Build: **VLF Rcvr., Syncopated Metronome, Super-Speed Strobe**

ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

MARCH 1966 • 35¢

EXCITING NEW READER-PARTICIPATION FEATURE BEGINNING IN THIS ISSUE!

UNCLE TOM'S CORNER

Conducted by **Uncle Tom Kneitel**

Build This PALM-SIZE ... R!

It weighs just 28½ ounces, ... rs, has 2 tubes a...

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

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

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

ELECTRONICS ILLUSTRATED

MARCH, 1966 A Fawcett Publication Vol. 9, No. 2

New Feature

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Construction Projects

Radio: CB • Amateur • SWL

Audio & Hi-Fi

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ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

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

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

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

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

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

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

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Address ____________

City ________ State ________

213

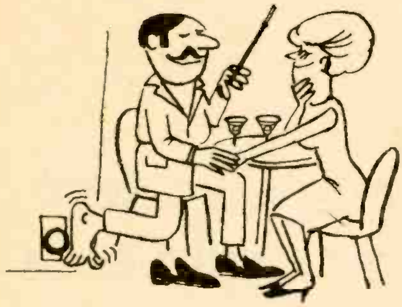
The Fisher

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

FEEDBACK from our readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th Street, New York, N.Y. 10036

● A SWINGER



I'm pretty good looking and have a fair amount of charm but that new light-dimming gadget (UNIVERSAL LIGHT DIMMER, Jan. '66 EI) should give me a perfect score. Give most broads a nice romantic setting and a little schmaltz and you have no worries. If you have any more little goodies lying around I sure would like to hear about them.

M. G.
New York, N.Y.

● CASCADER

I seem to be having a problem with a few amplifiers of mine and I regard you as just the people I was looking for. Here's my problem: now I know this sounds silly, but I'm having trouble hooking one amplifier (phono) into another and getting a clean signal, one without hum. The output impedance of the first amplifier is 4 ohms and I don't have any idea how many thousands of ohms the input of the second one is. What I actually want to do is tie four 4-ohm outputs together and feed them into one amplifier (phono type) input.

Stephen C. Keating
Topeka, Kan.

Why?

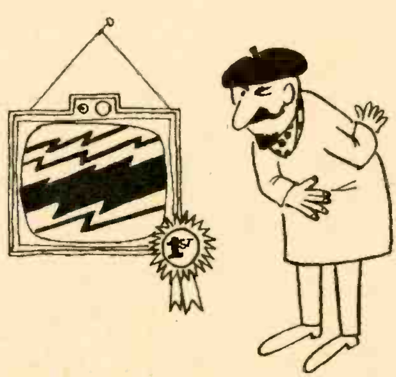
● SHOPPER

I have been working in order to establish the design and performance characteristics for a tri-pitched femto waveguide. I am attempting to establish the relationship among the circular cylinders to the left and the quadri-rectangular-prismic resonant cavity. As of this date I have experienced flat response through the upper cylinder with low-pass response in the direction of the lowest cylinder. The mode lattice was impossible to establish in the left central cylinder even though it appears better than the Moreno cross guide coupler. Even and also odd mode impedance in the parallel and the slab line has given me difficulties. Where will I be able to find data that has the potential to establish the necessary susceptance of symmetrical irises?

D. M.
Ann Arbor, Mich.

Have you tried the Yellow Pages?

● A WINNER!



As for Whistler's Ma (AND NOW . . . FLAT TV!!!, Jan. '66 EI), she's been off her rocker for years. And so is anyone who doesn't believe that flat TV will not only be the greatest thing in home entertainment since sex but the biggest inspiration for pop art since the Campbell soup label. Dig those crazy test patterns, man. Who needs Picasso?

C. Z.
San Francisco, Calif

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PROGRESSIVE RADIO "EDU-KIT"®

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★ SQ. WAVE GENERATOR
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★ AMPLIFIER
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★ CODE OSCILLATOR

★ No Knowledge of Radio Necessary
★ No Additional Parts or Tools Needed
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YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

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

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

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

FREE EXTRAS

• SET OF TOOLS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

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

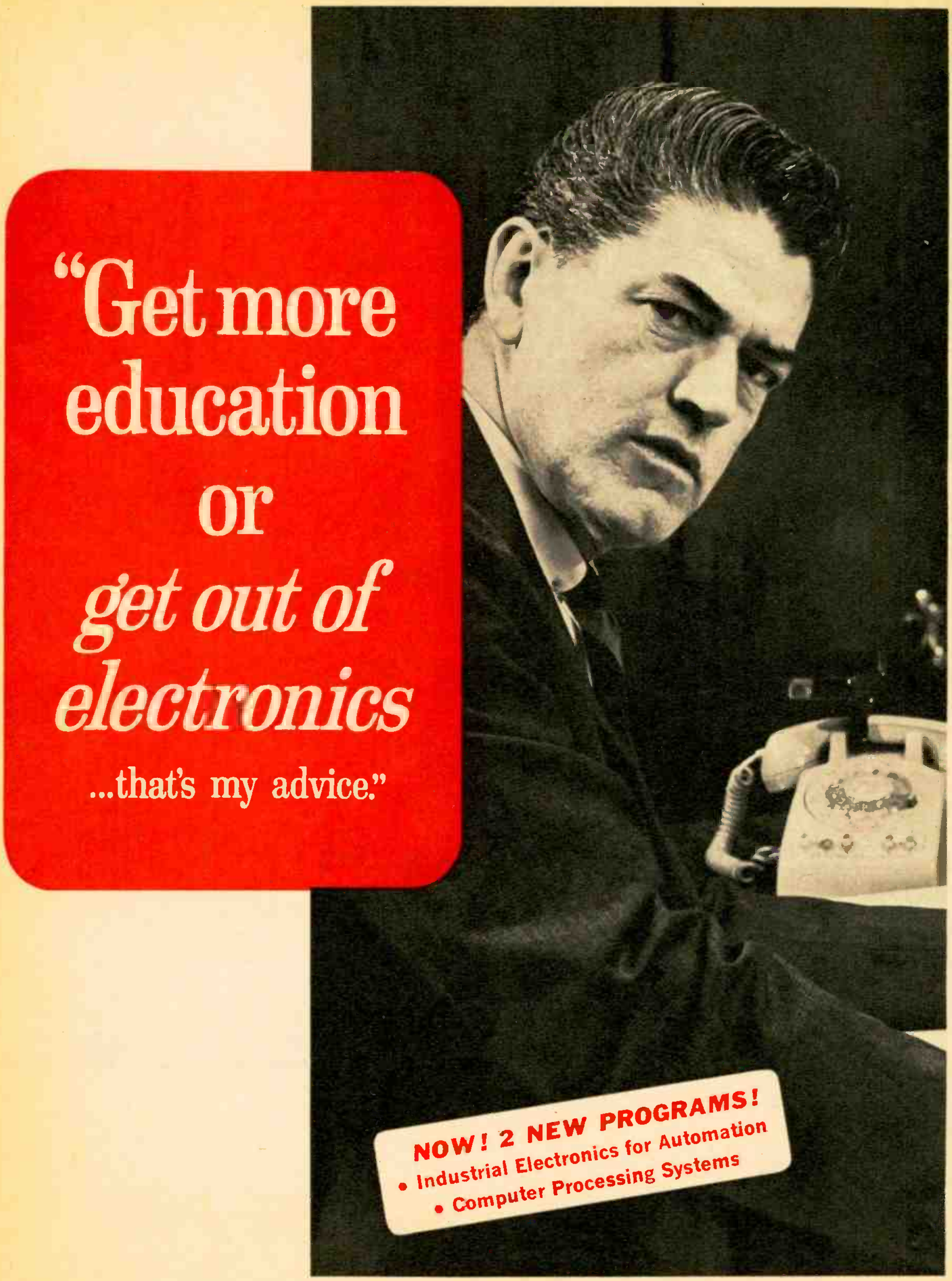
Name ______________________________

Address ______________________________

____

PROGRESSIVE "EDU-KITS" INC.

1186 Broadway, Dept. 571AE, Hewlett, N. Y. 11557


"Get more education
or
get out of electronics
...that's my advice."
NOW! 2 NEW PROGRAMS!
• Industrial Electronics for Automation
• Computer Processing Systems

FROSTY SILENCE . . . Because booster thrust always is limited, output from transmitters on satellites ordinarily is restricted by considerations of weight and space. Result is, conventional receivers here on earth have trouble picking up satellites' feeble signals. Even low-noise amplifiers fill the bill only to a point, and adding additional stages to boost weak signals coming from greater distances only results in more noise than signal. Promising solution to the problem is a device called a cryogenic stripline circulator being tested by the gal in our photo at the Marconi Research Laboratories, Great Baddow, England. Explanation is that even low-noise amplifiers grow more silent the frostier they become. And at the frigid levels of liquid nitrogen (—196°C) and liquid helium (—269°C) the hush is noiseless as pure nothingness. Anxious earthlings now will be able to tune in on signals from distant satellites in a silence that is golden.

...electronics in the news

Round, Man . . . A sphere easily can be seen in the mind's eye, though a perfect sphere (like a perfect anything) seemingly exists more perfectly in the mind than in reality. To be sure, man does pretty well at the sphere business, which explains why it takes sensitive instruments to measure a sphere's irregularities. Such an instrument recorded the amplified imperfections of the 3½-in.-diam. ball in our photo. Currently being used by researchers at the Albuquerque Division of ACF Industries, the device is so sensitive that variations of a mere 3 millionths of an inch appear as minor mountains on the trace.

Junior Juke . . . A record changer sans turntable sounds as believable as smoke without fire, though a trip to Norway's capital city of Oslo soon would reveal that such a changer exists. Developed by Norway's Radionette and known as the Multiplayer, this unique device accepts up to twenty-five, 7-in. 33⅓- or 45-rpm recordings. All spin simultaneously on a single horizontal spindle. Thing is, pressing one of the 50 buttons juke-box-style causes one of two arms to travel along a guide rail to the desired record side. Total playing time? Over six hours, with hi-fi sound furnished by a built-in, 15-watt, solid-state amplifier and speaker or from optional external speakers that easily may be attached.

In this age of extravagance we set out to build the sensible receiver!

We assume your first interest is in the music, not the machine—with no zest for unneeded bulk, excess cost, or useless gewgaws in your equipment.

That's why controls are uncomplicated on the E-V 1178 receiver, despite its versatility.

That's why it is one of the smallest all solid state receivers you can find, despite its 50 watt amplifier power and full AM/Stereo FM capabilities.

And that's why our performance standards meet the most critical musical taste, not some theoretical ultimate of perfection in printed specifications. The sound is just exceedingly good.

The crisp decorator look of the E-V receiver is your extra bonus.

Just $315.00 with integral walnut-paneled enclosure.

Guaranteed for two years—the new Model E-V 1178.

We also offer a Stereo FM receiver (E-V 1177) realistically priced at $280.00. Separate tuners and amplifiers, too. A postcard will bring our color brochure. It makes good sense.

ELECTRO-VOICE, INC.
Dept. 3641, 622 Cecil Street
Buchanan, Michigan 49107

Electro-Voice®
SETTING NEW STANDARDS IN SOUND

...electronics in the news

Philippine Powerhouse . . . Though the chap in our photo looks as if he's trying to do something right down at the Rheingold brewhouse, he really is a technician inspecting a motor-

driven tank coil. A vital part in each of ten new transmitters under production at Hughes Aircraft, the coils will be used in the Voice of America's new station in the Philippines. The VOA ordered the 250-kw transmitters with a mind to bridging the Bamboo Curtain. Reason: each can be tuned to any of 20 preset channels in a mere 20 seconds, thus giving operators an edge in electronic fencing games with Red jammers. The broadcasting complex will be surrounded by some 50 antennas, each capable of radiating a signal as far as 5,000 miles. And should Red jamming ever become too severe, the station still will have an ace in the hole. All ten transmitters tuned to the same frequency would blast a billion watts of effective radiated power.

ITEM . . . The increasing number of pirate stations operating off the British Isles may hammer the government into accepting commercial radio. Official circles, keeping one eye on the popularity ratings of pirate programming and the other on possible fees and taxes, are looking for a face-saving method of issuing licenses. Government recognition of the stations would permit them to move ashore. But, once on land, they would be required to pay income taxes and broadcasting fees. They pay neither now, while enjoying large audiences, large incomes, social acceptance, listings in entertainment columns ("First installment of first pirate radio soap opera, Dr. Paul," notes London Life) and even car-racing gamesmanship. So why should they accept an invitation to come ashore? We don't know—unless they just like to do everything wrong.

Only Courier gives you a 23-channel transistor CB rig for $169

and can guarantee it for 10 years!

What do you do for an encore after introducing the industry's finest 23-channel transistorized CB rig for the unheard price of $169? Tag it with a 10 year guarantee!

Silicon-transistors throughout bring the size down to 5¾"W x 6¼"D x 1⅞"H. With big-size performance. Complete, with microphone and a long list of features you want. Illuminated S meter. Illuminated channel selector. All crystals supplied for 23 channels. PA system. Auxiliary speaker jack. Single-knob tuning. Modulation indicator. DC cord. Chrome cabinet. Plus exclusive Courier "Safety-Circuit" to protect against mismatched antenna, incorrect polarity, and overload.

You can see the Courier TR-23S at your nearest Courier dealer. Or use the coupon for all the data on the amazing Courier TR-23S—the CB rig with the ten year guarantee.

EI-63

e.c.i. electronics communications inc.
56 Hamilton Avenue, White Plains, N.Y.

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

Name______________________________

Address____________________________

City____________ **County**__________ **State**__________

ELECTRONIC SWAP SHOP

El's Swap Shop provides a way for readers to obtain equipment they want in exchange for items they no longer have use for. Notices must be from individuals; commercial concerns are referred to El's classified advertising columns. Entries must include your name and address as well as a description of what you now have and what you would like in exchange. Address: El's Swap Shop, ELECTRONICS ILLUSTRATED, 67 West 44th Street, New York, New York 10036.

WESTON 301 meter. Make swap offer. L. Cohen, 151-40 13th Ave., Beechhurst, N.Y. 11457.

EICO 368 sweep generator/marker. Want Dynaco 100 or 200 microphones. David J. Raibert, 10 Wilsey Square, Ridgewood, N.J. 07450.

HEATH Apache, Heath DX-40, Hallicrafters SX-99, EICO 723 and Knight Span Master. Will trade for 6- and 2-meter gear. Jim Batka, WA9CUH, 350 18th Ave. S., Wisconsin Rapids, Wis. 54494.

KNIGHT Span Master. Want signal generator or Novice transmitter. Jim Hughes, 412 N. Walnut, Itasca, Ill. 60143.

HOMEBREW signal generator, variable 150-VDC power supply, transistor amplifier and preamp, electric clock, 125-V crank generator. Want coils, crystals, old radios. J. Rodney Clark, 1586 Liveoak Dr., Port Credit, Ont.

TRF BC receiver. Will trade for EICO 211 tube tester. Francis Elmer, Maribel, Wis.

HEATH HX-11 Novice transmitter. Will swap for 2-meter transceiver. Gil Colaiannl, 3 Loretta Circle, Little Rock, Ark. 72205.

EICO 955 capacitor checker, Knight Star Roamer. Will trade for CB transceiver. David W. De Wald, 13240 Vassar Dr., Detroit, Mich. 48235.

ATWATER-KENT model 44 receiver, assorted old tubes. Will trade for RCA TV model 9T256. Earle Philhower II, Box 3, Yardville, N.J. 08620.

SPRAYBERRY electronic course. Will swap for automatic code sender. Michael Sutton, 83 Maple St., Rouses Point, N.Y.

AMPLIFIER (6-tube), other items. Want small tape recorder. B. Willmann, 86 Brent St., Port Arthur, Ont.

INVERTER, 6VDC to 120VAC. Need 12VDC inverter or communications equipment. Rich Young, 2-S Laurel Hill Rd., Greenbelt, Md. 20770.

SIMPSON 262 VTVM, model airplane engines. Will exchange for communications equipment or tape recorder. Bob Goldstein, 2620 Ocean Pkwy., Brooklyn, N.Y. 11235.

FISHER-PIERCE 3000-watt lighting control. Want all-band receiver. Norman Spryer, 3659 Ashgrove Dr., Grove City, Ohio 43123.

TRANSMITTING TUBES (5514s), 1200-V plate transformer. Will swap for anything of equal value. D. C. Payne, Pop's Men's Wear, Haw River, N.C.

KNIGHT RF generator, Heath Q-multiplier, BC-453 receiver. Need Knight T-60. Greg Gebele, 421 Second St., Lakewood, N.J. 08701.

HARVEY WELLS Bandmaster with VFO. Will trade for Viking Ranger. Gerald Manning, K4WWL, Rocky Face, Ga.

TESLA COIL TRANSFORMER, 905 CRT, 922 photocell, assorted crystals. Will swap for Novice transmitter. Dave Bock, 58780 Romeo Plank Rd., Washington, Mich.

WEBCOR tape recorder. Will exchange for anything of equal value. Joseph Zak, Box 131, Sagamore, Pa. 16250.

HALLICRAFTERS S-38 receiver. Make swap offer. Mike Nazzaro, WA2VBX, Box 85, Rocky Point, N.Y. 11778.

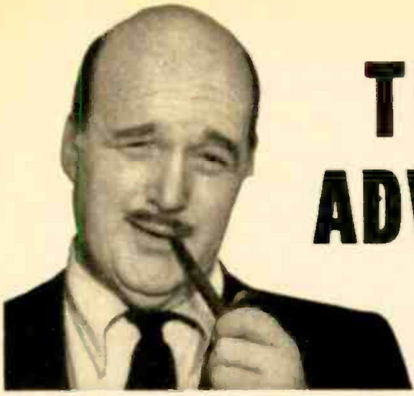
HEATH Twoer transceiver. Need Knight T-60. David Meade, WN2SYR, 91 Elberon Ave., Hawthorne, N.J.

BIG EAR listening device, dynamic mike. Will exchange for any mike listed on p. 215 of Lafayette catalog 650. P. J. Yudell, 425 W. Sierra Madre Blvd., Sierra Madre, Calif.

KNIGHT 100-in-1 electronics lab kit, assorted components. Will swap for transistor radio or hi-fi amplifier. Bob Goettsche, 22439 Park, Dearborn, Mich.

ROYAL typewriter, cameras, other items. Will exchange a tape recorder, Novice transmitter, test

[*Continued on page* 16]



ELECTRONIC SWAP SHOP

continued from page 14

equipment or SW receiver. Barry Schlosser, 7513 Adventure Ave., Miami Beach, Fla. 33141.

EPSILON Records code course. Will trade for Knight C-100 CB transceiver. Bruce Bennett, 938 Kintyre Way, Sunnyvale, Calif. 94087.

JAPANESE all-band receiver. Will trade for Heath Twoer or other ham or CB gear. Arthur B. Epstein, 3215 Hull Ave., Bronx, N.Y. 10467.

NATIONAL NC-88 receiver, Heath DX-60 transmitter. Want test equipment. William Altenberndt, 258 Harrison St., Chelsea, Mich. 48118.

BC-683 receiver. Need hi-fi tape deck or complete tape recorder. Scott Marovich, 2407 S. Rose St., Kalamazoo, Mich. 49001.

SURPLUS transmitter and WRL TC-6 6-meter transceiver. Want SW receiver. Fred Quandt, 1059 Coronet Dr., Warminster, Pa. 18974.

HEATH HD-11 Q-multiplier. Will trade for walkie-talkie. Pete Kemp, 25 Prince Pl., Stamford, Conn.

SENTENIAL TV. Want CB walkie-talkies. Lee Freshwater, 2601 Lancaster Dr., Muncie, Ind. 47304.

KNIGHT T-60 transmitter, ARRL books, code course, other items. Will swap for tape recorder or SWL antennas. John Baurhenn, 29-B Robson Pl., Hempstead, N.Y. 11550.

KNIGHT Star Roamer. Will swap for anything of equal value. Greg Virtue, 4580 Fair Oaks Blvd., Sacramento, Calif. 95825.

LAFAYETTE HE-29C walkie-talkie. Want 3- or 4-tube amplifier. T. Cinquini, 6917 Chester Ave., Philadelphia, Pa. 19142.

MAJESTIC AM/FM/SW receiver, tubes, books. Will swap for communications receiver. Dennis Hasler, 1821 N. Routiers, Indianapolis, Ind. 46219.

LIONEL train set with accessories. Want small SW receiver. Stephen Fenn, 441 Chelmsford, Lowell, Mass. 01851.

CDR rotator with control box, Pickett N4-T slide rule. Will exchange for Hallicrafters SX-28, CB rig or what have you. Thomas C. Bennett, Apt. 16, 203 S. Edgefield, Dallas, Tex. 75208.

RECORDING WIRE. Will swap for anything of equal value. Carleton B. Underwood, Mellwood Dr., New Lexington, Ohio 43764.

LAFAYETTE stereo record changer, homebrew AM/FM tuner, 8-watt amplifier, assorted components. Need ham or CB transceiver. John L. Chapin, Jr., 3161 S. Yale St., Wichita, Kan.

COLORORGAN (dancing lights), FM antenna booster, 8-in. hi-fi speaker, other items. Will swap for SW receiver. Rev. Pat Jeffares, Box 38, Campbellville, Ont.

MOBILLETTE 61 converter. Will swap for typewriter or SW receiver. Tommy Baker, Rte. 3, Salem Lane, Gallatin, Tenn. 37066.

HEATH GW-10 CB transceiver, Heath VFO. Want mobile ham antenna or other ham accessories. Bob Battagin, 2541 Hayward Dr., Burlingame, Calif. 94011.

LAFAYETTE Explor-Air receiver, ARC/RU receiver and transmitter, other items. Will exchange for CB walkie-talkie. James Loniak, 31-65 29th St., Astoria, N.Y. 11106.

ELMAC transmitter and receiver, other items. Will swap for anything of equal value. Ronald P. Johnson, Rte. 3, Box 229A, Huntsville, Ala. 35806.

ZENITH Transoceanic, signal generator, Knight C-100 walkie-talkies. Want CB transceiver, SW receiver or tape recorder. Daniel Litteral, Box 17, Eagle Mountain, Calif. 92241.

SHURE telephone transducer. Will swap for 64-in. mike stand. P. J. Yudell II, 425 W. Sierra Madre Blvd., Sierra Madre, Calif. 91024.

RCA Mark II CB transceiver, Wollensak tape recorders. Interested in Collins or Hammarlund communications receiver. Fred Sanborn, Box 667, Eagle River, Wis.

KNIGHT Star Roamer, American Flyer trains. Want Lafayette HE-80. Mark Jenkins, 15103 N.E. 12th St., Bellevue, Wash. 98004.

BC-459. Will swap for Command receiver. M. Sherman, 18891 N.E. 20 Ct., N. Miami Beach, Fla. 33162.

EICO 369 sweep and mark generator, Paco V-70 VTVM. Will exchange for Heath test equipment. William G. Beck, 247 W. Main St., New Holland, Pa. 17557.

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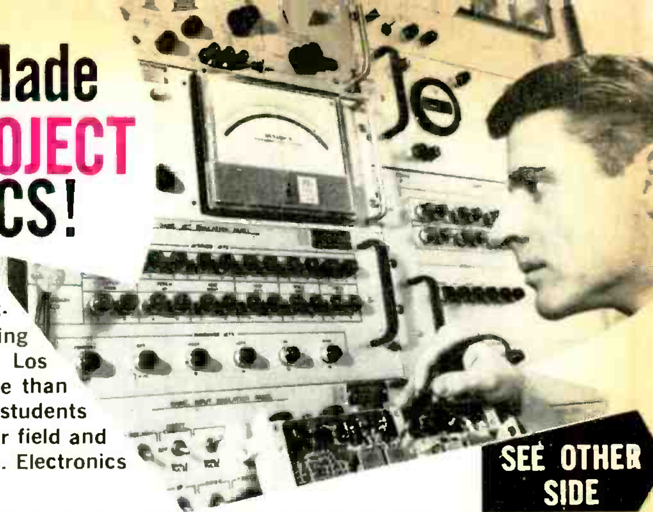

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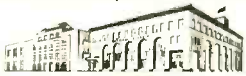

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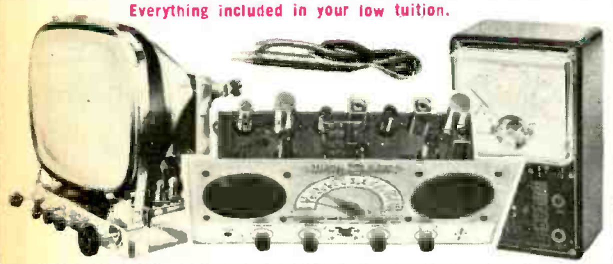

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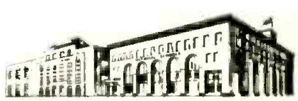

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BROADSIDES

Pamphlets, booklets, flyers, application notes and bulletins available free or at low cost.

Mobile and base-station **CB antennas and accessories** are illustrated and described in a new brochure from New-Tronics Corp. For your copy of bulletin NT-109, write New-Tronics Corp. 3455 Vega Ave., Cleveland, Ohio 44113.

Canadian electronic hobbyists will be interested in a **24-page catalog** available from an Ontario-based parts distributor. The catalog contains many special introductory offers and all items are shipped postpaid. A copy of Introductory Catalogue No. 1 can be yours by writing Gladstone Electronic Supply Co., 165 Robert St., Toronto 4, Ont.

The more changes a hobbyist makes in a given project, the more the chassis begins to look like aluminum Swiss cheese. But the Seezak people know a way to **breadboard chassis** which requires drilling nary a hole. Their patented 420-line series is designed specifically for breadboarding and a new bulletin explains precisely what the system entails. For your copy, write Seezak Products, Inc., 5057 W. Washington Blvd., Los Angeles, Calif. 90016.

