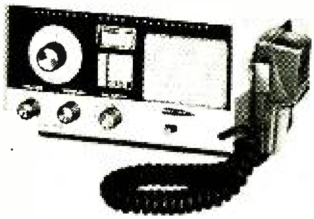
New! Heathkit Shortwave Radio! Covers 550 kc to 30 mc—includes AM plus 3 shortwave bands; 5" speaker; lighted bandspread tuning dial, relative strength indicator & 7" slide-rule dial; BFO; 4-tube circuit plus 2 rectifiers; "low-boy" metal cabinet; 13 lbs.



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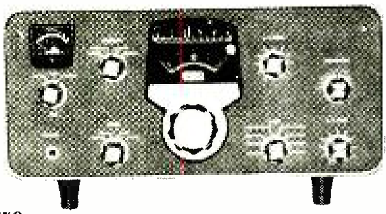
Deluxe 5-Channel CB Transceiver! Features 5 crystal-controlled transmit & receive channels; new front-panel crystal socket to change transmit crystal of one channel; new spotting switch; new TVI filter; new calibrated "S" meter; 3-way power supply for fixed or mobile operation; metal cabinet; 19 lbs.



Deluxe Single Sideband Amateur Receiver! Covers 80 thru 10 meter bands with all crystals furnished, plus provisions for VHF. 1 kc dial calibrations—100 kc per dial revolution. Tuning dial to knob ratio approx. 4 to 1. Less speaker, 22 lbs. Matching transmitter & KW linear amplifier also available.

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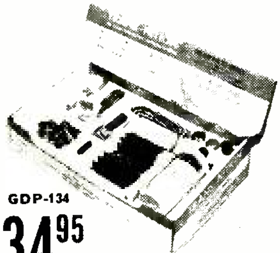

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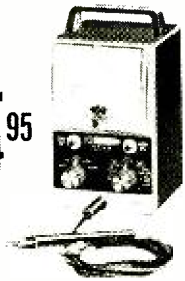

Heathkit Vacuum Tube Voltmeter Single AC/Ohms/DC probe; 7 AC/DC/Ohm ranges; 1% precision resistors for high accuracy; frequency response ± 1 db from 25 cps to 1 mc; voltage doubler rectifier; simple circuit board construction; 5 lbs. Available wired, IMW-11, at $39.95.

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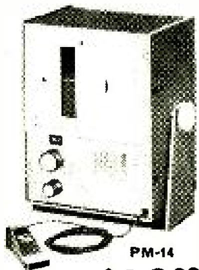

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CIRCLE NO. 13 ON READER SERVICE PAGE

Strobelight Slave

(*Continued from page 63*)

150 and less than 180, turning *S1* on will make the slave more sensitive to low light levels without danger of damaging the strobe.

Construction. To determine which Strobelight Slave you should build, turn on the strobe you intend to use with it, and carefully measure the d.c. voltage *across the contacts of the shutter socket* when the "ready" light comes on. While you're at it, observe the polarity of the voltage at the shutter socket, and permanently mark the positive contact with a plus sign.

The assembly of both slave units is simple and straightforward; the basic Strobelight Slave is housed in a 2¼″ x 2¼″ x 4″ box, while a 3″ x 4″ x 5″ box is used for the booster model. Simply mount the parts as shown in the photographs, using spacers to hold *V2*'s socket away from the bottom of the box. With the booster slave, be sure to mount the parts so that the batteries can be secured in the back of the case; a battery retaining strap can be made from scrap aluminum.

Make a shield can with a window in it for *V1* to minimize triggering of the slave by stray light. A tube shield or cover from an old i.f. transformer can be used for this purpose. For some applications, however, it may be desirable to remove the shield to obtain greater sensitivity.

Both versions of the Strobelight Slave are designed to work without any modifications to the strobe unit itself. Just make sure that the connecting cord between the two is properly polarized by marking a plus sign on the positive contact of the socket on the strobe and the positive contact of the socket on the slave. In Figs. 2 and 3, the positive contact of *SO1* is the upper one, and is connected to *V2* or *D1* respectively. *Damage may result to one or both units if the cord is incorrectly polarized.*

The basic slave shown in Fig. 2 can be built for about $6, and the booster slave for about $16, the primary increase being in the cost of the batteries. –30–

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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.

(Do not fill out)

(Please Print)

Name ....

Street, City and Zone ....

State and Zip ....

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

Make .... Model ....

Age .... Occupation ....

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

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

I use the following antennas ....

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

Signature .... Date ....

Short-Wave Report

(*Continued from page* 78)

of the verification story, as given to us by one of Europe's top short-wave stations.

Monitor Registration. Please note that all applications and communications pertaining to the Monitor Registration Program should henceforth be sent directly to MONITOR, P. O. Box 333, Cherry Hill, N. J. 08034. New applicants will find an application blank on page 107 of this issue. Please note also that the registration fee has been increased to 50 cents. Reports for this column or correspondence pertaining to the DX Awards Program should also be sent to the same P. O. Box, but in a *separate* envelope.