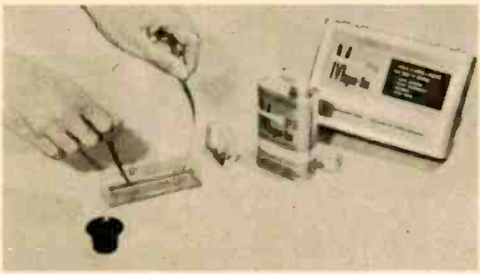
Though **Piezoelectric Technology Data For Designers** may sound like a book for engineers only, the publication can be understood readily by most electronic hobbyists. From the definition of piezoelectricity in the opening to the useful tables, charts and graphs at the close, this 45-page booklet steers the reader toward a comprehensive understanding of crystals and their workings. A copy is free for the asking from Clevite Corp., Piezoelectric Div., 232 Forbes Rd., Bedford, Ohio.

New audio equipment always is of interest to hi-fi buffs who constantly are in search of better sound and better values. Leaflet SAH-96 gives the full rundown on the RM-2—a new low-price **speaker system** by Sonotone. Available free of charge, the publication can be had by writing Sonotone Corp., Electronic Applications Div., Elmsford, N.Y. 10523.

Chances are, you faced a part number rather than a capacitance value last time you replaced a faulty electrolytic capacitor in your TV set, which fact probably forced you to play it leery. Thing is, the **TV Electrolytic Capacitor Replacement Guide** translates these numbers into usable capacitance and voltage ratings and indicates the recommended Aerovox replacements. The booklet is available for 50 cents from Aerovox Corp., 740 Belleville Ave., New Bedford, Mass.

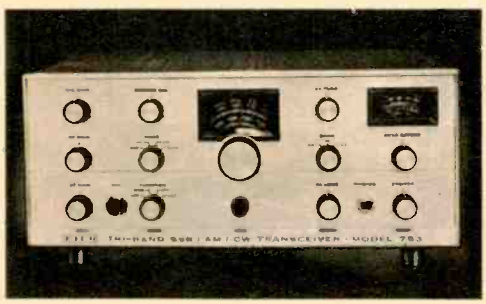
ELECTRONIC MARKETPLACE

INDICATIVE . . . Lacking elaborate instruments, aligning heads on a tape recorder can be a tedious and time-consuming chore. But whether applied to video, instrumentation or



sound recording tape, a substance called Magna-See makes the recorded tracks instantly visible. Result is that head alignment, head wear and track uniformity can be conveniently checked. What's more, tapes can be easily edited with speed and accuracy. $12. Reeves Soundcraft, Great Pasture Rd., Danbury, Conn.

Tri-Banded . . . Available in both kit and factory-wired versions, the three-band 753 ham transceiver sports a 200-watt PEP input on both



SSB and AM as well as a 180-watt CW input on 80, 40 and 20 meters. Thanks to inclusion of an off-set tuning control, the receiver can be tuned over a 10-kc range without disturbing the transmitter frequency. Kit, $179.95; factory-wired, $299.95, both less AC power supply/speaker or mobile power supply/speaker (kit, $79.95; factory-wired, $109.95). EICO, Inc., 131-01 39th Ave., Flushing, N.Y. 11352.

MARKETPLACE

Chargeable . . . Though most battery-powered portable tape recorders handle only a given number of tapes before the cells must be replaced, the Charger 760 is equipped to recharge its own.

The 760 will record up to four, hour-long tapes before its nickel-cad battery begins to feel winded. Recharging is an overnight operation. What's more, the 760 can record or play back during the time its battery is undergoing refueling. The book-size, easily totable 5-lb. machine employs a 3¾- and 1⅞-ips capstan drive and can be recharged from any 117-VAC outlet. $129.95. V-M Corp., Benton Harbor, Mich. 49022.

Color-Coded . . . The KG-625 VTVM likely will interest most any hobbyist, be he novice or

pro. In kit form, the KG-625 provides excellent construction experience for the beginner; factory-wired, it promises to be a welcome addition to the test bench. Multi-range, color-coded scales read AC and DC voltages to 1,500 V, peak-to-peak voltages to 4,200 V and resistance to 1,000 megohms; an optional high-voltage probe boosts the unit's voltage range to 25,000 VDC. $36.95, kit; $53.95, factory-wired. Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680.

UNCLE TOM'S CORNER

Uncle Tom answers his most interesting letters in this column. Write him at Electronics Illustrated, 67 West 44th St., New York, N. Y. 10036.

By TOM KNEITEL, K2AES/KBG4303

★ *I do a lot of driving and have considered getting one of those little radar-detector gadgets for my car. What's the story? Do they really work? Thirty dollars is a large investment for a gizmo the size of two packs of smokes.*

Art Delwynne
Azen, Mo.

I had one of these things on my car for two years and found that if I went more than a few mph over the limit the detector didn't give me sufficient advance warning of a speed trap so I could hit the brakes and avoid getting pinched. Your best bet is either to invest in driver-education courses—or do what I did and buy a Jag that can outrun the fuzz.

ABOUT THE AUTHOR

Tom Kneitel has been called an irascible misanthrope, a rabble rouser and the dirty old man of electronics. Whatever he's called, Tom has had a greater influence on hobby electronics in recent years than any other author. As the leading short-wave-listening writer, he once took a major hand in shaping that avocation. He then gave the Citizens Band its name and was instrumental in making it into the world's most dynamic radio service. Tom also has written extensively about ham radio, hi-fi and other areas of electronics. He is noted for his knowledge of his field, his pungent comments and his readiness to state a colorful opinion. He was born in Brooklyn in 1933, started out as a disc jockey, then spent six years with United Artists, selling 16mm films in—of all places—Greenland and Liberia. He is author of four books and scores of articles in a dozen magazines and, along the way, has lived in New York, Florida, California and Oklahoma. Tom now is editor of S9, a special-interest CB magazine, and lives far out on Long Island. His hobbies are fast cars, coins (old or new), hamming and DXing. He drives a Jaguar and leads a bloodhound named Zelda.

★ *Like you, I'm a ham radio operator. My problem is my girl friend—she claims that I spend far too much time operating the ham gear. Any advice?*

B. L. Morrison
Chicago, Ill.

Explain to her that ham radio is one of the true class hobbies, that the most distinguished and prominent scientists, educators and other citizens choose ham radio to further their intellectual interests. Then whack her good in the slats. She'll get the point.

★ *If I'm not mistaken, didn't you work at a Florida radio station a few years ago? Or was it some other Tom Kneitel?*

Abner Sherlinn
Kendall, Fla.

Every now and then my past comes back to haunt me. You're right. That was station WTTT in Coral Gables, a little 250-watter. In 1951-52, while attending the University of Miami, I was a disc jockey and studio engineer. Our antenna tower blew down in a hurricane and we were broadcasting on a long-wire for the last year of the station's life. The studio was five miles from the transmitter on the dead end of the antenna. At night we barely could hear our own signals. If you picked up this bomb in Kendall you must have been a world-champion DXer.

[*Continued on page* 24]

Uncle Tom's Corner

Continued from page 23

Ham Beef Dept. Most ham operators, including this one, are bugged by the FCC's proposed new rules which would further force artificial class distinctions upon amateurs. Under the new plan each class of license would have a distinguishing call sign. It's bad enough now with General ops sneering at Technicians and Technicians laughing at Novices. Just think what it's going to be like when the differences are made even clearer. Today ham radio is growing at the slowest rate since the late 1940s. It doesn't need this latest FCC innovation to slow progress even more.

★ *There is a broadcasting station on 1540 kc with a power of 50 kilowatts. They are about five miles from me. Their equipment generates harmonics on 540 and 635 kc. Is there any way I could get rid of the harmonics and also limit the station to about 10 kc (they now occupy most of the frequencies from 1500 to 1580 kc)?*

Kyle Warren
Cooksville, Ont.

Your problem isn't the broadcasting station. It's the dud you are using for a receiver. If you don't want to invest in a new receiver, try disconnecting the antenna from the set you are using. Or take up home movies.

Lost Souls Dept. I don't know the why but short-wave listeners have been the lost souls of electronics for years. They have no licenses and no leadership and they support a dozen or so clubs which (despite a facade of friendliness) hate each other like poison. And the clubs themselves often seem coldly rude to prospective members, businesses and publications—and even to their own members. Worst of all, the SWL has been all but ignored by the electronics industry, which has spent millions to cultivate ham operators and CBers.

Manufacturers of receivers, for instance, produce a variety of general-coverage sets which have a bandspread calibrated for the ham bands. Why don't these manufacturers sell paste-on strips or replacement dial plates calibrated for the short-wave-broadcasting bands? It would be a simple matter to produce this type of accessory, which could be sold for less than a dollar. Or it could be factory-installed if the set were bought on special order.

That's just one little thing on a long list of injustices being tolerated by SWLs. I can't decide whether SWLs are aware that they are second-class citizens or whether they know it and just don't give a damn.

★ *Can you give me some ideas on obtaining a device which will enable me to see through stone, brick or wooden walls? I know that recent technological developments have placed radar within the budget of home experimenters. How about this?*

Robert Ellis
San Mateo, Calif.

Perhaps you are referring to an amazing invention from Venice. Check your hardware store and ask for window glass.

★ *For years now I've been reading your smart-aleck nonsense in various publications. I think that I know more about electronics than you but I've had dozens of really good manuscripts rejected by leading magazines. If you ask me, something funny is going on somewhere.*

F. B.
Fort Valley, Ga.

Who asked you?

★ *Help! I've been swamped with specifications and statistics on hi-fi gear. Manufacturers must think everyone who buys their equipment is an audio engineer. Where can I obtain a translation of this technical double-talk?*

Vincent Bonnelli
Brooklyn, N.Y.

I know purists are going to stick pins in fat little bearded dolls at this answer but, in my opinion, manufacturers go overboard with dazzling arrays of factual but unnecessary statistics on their equipment. I once did an experiment which consisted of interconnecting expensive and moderately priced components and then switching them in and out of a hi-fi system. Most listeners couldn't tell what was playing when! Fact of the matter is that you can't buy hi-fi gear from a poop sheet. The only way to do it is by listening. If an inexpensive component sounds good to you then don't waste your bread on a bushel of statistics and impressive specifications which your ears can't detect.

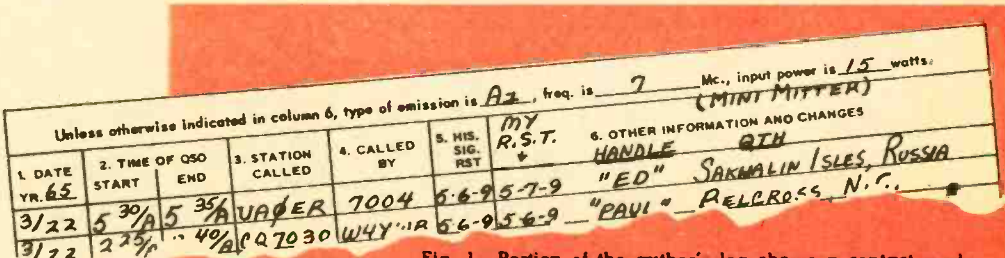
the Mini Mitter

By RUSS ALEXANDER W6IEL

IT occupies little more space than a telegraph key, weighs less than the power transformer it does not have, yet is more powerful than any of the popular lunch-box rigs—that's our Mini-Mitter, a neat 28½-ounce package that can put a clean 15-watt (input power) signal on the 40-meter band.

Secret of the Mini-Mitter's small size, of course, is the missing power transformer. In its absence, power is provided by a solid-state voltage doubler. The two tubes aren't visible because they're mounted on the outside of the back panel to keep everything cool. And because the two tubes have 50-V heaters they are connected in series with a power resistor across the line. This means no filament transformer, either.

The first day we put the Mini-Mitter on the air in California we contacted not only the East Coast but UAØER in *Russia* as well (see log excerpt)!



Unless otherwise indicated in column 6, type of emission is A1, freq. is 7 Mc., input power is 15 watts. (MINI MITTER)

1. DATE YR. 65	2. TIME OF QSO START	END	3. STATION CALLED	4. CALLED BY	5. HIS SIG. RST	MY R.S.T.	6. OTHER INFORMATION AND CHANGES HANDLE	QTH
3/22	5 30/A	5 35/A	UAØER	7004	5-6-9	5-7-9	"ED"	SAKHALIN ISLES, RUSSIA
3/22	2 25/P	" 40/P	CQ 7030	W4Y..R	5-6-9	5-6-9	"PAUL"	BELCROSS, N.C.

Fig. 1—Portion of the author's log shows a contact made with UAØER in Russia with the Mini-Mitter on 40 meters. Input of 15 watts goes to show you that power isn't everything.

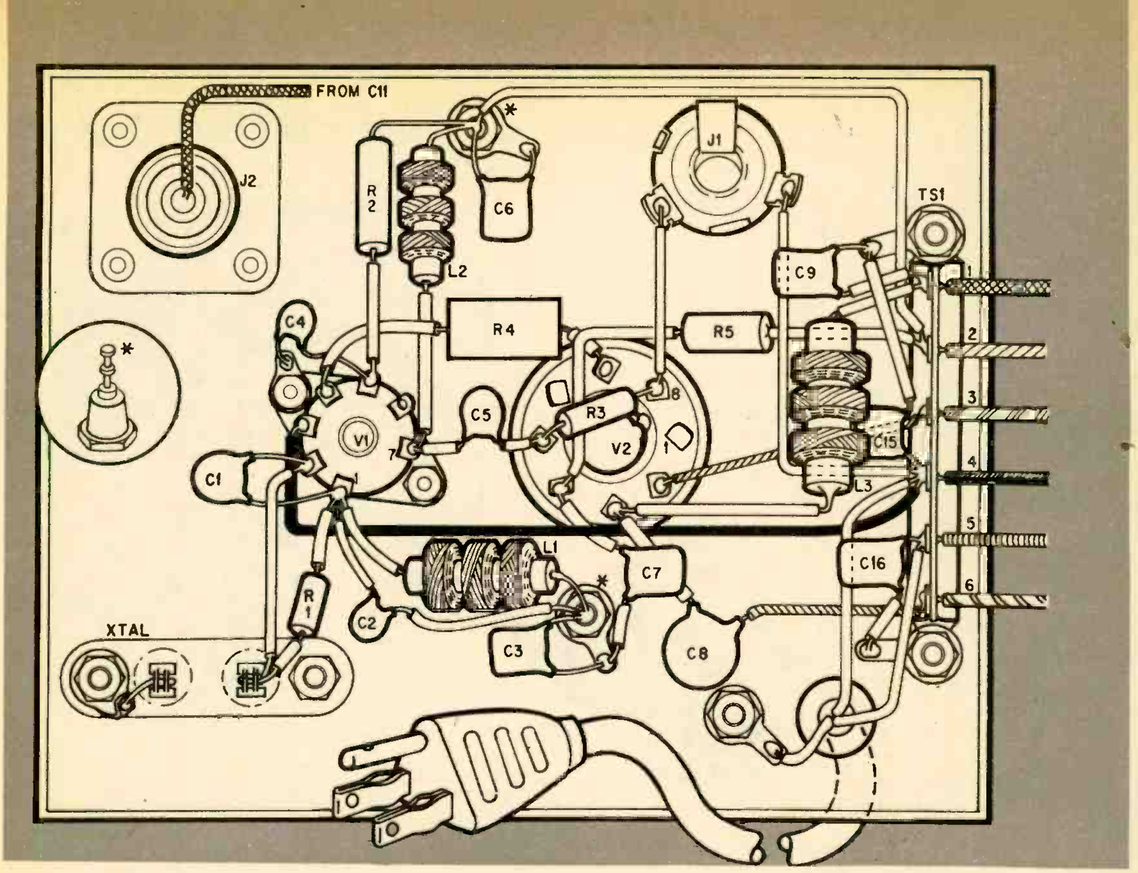


Fig. 2—Rear (above) and front (right) panels. Standoff terminals (circle at extreme left) that hold R9 are sol-

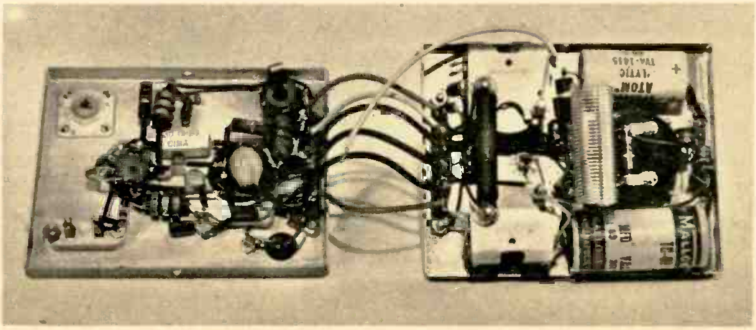
Mini-Mitter

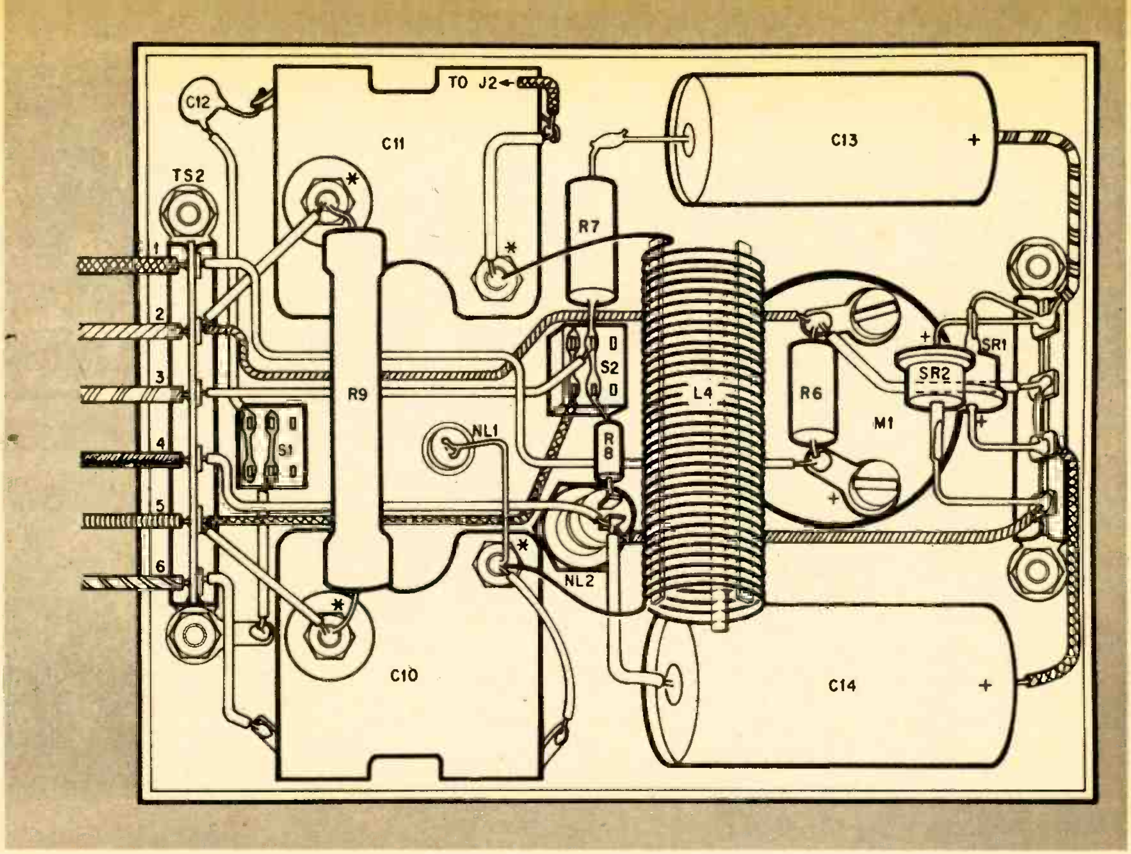
Later we worked Japan, Alaska and many points in the U.S.A.

When our main rig failed, Mini-Mitter kept up our MARS schedules and maintained other schedules up and down the Pacific Coast. Because of its vest-pocket size, Mini-Mitter has been carried along on several field trips without difficulty. It and a Drake 2-B receiver were powered by a 12 VDC-to-117 VAC converter in the car. On several radio picnics we used all sorts of antennas hung from trees, kites and balloons.

The Mini-Mitter circuit is pretty straightforward but includes several unusual features. As we said, instead of the usual heavy power transformer, there is a solid-state voltage doubler for the plate supply. A neon lamp is used as an RF-resonance indicator.

Fig. 3—Photo of completed panels ready to be installed in cabinet. Only lead from C11 on right panel remains to be connected to J2 in upper corner of left panel. Watch for loose strands on interconnecting wires at terminal strips. These strips are close to panel edges. Mount all of the components near panels.





dered to C10, C11. Mount others with screws, seeing that screw heads on L4's don't touch plates of C10, C11.

The rapid response of the lamp to RF voltage provides visual monitoring while you send and is of great help when tuning.

The final has pi-net tuning and there's a switch to add or remove capacity for matching to different impedance antennas. The power supply delivers about 310 V when the key is down. All of this goes to putting out a mighty easy-to-copy signal.

Mechanically, the Mini-Mitter has several features which simplify its construction. Refer to the pictorial in Fig. 2. Note that the front and back panels are separate parts that are joined electrically by flexible leads. This makes it possible to mark and drill the panels and then mount and wire the components on a flat surface. Layout and handling are thus simplified.

Construction

The first step is to remove the front and back panels from the 3 x 4 x 5-in. case. Holes

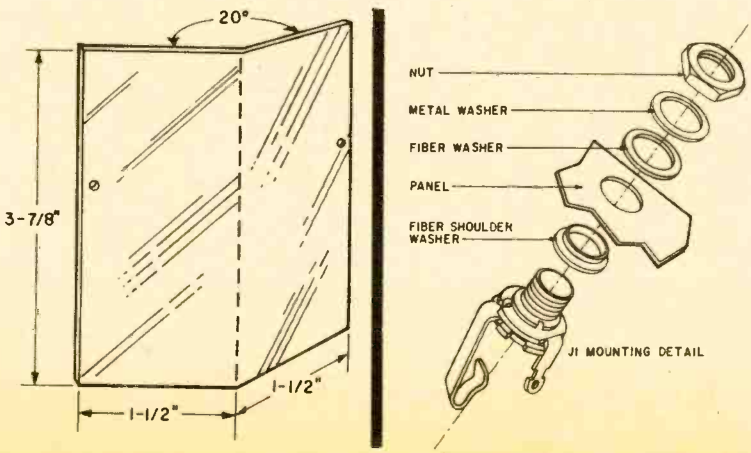


Fig. 4—Sketch at far left is of supporting plate (of 1/16-in. scrap aluminum) that should be used to support and electrically connect front and rear panels so transmitter can be operated out of cabinet. Plate is shown in use in Fig. 6. Sketch at left shows method of mounting key jack J1 so it is insulated electrically from cabinet.

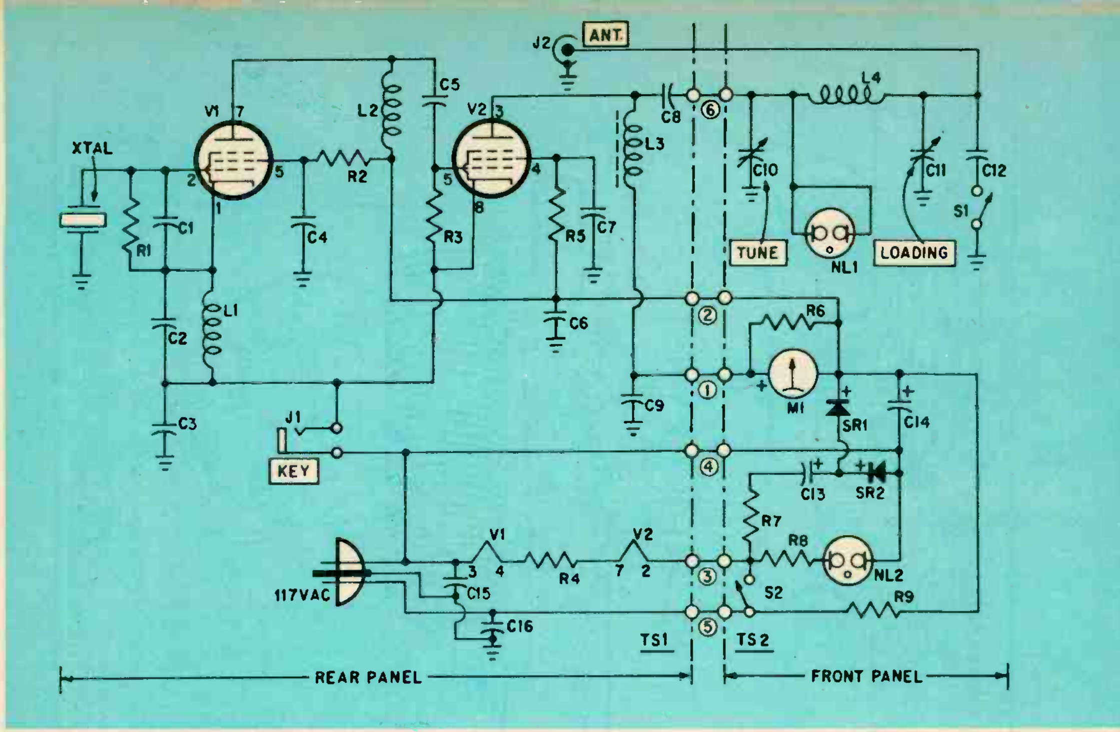


Fig. 5—Schematic of Mini-Mitter. Since J1 is connected directly to one side of line, it must be insulated from cabinet. Make sure the AC plug is wired so that one side of the key will not be hot.

Mini-Mitter

for mounting the components should be drilled next. As an aid to laying out the panels, rubber-cement brown wrapping paper on them. After marking and drilling is completed the paper can be pulled off easily and the rubber cement can be rolled off. This technique prevents the panels from being scratched and permits laying out all holes with easy-to-see pencil markings.

Next, install 6-lug terminal strips (TS1, TS2) on the bottom of each panel. The lugs are the component and wiring terminations (shown as circles on the schematic) and are used to join circuits on front and back panels.

The power-supply filter capacitors (C13 and C14) are mounted by cementing their cardboard jackets directly to the front panel. Cambion (Cambridge Thermionic Corp.) standoff terminals rather than ordinary terminal strips are used to support several components. These lugs are excellent space savers for miniature equipment. One is shown in detail in the circle at the extreme left of the

PARTS LIST

Capacitors: ceramic disc unless otherwise indicated
C1—30 μμf, 1,000 V, C2—220 μμf, 1,000 V
C3, C6, C9, C15, C16—.02 μf, 500 V
C4, C5—.001 μf, 500 V, C7, C8—.01 μf, 500 V
C10, C11—10-365 μμf variable capacitor (J. W. Miller No. 2111. Newark Electronics 40F190. $2.10 plus postage)
C12—390 μμf, 1,000 V
C13—60 μf, 150 V electrolytic
C14—60 μf, 350 V electrolytic
J1—Open-circuit phone jack
J2—Coax connector, SO-239
L1—620 μhy RF choke (J. W. Miller No. 4650)
L2—.15 mh RF choke (J. W. Miller No. 4644)
L3—2.5 mh RF choke (J. W. Miller No. 6302)
L4—Barker and Williamson Miniductor No. 3007. 2-in. long, ⅝-in. dia., 16 turns per in. (Lafayette 40 R 1616 or equiv.)
M1—0-100 ma DC milliammeter (Lafayette 99 R 5055 or equiv.)
NL1, NL2—NE-2 neon lamp
Resistors: ½ watt, 10% unless otherwise indicated
R1—47,000 ohms, R2—8,200 ohms, 1 watt
R3—27,000 ohms, R4—130 ohms, 5 watts
R5—6,200 ohms, 1 watt, R6, R7—10 ohms, 1 watt
R8—100,000 ohms, R9—40,000 ohms, 10 watts
S1, S2—Miniature DPDT toggle switch (Lafayette 99 R 6162 or equiv.)
SR1, SR2—Silicon rectifier, minimum ratings: 750 ma., 600 PIV
TS1, TS2—6-lug terminal strip
V1—50HC6 tube, V2—50L6GT tube
XTAL—40-meter crystal and socket
Misc.—Solder terminals (6 reqd. Cambion No. 1947-2. Newark Electronics 40F1842). 7-pin tube socket, octal tube socket, 3 x 4 x 5-in. utility box (LMB No. U-C 971, Newark Electronics 91F1025), 4-lug terminal strip

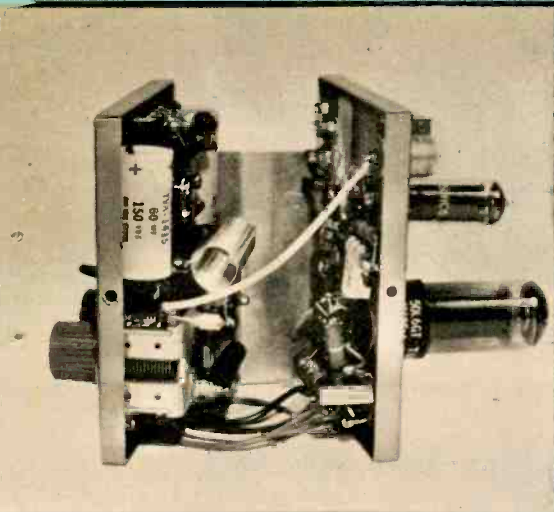


Fig. 6—Photo shows how mounting plate shown in Fig. 4 supports front and rear panels to permit transmitter to be operated out of the cabinet.

Fig. 7—Rear view of Mini-Mitter. If you feel uneasy about building the transmitter in such a small box the answer is obvious. Get a larger cabinet!

pictorial in Fig. 2. Their locations are indicated by asterisks.

Tank coil L4 and bleeder resistor R9 are mounted on two terminals which are soldered to the frames of variable capacitors C10 and C11. Key jack J1 *must* be insulated electrically from the panel with fiber shoulder washers as shown in Fig. 4. To be sure the jack is insulated from the cabinet, check it with an ohmmeter.

Since one side of the line is connected to the key (and J1) be sure you wire the power cord correctly or there will be a dangerous shock hazard. After the unit is wired, connect the front and back panels with the plate shown in Fig. 4. Turn on power and measure the voltage between jack J1 and either panel. If you measure line voltage, interchange the line cord's leads to lugs 4 and 5 on TS1.

Both leads of neon lamp NL1 are soldered together and connected by a single wire to the ungrounded side of *tuning* capacitor C10 at a standoff terminal. The bulb should protrude slightly through a ¼-in.-dia. hole in the front panel. The lamp's internal elements are coupled capacitively to the panel and RF energy through this capacitance lights the lamp.

After wiring both front and back panels connect the two with flexible insulated leads between the indicated lugs on TS1 and TS2.

Tune Up

The Mini-Mitter is now ready for testing with a 15-watt, 117-V lamp. After inserting the tubes, plug in a 40-meter crystal and the key. Turn on your receiver and tune it to the crystal's frequency. Turn on the receiver's BFO. Turn on the Mini-Mitter's power and note if NL2 and the tubes light up.

After a warmup of about one minute, press the key. If the Mini-Mitter is wired correctly you'll hear its signal on your receiver. Close S1 and adjust C10 (*tune*) to obtain the brightest glow from NL1 and the lowest plate current, as indicated on M1. (From the full counterclockwise position, we used the first dip.) The 15-watt lamp should glow, indicating RF output.

To load the transmitter, gradually decrease the capacity of C11 (open its plate), simultaneously dipping plate current by adjusting C10. At maximum loading the meter should indicate about 80 ma and the neon and 15-watt lamps will glow brilliantly.

The Mini-Mitter is now ready to go on the air. Connect it with RG59/U coax to a dipole or vertical 40-meter antenna and tune it again, using an SWR or field-strength meter, if available. Capacitor C12 may be cut in or out of the circuit, as needed, for different antennas.

KIT EI REPORT

Stereo Tape Deck

Knight-Kit KG-415

A DECISION by Allied Radio's Knight-Kit division to put out a stereo tape deck in kit form means the market now is being shared by two companies and that, in any area of electronics, is the rare and absolute low number of competitors possible. More people are fighting over the first ticket to the moon.

Tape decks and tape recorders never have been big sellers as kits. The reason probably has to do with the fact that performance depends so much on mechanical components—the tape transport—which can't be assembled easily by a hobbyist. It's an expensive, exacting job done best by a factory. Thus, manufacturers have little room to maneuver between offering the electronics of a machine in loose-leaf form or wired. And it used to be difficult to create a significant kit/wired price differential. The Knight is a departure from this state of affairs.

The machine, called the Superba KG-415, is a solid-state stereo deck with a pre-assembled transport supplied by Viking, a recognized quality name in the field. The builder's job mainly is one of putting together preamplifiers for recording, playing back and monitoring and other circuitry for switching.

When the job is complete the builder has a deck of unquestioned high quality with all the functions and conveniences of a professional model. A comparable factory-wired deck would cost upwards of $400.

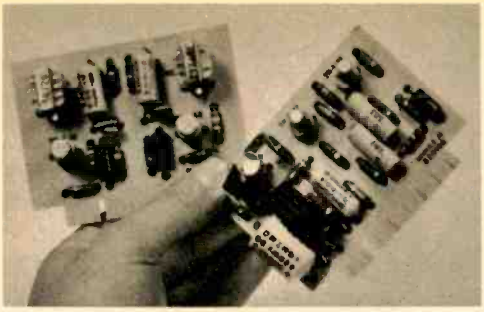
The KG-415 has a basic price of $249.95. To that can be added $19.95 for a walnut base ($29.95 for a portable carrying case), $10.85 each for a pair of matched dynamic microphones and as much as $8.10 for express charges from Chicago (the $8.10 is for shipment to San Francisco). The total goes to roughly $300, representing a substantial savings over a comparably equipped assembled model.

Clearly, for a person in the market for a quality tape deck—and who has had some little experience in kit-building—the KG-415 makes good monetary sense. And that's something that could not be said of most electronic kits—the money-saving possibilities usually are of minor importance.

The KG-415 is a two-speed (3¾ and 7½ inches per second) deck with three heads that is suitable for stereo or mono recording and playing back (one head gives you the valuable ability to monitor the tape just after it has been recorded).

Knight's offering comes off as a machine that once might have been called a *tape recorder*. But tape terminology is getting sticky. A *tape deck*, such as this one, has no speakers. Its preamplifier outputs must be fed into an amplifier to drive one or more speakers. The mechanical part that transports the tape we once called a *tape deck*. Now it is the *tape transport*. A *tape recorder*, on the other hand, is anything with a built-in speaker. But we are going astray.

Assembling the KG-415 is a relatively straightforward procedure with both easy and difficult spots. Most operating compo-



MAJORITY of KG-415 components are mounted on six printed-circuit modules similar to these two.

nents are mounted on six printed-circuit modules (two record amplifiers, two playback amps, a bias-erase module and a monitor amp), which are easy to assemble. Much of the underchassis work consists of interconnecting leads and, though Knight has done an excellent job of figuring out routing and of locating cable clamps, wiring is intricate and much patience is required. It is for this reason that we say the prospective builder should have a kit or two under his belt before tackling the KG-415. Neophytes often lack the patience and willingness to follow instructions exactly as required here.

The instruction manual is well-done, being logical and easy to follow. Our builder had only one fuss: on page 6, step 13, two sheet-metal screws are threaded into the chassis after mounting other hardware and it is difficult to start them without a screw-holding screwdriver, which should be specified. He also ran short of 4-40 x ½-in. machine screws but his kit probably was atypical because such hardware is packaged by weight and most Knight kits include an excess.

Our man got the KG-415 together in 30 hours, 5 minutes. He is an average builder, having put together half a dozen kits, but he is slower and more methodical than average. Even so, he made an error in the underchassis part of the monitor circuit and this required considerable troubleshooting. Oscillation also developed at one point but this was cured easily by moving some of the underchassis leads. Knight's instruction to route all leads directly and keep them close to the chassis must be taken extremely seriously. Failure to keep them close or to route as instructed can produce a multitude of problems.

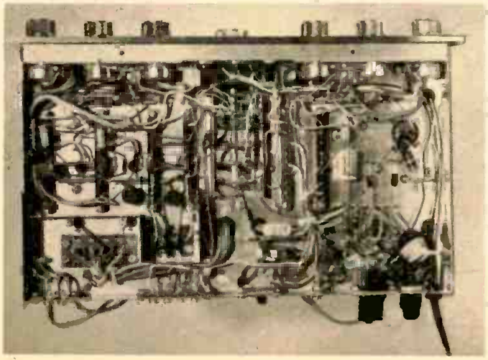
After the machine was finished and interconnected with the tape transport our builder tried to slip it into the walnut base—and failed miserably. The manual does not include an in-it-goes instruction, none is packaged with the base and how the two go together is not that obvious. In future production such instructions no doubt will be included somewhere.

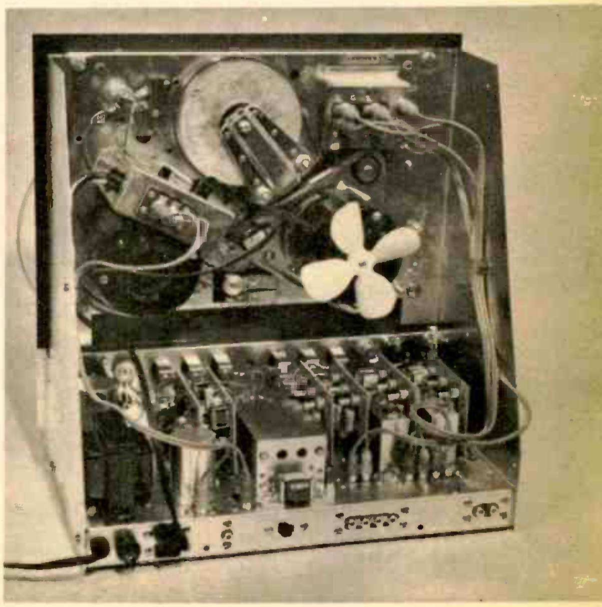
We were impressed by several features of

[*Continued on page* 95]

RIGHT—Chassis is wired and modules are in place at bottom of photo; reverse side of transport is above. Note flywheel at top, fan on the motor. Connecting cables come down at left and right.

BELOW—View of underside of chassis indicates the complexity of the wiring. Our builder found the wiring tedious but instructions were excellent. Front-panel control knobs are at top of photo.





The LISTENER

C. M. STANBURY II

HIGH SEAS . . . Weaknesses in the country system of gauging DX prowess are advanced from time to time and we often have said the number of countries logged and verified was not necessarily the best measure of a DXer (e.g., THE LISTENER, July '65 EI). Currently, a small group of expert DXers is suggesting that cities logged and verified be used as another criterion, an idea obviously not without merit.

But the biggest weakness of the country system has yet to be mentioned. Two thirds of the earth's surface—the water—usually counts for nothing at all. (EI'S DX Club, however, does count International Waters as the equivalent of one country.) Considering the territory involved, this hardly seems fair, especially for utility DXers.

Thing is, if stations on the high seas are to be divided up, exactly how do you go about it? Would the Caribbean be counted as separate from the Atlantic? Would the Gulf of Mexico be credited separately from the Caribbean? And, if so, where exactly would you draw dividing lines?

Without going into these controversies, there would be six divisions no one could quarrel with—well, almost no one, anyway. These are the Atlantic, Pacific and Indian Oceans plus the Mediterranean, Black and Arctic Seas. Paradoxically, easiest way to log any of these isn't via stations aboard ships (with one possible exception). Aircraft passing over these waters afford ample signal sources, assuming you are aware of the various AERO frequencies. (Our map shows some of the better frequencies for the six divisions mentioned above.)

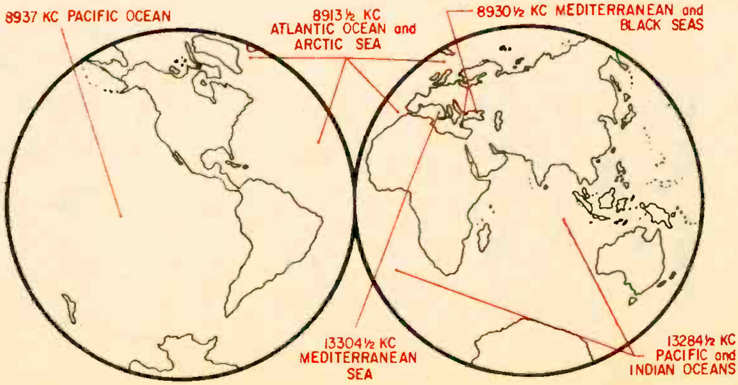
If you find this new approach to DX gauging worthwhile, let us know. And if enough interest is shown, we'll tackle those controversial areas like the Caribbean and perhaps change the Official Countries List for EI's DX Club.

SW Receiver. A new product recently put on the market by Hallicrafters seems aimed specifically at the DXer. Selling for around $60, the S-200 is the first U.S.-built receiver in recent years to cover *only* the short-wave broadcast bands—49, 31, 25 and 19 meters—plus the medium-wave BCB. Further (and this is the big thing), a separate 8-in. scale is provided for each band.

This is not to imply that the S-200 doesn't have disadvantages. In addition to virtually no utility coverage (there is a little at each band's edge), there is no RF amplification (so expect images) and only one IF stage. There also is no coverage of tropical bands and, of course, the country names appearing at various points on the dial can be put down as plain decoration. But the fact remains that there is nowhere else, for that price, that the beginner can get such fine tuning and calibration.

Pink-Slip Caper. No one is much surprised that many SWLs are sadly lacking in general reporting know-how. But we recently ran across one DXer who sent out so-called pink slips to stations who did not answer his reports promptly, an approach we think unlikely to win stations or influence chief engineers. (By way of explanation, *pink slip* is another name for an official FCC violation notice—

[*Continued on page* 103]



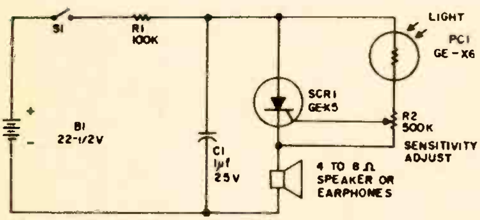
Water accounts for the better part of the earth's surface, yet the entire area usually counts as one country—if that—for DX purposes. And though aircraft flying over oceans and seas provide a convenient means of logging these areas on frequencies indicated, problem is how adequately and correctly to delineate such regions.

GOOD READING

By Tim Cartwright

ELECTRONIC COMPONENTS HOBBY MANUAL. Edited by R. G. Kempton. General Electric, Owensboro, Ky. 199 pages. $1.50

General Electric usually is right on target when it aims a book of electronics projects at the hobbyist, and this one is no exception. Well thought-out and well presented (with lots of ultra-clear photos and diagrams), this volume—a second edition—should be a pleasure for anyone to work from.



Taken from the Hobby Manual discussed above, this diagram shows a simple circuit for what GE calls a light-sensitive electronics watch dog.

The projects range in meatiness from a simple warning chime intended to keep you from leaving your car with its headlights on to a dual-voltage power supply that can handle a typical 100-watt ham transmitter. The theory in the book's opening section is presented with just the right tone for a text aimed at hobbyists, and the entire presentation is in marked contrast to other, hastily-thrown-together hobby books. A very nice job, highly recommended.

BASIC ELECTRONICS. Produced by RCA Institutes. Edited by Jack W. Friedman, Harry G. Rice and Gerald McGinty. Prentice-Hall, Englewood Cliffs, N.J. 534 pages. $12.95

A programmed text for self-instruction, this volume perhaps is the first on the subject of basic electronics. The idea, in case you haven't been exposed to it, is that you work your way through a series of simple statements (frames), usually supplying a missing part of each statement as you go along. The statements grow weightier in almost imperceptible steps, and you gradually are supposed to find that you painlessly have absorbed an awful lot of information.

Given a few reservations, the approach does work. To be sure, the order of the topics may seem a bit strange and frustrating to someone with but slight acquaintance with the subject, a curious mind may not be able to go in any but one direction at a given moment and there is no real stimulation despite a cleverly programmed text. All in all, though, there's no doubt you *can* learn electronics this way, with a minimum of fuss and feathers. And the cost is pretty low.

HANDBOOK FOR ELECTRONIC ENGINEERS AND TECHNICIANS. By Harry E. Thomas. Prentice-Hall, Englewood Cliffs, N.J. 427 pages. $15

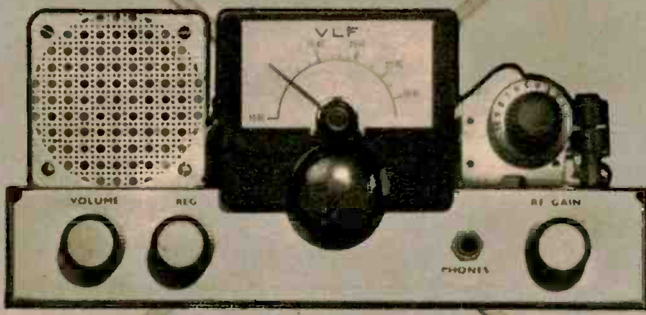
If the programmed text is very much a product of our era, so is this handbook. More than just a reference for engineers, it also should prove useful to purchasing agents, draftsmen and others on the fringe of today's technology, including anyone concerned with those endless mil spec products for the government.

The book opens with a description of electronics construction and drafting techniques, then proceeds to a discussion of electronics math and a description of testing and measurement procedures for just about every piece of gear under the sun.

INSIDE ELECTRONICS. By Monroe Upton. Signet Books, New York. 222 pages. $.60

An inexpensive paperback version of the Monroe Upton book reviewed here some time ago, this remains as nicely done and readable an introduction to various electronic subjects as you're likely to find anywhere.

Full-Band



VLF RCVR

Explore radio's fascinating basement with our 3-tube receiver!

By CHARLES GREEN, W3IKH

TELL someone you have a radio that tunes from 10 kc to 30 kc and he'll figure you spend your time listening to dog whistles and super-duper tweeters.

But way down in this world called VLF (very-low frequency) there's some mighty interesting activity. Imagine hearing a U.S. Navy station transmitting messages to ships at sea and *submerged* submarines! In addition, you'll be able to pick up useful frequency-standard and time transmissions similar to those from WWV.

Why such low frequencies for communications when the trend nowadays is toward higher and higher frequencies in the gigacycle region and beyond? Greater reliability for one thing. Transmissions down in radio's basement are affected little, if at all, by ionospheric disturbances. The other reason is that VLF is about the only way to communicate with submerged subs hundreds of miles from land. Matter of fact, VLF station NAA (17.8 kc) at Cutler, Me., puts out the world's most powerful signal—a 2-million watter—that can be picked up by submerged subs almost anywhere in the world.

You'll find the activity on the VLF band is of two types: frequency-standard and time signals and straight coded CW. The stability of VLF frequency-standard transmissions is much greater than those from WWV since the signals are not affected by ionospheric conditions and magnetic-storm blackouts. The CW often is marine communications, in the form of weather and time reports, and is excellent for code practice.

The output power of most VLF stations is many times greater than that of higher-frequency stations. The power, frequency and type of transmissions of a few stations are listed in our table. But frequencies, power and operating hours change occasionally since experimentation is going on constantly.

Full-Band VLF RCVR

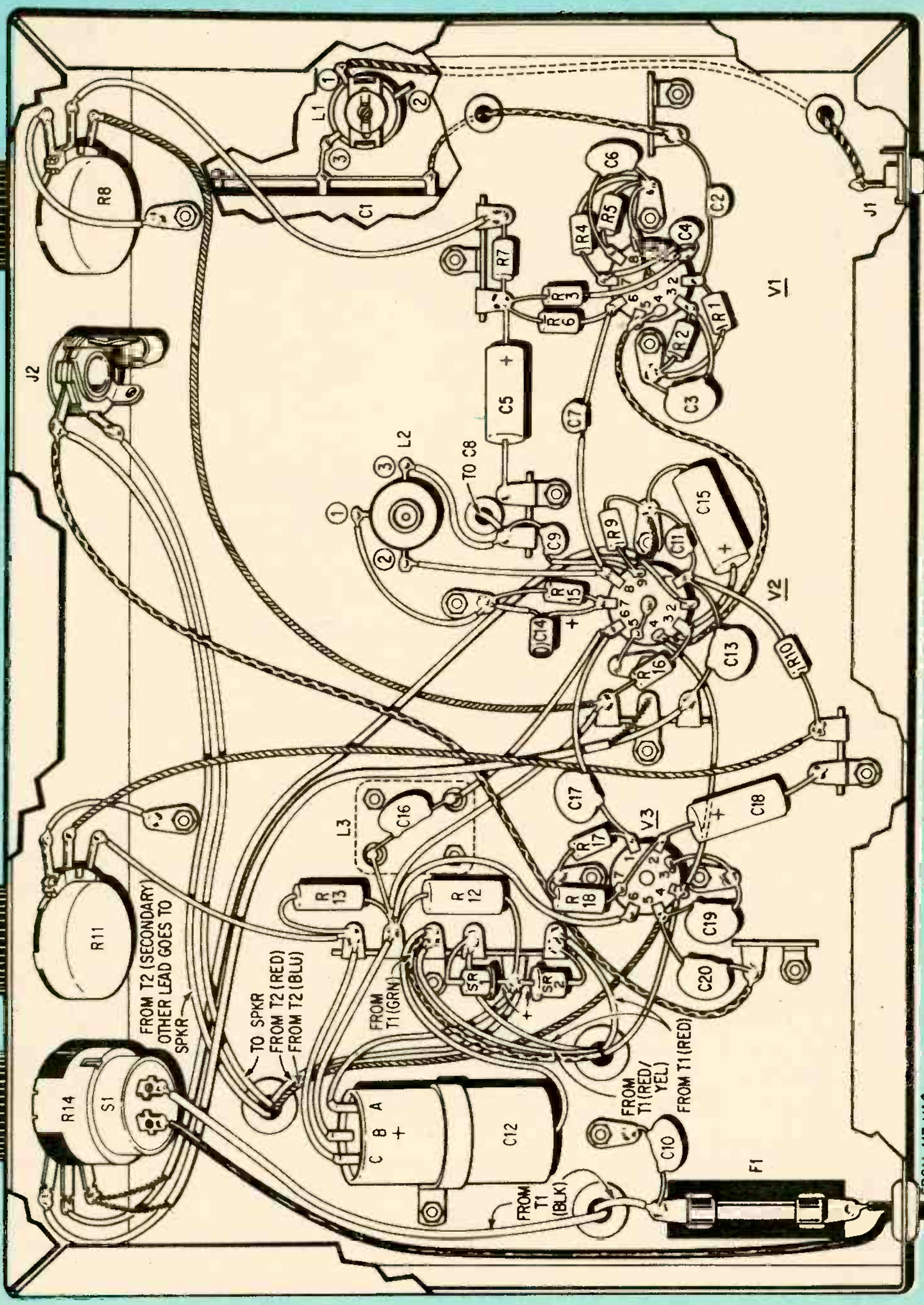


Fig. 1—Underside of receiver. To lay out your chassis, take dimensions from diagram and multiply by 1.7. For best performance duplicate layout as closely as possible. Chassis has been cut away under C1 in diagram to show how three sections of C1 are connected. C8's sections also are tied together.