Attention West Coast DX'ers. We have received an interesting letter from Graham Baker, VK3PE1J, in Heatherton, Victoria, Australia, in which he lists several stations in Australia and New Zealand that utilize the 1600-1800 kc. range. While most North American DX'ers will probably not be able to hear these stations, West Coast DX'ers who possess a sharp receiver and an efficient antenna-ground system should try tuning during the two-hour period either side of sunrise (local time). One or more of these stations just might come through.

1610 **1690**	The Royal Flying Doctor
1615	New Zealand beacon signal; ID is *OR* in Morse code.
1665	Melbourne and Metropolitan fire brigade; a modulated tone every 30 seconds with vocal transmissions giving the call VKN8
1725	Yacht clubs of Victoria (weekends from October to February)
1780	Station VL2UV, University of New South Wales; transmissions on weekdays at 0300-0600

We would like to have more information on "The Royal Flying Doctor." Readers in Australia or New Zealand are hereby invited to submit an illustrated article for possible inclusion in a future column.

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 P.O. Box 333, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the eighth of each month; be sure to include your WPE Monitor

Registration and the make and model number of your receiver.

Afghanistan—A recent schedule from Kabul lists Eng. to the Far East at 0530-0600 on 15.225 kc., to S. E. Asia at 0600-0630 on 15.125 kc., and to Europe at 0900-0930 on 4795 kc. Send reports to *Radio Kabul*, Bagh-I-Umoomi, Kabul, Afghanistan.

Algeria—The newest schedule shows uninterrupted broadcasts in Arabic at 0030-1930 on 6160 and 11.810 kc.; in Kabyl at 0130-1800 on 6080 and 9685 kc.; in French at 0130-1700 on 11.835 kc.; in Eng. at 1700-1730 and in Spanish at 1730-1800, also on 11.835 kc.

Australia—DX'ers and SWL's the world over are mourning the passing of Graham Hutchins, the Editor of *Radio Australia*'s "DX'ers Calling."

Bechuanaland—Station ZNB. Mafeking, closed in February, and ZND was expected to close shortly afterward. The new station at Gaberones will have a 1-kw. and a 10-kw. xmtr on 3356, 4836, 5965, or 7298 kc. with programs in Tswana and Eng. for about four hours daily, and is expected to go on the air during mid-1965.

Bolivia—Station CP55 (?), *R. Universidad*, Tarija. 5460 kc., features a world news bulletin in Spanish ending at 2030, followed by non-stop classical music until 2300 s/off. Time checks and ID's are given irregularly.

A new station on 4742 kc. is *R. Rararenda*, Casilla 20, Camiri; operating with 200 watts. it signs off at 2200. *R. Centenario*, Santa Cruz de la Sierra, 4873 kc., usually signs off at 2200 but may run past 2230 with listeners' requests.

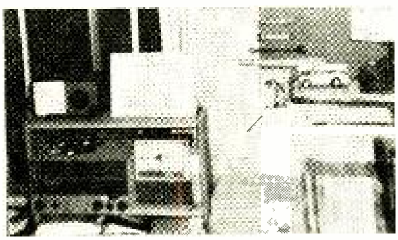
Cameroon—*R. Yaounde*, 4972.5 kc., has Eng. news and pop music at 0000-0030, French at 0030. Tune carefully—a teletype station is on almost the same frequency.

Canary Islands—The new short-wave outlet of *R. Nacional de Espana* in Tenerife is on 9640 kc, at 0900-1100 and on 11,800 kc. at 1900-2200.

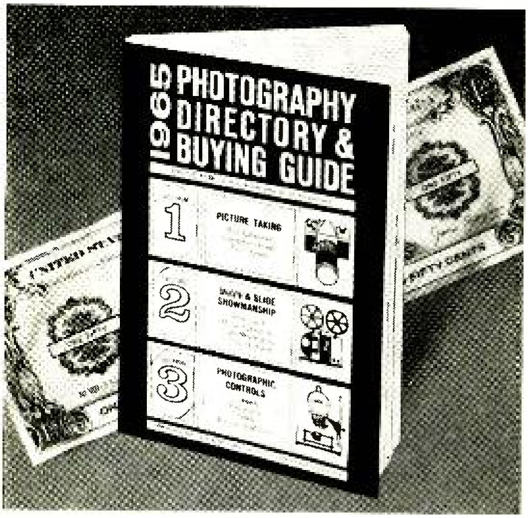
China—*R. Peking* has Eng. to Europe at 1430-1530 on 5145, 6270, and 6825 kc., and at 1530-1630 on 5145. 6210. 6270. 6825. 7080. and 9457 kc. English to N.A. is scheduled at 2000-2100 and 2100-2200 on 7035, 9480, 11,945. and 15,095 kc. and at 1900-2000 and 2000-2100 on 7080, 9457. 11,820. and 15,115 kc. It is also noted at 0700-0730 on 9457, 11,820. and 15,115 kc. and at 2000 on 11,590 kc.

Cuba—Often changed. the current schedule reads: Eng. to Northern Europe at 1510-1640 on 6015 kc.. French on the same channel at 1400-1510; Eng. to N.A. at 2200-2330 and 0000-0100 and French at 2330-0000 on 6135 kc.; Eng. to South America at 1550-1650 on 15.135 kc.; French to Mediterranean areas at 1610-1640 and Arabic to the same areas at 1500-1610 on 9655 kc.; Portuguese to South America at 1800-1900 on 15.340 kc.; Creole to Caribbean area at 2100-2200 on 6060 kc. The medium-wave outlet on 730 kc., CMCA, has moved to 830 kc. and now operates almost exclusively in English.

Ecuador—Station HCVS6, *La Voz de Saquisili*, 4899 kc., has much Ecuadorian music after 2127; closing varies from 2200 to 2300. Station HCEH3, *R. El Progresso*, Loja. 4753 kc., has moved from 4701 kc.. features many request music programs, and has a very irregular closing from 2100 to 0100; don't confuse this station with *R. El Mundo*



This neat listening post belongs to Allen Hanna, WPE9HDR, of Indianapolis, Ind.



SHORT-WAVE ABBREVIATIONS

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

of Guayaquil on 4751 kc. Reports on HCEH3 on 4753 kc., prior to this report, are probably in error, for HCMX4, *R. Cenit*, Portoviejo, has been operating here.

England—At deadline time, "English By Radio from London" is scheduled at 0030 on 3975, 7230, 5975, 5990 and 7260 kc.; at 0145 on 3952.5, 6150, 7230, 7260, and 9625 kc.; at 0730 on 7150, 9510, 9755, 11,780, 11,820, 15,180, 15,230 and 17,695 kc.; at 1200 on 3952.5, 5975, 6110, 7185 and 9770 kc.; at 1330 on 7230, 9510 and 9690 kc.; at 1430 on 3975, 5975, 7110 and 7185 kc.; at 1530 on 7230 kc.; and at 1745 on 3975, 5975, 6180 and 7325 kc.

Finland—English to N.A. from Helsinki is aired on Tuesdays and Saturdays only at 0715-0815 on 15.185 kc.

France—Paris has been experimenting on a large scale and was monitored as follows: on 21,620 kc. at 0800-0830; on 15,245 kc. at 1020; on 15,160 kc. at 1200; on 15,130 kc. at 0800; on 11,845 kc. at 0930-0950 and around 1700; on 9755 kc. at 2100; on 9735 kc. at 1830; and on 6145 kc. at 1730-1800. But the most widely reported test program is on 5955 kc. at 1700-1815 and 2115-2200. Most of the programs feature French or European music with multi-language ID's, including English. Reports are requested.

Germany (East)—*R. Berlin International* has been noted on 15,240 kc. with Eng. to S. E. Asia parallel to 11,765 kc.

at 0700-0800 and at 1030, at the latter time in

India—The latest Eng. schedule for the External Services is: to S. E. Asia at 0830-1000 on 11,810 and 15,225 kc.; to Burma and Malaya at 1930-1940 on 6150, 7225 and 9765 kc.; to Australia and New Zealand at 0500-0600 on 11,710 and 15,165 kc.; to China, Korea and Japan at 0500-0600 on 9655, 11,770, 15,105, and 17,855 kc.; to East Africa at 2330-2340 on 15,130 and 17,855 kc. and at 1340-1430 on 7180, 9680, 11,815, and 11,940 kc.; and to West Africa, United Kingdom, and Western Europe at 1445-1545 on 6130, 7125, 7235, 9690, 9915, and 11,740 kc.

Iran—*R. Teheran* is scheduled to Europe in Russian at 1230, in Turkish at 1300, in Arabic at 1330, in French at 1430, in Eng. at 1500, and in Persian at 1530-1700, all on 11,730 and 15,110 kc.

Iraq—*R. Baghdad* is scheduled to Europe in Eng. at 1430-1520, in German to 1610 and in French to 1700 on 6030 and 7180 kc., although several European reports list the frequencies as 6030 and 6095 kc.

Lebanon—Beirut has been noted to N.A. at 2130-2200 on 9750 kc. despite the station schedule which lists the frequency as 9625 kc.

Malaysia—*R. Malaysia* will shortly receive a new 100-kw. short-wave xmtr built by Gates Radio Co. of Quincy, Ill. Once in operation, it will be the most powerful xmtr in the country.

Martinique—*R. Martinique*, Forte de France, 4895 kc., is noted at good level in French at 1915.

Mexico—A station on 11,740 kc., as yet unidentified except for an ID of *Estacion De Musica Mejicana*, is noted at 1330, 1440, and 1515 with this ID. The station has numerous commercials for Banco Comercio. Can anyone identify it?

Netherlands—A letter from *R. Nederland* reveals that the monthly program bulletins have had to be discontinued. Replacing them will be printed schedules to be issued in March, May, September, and November.