PARTS LIST

Capacitors: 600 V ceramic disc unless otherwise indicated
C1A, B, C; C8A, B, C—3 gang variable capacitor: 12-367 μμf per gang. (Allied 13 U 522)
C2, C4—1,000 μμf
C3, C6, C19—.01 μf
C5, C15—4 μf, 150 V electrolytic
C7, C9, C11—500 μμf
C10, C13, C17, C20—5,000 μμf
C12A, B, C—20/20/20 μf, 150 V electrolytic
C14—5 μf, 6 V electrolytic
C16—2,000 μμf
C18—10 μf, 25 V electrolytic
F1—1 A fuse and holder
J1, J3—Phono jack
J2—Closed circuit phone jack
L1, L2—65-300 mh tapped adjustable inductor (J. W. Miller No. 9018. Lafayette 34 R 8999)
L3—10 hy variable inductor (UTC No. HVC-9. Allied 62 G 123, $9.60 plus postage: not listed in catalog)
Resistors: ½ watt, 10% unless otherwise indicated
R1, R4—1.2 megohms
R2, R5—4,700 ohms
R3, R6, R10, R16—180,000 ohms
R7—15,000 ohms
R8—200,000 ohm, linear taper potentiometer
R9—2.2 megohms
R11—30,000 ohm, linear taper potentiometer
R12—1,800 ohms, 2 watts
R13—47,000 ohms, 2 watts
R14—1 megohm, linear taper potentiometer with SPST switch
R15—1,000 ohms
R17—1 megohm
R18—560 ohms, 1 watt
S1—SPST switch (on R14)
SPKR—3-4 ohm, 3-in. speaker
SR1, SR2—Silicon rectifier: 500 ma, 400 PIV (Lafayette 19 R 4204 or equiv.)
T1—Power transformer, secondaries: 250 V c.t. @ 25 ma, 6.3 V @ 1 A (Allied 62 U 008 or equiv.)
T2—Output transformer, primary impedance: 10,000 ohms; secondary impedance: 4 ohms (Allied 61 U 448 or equiv.)
V1—12AT7 tube
V2—6U8A tube
V3—6AK6 tube (Allied $1.40 plus postage)
Misc.—2 x 7 x 11-in. aluminum chassis (Premier ACH-405 or equiv.), 7- and 9-pin tube sockets, terminal strips, No. 28 enameled wire, phone plugs, RG174/U Coax.

With this sensitive 3-tube receiver you'll be able to tune in all this activity from 10 to 30 kc. The circuit is a TRF/regen and has both a speaker and a jack for headphones.

Construction

Best way to build the receiver is as we did it—on a 7 x 11 x 2-in. aluminum chassis, mounting the components where shown in the pictorial (Fig. 1) and top-chassis photo (Fig. 5). Since the operating frequency is so low the layout is not terribly critical.

First, drill and punch the chassis. The easy way to mount variable capacitors C1 and C8 is to make a paper template of the undersides. Then transfer the mounting-hole locations to the chassis. Make sure that C8 is mounted right at the front of the chassis to permit the dial to operate properly. Mount the dial on the chassis with two brackets and extra-long mounting screws.

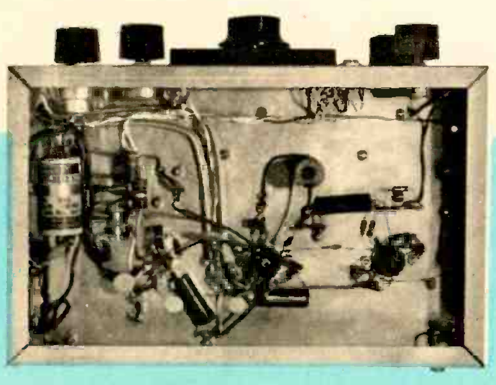


Fig. 2—There's plenty of space so there should be no crowding. Keep long runs of wire at top and center close to chassis in the locations shown.

To mount L1 and L2, first put ⅜-in. rubber grommets in the chassis. Next, remove the core and mounting clip from both coils and insert the forms in the grommets as far in as they will go. Then replace the cores and clips. Make sure that you locate L1's mounting hole so C1 doesn't touch the coil.

When wiring the receiver make sure that leads from pin 6 on V2 to L3 and capacitors C2, C4, C7, C9, C13 and C17 are positioned above surrounding wiring. Use rubber grommets when running wires through chassis holes to prevent fraying of insulation.

Antenna Construction

Cut four 22-in.-long x ¾ x ¼-in. wood strips and mount them at the corners of a 9½-in.-square piece of perforated Masonite as shown in Fig. 5. Wrap plastic electrical tape on the four screws mounted at the ends of each strip to prevent chafing of the wire.

Wind 38 turns of No. 28 enameled wire

[Article continued on next page, text continued on page 44.]

VLF RCVR

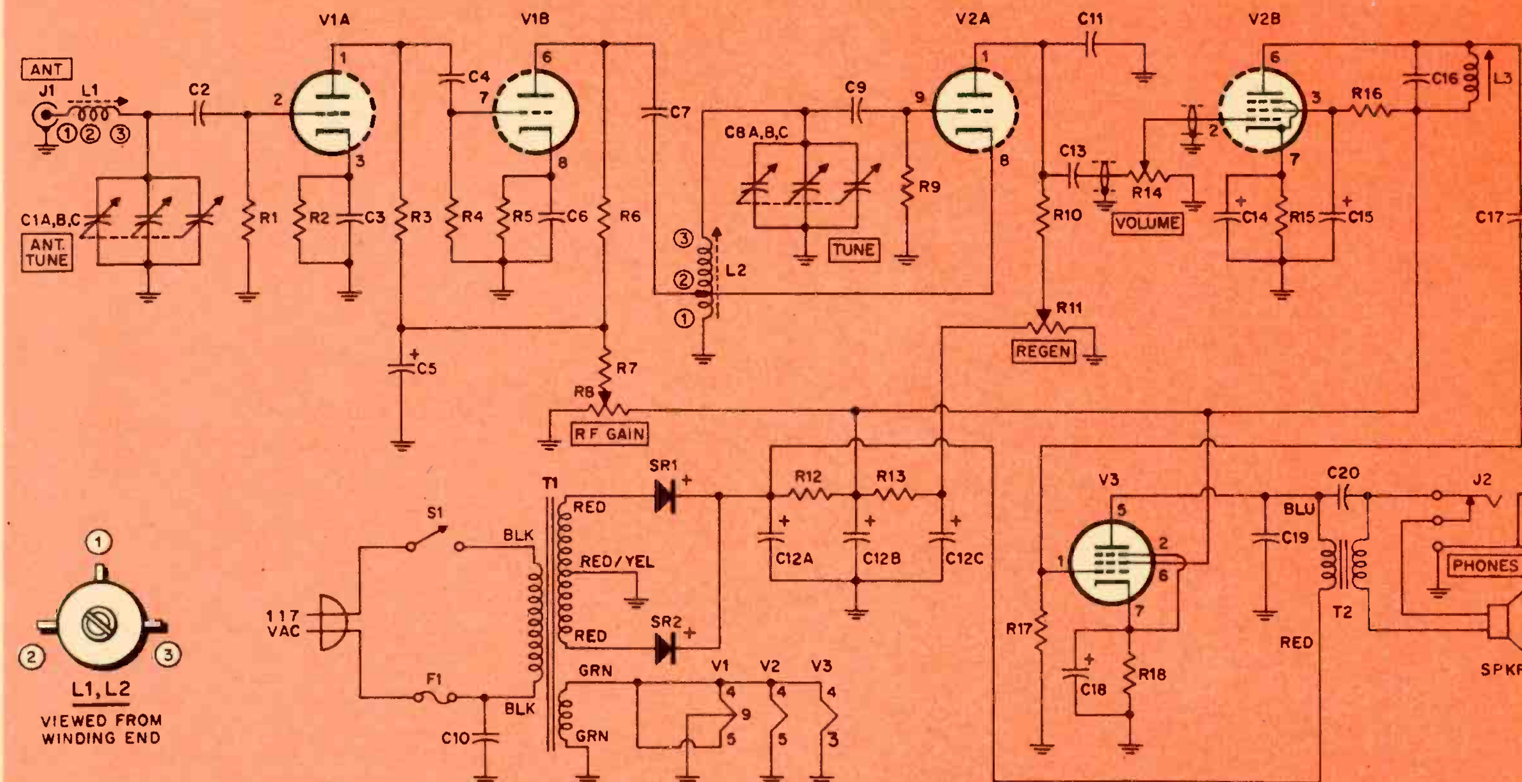


Fig. 3—Schematic of receiver. Signals from the loop antenna enter at J1 and are fed to the L1/C1 tuned circuit. V1A and V1B amplify selected signal and R8 controls the gain of the stages. C7 couples the amplified signal to the regenerative detector V2A via the cathode tap on L2. L2 is tuned by three-gang variable capacitor C8. R11 controls amount of regeneration and C13 feeds the detected signal to volume control R14. Signal then goes to audio amplifier stage V2B. L3 and C16 in V2B's plate circuit constitute a 1-kc peak filter that sharpens receiver selectivity. C17 couples the audio signal to V3 where it is further amplified to drive speaker. T2 and C20 provide output to speaker or phones jack J2. The B+ and heater power is supplied by transformer T1, full-wave rectifier circuit comprising SR1, SR2 and R/C filter which includes R12, R13 and C19A, B, C. Output tube V3, a 6AK6, is capable of delivering up to 1 watt of audio.

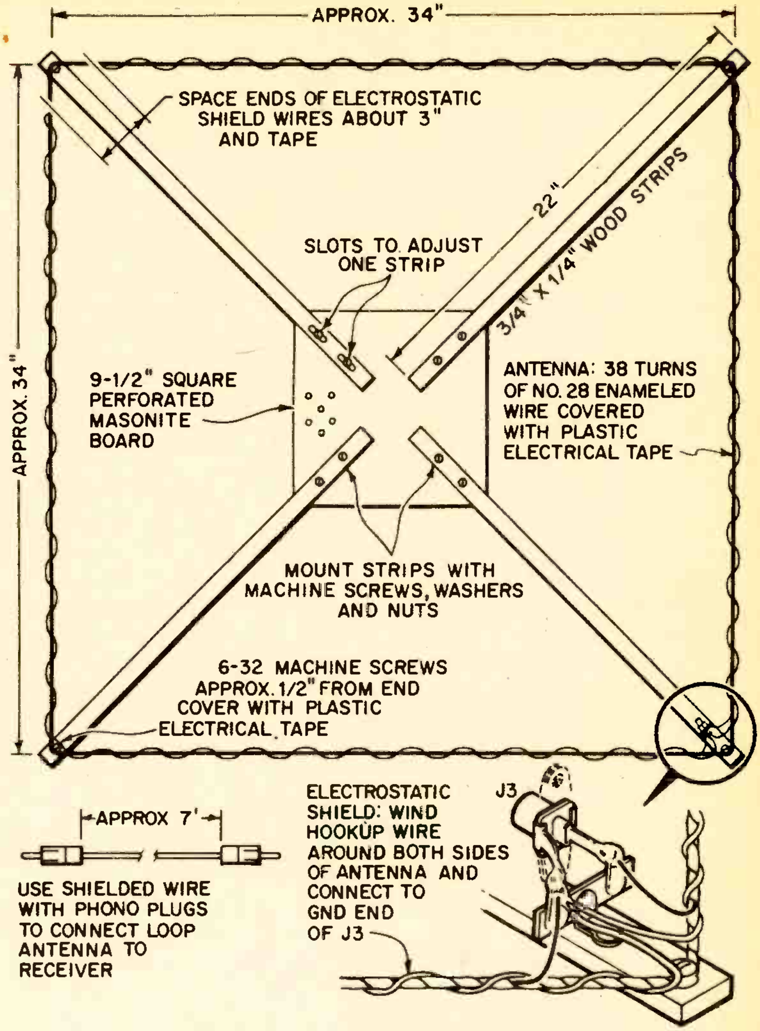


Fig. 4—Loop antenna. Three wooden strips are mounted firmly to Masonite board. Fourth strip should have slots cut for mounting screws so strip can be adjusted to tighten loop. Wind 38 turns of No. 28 enameled wire around screws at ends of wood strips and cover turns with plastic electrical tape. Then wind electrostatic shield over loop. Be sure to space ends of shield as shown in upper left corner. Detail diagram at lower right shows connections of loop and shield. Be sure to connect shield to ground lug on jack J3.

SOME VLF STATIONS

Call	Freq. (kc)	Power (kw)	Location	Transmission
FUB	17.0	—	Paris, France	—
GBR	16.0	300	Rugby, England	—
NAA	17.8	2,000	Cutler, Me.	CW—Navy traffic
NBA	18.0	36	Balboa, C.Z.	Pulses each second. Every fifth pulse omitted.
NPG/NLK	18.6	250	Jim Creek, Wash.	CW—Navy traffic
NPM	19.8	100	Lualualei, Hawaii	CW—Navy traffic
NSS	21.4	100	Annapolis, Md.	CW—Navy traffic
WWVL	20.0	1	Ft. Collins, Colo.	Frequency and time standards. Call sign given every 20 min. and on the hour.

around the screws and connect the ends to a two-lug terminal strip. Cover the loop carefully with a single layer of plastic tape. To minimize noise pickup, an electrostatic shield made of ordinary hookup wire must be wound around the loop. Connect one end of each electrostatic shield wire to the *ground* side of J3 as shown in Fig. 4 and wind the wire spirally with about 1-in. spacing around the loop. Leave a 3-in. space at the ends of each shield wire as shown. For best performance you can try different loop sizes.

Calibration and Operation

An audio signal generator with a range of 10 kc to 30 kc is a must to calibrate the receiver. If the generator goes only to, say, 20 kc use the second harmonic of a lower frequency.

Allow the receiver to warm up for a few minutes, then connect the output of the audio generator to ground and the high side of *volume* control R14. Set the generator to 1 kc and adjust the screw on L3 for peak volume.

Connect the generator to J1 and set its output to 10 kc. Set R14 to half rotation, adjust *regen* control R11 until the receiver starts oscillating, then turn *RF gain* control R8 counterclockwise to prevent overload.

Close C8's plates and adjust L2's slug for zero beat. Use the audio generator to calibrate the dial, being careful not to disturb the adjustment of L2. We calibrated our receiver at 1-kc points to 20 kc and every 2.5 kc to 30 kc. Use C1 to peak the signal as required but be sure that you're not tuned to the wrong harmonic.

After the dial is calibrated disconnect the signal generator and connect the loop antenna. When hanging up the loop keep it away from fluorescent lights and large metal objects.

Couple the audio generator loosely to the receiver by connecting a length of hookup wire to the hot side of the generator's output cable and placing it near L1. Set the generator's output to 10 kc and tune the receiver to about 11 kc for a beat note. Set C1 to full capacity (plates closed) and adjust L1's slug for maximum beat-note volume. Disconnect the signal generator and turn it off to eliminate any chance of the receiver's picking up its signal.

Now tune the receiver for signals, keeping C1 in approximately the same position as C8 to minimize reception of station harmonics. Turn the loop around to find stations.

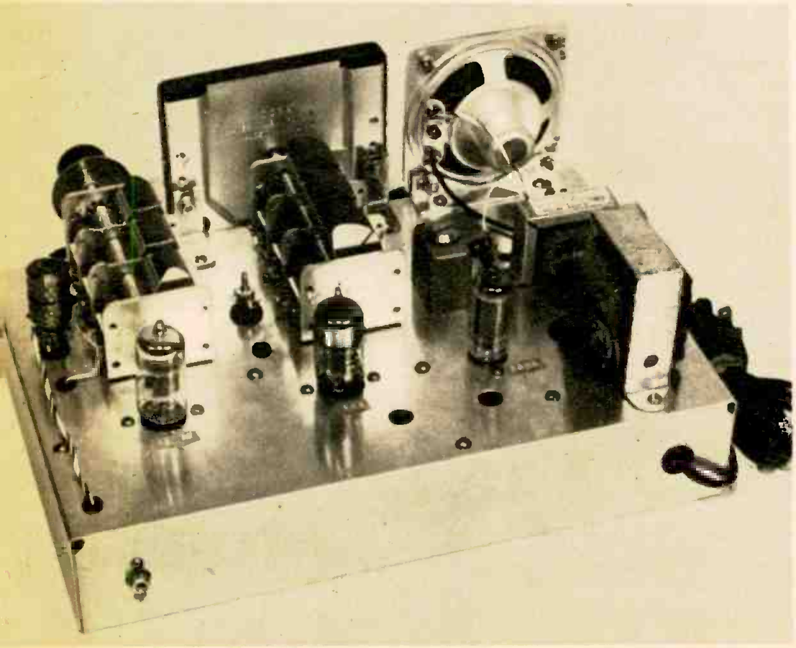
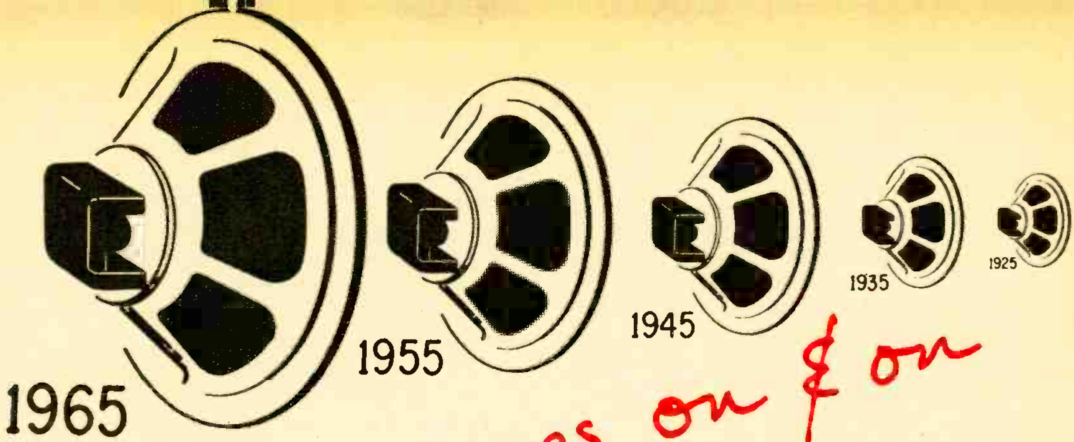


Fig. 5—Top of receiver. Coil L1 is at extreme left and antenna tuning capacitor C1 is right next to it. V1 is behind C1. Main tuning capacitor C8 is located in center of chassis. L1 is located between C1 and C8. Variable inductor L3 is low gray object to the right of C8. Power transformer T1, output transformer T2 and speaker are at right side of chassis.



Life ~~begins~~ goes on & on at 40

BY KEN GILMORE

THE ART (some would have it a science) of sound reproduction has been perfected so markedly in the last decade that it sometimes takes a keen ear to tell real from recorded. And so carefully designed are current stereo sets that few buffs would dare dream—let alone argue—that a 40-year-old component plays a leading role. But it's true.

"A relic in *my* rig?" you gasp. An antique? A fugitive from the age of crystal set and the wind-up phonograph? Right four times over.

To be sure, most of the home-music machine of the 1920s is dead as a pickled oyster. But one part in the modern audio scene is virtually identical to its 40-year-old ancestor. The basic noisemaker, the loudspeaker in your living room, has remained almost the same since the days of the Stutz Bearcat, the flapper and bathtub gin.

"There have been no real changes in decades," says Karl Kramer, manager of technical services for the Jensen Manufacturing Co., "and there aren't any on the horizon."

"New trends?" asks Saul J. White, chief engineer of Rek-O-Kut's Audax Division. "They don't exist. The dynamic speaker hasn't had any serious competition for years and it will still be around for a long time to come."

The 24-carat wonder is not that it's been around for so long but that it works at all. Take a frame roughly the size and shape of a hubcap, throw in a magnet, a few turns of fine copper wire and a pie-size slab of cardboard. The resulting contraption is supposed to make noises like the Beatles or bongos, a string quartet or a hundred-man symphony. Funny thing—it does!

This fantastic machine, the direct-radiating dynamic loudspeaker, got its start back in the 1920s. Calvin Coolidge occupied the White House, prohibition was in full swing and the air was full of a strange new sound called radio. Most common sight of the times was an ardent kilocycle-chaser bent over his crystal set far into the night. But radio listeners soon tired of the heavy, uncomfortable headsets. And sometimes several people wanted to listen at once. Needed: a practical loudspeaker.

A lot of people tried to build one. And many speaker makers of the time enjoyed a brief moment of fame. Radio magazines were full of glowing reports.

"The design of this loudspeaker is such that the low notes of the 'cello, organ, piano, and the brass instruments of the lower register are faithfully reproduced," said one.

The object of this praise was a weird device that looked like a cross between a flying saucer and a reading lamp. The description just quoted appeared in Scientific American magazine for December 1924.

And listen to this: "The performance of this new loudspeaker is remarkable for its

Life begins at 40

brilliancy and faithfulness over the whole range of musical notes." That, from the March 1928 Radio News magazine was written in praise of an odd contraption of linen cloth, square wooden frame and adjustable brass rods. It was designed to play music, though it well might have taken off in a high wind.

Competition was intense among the many kinds of speakers on the 1920s market and there was no way of telling which might win out. Then almost without notice two engineers at the General Electric research laboratories in Schenectady began to take a hard look at what device best might make like violin, tenor, marimba band or foghorn.

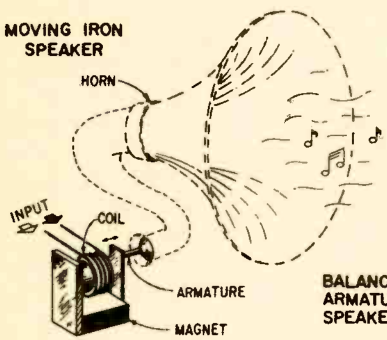
Chester W. Rice and Edward W. Kellogg built and tested nine basically different speaker designs, from a curious gadget called the Frenophone to an even stranger one known as the gold-leaf thermo phone. Their conclusion, published in the Journal of the American Institute of Electrical Engineers in September 1925: the dynamic moving-coil speaker they had developed was the hands-down winner from every point of view—sound quality, efficiency, cost, ease of construction. Fully forty years later it still is.

The Rice-Kellogg wonder—the dynamic or moving-coil speaker, the one still making the sounds in your stereo set today—works on a simple principle. A small coil of wire known as the voice coil is mounted in a magnetic gap. (Most speakers now use permanent magnets, though electromagnets were commonplace years ago.)

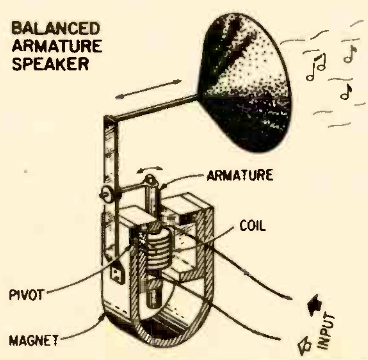
When an electrical current flows through the voice coil it sets up a magnetic field which pushes against the magnetic field in the gap. Shoot current through in one direction and the voice coil moves out. Reverse the current and the voice coil bounces in the other direction. Send an audio-frequency signal through the voice coil and its movements are proportional to the fluctuations of the current. Attach a diaphragm—usually a large paper cone—to the voice coil and the coil's vibrations will move large amounts of air and thus generate sound waves.

Simple? Sure. But it's also unbelievable when you consider that it has withstood all competition for two generations. And there's been plenty. Take one competitor you no doubt are familiar with: the electrostatic speaker.

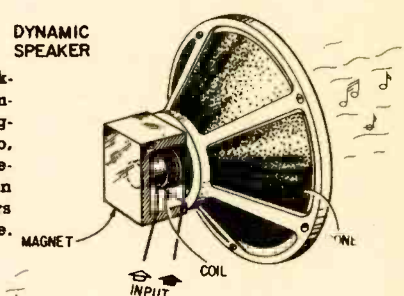
This odd sound-maker, which caused a lot of excitement as recently as the 1950s, really is nothing but a big capacitor. Three (some-



Moving-iron speaker formed basis for most early models. Built-in resonances, absence of bass and tendencies toward heavy distortion and coloration soon tolled the death knell for this primitive device.



Balanced armature speaker proved significant improvement over moving-iron type, though it, too, lacked true bass response. It vanished soon as moving-coil speakers reached the marketplace.



Dynamic or moving-coil speaker, developed by Messrs. Rice and Kellogg some 40 years ago, remains the champ in a highly competitive field. Original unit utilized 6-in. cone with rubber surround but flexible surrounds later were dropped in order to facilitate mass production.

times two) large plates are mounted so one is movable, the other rigid. When a varying voltage is placed across the plates, electrostatic attraction and repulsion make the movable plate vibrate.

The electrostatic looks great in theory. Rice and Kellogg thought so, too. It was one of the speakers they tried back in 1925. It couldn't, they found, compete with the dynamic. Electrostatics since have come on the market from time to time and today excellent ones are available. Same old story, though. On the basis of performance, cost, ease of construction and efficiency, they can't beat the dynamic.

Another promising competitor was developed a few years ago by a Paris-born inventor named Siegfried Klein. Klein was trying to overcome one of the speaker designer's greatest problems: the inertia of a diaphragm. Theoretically, the perfect diaphragm would have no mass at all. Such an inertia-less device could wiggle back and forth fast as electrical current could change. It would make a fine high-frequency reproducer.

Klein, for all practical purposes, succeeded in building the mass-less diaphragm. In his speaker, called the Ionovac or Ionophone, air itself is the diaphragm. The air in a pencil-size quartz tube is ionized by radio-frequency current.

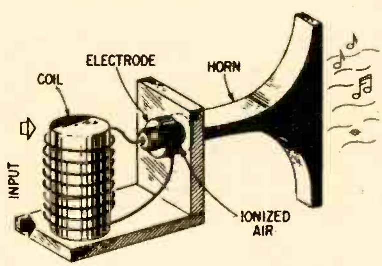
An audio signal, representing a modulator, makes the little lavender cloud of glowing air expand and contract. This jiggling gas cloud produces sound, just as does the vibrating diaphragm of a dynamic speaker. (As you might guess, Rice and Kellogg were there first with this one, too. A close relative of the Ionovac was one of the devices mentioned in their landmark paper back in 1925.)

The Ionovac, despite its fine performance, never has made it big for two reasons. First, it's expensive—around $70. And, second, dynamic tweeters have improved so much in recent years that any differences in performance are marginal.

Another new design that so far has failed to run the dynamic much of anywhere is the French-built Orthophase speaker. A conductor that takes the place of the voice coil is glued in a zig-zag pattern on the back of a flat, grooved plastic panel. The movable panel is mounted so that the wires slither back and forth between rows of small fixed magnets. When current flows through the wires, the magnetic field it generates reacts with the fixed magnets and moves the plastic panel. Surprise: it's a variation of the old ribbon speaker mentioned—naturally—by Rice and Kellogg.

Speakers working on different principles continue to come along from time to time.

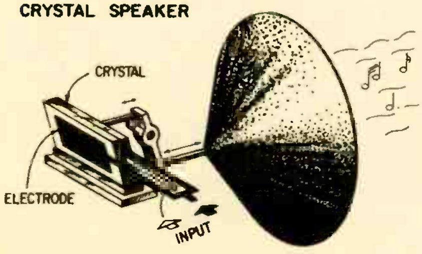
IONOVAC SPEAKER



Crystal speaker relies on piezoelectric properties of ceramic or quartz and basically is a crystal microphone in reverse. Though a satisfactory high-frequency reproducer, the device has proven incapable of covering the full audible range.

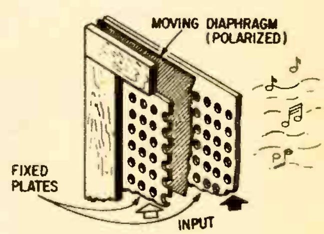
Electrostatic speaker is modeled on the capacitor and has been produced in both single-side and push-pull versions. Old as the dynamic, it has proven an excellent performer, though the moving-coil remains king of the speaker world.

CRYSTAL SPEAKER



Ionovac or Ionophone speaker employs no moving parts and, therefore, has strong theoretical appeal. Like the crystal speaker, it primarily is a high-frequency reproducer and has yet to unseat the more versatile dynamic or moving coil.

ELECTROSTATIC SPEAKER



Life begins at 40

A few months ago Motorola announced its new solid-state tweeter. Heart of this soundmaker is a thin, 2-in.-long tube of lead zirconate and lead titanate which shortens and lenghtens slightly with a varying electrical signal. One end of the tube is anchored rigidly to the speaker frame and the other end attached to a small diaphragm. Feed a signal to the tube and the diaphragm vibrates. In some ways, it's similar to the old crystal speaker that enjoyed a spurt of popularity early in the 1930s.

The fact that no other type of speaker ever successfully has competed with the dynamic doesn't mean that the art of speaker building has stood still four decades. But advances have come largely in improvement and refinements of the dynamic speaker. For though the dynamic has been a remarkably successful machine from its inception, it's been plagued with certain problems, too.

One problem, for example, is what engineers call breakup. At relatively low frequencies the speaker cone moves in and out as a single unit—so-called piston action. As frequency rises, though, the outer edge can't keep up with the faster back-and-forth movement of the voice coil. It begins to vibrate crazily on its own and produces a rough, distorted sound.

The way to minimize breakup, of course, is to make the cone stiffer so it will act as a true piston at all frequencies. But make it stiffer and it also tends to get heavier. Needed is a new speaker material—both stiffer and lighter.

Some speaker designers now feel they finally have found the wonder stuff: plastic foam. Fine speakers have been built using thick but light foam cones.

"Foam construction entirely eliminates breakup over the range in which it is used," says Peter Prichard of Audio Dynamics. "Either the cone moves properly or it doesn't move at all."

Others take a more conservative view. "There are certain advantages in using foam for some applications," observes Larry LeKashman of Electro-Voice. "We use it in some of our speakers. But you can do the same thing in other ways."

And some designers fail to see much advantage in the new substance. Victor Brociner of Scott argues: "It is possible to make very good speakers using some of the new materials. But I'm not convinced they're really any better than the old ones."

Other space-age materials and techniques have come along, too. Magnets, for example, now are far stronger, more compact, longer lasting. Famed British speaker authority G.A. Briggs of Wharfedale pioneered the use of flexible material around the cone's outer

[*Continued on page* 96]

The thoroughness with which Messrs. Rice and Kellogg approached their task of developing a "loud speaker free from the most objectionable of the distortion which characterizes loud speakers in general" is revealed in this old, unretouched photo of their lab at General Electric. Their conclusion: that "it should be possible to make an ideal sound reproducer" utilizing what is known as the moving-coil principle.

LAST STAND FOR BRASS POUNDERS

BY ELBERT ROBBERSON, W2FRQ

A FEW short years ago, International Morse smeared the spectrum from the bottom step clear up to the then-quiet kilocycles we now call VHF. Pros boasted ears so keen they could read anything sent, even when revved up to machine-age speeds near 100 wpm. In between the tape transmitters, you still could hear real people sending—with artistry only humans can muster and techniques only a book could describe (the Lake Erie Swing and the QLF, two styles familiar to old-timers, perhaps merit mention).

Tune the spectrum now, though, and you'll be hard-pressed to find manual operators anywhere but on commercial ship frequencies and the ham bands. The fluting of teletypes and buzzing of green hornets have taken over. Fact is, commercial brass-pounders look doomed. Wallpaper is about the only thing you can make of telegraph tickets. The brass-pounders truly are making their last stand.

The Beginning. Marconi's first signal spanned the Atlantic in December of 1901. Only seven years and a few days later, on January 23, 1909, the White Star liner Republic was rammed and sunk off Nantucket. Wireless operator Jack Binns summoned help by sending the first pre-SOS distress call (a CQD, presumably meaning CQ distress). Result was that all but six passengers were saved.

In 1911, radiotelegraph became compulsory on U.S. ships. And a ship's radio-distress call again brought help for survivors in 1912, when the Titanic suffered a fatal gash from an iceberg. Jack Phillips, chief operator, lost his life in the disaster and joined the growing ranks of operator-heroes.

On shore, companies formed and folded fast as wildcat oil drillers to capitalize on the miracle of being able to send messages across continents and oceans without wires. Until high-frequency communications were developed, signals were pushed long distances by brute force. To generate the necessary power, great sparks buzzed, molten arcs sizzled and mechanical alternators revved up to as high as 20,000 rpm, their rotors yearning to fly apart with all the urge of 68,000 Gs.

To make these rock-crushers work, an early operator had to be electrician, steeple jack, rigger, mechanic and oiler. To turn on some arc transmitters he also had to be something of an acrobat. The arc was struck by pushing the carbon-holder in by hand until the carbon contacted the other electrode, starting current flow. When forward pressure was removed, the carbon drew back and an arc flamed between the electrodes.

Trouble was, the arc chamber was filled with hydrocarbon gas (which helped the operation). If there also was the right amount of air in the chamber, the gas blew up and the carbon was fired back at the operator. Special starting strokes were developed to avoid broken wrists.

Because receivers had little or no amplification, the operator was forced to develop sensitive hearing. According to the expression, a man would crawl into the headphones in order to copy weak signals. He also had to be able to telegraph. Though some point-to-point circuits used machine transmission and reception, most signals were broken into the dots and dashes of International Morse Code, much of it banged out by hand. Key current was high, contacts had to be heavy and, unless you wanted to burn the contacts on your Bug (a key operated with a side-to-side movement), you used the old pump handle (an ordinary up-and-down key).

Stations ordinarily were hundreds of miles apart and sending had to be slow. A distant spark signal, for example, sounded like a gnat sighing through a screen and the burbly signal of a far-away arc transmitter might be weaker than the noise, the methodically tapped dihs and dahs audible only through holes in the static. So all-important was an individual's adeptness that every operator struggled to avoid ending up with the trade's own brand of punch-drunkenness—a tin ear and a glass arm.

The Buildup. In the '20s and '30s vacuum tubes took over. Signals became sharper, receivers more sensitive and selective and high frequencies bounced farther with less power than ever was possible with the old ground-slogging lows. It all added up to a boom in radiotelegraphy, scarcely threatened by the novelties of voice transmission and the rattling of a few robot operators.

At high-speed point-to-point stations, tape keyers sent the messages. On the receiving end, inkers squiggled a line of dots and dashes on a tape that was read by the eye. If the tape fluffed in transmitting, the human operator tending the machines either could pull the tape back for a rerun or send the erroneous part by hand.

On circuits where conditions were poor, human operators using the old sending iron (a now-obsolete term for a key, perhaps akin to shooting iron for a gun) and the naked ear would handle traffic through fading, atmospheric noise and interference severe enough to have driven a machine out of its metallic

Lord of the seagoing radio shack and sole contact with a ship's outside world, the radioman aboard a freighter or liner likely will continue to rely primarily on radiotelegraphy for many years to come. For, despite its demise elsewhere, code remains unsurpassed in reliability, the prime requisite for most shipboard communications.

Grace Line

mind. Shipboard operators handled few messages—except on the largest liners, a couple a day was tops. At 21 cents or so a word, people thought twice before putting pencil to paper. Main function of the shipboard sparks was to insure safety. The military, naval and point-to-point circuits, however, handled messages by the stack.

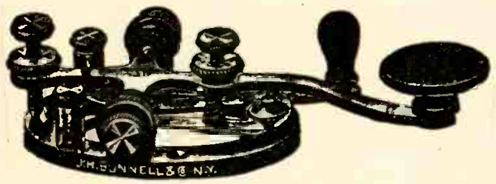
Every service had its distinct ways of handling traffic, as well as its own special procedures and signs. Some circuits were fast, some were slow, some even sloppy. But the operators all pushed traffic fast as their reflexes could function.

On a hot circuit it wasn't uncommon to go on duty and be handed a stack of unsent messages that would take the entire watch to clear. While tapping it out on the key with your right hand, you'd be endorsing the message blank with your left—pencilling time, date, to whom the message was sent and your sine or initials. Then you'd peck out the data on the log sheet, wound around the platen of your mill (typewriter).

When receiving, you'd roll a message blank into the mill, on top of the log, and endorse the blank. By this time, the sender was halfway through the address, so you had to catch up with him. You copied behind, or else turned in your green eyeshade. In your spare time you would log the messages handled.

At one time, Navy operators were doing this by what was called F- or no-answer method. You just didn't miss anything because you got no repeats. It was assumed that you copied everything slammed at you so you even didn't R upon receipt of messages.

It was fairly common to copy press transmissions on a mimeograph stencil. Once you got the hang of it you could take care of overstrikes with the little glass stylus and correcting fluid, then catch up and go on with your copying. And when you got to be an operator, you could do this and smoke, drink coffee and read a book at the same time.



Still popular in some ham circles and aboard ships, the familiar telegraph key has become all but a relic in the commercial radio world.

Plenty of people could copy over 60 words per minute. Champion T. R. McElroy topped 70. And for sending code that would squirt out like water from a hose, speed artists would talcum their fingers.

The Decline. About the time that World War II was brewing, the telegraph key was starting to slip (though automation still was an unthought-of term). As radio-circuit reliability improved and as more effective frequencies were utilized, extensive use of teletype machines became practical. An operator who didn't need to know any more than where the keys were on a typewriter could punch out a message. A thousand or more miles away another machine would print it, at 60 words a minute.

Further, instead of using a radio transmitter for just one message, its carrier could be modulated with several subfrequencies, each of which could be used for a teletype channel. Time-splitting techniques further allowed multiple-circuit use of a radio transmitter. The result sounded like a concerto for buzz saws. But no matter, thousands of words could be transmitted in the time it previously had taken for hundreds.

Whenever the traffic load warranted and sufficiently reliable radio contact could be maintained, machines began to gobble up the traffic. What the machines didn't handle, voice circuits did. Where conversational interchange was necessary, the radiotelephone gave practically the same quick convenience of wire circuits. With the development of single sideband, voices began to relay messages over distances that previously could be spanned only by dots and dashes.

The Twilight. With improved radio circuitry, reliability and automation, it would be easy to conclude that the world is about ready to put a spade in the face of the honorable but old-fashioned order of the commercial brass-pounder. Modern radio schools almost completely have dropped radiotelegraphy courses. And FCC license examiners report that applicants for radiotelegraph licenses virtually are non-existent.

But though on the decline, manual radio-

[*Continued on page* 101]

HI-FI TODAY

By John Milder

- Platters & promises
- Dig that Dynarange

ONE of hi-fi's more interesting trends over the past three or four years largely is unsung. It's the drift away from the transcription turntable (to which you add the tone arm of your choice) and toward the integrated turntable/arm combination. The past three years, in fact, have seen not one new transcription table marketed in this country, though more than a dozen integrated units—automatic and single-play—have appeared.

What happened? For one thing, manufacturers of automatic turntables have managed to come up with tone arms comparable to transcription designs. The secret is a new breed of changer mechanisms that requires precious little push from a tone arm to trigger the changing cycle and that leaves the arm completely free of restriction during its normal travel across the record. And as things now stand, one would be hard-pressed to find a transcription arm (of the kind that we purists used to shell out $30-$70 for in the late '50s and early '60s) of any better overall performance than those now found on automatics like the Dual 1009, Garrard Lab 80 and Miracord 40 (all of which fall in the $80-$100 class—with cartridges often thrown in for a penny).

It also pretty well has been demonstrated over these past few years that the integrated designs can offer better performance than the supposedly perfectionist combination of table and arm-of-your-choice. First real hint of this came with introduction of the Stromberg-Carlson PR-500 turntable in '59.

The PR-500 was the first to suspend tone arm and turntable platter on a single subassembly sprung from the motorboard. This isolated arm and platter from any vibration that might find its way from motor through baseplate. Additionally, it resulted in an arm and platter that responded in unison to outside disturbances like kids racing across the living-room floor. You presumably would be aware that footsteps were shaking the player but the unison movement of arm and platter helped keep the stylus in the groove.

Stromberg wasn't in audio long enough to do much with the PR-500 design. But Acoustic Research later took the basic premise, added some important refinements (including a lightweight tone arm and a special belt-drive) and proceeded to show just how quiet a turntable could be. The AR design demonstrated how an integrated suspension of platter and arm could diminish all sorts of problems by eliminating mechanical and acoustic feedback through the turntable assembly. I won't forget easily the shock of substituting the then-$58, single-speed AR table (now $78 and two-speed) for my $250 transcription combination and hearing how much clearer all my stereo discs sounded.

Since the AR's arrival the integrated design has become the almost-universal approach. Others (beside the whole new breed of automatics) include the Empire 488, Rek-O-Kut

[*Continued on page* 103]

Dynarange 200 by 3M (Scotch) and Formula 15 Low Noise by Audio Devices (Audiotape) are two entries in the low-noise tape field. Ampex's 500 series (not pictured) is a third.

CB CORNER

BY LEN BUCKWALTER KBA4480

INSTANT ENFORCEMENT

STORY goes that CBers have a flock of dodges for boosting operating range—from screaming into the mike (which doesn't work) to adding outboard amplifiers (good for a $500 fine). But the best range-busting technique in many a year is part of a tale told by Don Nelson of Sioux Falls, S.D.

Seems the boys up Dakota way were running a giant jamboree. As in most of these affairs, there was a CB-equipped control center to handle communications in the area on the big day. But what an antenna system they cooked up! Transporting component parts for the giant skyhook required a two-wheel trailer.

Came the appointed hour and the trailer unloaded a cargo of long pipe sections. Up went the pipes until they topped out at about 50 ft. above ground. The base was footed firmly in the trailer bed while a series of guy wires kept the slim assembly from toppling. Planted atop this plumber's dream was a Magnum base-station antenna that never had seen such days. Connected to a CB rig down at the car, it transmitted and received signals over a whopping 20 miles.

Meanwhile, down at the jamboree, seeds of the hook's destruction were being sown. Who was star speaker of the day? None other than the local FCC field engineer. Spotting the cool collinear, he applied what might be called instant enforcement in the first case on record of excessive antenna height on a mobile rig. Take it down, he said, and down it came. The 20-ft. rule seems to apply equally to terrace, tent or Tin Lizzie.

New Kaar Guarantee . . . The auto industry backs it go-carts to the tune of 50,000 miles and TV makers are toying with five-year warranties. Now it is CB's turn. Kaar Engineering, long-time CB maker, is marketing two new transceivers bearing a full two-year guarantee (see our photo). That's an 800 per cent improvement over the usual industry (EIA) 90-day coverage.

"What's the secret?" we asked Frank Genochio of Kaar. Space age, he said, then ticked off components that sound like a bill of materials for Early Bird.

Behind the guarantee lies a canny bit of marketing strategy. Kaar believes its new rigs soon should outdistance the $99 talk-listen box that provides function but not necessarily long-term reliability.

Big HELP? . . . Unofficially residing on Channel 9, the HELP program really is a sort of old-fashioned CB operation. Public-spirited citizens monitor the frequency for motorists in distress, then dispatch help via 5-watt transmitters. But if a petition now before the FCC reaches fruition, 5 watts could become 30. That petition is the work of the Automobile Manufacturers Association, now

[*Continued on page* 105]

Pace-setter from Kaar Engineering is a two-year guarantee covering workmanship and materials in its new rigs. Usual guarantee is only 90 days.

Notes from EI's DX CLUB

ONE of the most interesting BCB DX catches of the year proved to be right here in North America. It was HIFA, the military junta station at San Isidro, Dominican Republic. HIFA opened up on 647 kc as the rebellion began, then moved up to 652, where it stayed until silenced by the provisional government. How many were lucky enough to nab this one?

To answer a question raised by Roger Hallan, WB6BOW, you may use GMT (Greenwich Mean Time) in your EI DX Log if you wish. But if you do so, be sure to indicate that this is the case.

From Fred L. Parsons (Ontario) comes word that R. Ghana now is beaming programs to North America. Times are 2230-2330 EST on 6110 kc and 1500-1600 EST on 9760 and 11800 kc.

As most readers already are aware, Singapore has left the Malaysian Federation and once again counts as a separate country. Easiest spot to log R. Singapore is 11940 kc until 1130 EST sign-off. Incidentally, Perry Brainin (New York City) reports having logged R. Malaysia the hard way. He bagged two of their 49-meter transmitters, 6105 and 6175 kc, between 0600 and 0700 EST.

Reception of R. Malawi on 3380 kc is reported by both Gerry Klinck (Buffalo) and William Sparks (California). Station's 2300 EST sign-on is preceded by the sound of drum beats and a cock crowing. East Coast DXers really have to be sharp on this one, though, since fade-out hits soon after sign-on.

The Burma Broadcasting Service has ventured into the upper SWBC bands and can be heard on approximately 9530 kc until 0200 EST.

The BBC's East Mediterranean relay, transmitting from strife-torn Cyprus, is reported on 7140 kc at 2300 EST. (Be careful not to mistake 7140 for BBC London on 7150 kc.) Bob LaRose (Binghamton, N.Y.) also has logged this same Cyprus relay on 15420 kc at 1300 EST.

R. Tarawa (Gilbert & Ellice Islands) has moved down to 4912 kc, leaving 49-meter QRM behind. Watch for this one around 0200 EST or a little earlier. Chances for picking this one up on the East Coast should improve as spring approaches; station also may show up on 3218 kc.

Dave Bennett (British Columbia) advises that the CBC's two regional SWBC relays have changed calls. The station at Vancouver, B.C., now is CKZU and the one at St. John's, Nfld., has become CKZN. Both operate on 6160 kc.

A new standard time and frequency station is being heard on 15000 kc late afternoons, identifying as RTA. That's a Soviet call, though no one seems to know much about the station.

Larry Thompson (Cincinnati) recently came up with the Solomon Islands Broadcasting Service on 3995 kc at 0500 EST, clear indication that the East and West coasts have no monopoly on DX. Like R. Tarawa, this station should improve with spring's arrival (as will Down Under hams on 80 meters). Should be interesting to see if amateurs can match these SWL feats on the lower bands.

R. Nacional del Peru's 31-meter outlet has begun to drift up from 9562 kc. Station has been rockbound on that frequency for several years.

Propagation: As days begin to lengthen and static levels in the northern hemisphere

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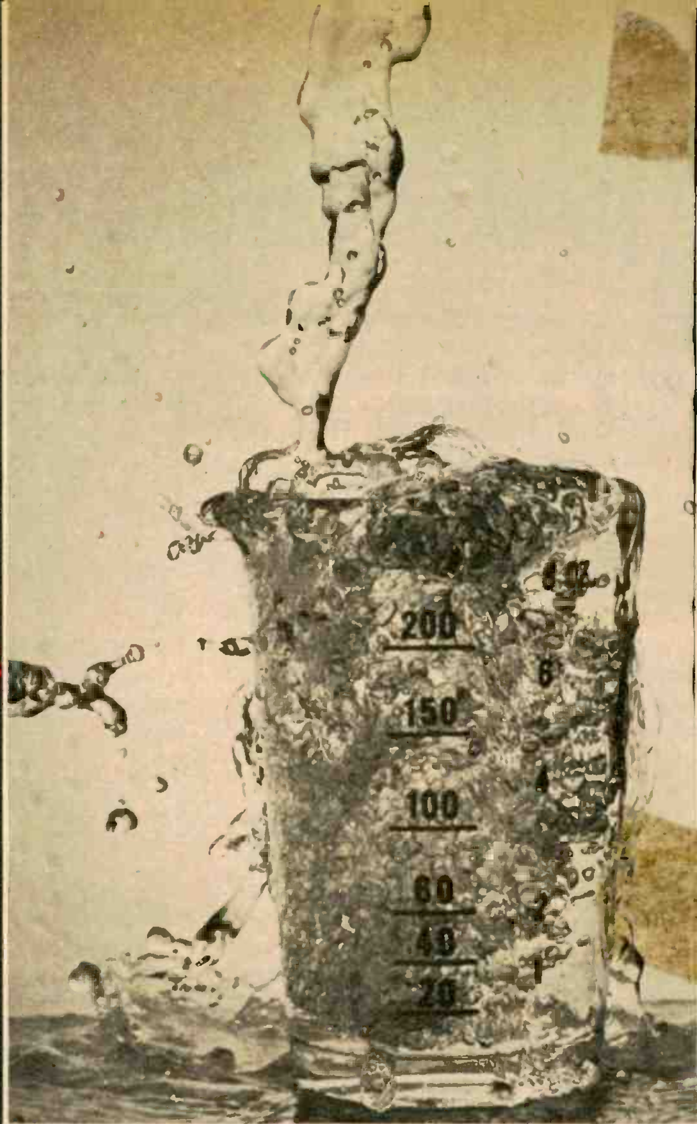
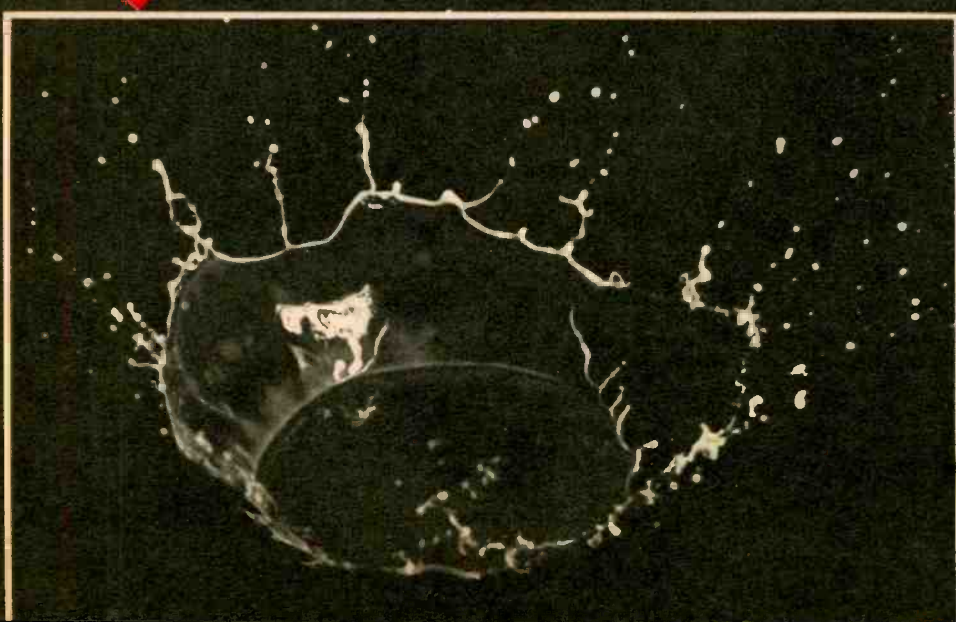
SUPER SPEED STROBE CAN STOP THIS ACTION! AND THIS!





By JIM KYLE, K5JKX A DROP of milk strikes a surface. The eye and an ordinary strobe flash see nothing but a blur. But the 1/10,000-sec. flash of EI's Super-Speed Strobe freezes the action and the milk drop turns into a crown shape in the magnificent photo shown at the bottom of the opposite page. A stream of water falling into a graduate becomes an arresting still-life in the upper photo.

These spectacular photographs could have been taken with a commercial strobe—but only with one manufactured a dozen years ago, not with a modern model. Those early models, though fast, were bulky, had high operating voltages and cost plenty.

As strobes developed over the years, size and cost decreased. But, unfortunately, a price was paid for this—flash speeds decreased. Today, ordinary strobes have speeds that range from about 1/1,000 sec. to 1/2,500 sec.

High-speed photography does not require the expensive bulky strobe equipment of yesteryear. The Super-Speed Strobe proves this. Its power pack is 4 x 5 x 6 in. and it is not much heavier than a dozen or so rolls of film. Best of all, its cost is low. Less than $50 should put it in your hands.

The Circuit. Before we build it, let's take a quick look at the circuit in Figs. 6 and 7. The power supply is a conventional half-wave voltage doubler that furnishes 450 VDC to storage capacitor C2. To achieve the 1/10,000-sec. flash speed, C2 must be a computer-grade electrolytic capacitor. The type specified in our Parts List is not expensive ($1.12) and you *must not* substitute an ordinary electrolytic for it.

The charge on C2 is applied to the flash-tube through a connecting cable that should not be longer than 10 ft. After power is turned on, capacitor C3 charges to 225 VDC through R1 and the primary of T2. When the shutter contacts close (SO1's or SO3's contacts are shorted),

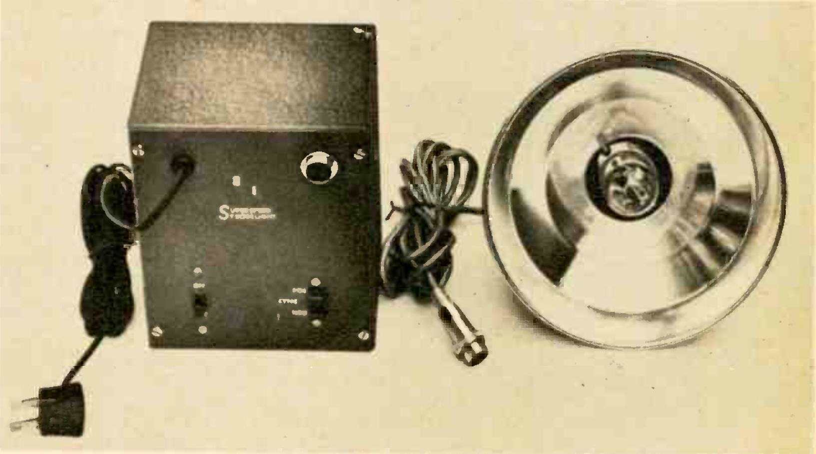


Fig. 1—Strobe consists of 4 x 5 x 6-in. power pack and 6¾-in.-dia. flash head. Flash head plugs in socket at top of power pack. Socket below is for sync cable to camera.