New Zealand—Until further notice the following schedule from Wellington will be in effect: to the

Pacific Islands at 1200-1445 on 9540 and 11,780 kc., and at 1500-0045 on 15,280 kc.; additional non-Home Service programs to the same area at 0100-0345 on 9540 and 11,780 kc., with 9540 kc. off between 0300 and 0400; to Australia at 1500-1730 on 11,780 kc., at 1745-0045 on 15,110 kc., and at 0400-0645 on 9540 and 11,780 kc.; to Antarctica (Sundays only) at 0315-0345 on 6080 kc.; to Samoa in the Samoan language (Tuesdays only) at 0200-0230 on 9540 and 11,780 kc.; to Cook Islands and Niue in the Rarotongan and Niuean languages at 0245-0305 on Wednesdays and at 0300-0320 on Saturdays on 9540 and 11 780 kc.

Nicaragua—Station YNHC, *R. Hernandez Cordoba*, Ocotal, 6100 kc., is noted at 1730-1900 with all-Spanish programs of Latin American pop and native music, frequent announcements and commercials. A news bulletin is given at 1800.

Peru—Station OAX5V, *R. Villarica*, Huancavelica, has moved from 4943 kc. to 4805 kc. and closes at 2300. Station OAX3B (?), *R. El Pongo,* Tingo Maria, on 1785 kc., is a new station and reports are requested; the station operates dual to OAX3C on 1060 kc. and s/off time is 0000.

An interesting note: in Peru, the word "pongo" means a natural bridge uniting two sides of a

SHORT-WAVE CONTRIBUTORS

Frank Welch, Jr. *(WPE1CRV)*, Rochdale, Mass.
Clifford Stott *(WPE1FNQ)*, W. Springfield, Mass.
Phil Zucchi *(WPE1FXF)*, Manomet, Mass.
Robert Jacobs *(WPE2EH)*, New York, N. Y.
Gene Bond, Jr. *(WPE2JHW)*, Moorestown, N. J.
David Leibowitz *(WPE2JWF)*, Bronx, N. Y.
Al Quaglieri *(WPE2KMI)*, Albany, N. Y.
Ronald Coppola *(WPE2KNH)*, Buffalo, N. Y.
Louis Baker *(WPE2LKR)*, Brooklyn, N. Y.
Robert Holbrook *(WPE2LQP)*, Lake Placid, N. Y.
John Hall *(WPE2LZO)*, Hornell, N. Y.
Robert Harris *(WPE2MHG)*, Syosset, N. Y.
Bernard Greene *(WPE2MNI)*, Brooklyn, N. Y.
Tom Palmer *(WPE4GEL)*, Sanford, Fla.
David Brodsky *(WPE4GNZ)*, Arlington, Va.
David Chaffin *(WPE4HJZ)*, East Ridge, Tenn.
Aldridge Salisbury *(WPE4HLD)*, Falls Church, Va.
Bobby Conder *(WPE4HQT)*, Winston-Salem, N. C.
Hubert Beavers *(WPE5DWC)*, Albuquerque, N. M.
Albert Henry *(WPE6ESF)*, Anaheim, Calif.
Robert Sabin *(WPE8DB)*, Wilmington, Ohio
Ken Anderson *(WPE8KL)*, Akron, Ohio
Robert Eddy *(WPE8EQW)*, Newport, Ohio
Ronald Boelman *(WPE8FDE)*, Kalamazoo, Mich.
Jim Pirnat *(WPE8GQX)*, Euclid, Ohio
Thomas Kelly *(WPE8HMR)*, Novelty, Ohio
Kenneth Rosen *(WPE8HSZ)*, Detroit, Mich.
David Meisel *(WPE8IAD)*, Worthingon, Ohio
Tim Kerscher *(WPE8ICA)*, Columbus, Ohio
Robert Crow *(WPE8IFB)*, Warren, Ohio
Dennis Eksten *(WPE9DT)*, Loves Park, Ill.
Wayne Winston *(WPE9GSI)*, Chicago, Ill.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Jack Perolo *(PY2PE1C)*, Sao Paulo, Brazil
Grant Cooper *(VP9PE1G)*, Smiths Parish, Bermuda
Pat McGrath *(6Y5PE1A)*, Kingston, Jamaica
Leo Alster, Rahway, N. J.
John Birtie, Providence, R. I.
Henry Enman, Jr., Worcester, Mass.
Joe Esser, New Kensington, Pa.
Robert Floyd, Glen Burnie, Md.
Norman Kiel, Bronx, N. Y.
Joe Piechuta, Meriden, Conn.
Joe Rudolph, Red Bank, N. J.
Al Sauerbier, Washington, N. J.
G. White, Lansing, Mich.
George Zaher, New Haven, Conn.
Radio Nederland, Hilversum, Netherlands
Radio New Zealand, Wellington, N. Z.
Deutsche Welle DX Bulletin, Cologne, West Germany
Radio New York Worldwide, WRUL, New York, N. Y.
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

river or even two mountains; this phenomenon is typically Peruvian and is especially common in the Departmento of Huanuco where the above station is located.

Saudi Arabia—Test xmsns with the new installations in Jeddah are made, according to station announcements, at 0700-1300 on 9670 kc., at 0700-1000 on 11,950 kc., and at 1000-1300 on 7120 kc. However, overseas sources claim some deviations from this schedule. Reports go to: Deputy Minister, Ministry of Information, Jeddah, Saudi Arabia.

South Africa—On-the-air announcements list this schedule for the Africa Service of *R. South Africa:* 0500-1210 on 15,220 and 17,805 kc.; 1210-1330 on 11,900 and 15,220 kc.; 1330-1500 on 9525 and 11,900 kc.; and 1500-1615 on 7270 and 9525 kc.

Switzerland—The East Coast xmsn from Berne is broadcast at 2015-2130 on 9535, 6120, and 6080 kc.; presumably, the 6120-kc. outlet replaces the published frequency of 6105 kc. The West Coast xmsn is still given at 1015 on 15,305 kc.

Thailand—Thai National Broadcasting Station, Bangkok, operates to N.A. at 2315-0015 and 0525-0657 on 6160, 7305, and 11,910 kc.; the Home Service relay for Thai Forces is on at 0430-0520 and 0800-0900 on 11,910 kc., and the Home Service relay at 1900-2000 and 0700-1030 on 4830, 6070, 7305 and 11,910 kc. Programs in Laotian are aired at 2005-2310 on 4830 kc. and at 0800-0830 on 6097 kc.; in Chinese at 2130-2145 on 6097 kc.; in French at 0030-0100 on 11,910 kc.; and in Malay at 0130-0145 on 4830 kc.

Venezuela—According to tuned announcements, YVCN, 2430 kc., and YVPM, 6110 kc., *Escuelas Radiofonicas de Venezuela,* carry educational, cultural, and recreational programs for adult education under the Ministry of Education. These stations are located in San Fernando. Station YVCN is strong in New England; YVPM is readable, although considerably weaker.

Unidentified—*La Voix du Laos* has been heard on 7340 kc. with daily opening around 0610. The IS is played on an organ. At 0615 there is a program in Laotian (?), news in French at 0700, s/off at 0715.

"The Golden West Network" is noted around 14,740 kc. from 1740 to 1900/fade with football games and American-type commercial ads. The Oakland and Bay areas are often mentioned. (I believe this is part of a commercial point-to-point relay service; further details are requested—*Ed.*)

Medium-Wave Stations

Numerous medium-wave stations are still being reported, especially along the East Coast. Here is a sampling of some of the latest reports, listed by frequency in kilocycles.

560 British Guiana at 1745 in Eng. No QSL to date.

566 *R. Eireann,* Ireland, at 1800, with Eng. and some Gaelic. Letter verification. This particular report came from Bermuda; has any stateside DX'er ever heard or verified this station?

570 Station ZIZ, St. Kitts, at 1830, with Eng. relays from London. Letter verification.

DX Country Awards Presented

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

One Hundred Countries Verified

Jack Forbing (WPE9AMH), Fort Wayne, Ind.
Chuck Edwards (WPE4BNK), Fort Lauderdale, Fla.
Marlin A. Field (WPE8FRE), Benton Harbor, Mich.
Frank Gregory (VE3PE1VQ), Brampton, Ont., Canada
Robert Eddy (WPE8EQW), Newport, Ohio

Seventy-Five Countries Verified

Jack Lane (WPE9EVU), Lafayette, Ind.
George R. Oppegard (WPE3ELI), New Castle, Del.
Dave Siddall (WPE1EBN), Hyannis, Mass.
Edward J. Fellows (WPE7BLN), Seattle, Wash.
Gerry Klinck (WPE2FAH), Buffalo, N. Y.
Louie A. Stober (WPE7OO), Tigard, Oregon
Frank Welch Jr. (WPE1CRV), Rochdale, Mass.
William A. Lund (WPE6CJ), Manhattan Beach, Calif.

Fifty Countries Verified

Dave Brown (WPE6EMI), Woodland Hills, Calif.
David W. Johnson (VE2PE1BS), Montreal, Que., Canada
Norman Kiel (WPE2LON), Bronx, N. Y.
Leo Fleury (WPE2KUR), New York, N. Y.
W. J. Dwyer (WPE3CKC), Little Silver, N. J.
L. P. Olsen (WPE6DKR), Montebello, Calif.