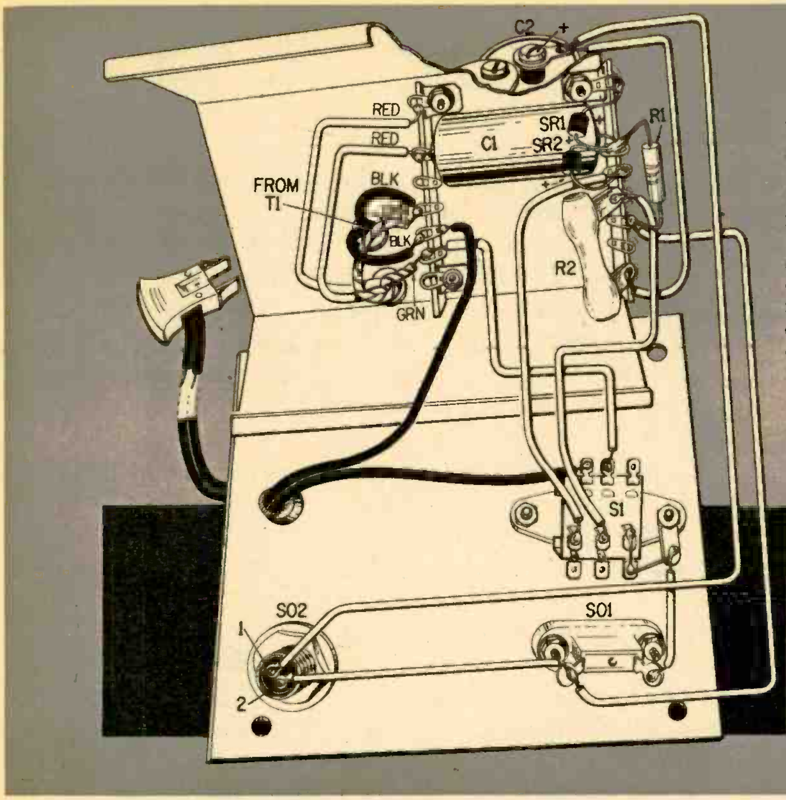


Fig. 3—View of underside of chassis shows wiring to sockets and switch on cabinet cover plate. Negative lug on C2 is connected to chassis with a strap made of scrap aluminum. Before closing cabinet check to make sure lugs on S1 and SO1 don't touch edge of chassis.

SUPER SPEED STROBE

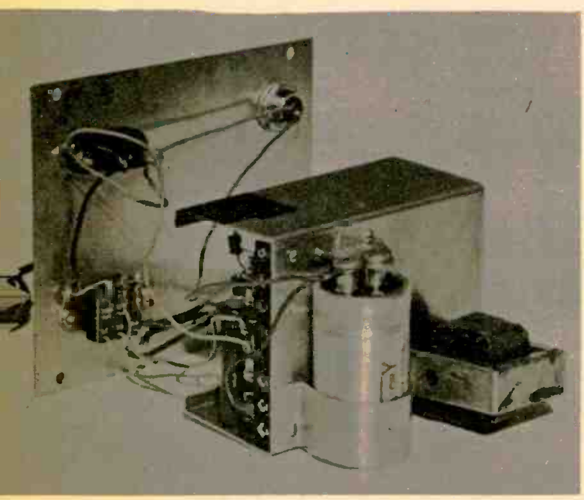


Fig. 2—View of chassis shows how transformer is mounted. Capacitor C2 is held in place with homebrew strap using screws which hold terminal strips. Leads to cover should be at least 6-in. long.

C3 discharges through T2's primary, causing T2 to produce a 3-kv pulse. This pulse is applied to the flashtube and fires it.

Resistors R3 and R4 (Fig. 6) are a voltage divider for the neon ready-light (NL1). Capacitor C4 causes NL1 to blink, indicating the unit is ready to fire again. The lower C4's capacitance, the faster the blink rate. C2's recharge time and the time it takes NL1 to start blinking after a flash normally are under three seconds.

Construction. Start off with the power supply, which is built on a 2 x 4½ x 3½-in. aluminum chassis as shown in Figs. 2 and 3. Mount transformer T1 and connect its leads but *do not* cut or solder them. Apply 117 V to T1's primary and measure voltage across the red secondary leads. Now interchange the connections of the 6.3-V (green) leads and measure the voltage again. If it's higher, solder the leads in place. If the voltage is lower, *reverse* the connections of the green leads and solder them. Now solder T1's other leads.

Next, install C1, R1 and R2. When connecting SR1 and SR2, hold their leads with

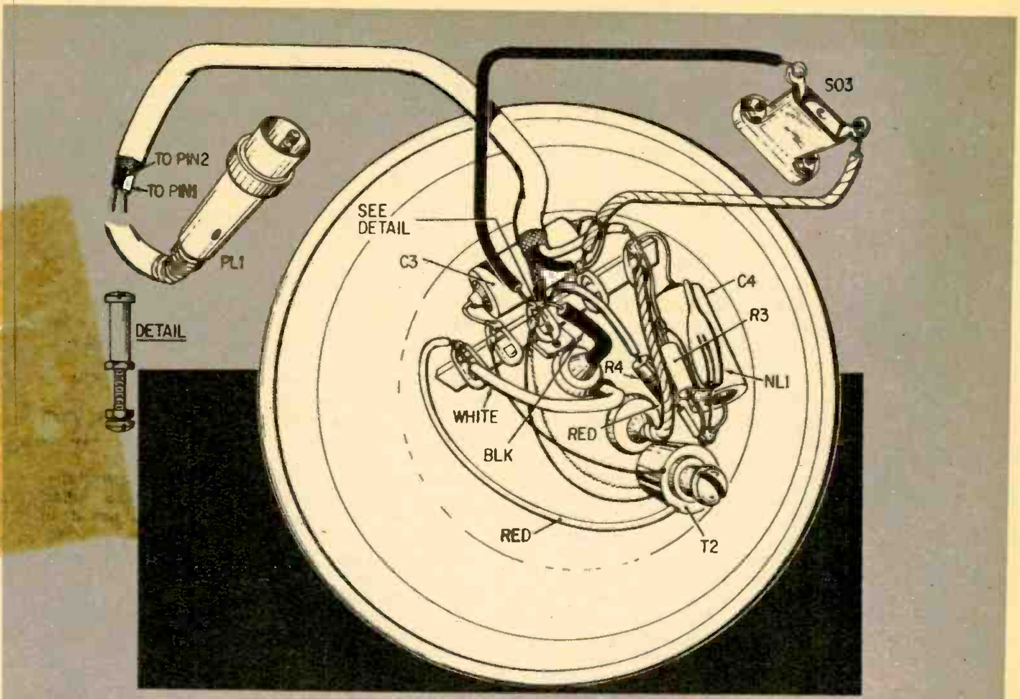


Fig. 4—Back of flash head. Reflector is supplied with holes predrilled for red, white and black leads from flashtube and screws that hold terminal strip and T2. Detail sketch at left shows how a 1¼-in. screw is installed through the reflector to hold the terminal strip and the back cover.

long-nose pliers to prevent heat damage. Mount S1, SO1 and SO2 on one of the box's cover plates and install a grommet for the line cord. Install the line cord then mount C2 (next to T1) on the top of the chassis (Fig. 2) with a homemade clamp. Watch the polarity when connecting C2. After wiring to S1, SO1 and SO2, attach the chassis to the box's other cover plate.

Fit the flashtube's glass lead stems through grommeted holes in the reflector then put two 6-32 x 1-in. long machine screws through the pre-drilled holes (1¾-in. centers) in the reflector. Run nuts on both screws then slip T2 on one of the 1-in. screws. Put a terminal strip and nut on the other screw as shown in Fig. 4 and 5. (Use a fiber washer on both sides of T2 so you don't damage its windings.)

When connecting the flashtube's leads to the terminal strip shown in Fig. 4, use care or you'll break its glass stems. Now install R3, R4, C3, C4 and NL1.

Drill holes in the reflector's back cover for the cable and for SO3. Attach PL1 to the cable making sure the 450-V lead goes to pin 1 and the 225-V lead goes to pin 2. Put threaded spacers on the ends of the two 1-in. screws and tighten them so that the rim of cover touches the back of the reflector. Attach the cover with 6-32 x ¼-in. screws.

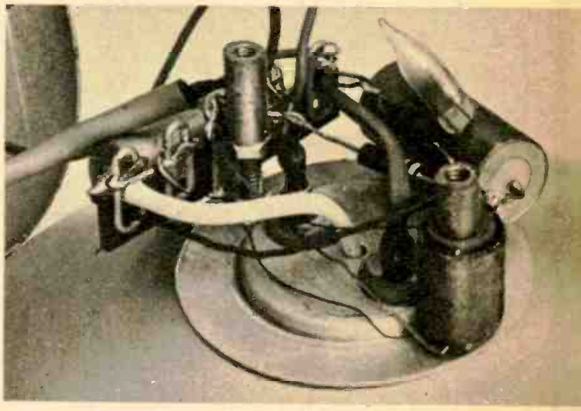


Fig. 5—Back of flash head. Threaded spacer on terminal-strip mounting screw is ⅝ in. long. The threaded spacer that holds T2 is ¼ in. long.

Checkout. Plug in the line cord and turn

S1 on. Ready-light (NL1) should begin to blink within 15 seconds. If it does not, connect a jumper across either SO1's or SO3's contacts and see if there's a flash. If there is, the trouble is in NL1's circuit and is not serious. If you don't get a flash, turn everything off and check your wiring. Before you touch anything, discharge C2. *If you touch it when it's charged the shock could be fatal!*

Using The Strobe. Connect the sync jack on your camera to the strobe at either SO1

[*Continued on page 95*]

PARTS LIST

- B1, B2—180/225 V battery (Eveready 492 or equiv.) Optional, see Fig. 8.
- C1—8 µf, 450 V electrolytic capacitor
- C2, C5—40 µf, 450 V computer grade electrolytic capacitor (Mallory, Lafayette 30 R 5738 or equiv.)
- C3—.1 µf, 600 V tubular capacitor
- C4—.1 µf to 4 µf (metallized paper, not electrolytic) 200 V capacitor. See text.
- C6—525 µf, 450 V energy-storage electrolytic capacitor. Sprague FF-1, Allied 15 Z 726, $13.50. Not listed in catalog.
- NL1—NE-2 neon lamp
- PL1—Double contact plug. Amphenol 80-MC2M. Lafayette 32 R 1920 or equiv.)
- R1, R6—22 megohm, ½ watt, 10% resistor
- R2, R5—300 ohm, 10-watt resistor
- R3—1.5 megohm, ½ watt, 10% resistor
- R4—3.3 megohm, ½ watt, 10% resistor
- S1A, S1B, S1C—3 pole, DT slide switch (Lafayette 99 R 6166 or equiv.)
- S2—SPST switch
- S3A, S3B—DPDT switch
- SO1, SO3, SO4—Chassis mount AC socket (Cinch-Jones 2R2 or equiv.)
- SO2, SO5—Double contact chassis connector. Amphenol 80-PC2F. (Lafayette 32 R 1919 or equiv.)
- SR1, SR2—Silicon rectifier; 750 ma, 400 PIV (Allied 39 U 669M or equiv.)
- T1—Power transformer; secondaries: 125 V @ 15 ma, 6.3 V @ 0.6 A. (Allied 61 U 410 or equiv.)
- T2—Flashtube ignition transformer; primary: 180 V, secondary: 3-5 kv. Amglo ST-25, Allied 7 Z 914, $2.50 plus postage. Not listed in catalog.
- FLASHTUBE—Amglo HD-1, Allied 9 Z 380, $9.50 plus postage. Not listed in catalog.
- Misc.—Reflector: Amglo AR-365-D, Allied 6 P 637, $8.00 plus postage (not listed in catalog); flash head back cover: Amglo R-65C, Allied 6 P 636, $6.75 plus postage (not listed in catalog); 4 x 5 x 6-in. utility box (Bud AU-1029 or equiv.); 2 x 4½ x 3¼ (Bud CB-1625 or equiv.); terminal strips; wire.

SUPER SPEED STROBE

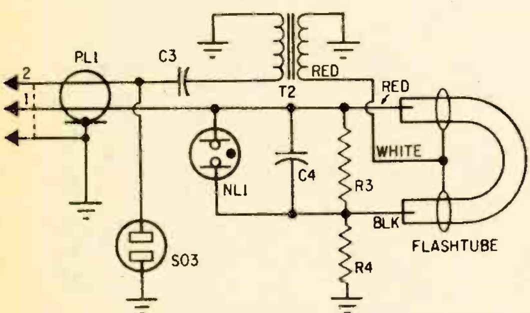


Fig. 6—Flash head schematic. When shutter is tripped C3 discharges through T2's primary. T2 steps up pulse to 3 kv. causing flashtube to fire. SO3 is optional.

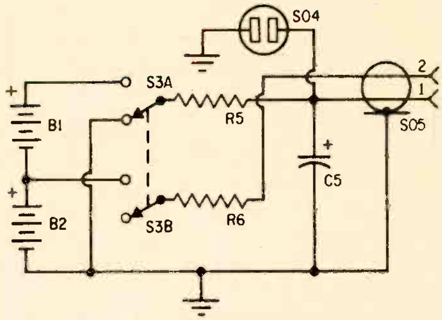


Fig. 8—For portable operation build this power supply, which uses 225-V batteries. However, keep in mind that batteries cost almost $8 each and their life will be short.

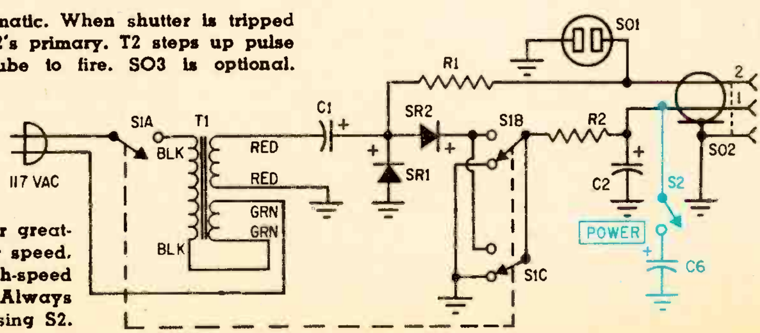


Fig. 7—Power supply. For greater light output but slower speed, add C6 and S2. For high-speed operation leave S2 open. Always turn power off before closing S2.

PRESIDENTIAL DX

THE WHITE HOUSE over the years has laid claim to everything from bronco busters (Teddy R.) to waltz wheedlers (Harry T.) but never a dyed-in-the-wool DXer. It doesn't even today, of course, though LBJ does get into the DX act like no previous president. Reason, as most everyone knows, is that Lyndon B. Johnson owns a radio station—or at least Lady Bird does. And with a little effort, DXers in every part of North America should be able to log it.

The station, KTBC at Austin, Texas, actually sports three outlets—AM, FM and TV. Of the three, KTBC-AM probably will be easiest to log. It operates 24 hours a day, seven days a week, on 590 kc. To be sure, there are other 24-hour stations on this same channel, though most go off once a week for maintenance purposes. Thing to do is check early Monday (or possibly Sunday) mornings when such other stations frequently will leave the air for a time. Assuming they do, there's good chance of your picking up KTBC-AM without much trouble.

Unfortunately, KTBC-TV operates on Channel 7 which rules out skip and limits DX reception to the trop mode—in other words, to a maximum of about 500 miles, depending on your equipment. If KTBC does appear on your TV set, you also should give a listen for their potent FM signal on 93.7 mc. This procedure will work in reverse as well, of course (though KTBC-FM occasionally will make it on skip when the TV channel displays nothing but snow).

Nicest thing about the KTBC stations is the fact that all are excellent verifiers. Correct reports are answered on an attractive letterhead that makes a fine addition to any QSL collection. Mailing address for all three stations simply is P.O. Box 1155, Austin, Tex.

—*Alex Bower*

Wide World

Located in the heart of downtown Austin, Tex., stations KTBC-AM/FM/TV commonly are known as the Johnson stations after the name of the family that owns them. The President's family also holds interest in a number of other stations, including KLFY-TV in Lafayette, La.

The Phonecom

An intercom for only $5 a station? Right, and every unit is a master from which you can call all others.

By LAWRENCE GLENN

LIKE the chap who got a real bargain when he bought a pair of $1,000 elephants for only $500, you'd be hard pressed to find a better buy than the no-guts telephones that are now available for around $8.50 a pair. Only problem is—like the gent with the elephants—what do you do with them after you get them home?

Though they come with handset, cradle and wiring, the phones can do absolutely nothing as they are because they have no bell and no repeat coil, not to mention a few other deficiencies. But for $1 or so you can make these white elephants into useful telephone intercoms—complete with signals and multi-station convenience (phones are connected in parallel so additional units do not require rewiring the complete system).

The Modification

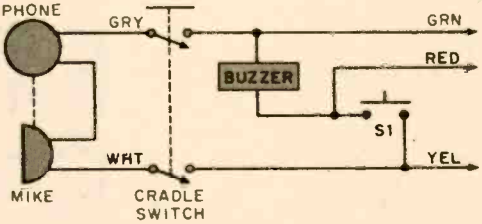
To convert the basic phone into something useful cut the red wire from the telephone's handset at the terminal strip in the base where it connects to the red output wire. (Virtually all phones in surplus have the same wiring and color-coding.) Then connect a normally-open push-button switch and a 1½-V buzzer across the lugs to which the yellow and green leads connect as shown in the schematic at the right.

S1 is a miniature push-button switch mounted in the center of the dial-hole cover. Don't worry about drilling the case. There is a small knock-out plug in the center of the cover that exposes a pilot hole which you simply drill larger. If your phone doesn't have the pilot hole, center-punch the cover before drilling or you might crack it.

The buzzer is the sound unit from a one-cell bicycle horn; it can be mounted anywhere on the bottom plate. Both switch and buzzer are connected directly to the screw terminal strip on the phone base. Don't try to cut into the existing phone wires because they are a special cord-wound wire that won't take solder.

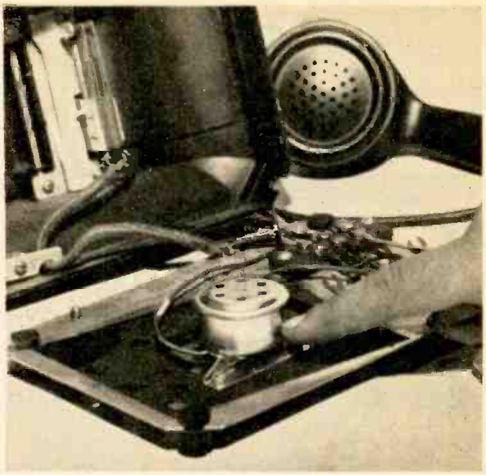
The cradle switch shown in our schematic is part of the telephone. Do not remove it and don't disconnect the wiring to it since it is used to disconnect the power supply when the handset is on the hook.

The power supply consists of a 6-V battery in series with the secondary (used as a choke) of a 6.3-V filament transformer (T1). To avoid getting a shock from the kick-back voltage when the buzzer sounds, cut off the black primary leads at T1's case. Do not



Basic telephone modified for intercom. In original unit you must remove red wire from lead connecting phone and mike to the red output wire.

Power supply consists of 6-V battery in series with filament transformer's secondary. Mount transformer as shown to change battery easily.

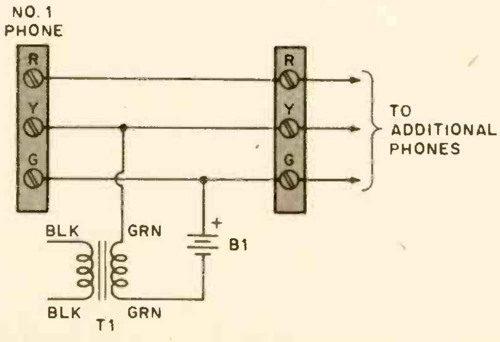


Best place to install the buzzer is inside the telephone on the base. Buzzer is sound unit that is removed from an inexpensive bicycle horn.

eliminate T1 because the system's audio signal is developed across it. If T1 is not used the battery's low internal impedance will short the signal.

Hooking Them Up

The modified phones are connected as shown below. Use a 3-wire cable and connect the matching color-coded wires from one phone to the other. The power supply connects to the yellow and green wires; battery polarity doesn't matter. Additional phones are connected to the system simply by hooking their output cables to the main cable or the nearest phone. Be sure to connect like colors. You can simply keep adding phones until the power supply no longer is able to deliver enough current to sound the buzzers.



External power supply consists of a battery in series with a choke (secondary of filament transformer). Connect all telephones in parallel.

Operation

The buzzers and the speaking circuit are in parallel. Depressing the button on any phone will cause all buzzers to sound. Anyone can then join the conversation by picking up the nearest handset.

If you use more than two phones, a coded-ringing system can be used for signaling. That is, one ring means the call is for phone No. 1; two rings would mean phone No. 2, etc.

B1 is a heavy-duty battery such as an Eveready 510S. If you don't want to use this type, use four standard D cells wired in series. The batteries and the transformer can be located at any convenient out-of-the-way spot near the connecting cable.

The important thing to remember is that the handset should not be lifted while you press the buzzer. If one of the phones is to be used in an area where there is a lot of noise (such as the basement workshop or garage) install a 6-V pilot lamp in the phone to provide a visual signal. Merely connect the lamp in parallel with the buzzer.

PARTS LIST

- B1—6 V battery (Eveready 510S or equiv.)
- S1—Miniature normally-open push-button switch
- T1—6.3 V filament transformer (Lafayette 33 R 3702)
- Misc.—Telephones (Lafayette 44 R 6501), buzzer from bicycle horn.

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The United States of America

NUMBER P1-20-6490

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SPECIMEN

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

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

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THE HAM SHACK

BY ROBERT HERTZBERG W2DJJ

PERPLEXER . . . On a visit to Italy a friend of ours bought an unusual gold-plated microphone with the hope it would make a good conversation piece (no pun intended) for his shack. But when he got it home and hooked it up, the transmitter refused to respond. After much head-scratching he finally made an interesting discovery.

Having been sold in Milan, the mike naturally had Italian markings. Near the control switch were two small legends, NO and SI. Previously our boy had only glanced at them and unconsciously read NO as ON. Then he remembered that SI in Italian means yes and NO means no and that SI, therefore, must indicate *on* and NO *off*. He flipped the switch and, of course, the rig came to life immediately.

Doing It Right . . . A ham who performs an important public service during an emergency usually is rewarded with a letter of appreciation from the mayor, governor or other official. But not so with Hector Seda, W2BFH, Brooklyn.

In response to an appeal from a doctor/ham in Maracaibo, Venezuela, W2BFH purchased some anti-rabies serum and arranged to have it flown down in a hurry. It arrived in time to save the life of a 9-year-old boy who had been bitten by a rat.

W2BFH's reward from the grateful family? An all-expense-paid trip to South America for himself, his wife and his four children.

Hector learned to pound brass in the Air Corps during World War II and got his ticket soon afterward. Needless to say, the ham fraternity is proud to count him as a member.

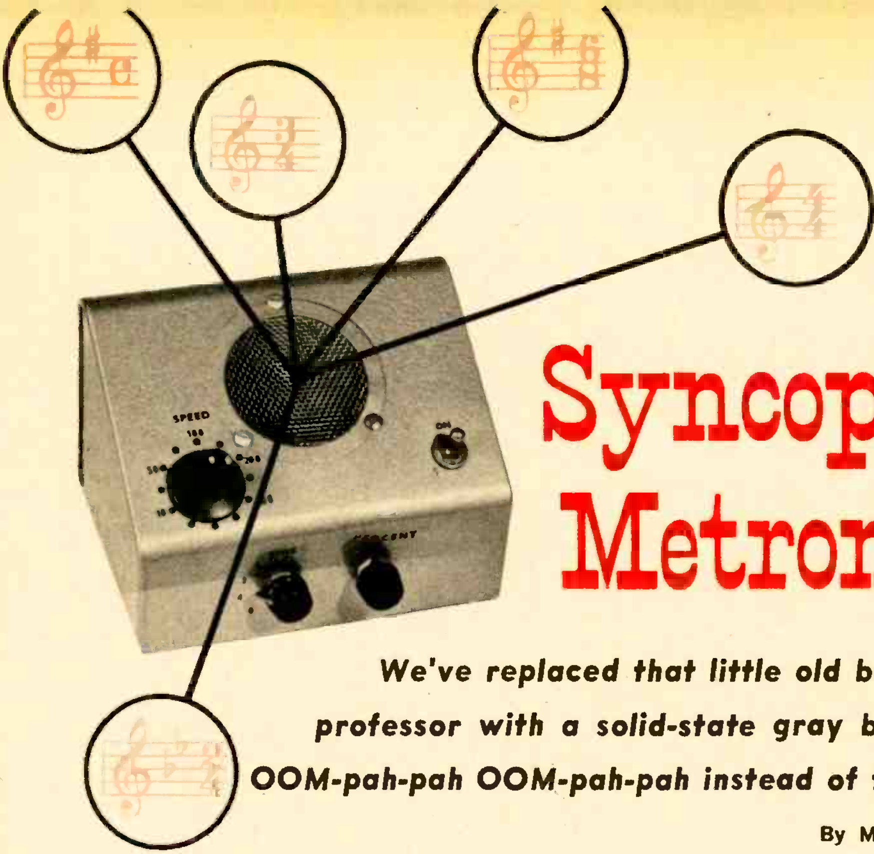
Pin-Up, New Style . . . For years we've wrestled with the problem of mounting QSL cards. Thumb tacks, staples, Scotch tape, rubber cement, library paste—each has ruined the walls of several shacks, though none seems ideal. What is? Answer may lie in the Plastic Pockets made by John B. Thomas, K4NMT, Box 198, Gallatin, Tenn. (see our photo).