Twenty-Five Countries Verified

Andrew Rippin (VE3PE2CM), Scarborough, Ont., Canada
Richard Bender (WPE2MAJ), Hoboken, N. J.
Bernard Greene (WPE2MHJ), Brooklyn, N. Y.
Christopher Maher (WPE5CEV), Jackson, Miss.
Mossman Roueche (WPE3DJR), Silver Spring, Md.
Robert McArthur (WPEØEFA), Kansas City, Mo.
Michael J. Loucks (WPE1FHC), Wrentham, Mass.
Jeff Tallent (WPE4HUZ), Louisville, Ky.
Douglas Bradham (WPE4GSZ), Rocky Mount, N. C.
Eric Lebowitz (WPE2JJY), New York, N. Y.
Robert Kaplan (WPE2MUR), Bronx, N. Y.
Bill Carlile (WPE8HSO), Columbus, Ohio
Robert Brickner (WPE3FYF), Pittsburgh, Pa.
Drew Ritter (WPE3FWP), Jenkintown, Pa.
Robert L. West (WPE4GZW), Fort Payne, Ala.
James H. Earl (WPE4HWP), Lynchburg, Va.
William Campbell (WPE2JHA), Canandaigua, N. Y.
Edward H. Rollfs (WPE1FNU), Topsfield, Mass.
Daniel Shapiro (WPE2MLL), Brooklyn, N. Y.
Anthony J. Cusimano (WPE3FSI), Baltimore, Md.
John DeHaven (WPE3FON), Lutherville, Md.
Bert Pestor (VE3PE9L), Sudbury, Ont., Canada
Richard A. Cohen (WPE1EWL), Winthrop, Mass.
W. Raisch (WPE2HVP), N. Bergen, N. J.
Richard Desharnais (WPE1FGI), Dracut, Mass.
Kenneth Rosen (WPE8HSZ), Detroit, Mich.
Jess Dyer (WPE8COJ), Detroit, Mich.
Leonard D'Andrea (WPE8HDA), Cincinnati, Ohio
Richard Heiser (WPE5DRF), Springer, N. Mex.
W. R. Davis (WPE4HYX), Ocala, Fla.
James Kowalski (WPE9GZB), Two Rivers, Wis.
Nelson Merrick (WPE8ICW), Livonia, Mich.
Charles H. Reinsch (WPE7CCH), Kirkland, Wash.
Robert Harris (WPE2MHG), Syosset, N. Y.
James G. Blinn (WPE1UL), Windsor, Conn.
Philip Rossman (WPE2MEY), New York, N. Y.
Cliff Goodlet (WPE4HXF), Chattanooga, Tenn.
Chris Nelson (KL7PE3L), Kethikan, Alaska
Charles P. Chaney (WPE3FDR), Baltimore, Md.
H. Hugh Whitehead, Jr. (WPE4FON), Hampton, Va.
Adelard Beaupre (WPE1FVO), Putnam, Conn.
John Karsies (WPE8IEY), Grand Rapids, Mich.
Joe Di Leo (WPE1FQV), Waterbury, Conn.

DX STATES AWARD RULES

Are you eligible to apply for a 20, 30, 40, or 50 States Verified Award? Here is a brief resume of the rules and regulations.

(1) You must be a registered WPE Short-Wave Monitor and show your call on your application. You'll find an application form on page 67 in the February issue.

(2) You must submit a list of stations (any frequency or service) for which you have received verifications, one for each state heard. You must also supply the following information in tabular form: (a) state heard; (b) call-sign or name of station heard and location; (c) frequency; (d) date the station was heard; (e) date of verification; (f) whether broadcast was a normal transmission for the class of station received, or a test. All of the above information should be copied from the station's verification. Do not list any verifications you cannot supply for authentication on demand. Do not send any verifications at this time. Should any verifications need to be sent in for checking, we will notify you and give you instructions on how to send them.

(3) A fee of 50 cents (U.S. coin) must accompany the application to cover the costs of printing, handling, and mailing. This fee will be returned in the event an applicant is found to be ineligible. Applicants in countries other than the U.S. may send the equivalent of 60 cents (U.S.) in coins of their own country if they wish. Please do not send International Reply Coupons (IRC's) when applying for an award.

(4) Apply for the highest DX award for which you are eligible. If, at a later date, you are eligible for a higher award, then apply for that award.

(5) Send your application, verification list, and fee to: Hank Bennett, Short-Wave Editor, P. O. Box 333, Cherry Hill, N. J. 08034. Do not include an application for a Short-Wave Monitor Certificate (you are not eligible for any of the awards until you have a Short-Wave Monitor Certificate in your possession). Reports, news items, or questions should be mailed in a separate envelope.

610 *R. Guardian*, Trinidad, at 1815, in Eng. Letter verification.

650 *Radiodiffusion Francaise*, Basse Terre, Guadeloupe; all French, heard daily. Card verification.

695 Windward Islands B/C Service, Dominica, in dual to St. Vincent on 705 kc., both weak but readable in Eng. around 1850. Card verification. Other stations in this network: St. Georges, 540 kc.; and Castries on 1580 kc.

730 *R. Trinidad*, Trinidad, at 1845. Power, 20 kw. Letter verification.

746 Hilversum 1, Netherlands, at 1600, with Dutch variety show, ID, and news.

750 *R. Jamaica*, at 1830, but with QRM from WSB, Atlanta. This one is difficult to verify.

795 *R. Barbadoes*, Black Rock, at 1845 in English. You may get QRM from PJB, Bonaire, if you are in the south.

885 *R. Montserrat*, Leeward Islands, at 1800 with Eng. relays from London. Letter verification. Reports go to P. O. Box 51, Plymouth, Montserrat.

960 Station ZFB1, Capitol B/C Co., Bermuda. S/off is at 0200. Until further notice, reports go to Berkley Rd., Pembroke, Bermuda.

970 Station WIVI, Virgin Islands. Power: 1000 watts nights; 5000 watts during the day. Card verification. This station may now be operating on a 24-hour schedule. —30—

POPULAR ELECTRONICS

March 1965

ADVERTISERS INDEX

ELECTRONICS MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. 75¢ per word (including name and address). Minimum order $7.50. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.
READER RATE: For individuals with a personal item to buy or sell. 45¢ per word (including name and address). No Minimum! Payment must accompany copy.