A single push-pin or thin brad is all that's needed to hang a pocket of 20 individual but connected transparent sleeves, arranged in two vertical rows. Cards can be inserted or removed in half a second. Better yet, they stay clean and you simply pin up additional pockets as the collection of QSLs grows. (You also can fold them up and take them to club meetings to show how much DX you've worked, all without damage to either pockets or cards.) Three of the pockets, enough for 60 cards, cost a buck.

It's Official . . . As long expected, the FCC has stretched the distance minimum for the Conditional Class license from 75 to 175 miles. Net effect is practically to eliminate the Conditional as a mail-order ticket since the Commission's examining points now cover all but the remotest corners of the 50 states. Still eligible for all the Conditional offers, however, are physically disabled people and members of the armed forces.

Novice Notice . . . Most hams know that the Novice license is good for only one year and cannot be renewed. Thing is, many are not aware that it is unavailable to anyone who ever has held a ham ticket of any kind and let it expire. Obviously, any ham about to give a Novice test should be certain to question the applicant closely on this point.

QSLs are displayed neatly and conveniently in Plastic Pockets available from K4NMT. Each holds 20 cards, can be supported by a single push-pin.



The Syncopated Metronome

We've replaced that little old bearded music professor with a solid-state gray box that goes OOM-pah-pah OOM-pah-pah instead of tick tick tick!

By MORRIS GROSSMAN

FINGERS on the correct keys? What are the sharps or flats? Am I holding my hands properly? What notes come next? When do I hit the pedal? Ready? Now start playing and watch the timing. With all these things on your mind in the early months of music lessons you begin to feel you won't be past chopsticks after a year of practice.

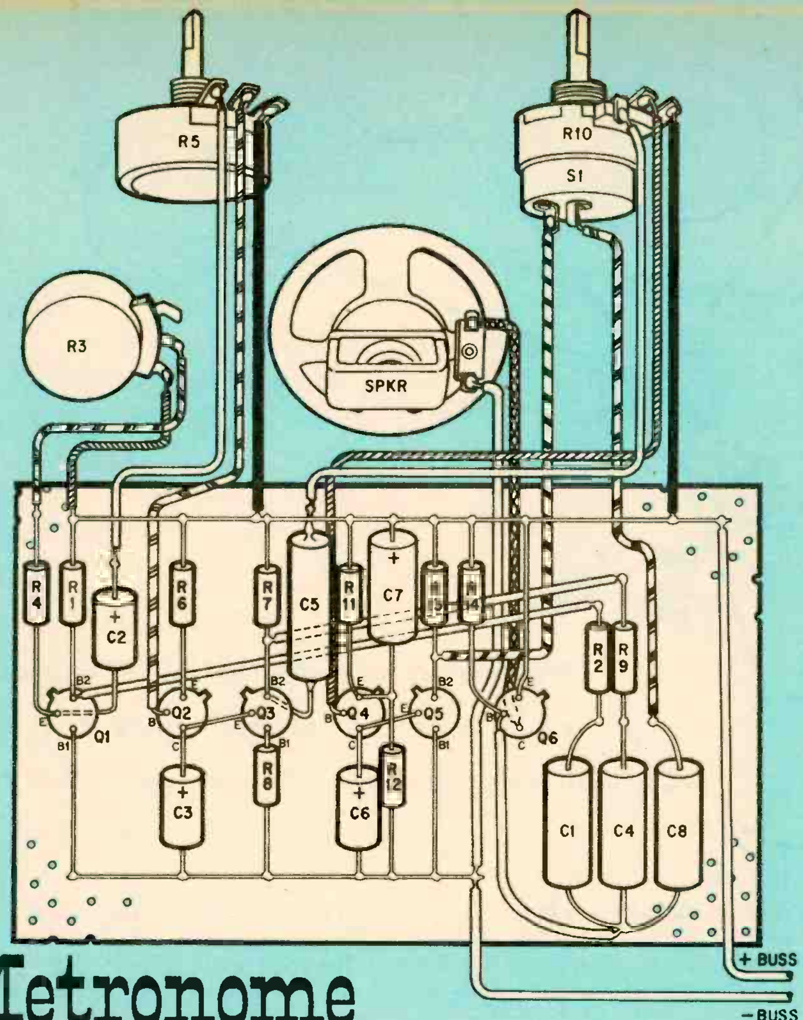
There are no shortcuts to learning to play a musical instrument. It takes plenty of disciplined practice. But one thing—timing—can be developed quickly with a metronome. However, the ordinary kind that just ticks isn't enough. Reason is, this kind merely helps build up speed and gives an evenness to your playing.

In all music, a specific beat in a measure is accentuated. For example, when you think of or play a waltz, you usually count to yourself, **ONE** *two three*, **ONE** *two three*, and so on. Or, the rhythm could be **ONE** *two three four*, **ONE** *two three four*. In both examples you must add a little emphasis to that first beat—**ONE**.

And this is what the Syncopated Metronome does. It relieves you of the chore of counting and accenting. Just set it for the speed you want (its range is about 10 to 300 beats per minute), set its *time* control for the time of the music (2/4, 3/4, 4/4, 6/8, 9/8) and you're free to concentrate on other things. While you take care of the keys, sharps and fingering, the metronome sits there setting the pace—**ONE** *two three*, **ONE** *two three*, **ONE** *two three*. It can almost play a tune itself. Fig. 2. shows the relative amplitude of its output pulses or tick sounds. The vertical bars in color are additional emphasis for 6/8 and 9/8 time.

In fact, it could be used to help dance students keep time. The rhythmic beats and accents also could be helpful in learning typing, doing exercises, lulling you to sleep, keeping you awake, providing inspiration for composing music and acting as an audible timer. Besides all that, it's a mighty interesting electronics project for the experimenter. To the best of our knowledge there is no similar product on the market. All metronomes we have unearthed just go tick tick tick. So if you're fast with the tools you may be the second person in the world to own a Syncopated Metronome (the author modestly claims to be owner No. 1).

Metronome



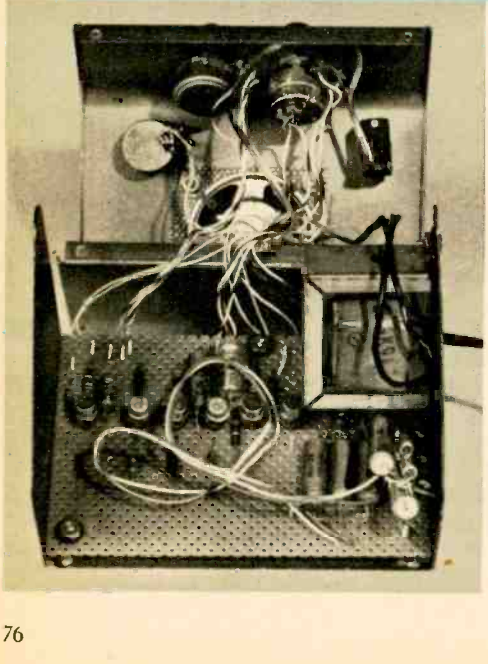


Fig. 1—Mount components on perforated board as shown above and run long leads to R3, R5, Spkr, R10 and S1. Leads to R2, R9 go under board. Mount board in U-section of cabinet as shown below. Toggle switch, upper right of photo, turns unit on.

Construction

The complete unit fits neatly in a 4¼ x 6 x 4-in. meter case. The circuit is built on a 3¾ x 5½-in. piece of perforated board. Most components are installed on the board and can be mounted either with flea clips or by bending their leads on the underside of the board. Interconnecting wires and parts' leads can then be soldered to each other. In most cases the component lead alone is sufficient to connect to its mating part. Very little extra hook-up wire is required. It is important that R3 have a reverse logarithmic taper, as specified in our Parts List, in order to spread out the markings on the *speed* dial.

The power supply can be built on the side of the case as shown in Figs. 1 and 3. The opening in the case intended for a meter accommodates the speaker perfectly. Use a piece of copper screen to protect the speaker cone and use three solder lugs to hold it in place. We used a 100-ohm speaker to eliminate an output transformer.

Mount all controls and switches on the front of the cabinet and make sure the leads to them are long. Should repairs be necessary, this will allow the component board to be completely removed from the cabinet without the need to unsolder wires.

Although the dress of the leads and component arrangement is not critical, the layout shown should be followed closely to avoid mechanical problems when the cabinet is finally assembled.

Calibration

The metronome can be calibrated by ear if you have a good sense of time; however, careful calibration of the *speed, time* and *accentuate* dials is desirable. The most important ingredients required for calibration are a watch with a sweep-second hand and

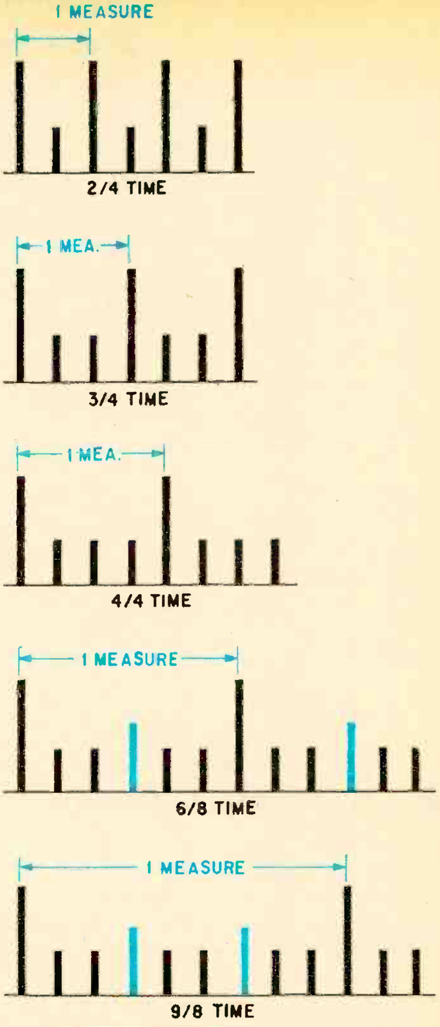


Fig. 2—Diagram shows number of beats in a measure for several times. The accentuated beats are determined by setting of R5. Close switch S1 and adjust R10 and you will get additional emphasis (pulses shown in color) for 6/8 and 9/8 time.

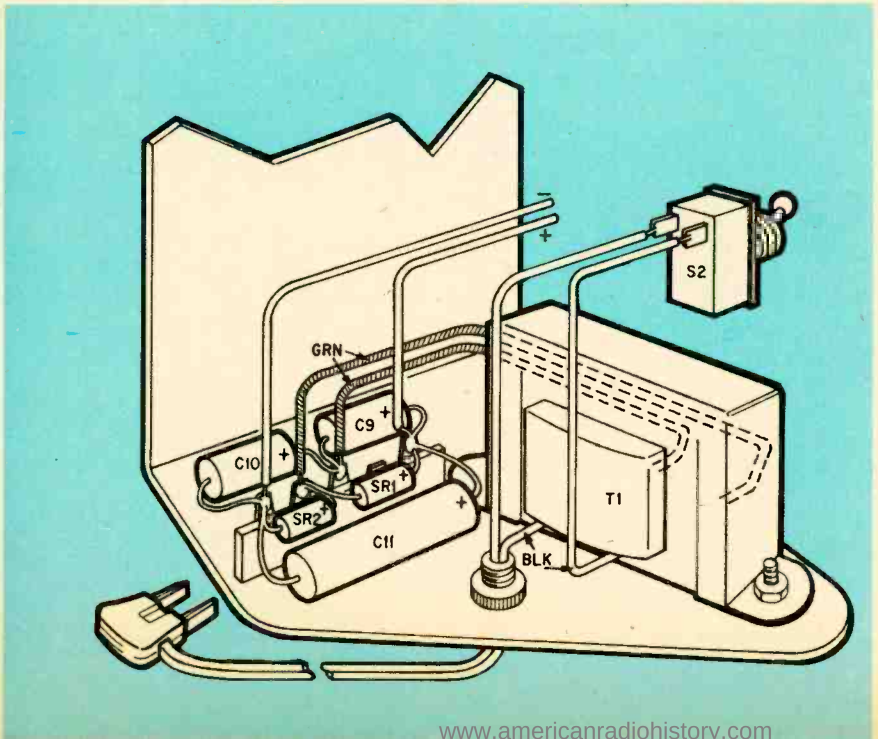


Fig. 3—Power supply is a simple affair that can be built on side of U-section of cabinet. Mount diodes and capacitors on 6-lug terminal strip and make sure ground lug is not used for a tie point. AC power switch S2 gets mounted in the main section of meter cabinet.

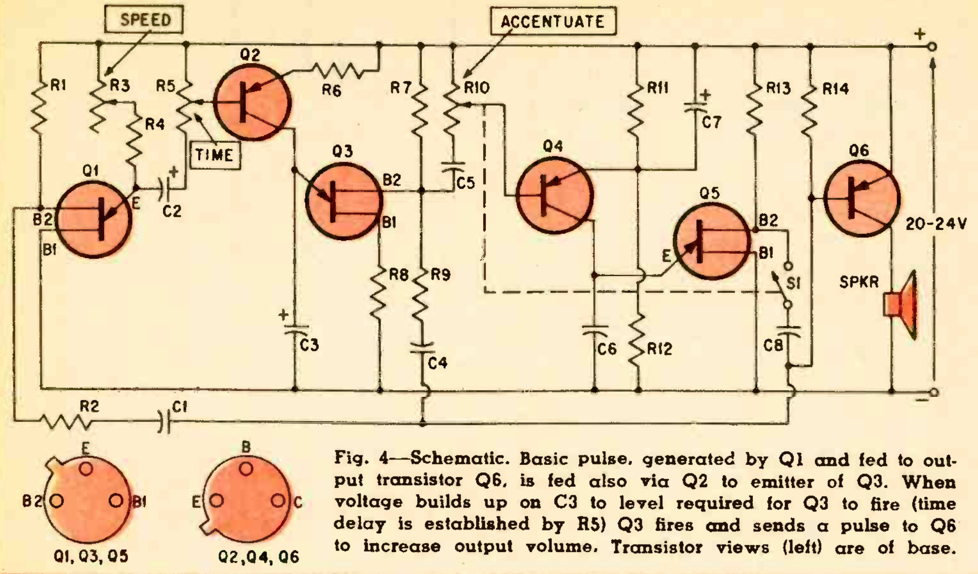


Fig. 4—Schematic. Basic pulse, generated by Q1 and fed to output transistor Q6, is fed also via Q2 to emitter of Q3. When voltage builds up on C3 to level required for Q3 to fire (time delay is established by R5) Q3 fires and sends a pulse to Q6 to increase output volume. Transistor views (left) are of base.

Metronome

a lot of patience.

Set the *speed* pointer anywhere, count the number of beats per minute and mark the dial accordingly. Repeat this for about a dozen places on the dial. Mark these points with a soft marker crayon. Then make the markings permanent with transfer-type numbers and a dab of lacquer.

The *time* dial (R5) is calibrated merely by listening for the emphasized beat. At some point near R5's most clockwise position, every *other* beat will be accentuated (2/4 time). Turning R5 counterclockwise will produce emphasis on every third, fourth, fifth, sixth, and so on, beats. The setting for each of the points is quite broad. The correct spot in each range is where the sound of the accentuated beat is loudest and cleanest. That is, the accentuated beat should not have a crackling sound. A convenient speed of, say, 60 beats-per-minute should be used when calibrating R5's scale.

The dial for *accentuate* control R10 is also calibrated by careful listening. This control and S1 are used to provide a second subordinated accent on, say, the fourth beat of 6/8 or 9/8 time, to visualize this, refer to the two bottom diagrams in Fig. 2. The settings here are somewhat more critical.

PARTS LIST

C1, C4, C8—.1 μf, 100 V tubular capacitor
C2—5 μf, 25 V electrolytic capacitor
C3—3 μf, 50 V electrolytic capacitor (Sprague TE-1302, Lafayette 34 R 8465, or equiv.)
C5—.47 μf, 100 V tubular capacitor
C6—1 μf, 25 V electrolytic capacitor (Sprague TE-1200, Lafayette 34 R 8506, or equiv.)
C7—20 μf, 10 V electrolytic capacitor
C9, C10—25 μf, 15 V electrolytic capacitor
C11—100 μf, 25 V electrolytic capacitor
Q1, Q3, Q5—2N2160 unijunction transistor (GE)
Q2, Q4, Q6—2N404 transistor
Resistors: ½ watt 10% unless otherwise indicated
R1, R7, R13—330 ohms
R2—22,000 ohms
R3—1 megohm, reverse log taper potentiometer (IRC/CTS type Q17-137. Lafayette 33 R 4354)
R4—33,000 ohms
R5—50 ohm, wirewound potentiometer (IRC WPK-50 or equiv.)
R6, R11—100 ohms
R8—22 ohms
R9—4,700 ohms
R10—500 ohm, linear taper potentiometer with SPST switch
R12—1,000 ohms
R14—10,000 ohms
S1—SPST switch on R10
S2—SPST toggle switch
SPKR—100 ohm, 2½-in. dia. speaker (Quam 22A06Z100, Allied 59 U 425)
SR1, SR2—Silicon rectifier; minimum ratings: 100 ma, 50 PIV (RCA 1N3253 or equiv.)
T1—Filament transformer; secondary: 12.6 V @ 1.5 A (Allied 64 U 136 or equiv.)
Misc.—4¼ x 6 x 4-in. meter cabinet (Bud CMA-1930. Allied 87 Z 583, $2.40 plus postage. Not listed in catalog), perforated board, knobs, AC line cord.

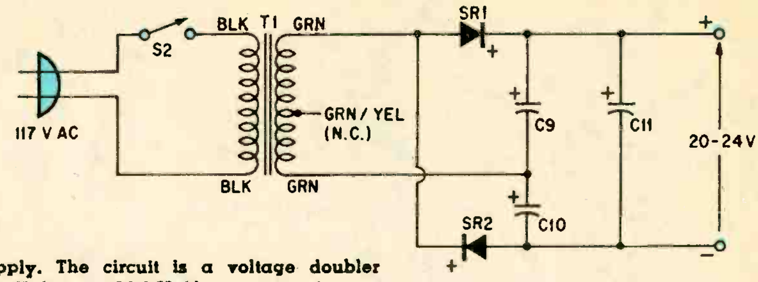


Fig. 5—Power supply. The circuit is a voltage doubler that supplies 20-24 V from a 12.6-V filament transformer.

The exact settings for both the *time* and *accentuate* dials are somewhat dependent upon the setting of the *speed* control and therefore the calibration points are to be considered more as broad guides.

The final setting should always be determined by listening. If R10 is not set properly, the second accentuate pulse may not coincide with the main accent pulse and the sound will be very rough. To correct this merely advance or retard R10 somewhat to pull it into step.

Resistors R2 and R9 affect the relative amplitude of the accentuated and non-accentuated beats. By changing their values you can change the relative amplitudes of the beats.

How it Works

The metronome uses unijunction transistors to provide stable operation. Take a look at the schematic in Fig. 4. Unijunction transistor Q1 is connected as a relaxation oscillator which provides the basic beats. The 1-megohm potentiometer (R3) labeled *speed* provides a speed range of about 10 to 300 beats-per-minute.

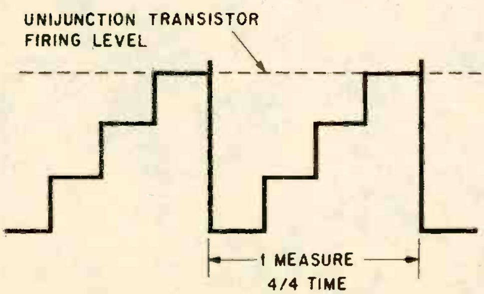


Fig. 6—Q2's collector waveform. When R5 is set for 4/4 time, three pulses charge C3 almost to Q3's firing level. Fourth pulse causes Q3 to fire and produce a pulse that also is fed to Q6.

When the voltage on a unijunction transistor's emitter rises to a particular percentage of the voltage difference between its bases, the transistor conducts, or fires. Until this happens, the impedance between the emitter and base 1 is high.

When power is turned on, Q1 conducts, the impedance between the emitter and base 1 drops to a low value and C2 charges rapidly. As soon as C2 is fully charged, Q1 stops conducting and C2 discharges slowly through resistors R3, R4 and R5. When C2 discharges to the point where Q1's emitter voltage is again at the firing point, Q1 again fires and C2 recharges. This cycle repeats itself continuously at a rate determined by the time constant of C2, and the series combination of R3, R4, and R5.

R4 establishes the maximum speed and R1 determines the lowest speed. Pulses, or spikes, of current, produced by the charging and discharging of C2, are fed via R2 and C1 to output transistor Q6. They produce unaccented ticks.

● **The Time Control.** Pulses of current caused by the charging and discharging of C2 also are fed to *time* potentiometer R5. This control establishes which beat will be accentuated by varying the amount of voltage of a pulse that is fed to the base of Q2 and subsequently the emitter of Q3—a staircase counter.

In other words, R5 determines the amount of charge that will be built up on capacitor C3 for each pulse produced by Q1. Depending on the setting of R5, 2,3,4,5, or 6 pulses from Q1 will be required to charge C3 to Q3's firing level. This is shown in Fig. 6. When the voltage on C3 exceeds the firing point of Q3, Q3 fires and its output pulse together with the output of Q1 are fed to out-

[*Continued on page* 98]

DX à

By DON CARTER

FROM the first Sputnik to the current Gemini and Early Bird projects, the now-numerous man-orbited earth satellites have held the public spellbound, and not without good reason. For as space exploit after space exploit becomes hard reality, even science-fiction shockers pale by comparison.

The space age truly has moved into high gear. Thing is, most any DXer can get in on the action first-hand. For unlike the average citizen, the DXer needn't content himself with what at best are second-hand TV accounts. His space DX can be as go-go as a racing car. Reason is he can pick up those history-making signals direct . . . and on his own equipment.

Significantly, Early Bird and the Gemini flights represent the two basic types of space DX. Early Bird, the world's first commercial satellite, operates exclusively in the VHF region and requires special gear to log (its 136.44-mc frequency just isn't tunable on communications receivers). And while the Geminis also operate primarily on VHF, they fortunately make use of a back-up short-wave system (due to line-of-sight communications gaps) which always will be tested during the course of any flight. And happily for the DXer, any of these tests can be logged by the SWL who chances to be tuned in on the channel (15016 kc) at the time.

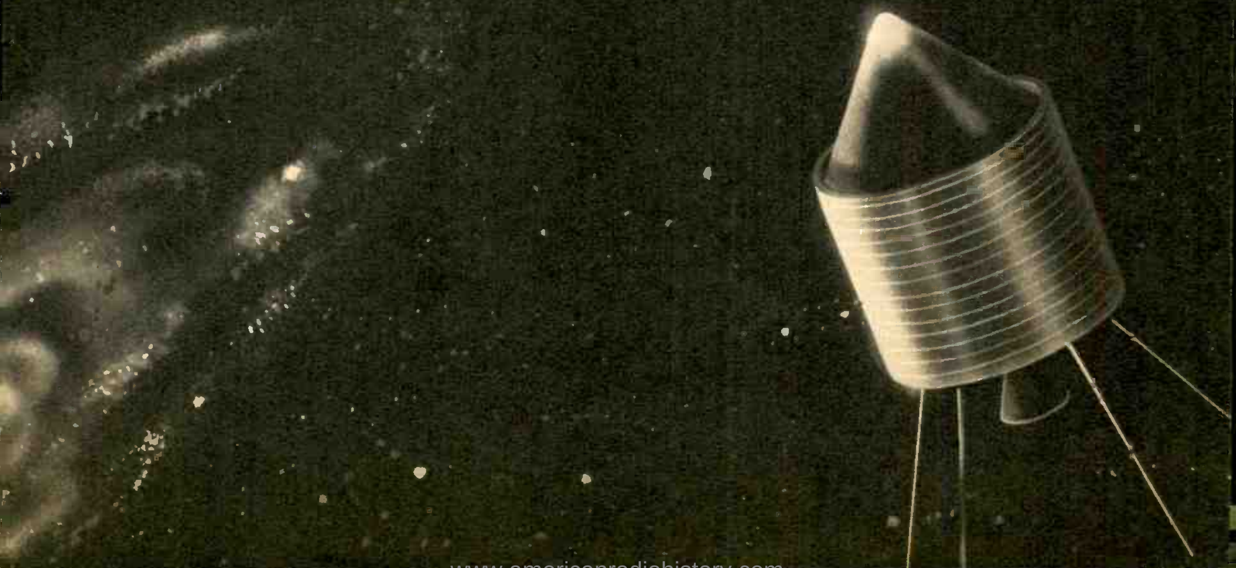
Prime requirements for success in any sort of space listening are a stable, accurately calibrated receiver and patience. Taking that last

go-go

first, most space DX hunts involve knowing the frequency in advance and simply sitting it out until something happens. Assuming your goal is to log one of the Gemini flights, your only out is to tune to 15016 kc, settle comfortably in your chair and wait. Or, taking another example, most Russian SW space activity takes place within 5 kc of 20000 kc (the actual band in this instance is 19990-20010 kc). If you were looking for Soviet cosmonauts (the so-called Voskhod flights use standard SW frequencies more extensively than their U.S. counterparts), you'd locate the 20000-kc spot, tune ever so slightly below it and keep listening. It all sounds alarmingly simple so far, and it is. Fact is, it's so simple the DXer well may fall asleep! (How's *your* staying power?)