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

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, components. Poly Paks, P.O. Box 942, Lynnfield, Mass.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Radios, Parts, Picture Catalog 20¢. Meshna, Nahant, Mass.

TRANS-NITION electronic ignition parts kit. Negative ground $20.00. Coil, Manual special $8.50. Manual $2.00. Anderson Engineering, Wrentham, Massachusetts.

QSL'S $1.75/100 up. Catalogue-samples 10¢. Longbrook, Box 393-Y, Quakertown, N.J. 08868.

DIAGRAMS for repairing Radios $1.00. Television $2.50. Give make model. Diagram Service, Box 1151 PE, Manchester, Connecticut 06042.

ROCKETS: Ideal for miniature transmitter tests. New illustrated catalog, 25¢. Single and multistage kits, cones, engines, launchers, trackers, technical information, etc. Fast service. Estes Industries, Penrose 18, Colorado.

CB WPE QSL Cards, Samples Free. Radio Press, Box 24, Pittstown, New Jersey.

"SPECIAL! WPE-SWL-CB-QSL cards, 3 colors, $2.50 per 100—Free Samples, Garth, Jutland, New Jersey."

TRANSISTORIZED Products Importers catalog, $1.00, Intercontinental, CPO 1717, Tokyo, Japan.

CANADIANS—GIANT Surplus Bargain Packed Catalogs. Electronics, Hi-Fi, Shortwave, Amateur, Citizens Radio. Rush $1.00 (Refunded). ETCO, Dept Z., Box 741, Montreal, CANADA.

TV CAMERAS, transmitters, converters, etc. Lowest factory prices. Catalog 10¢. Vanguard, 190-48 99th Ave., Hollis, N.Y. 11423.

WEBBER Labs. Transistorized converter kit $5.00. Two models using car radio 30-50Mc or 100-200Mc, one Mc spread. Easily constructed. Webber, 40 Morris, Lynn, Mass.

JAPAN & Hong Kong Electronics Directory. Products, components, supplies. 50 firms—just $1.00. Ippano Kaisha Ltd., Box 6266, Spokane, Washington 99207.

DIAGRAMS Radios $1.00 Televisions $1.00. Schematics, 618 Fourth Street, Newark, New Jersey 07107.

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

CB QSL-WPE-SWL cards—Attractive 2 & 3 colors, glossy white. Call records books, Plastic card holders, Warning, Police, Gag, Call letter signs, Plastic badges, Maps, etc. Send 25¢ (refundable) for catalog No. 107. WOODY, 2611 Shenandoah, St. Louis, Mo. 63104.

CB-WPE-QSL CARDS. New **"FROSTALEEN"** Paper. **16 SAMPLES,** 25¢. Dick, W8VXK, 1996P N, M-18 Gladwin, Michigan 48624.

NEW Supersensitive transistor locators detect buried gold, silver, coins. Kits, assembled models. $19.95 up. Underwater models available. Free catalog. Relco-A33, Box 10563, Houston 18, Texas.

COMPONENTS? Kits? Hardware? For catalogue write Trans-Vu-Pacs, Box 267, Chelsea, Mass. 02150.

CB QSLs $2.00 per 100 postpaid. Free sample. Hobby Print Shop. Umatilla, Fla. 32784.

INVESTIGATORS, FREE BROCHURE, LATEST SUBMINIATURE ELECTRONIC SURVEILLANCE EQUIPMENT. ACE ELECTRONICS, 11500-L NW 7TH AVE., MIAMI 50, FLA.

PRINTED CIRCUIT BOARDS. Hams, Experimenters. Catalog 10¢. P/M Electronics, Box 6288, Seattle, Wash. 98188.

YOU CAN UNDERSELL all catalog houses in America! Free details! Cam Company, 436-11 Bloomfield Ave., Verona, N.J.

CITIZEN BANDERS! Get base station Performance with your mobile units. No modifications or soldering necessary. Proven performance. Send for free details or send ($15.00) to: T. Francis, 15 Park Row, N.Y. 38, N.Y.

FLIP-FLOPS: Transistorized circuit mounted on a printed circuit board with plug-in connector. Operation up to 10,000 cps in set-reset or trigger mode. Can be used in counters, shift registers, and memories with no additional circuitry. $3.87 complete. Send for free literature. KOMTRON, Box 275, Little Falls, N.J. 07424.

DETECTIVES! Free brochures! Electronic intelligence devices for your needs and budget. SILMAR ELECTRONICS, 3476 N.W. 7th Street. Miami, Fla. 33126.

HEAR AIRCRAFT, TOWER EMERGENCIES, WEATHER. 9 transistor AM-FM, VHF aircraft portable pocket receiver. Complete $26.50. Free details. **BUILD TINY ULTRA-SENSITIVE FM WIRELESS MIKE** transmits 200'. Instructions only. $4.95. Parts available from us. TRANSCO, Box 13482 North Country Branch, St. Louis, Mo. 63138.

ACHTUNG! Das machine is nicht fur Gerfingerpoken und mittengraben. Is easy schnappen der Springenwerk, blowenfusen und poppencorken mit spitzensparken. Ist nicht fur gewerken by das Dummkopfen. Das rubbernecken sightseeren keepen hands in das pockets. Relaxen und watch das Blinkenlights. This attractive, engraved metal plaque only $2.00 each. ppd. Southwest Agents, Dept. P Box 12283, Fort Worth, Texas 76116.

CBer's, NEW Solid State Mobile Antenna Booster. Increase range, power, receiver sensitivity. Decrease SWR, noise. R.F., modulation indicator. Lightning protection. $9.95. Dynacomm. 4860 NW 2nd Avenue, Miami, Fla. 33127.

LASER: Hobbyists. experimenters, amateur scientists. Build your own coherent-light optical laser. Complete instructions. schematic diagrams and parts list. $6.00. Same as above, diode laser. $3.00. Technical Writers Group. Box 5501, State College Station, Raleigh, N.C.

RAY GUN—Want to build a Laser? Shoots a pencil-thin beam of light. burns anything in its path in a fraction of a second,—even through diamond! You can build our model for $100, or about 1/10th the price of other models! Get two friends interested and the price is only $33 a piece! Complete blueprints, directions, price and parts list. only $9.95. M. J. Research Company, 7110 Cedar, Shawnee Mission, Kansas.

INVESTIGATOR'S Electronic Surveillance Devices. 1965 Subminiature Professional Models. Free Details. Trol Electronics-PE, 342 Madison Avenue, New York, N.Y. 10017.

TRANSISTOR IGNITION described June 1963 Popular Electronics, "Operation Pickup." Complete kit guaranteed components. Now only $13.95. **NEW MODEL T-1A** including special DELCO transistor and 400:1 coil. Complete kit, $16.95. Factory wired, $18.95. **MONEY BACK GUARANTEE.** Specify make, year of Car. **ELECTROMART,** 1616 South 81st Street, Milwaukee, Wisconsin 53214.

VARIOUS backdate electronic magazines. Lists ....10¢ B. Landa, Clayton, Ga. 30525.

SELECTED ASSORTMENTS OF ELECTRONIC COMPONENTS $4.95 each. Send $1.00, balance C.O.D. **ASSORTMENTS AVAILABLE: RADIO-TVS, HAM OPERATORS, TRANSISTOR-DIODE, EXPERIMENTERS, SCIENCE PROJECTS.** Assortments range from five to twenty-five pounds. Satisfaction guaranteed. Write for free folder. Leslie's Electronics, P.O. Box 814, Iowa Park, Texas 76367.

CONVERT any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco Industries, Box 10563, Houston 18, Texas.

$1.00 DELIVERS Plastic Packets for 60 QSL's. TEPABCO, Brown Blvd., Gallatin, Tennessee.

WHO NEEDS THREE HANDS FOR SOLDERING? No one who uses the BLIXT Soldering Iron with patented solder feed contained in the handle—the tool everyone's been waiting for! The ideal iron for soldering while "heat sinking" a transistor lead with pliers, holding a component in place, or working in tight corners. Only $10.95 postpaid. Send for free brochure. Curin Electronics International, P.O. Box 243, Cicero, Ill. 60650.

TRANSISTORIZED Intercom Kit Complete with 50 Feet Cable, two speakers, solder, switch wire and amplifier board. Just $4.95, include postage. General Surplus Sales, 10 Alice Street, Binghamton, N.Y. Drawings Included.

NEW MAGNETIC DEVICE—Engineers, Inventors, Experimenters, Hobbies. Latest Theory in Basic Magnetism. Create new Products by Experimenting with the Magnetic Ladder Acceleration Solenoid using D.C. Plans $1.00. Jesse Costa, Box 26, Waquoit, Mass. 02570.

FREE catalog: Wholesale Electronic parts and equipment. Western Components, Box 2581, El Cajon, Calif.

PRINTED CIRCUIT BOARDS. High Quality, Fast Delivery. Catalog and Sample, 10¢. Lehighton Electronics, Box 281, Lehighton, Penna. 18235.

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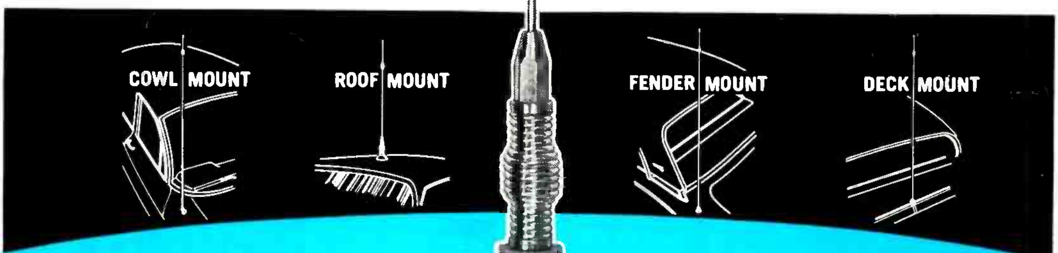

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