Locating the exact frequency on which to listen understandably requires extra-fine receiver calibration. You, of course, could tune for WWV's 20-mc signal (15 mc for Gemini) and exterpolate from there. But a far better bet is to add a crystal frequency marker—unless your receiver already is blessed with one of these helpful little gadgets. There are several outboard units on the market: the Bud FCC-90B, typical of the lot, runs about $20, has its own built-in power supply and, once connected to your receiver, provides a marker signal every 100 kc along the dial.

Naturally, there is little you can do about stability: your receiver either has it or it doesn't. But regardless of what your set offers in



this regard, it always should be well warmed up. If it still drifts even after adequate warm-up (say 30 minutes to an hour), you simply will have to tune back to the marker periodically. In this sense, the marker can be said to be partial compensation for a receiver with a liking to creep, though there clearly can be no substitute for stability.

So far we have mentioned only the Gemini and Voskhod flights. But there are numerous other satellites transmitting around 20000 kc. The Russians lay claim to the bulk, though our Explorer 22 and Italy's San Marco also are to be found in this general area. Catch is, the presence of numerous space signals (some coming from secret, unlisted sources) make foolproof identification of a particular signal highly hazardous.

However, a satellite usually will be heard on two or more consecutive orbits. Thus, if Explorer 22 is heard at 1800 after a prolonged monitoring period, it again should be heard 105 minutes later, i.e., at 1945. Reason, of course, is that this particular satellite's orbit period is 105 minutes, as our chart reveals.

On the other hand, if that signal does not appear again until 2049, you could be reasonably certain it is not Explorer 22. Instead, it presumably would be a Soviet vehicle, possibly Elektron 1, which at last report was transmitting on this same general frequency (20005 kc) and had an orbit period of 169 minutes. Or given a different time of reappearance, it might be the San Marco (orbit period: 94 minutes).

Aid in identifying a specific Voskhod flight frequently can be gained from newspapers, TV or radio, since all publicize orbit periods. Needless to say, there's little point in attempting to log a satellite without foreknowledge of its orbit period, since you otherwise would not know when to listen.

Not to be overlooked is the fact that space reception even at 20 mc sometimes can occur via skip. In other words, the signal first reaches the ground at some distant point, then is bounced to the ionosphere, goes around the earth's curvature and comes down to your receiver. Instances of skip at this frequency ordinarily are no more rare than on the 16- or 13-meter SWBC bands. And when skip does occur, signals from the

Early Bird, world's first commercial communications satellite, plays prime role in intercontinental TV. It transmits on a frequency of 136.44 mc.

satellites can show up in weird locations (as can signals from most any source). But despite this complication, the orbit period method of identification still is pretty good and certainly is as foolproof as any.

Should reception from what is presumed to be a satellite last more than 14 minutes, chances are that the station concerned is a perfectly ordinary utility broadcaster—radioteletype, telephone (wonder how many times these have been mistaken for a man in space?) or what have you.

Of course, all satellite signals (except that from the synchronous Early Bird) will show Doppler shift—frequencies will get higher as the vehicles are approaching, lower as they are moving away. Such frequency shifts normally can be detected through use of a BFO, though a receiver that drifts even slightly can fool you.

When it comes to the VHF side of things, DXing the satellites becomes all the more exciting, though all the more difficult. One of the prime requirements for ordinary SW space DX is a stable receiver. But on VHF (where satellites are considerably more plentiful) the prime requirement is any receiver at all! And since rigs tuning 136 to 137 mc (the major U.S. space band) are scarce, a converter ordinarily is called for.

As is the case with crystal frequency markers, there are several suitable converters on the market. One principal manufacturer is the Ameco Equipment Corp. of Mineola, N.Y., which produces a variety of units. Its model CN-144W Nuvistor converter, designed to cover the 2-meter ham band, will be supplied for 136-mc use if this is specified at time of ordering. (It also is necessary to state make and model number of your receiver.) This unit, incidentally, sells for $49.95 wired, $34.95 in kit form.

Still another unit is the AOR-C1 converter ($47) by the International Crystal Manufacturing Co. of Oklahoma City, Okla. Suitable for use with most any communications receiver, it tunes a 200-kc range and provides an output of 10700 kc. Needless to say, the better your basic receiver, the better your AOR-C1 will work.

Reception and identification of VHF space vehicles differ little from the standard SW variety and the same rules pretty well apply. For the most part, there'll be no skip to complicate things. However, satellites again can be distinguished from other broadcasters by the intermittent nature of their transmissions—intermittent in the sense that they will be heard only during a portion of the orbit period.

Of course, famed Early Bird differs from all other satellites in that it's stationary. You'll either hear it or you won't, depending on your location, receiver and antenna. However, the ionosphere has been known to play the tantalizer even at these frequencies, so it's best not to give up at first or second try. Then, too, variations in fringe-area reception of this satellite might make an interesting tale in themselves.

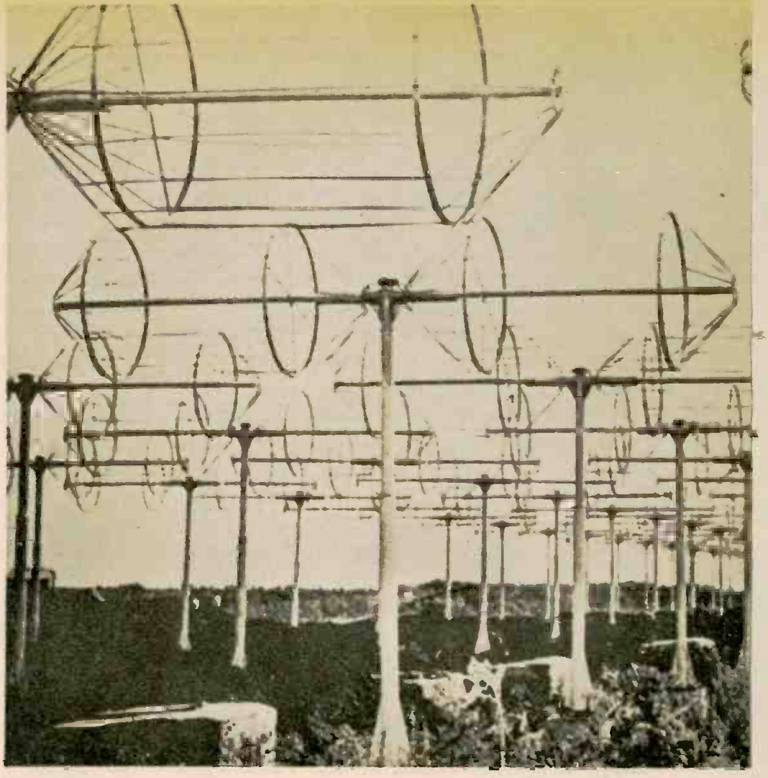
EI'S GUIDE TO OUTER SPACE

FREQ. (mc)	SATELLITE OR SERVICE	ORBIT (min.)
8.89A	GEMINI recovery network	
15.061	GEMINI capsules and ground communications stations	
15.90A	GEMINI capsules and ground communications stations	
16.015	Press corps aboard GEMINI recovery ships working RCA NY (WER46)	
19.895	POLYOT 2 (U.S.S.R.)	92
19.997A	Soviet manned space flights (voice and CW communications)	
20.005	EXPLORER 22	105
	EXPLORER 27	108
	ELEKTRON 1	169
30.008	ELEKTRON 1	169
40.01	EXPLORER 22	105
	EXPLORER 27	108
41.01	same as 40.01	
90.023	COSMOS 44(U.S.S.R.)	100
90.225	ELEKTRON 2(U.S.S.R.)	1356
136.02	ECHO 2	109
136.077	ALOUETTE 1 (U.S. & Canada)	106
136.08	EXPLORER 23	99
136.125	EXPLORER 28	8559
136.14	RELAY 1	185
136.147	EXPLORER 21	2097
136.17	EXPLORER 22	105
	ECHO 2	109
136.2	OGO 1	3837
136.232	TIROS 9	119
136.233	TIROS 8	99
136.234	TIROS 7	97
136.292	EXPLORER 25	116
136.326	EXPLORER 20	104
136.35	EXPLORER 20	104
136.406	ARIEL 1 (U.S. & Britain)	101
136.41	PEGASUS 1	97
	PEGASUS 2	97
136.44	EARLY BIRD	
136.468	SYMCOM 2	1438
136.47	SYMCOM 3	1436
136.558	ARIEL 2 (U.S. & Britain)	101

FREQ. (mc)	SATELLITE OR SERVICE	ORBIT (min.)
136.590	ALOUETTE 1 (U.S. & Britain)	106
136.62	RELAY 1	185
136.653	1963-38C	107
136.68	EXPLORER 20	104
136.712	OGO 2	96.5
136.739	EXPLORER 22	108
136.767	GRAVITY GRADIANT 3	70
137.801	SOLAR RADIATION 2	70
136.803	EGRS 1	104
136.842	EGRS 3	70
136.857	EXPLORER 23	99
136.86	EXPLORER 25	116
136.886	SOLAR RADIATION 1	104
136.89	PEGASUS 1	97
	PEGASUS 2	97
136.919	TIROS 9	119
136.922	TIROS 7	97
136.924	TIROS 8	99
136.98	EARLY BIRD	
	SYMCOM 2	1438
	SYMCOM 3	1436
145.85	OSCAR telemetry (amateur-radio satellites)	
145.95	OSCAR beacons	
145.9A	OSCAR ham relay	
150	TRANSIT 4A	104
	1963-49B	107
162	EXPLORER 22	105
	ANNA 1B	108
	EXPLORER 27	108
324	ANNA 1B	108
	EXPLORER 27	108
	EXPLORER 22	105
360.09	EXPLORER 22	105
	EXPLORER 27	108
400	TRANSIT 4A	104
	1963-49B	100
	1964-26A	107
400.25	OGO 1	3837
400.85	OGO 1	3837

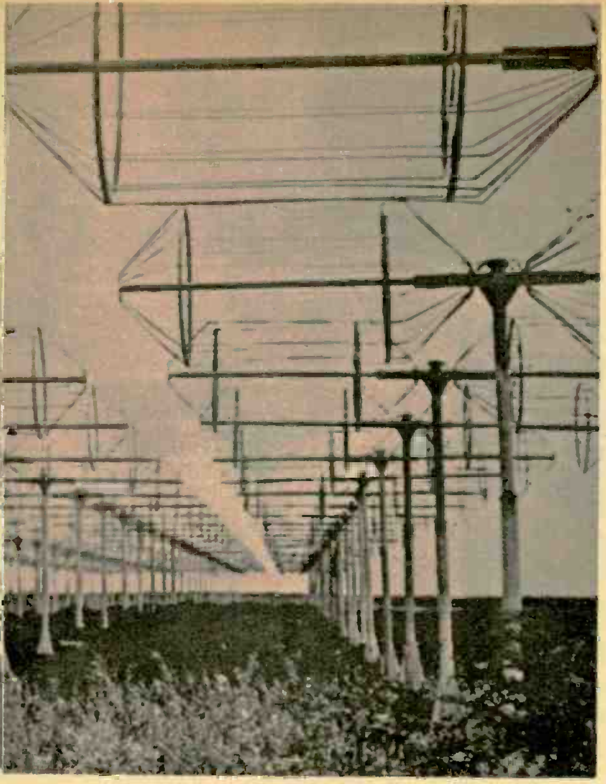
NOTES: Frequencies followed by letter A are approximate. All satellites are U.S. unless otherwise specified.

BIRDLESS BIRD CAGES?—If our photo is any indication, Soviet scientists currently have a peculiar preoccupation with what appear to be uninhabited bird cages. Fact is, this rare look at Ivan's secret antics behind the Iron Curtain actually discloses the ears of a Russian-style radio-telescope installation. Dotting the countryside of the northeastern Ukraine, these antennas are the prized possessions of the radio-astronomy observatory at the Radio Physics Institute of Ukranian Sciences Academy of Chuguev District, Kharkov Region, U.S.S.R. Hope is that these bird-cage-like structures will gather some of the feeble signals that long have been winging their way across millions of light years of space from radiating stars and nebula. And though the Soviets have yet to reveal just how many celestial birdies they've ensnared, their weird antenna array well may provide answers to riddles which have puzzled man for centuries.

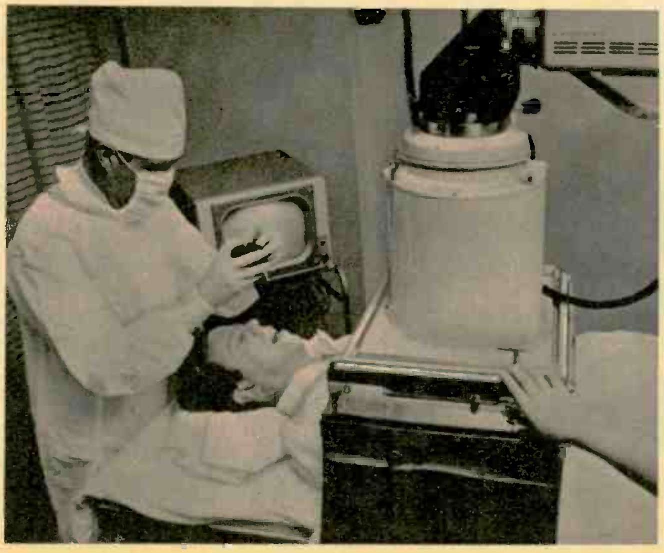


EI Picturescope

LUNAR LANDING SIMULATOR—How do you pick a winner when there are a million horses in the running? Answer is, you don't—unless you take a lesson from scientists and engineers at the Manned Spacecraft Center in Houston, Tex. Reason is the odds in a million-entry horse race are much the same as the ones the people down Houston way are whittling down. Their gigantic task is to reduce the number of sticky wickets a lunar space craft can get itself into at touchdown. Aided by a computer which approximates surface conditions on the moon, the men in our photo simulate lunar landings on a table top while observing and recording the behavior of a scale model of the lunar exploration module's landing gear. Effectively having run their horse race beforehand, scientists will rely on the data collected from these tests to indicate any necessary changes in the landing gear and help compile recommended procedures for the lucky astronaut who pilots the module to the moon.

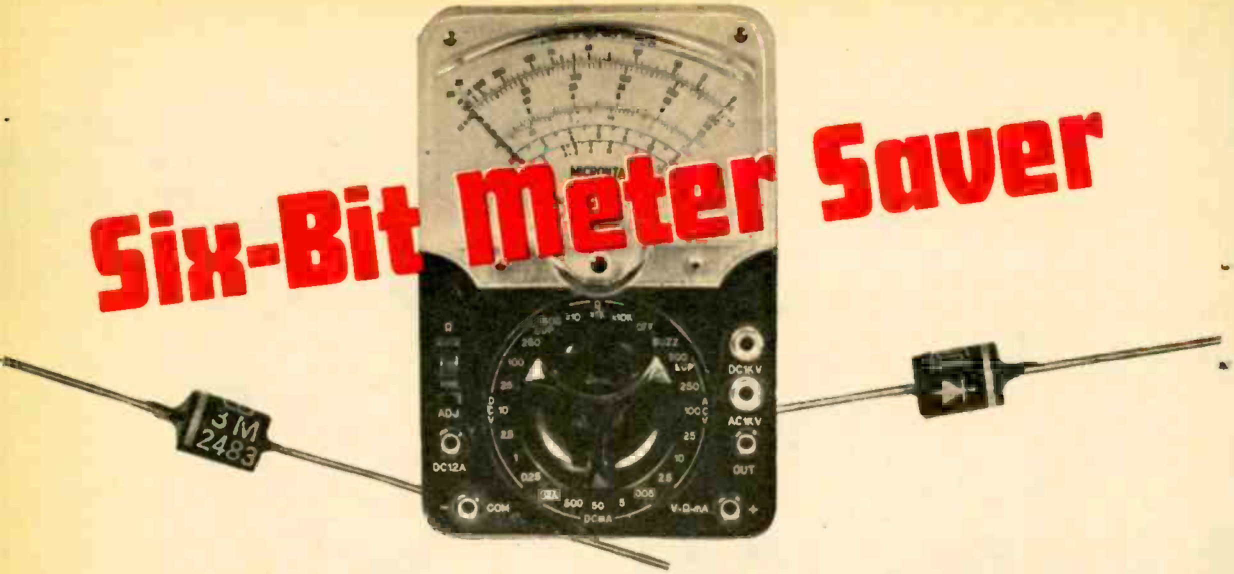


WEATHER WILLING—*Since this is Christmas Eve, I should vote for snow tomorrow; but snow might spoil my hairdo so I'd better vote for a sunny day.* What gives? Well, if the people at the Sheaffer Pen Plant, Ft. Madison, Iowa, have their way, willing the weather will be a cinch long about 2065. Plan is to have people cast their ballots on weather-voting machines. Results would be sent to a central computer and then a weatherman, who would oblige the majority.



SUPER RAY—Though the need for color X rays long has existed, none yet has been developed. But a Japanese invention introduced at St. Eriks Hospital in Stockholm, Sweden, will guide doctors to correct diagnoses by providing at least temporary solution to this electronic impasse. Capable of being maneuvered into hard-to-reach locations, the puppet-like device has been found to be particularly useful in identifying causes of stomach ailments. Under the watchful eye of a doctor, the camera, less its hand-held controls, travels down the patient's throat at the tip of a long, flexible tube. When the tip of the tube approaches the vicinity of the stomach, X-ray equipment is called into play to pinpoint the exact locations where pictures are to be taken. All the doctor then need do is shoot his color photograph.

Six-Bit Meter Saver



EVEN if it's only a $10 VOM, nobody likes to see it burned out by a moment of carelessness. And if it's a $60 instrument you've deep-sixed, the grief and loss of green stuff are horrifyingly real.

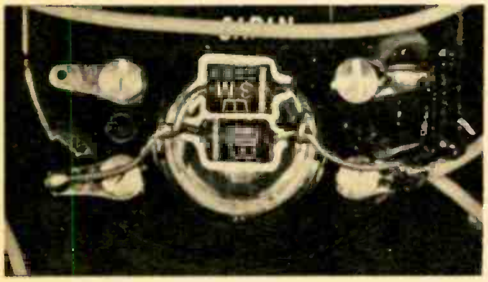
Sure, most of us at one time or another by incorrectly setting a switch or by putting a test lead in the wrong place have sent a meter movement to the big shop in the sky. It usually happens fast enough to prevent second chances. All it takes to burn-out proof most any meter is cigarette money and ten minutes work.

The secret is two inexpensive silicon diodes connected back-to-front and paralleled across the meter terminals, as shown below. But you cannot protect a meter that has a series resistor built into it. The terminals must be connected directly to the meter coil.

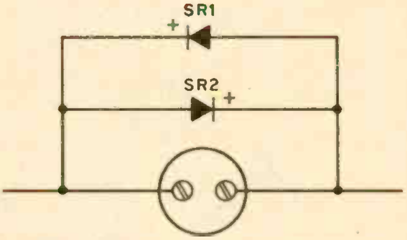
Silicon diodes require a nominal 0.7 V across them before they conduct. Most meters when deflected fully will have a voltage that is less than 0.7 V across their terminals. The diodes, therefore, will have no effect on the meter. But when the meter is overloaded severely the voltage across its terminals reaches the diode's breakover voltage, the diodes conduct and excess current is bypassed around the meter.

SR1 and SR2 can be any low-cost silicon diodes, such as Lafayette's 19 R 5001. They will protect virtually any 50-μa to 1-ma DC meter. With some meters the diodes may interfere with accuracy. To check whether they do, try them before they're installed permanently. Measure a voltage and note the quarter-, half-, three-quarter- and full-scale deflections. Connect the diodes temporarily across the meter terminals and repeat the procedure. If the meter readings don't change, connect the diodes permanently in place.

—*Chet Stephens*



Install diodes (shown here outlined in white) directly across meter terminals in VTVM or VOM.



Diodes bypass current around meter when full-scale deflection voltage is exceeded. Two diodes prevent overload either way.

BEGINNER'S CORNER

The Case of the INVISIBLE Gate

THERE are no moving parts, yet it switches. The knob you turn to make it dim lights as slow motors is twice its size.

It is the silicon controlled rectifier (SCR)—the up-and-coming little giant in electronics. The steady decline in its price is putting it into more and more light dimmers, battery chargers, motor-speed controls and automobile ignition systems—to mention just a few applications.

The SCR resembles an ordinary solid-state diode rectifier since it passes current in one direction only. But there's an important difference. You can regulate the amount of current the SCR will conduct by means of a third element, called a gate.

Shown in Fig. 1, left, is the schematic symbol of an SCR. Its three elements are anode (positive terminal), cathode (negative terminal) and gate. If this were a conventional diode it would conduct current instantly when connected as shown because its anode is connected to the + battery terminal and its cathode is connected to the – battery terminal.

But since it's an SCR, it will not conduct until a voltage is applied to the gate, which is positive with respect to the cathode. When the voltage on the gate is zero or negative, the SCR's anode-to-cathode resistance is high. It's like an open switch.

To get the SCR to conduct current all we have to do is adjust the potentiometer (R) so it puts a positive voltage on the gate. When you apply 2 V to the gate of the RCA 2N3228 SCR its internal resistance drops and a heavy current flows from cathode and anode. The SCR now functions like an ordinary diode. That is, current is proportional to the DC voltage applied across anode and cathode.

Now turn R to bring the gate voltage back to zero. Lo and behold, the SCR continues to conduct current! In other words, once current starts to flow the gate cannot stop it—even though it started it. To get the SCR back to its non-conducting, or off, state the voltage must be removed from the anode. But before we go on, let's take a look at how the SCR is constructed to see how it works.

Figure 1, right, shows the four layers of semi-conductor material found in an SCR. These sections (right), however, can be looked at as PNP and NPN transistors which have been joined together. The equivalent of the SCR, a 2-transistor regenerative circuit, is shown in Fig. 2. The gate, then, actually is the base of the lower transistor.

[*Continued on page* 92]

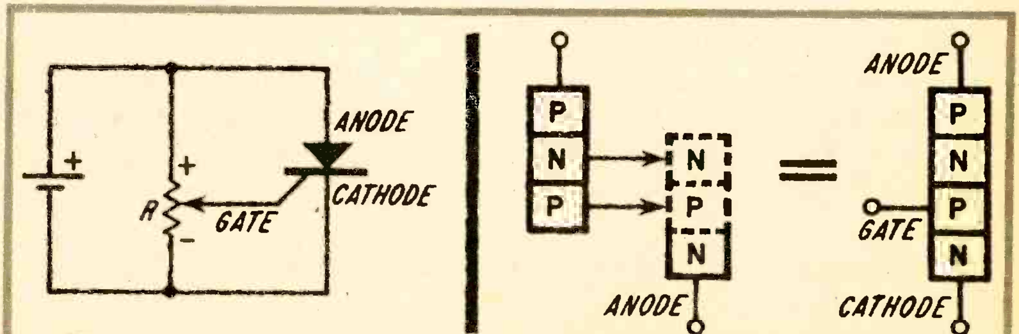


Fig. 1—Schematic symbol of SCR, left. Diagram at right shows SCR is four-layer device that can be thought of as combination of PNP and NPN transistors. When the gate is positive with respect to cathode, current flows through bottom PN junction. This starts anode-to-cathode current flow.

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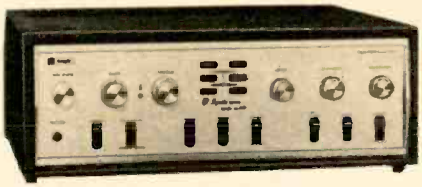

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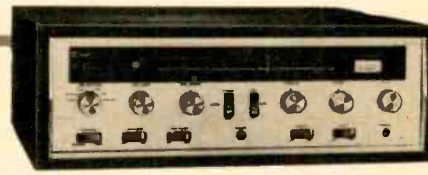

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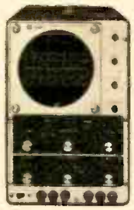

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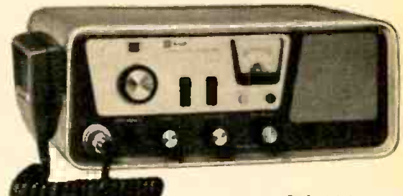

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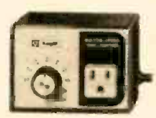

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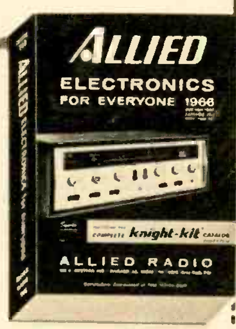

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We are going to show positive- and negative-going pulses on the elements of the transistors to make it a little easier to visualize what's happening. In a real circuit pulses, generally, do not exist as we show them.

A positive pulse applied to the gate increases current through the bottom transistor (NPN). At the collector the pulse is negative-going. The pulse goes to the base of the upper transistor (PNP) and causes it to conduct. The pulse is inverted again and is positive-going at the collector. However, the top transistor is connected to the lower one in a way that provides positive feedback. The result of this is that the original input signal is amplified and returned to the base of the lower transistor in greater amplitude. It's like positive feed-back. Current flow increases rapidly in both transistors and continues after the original input signal to the gate is removed. The only way to stop the current flow is to remove or lower the anode-to-cathode voltage. We'll get to this later.

The schematic of a lamp dimmer and motor speed control is shown in Fig. 6. Incoming AC is applied to the SCR anode and, through the load, to the cathode. AC is also impressed across a voltage divider consisting of R1 and potentiometer R2. This divider provides the gate-triggering voltage. The purpose of SR1 is to rectify AC since the gate operates only on a positive DC voltage.

At the instant power is applied, we'll assume the sine wave applied to the anode of the SCR starts to go positive (See Fig. 3). When the arm of R2 is at, say, the top of the control, the gate voltage reaches 2 V very quickly. Hence the SCR conducts early in the cycle and power is delivered during most of the positive half of the AC cycle.

But lower R2's wiper arm and the *applied* AC will have to rise to a higher value before

2N3228 SPECIFICATIONS		
Characteristic	Symbol	Rating
Gate-trigger voltage	VGT	2 V
DC gate-trigger current	IGT	15 ma
Average forward current (rms value)	IFRMS	5 A
Peak reverse voltage (repetitive)	VRM	200 V

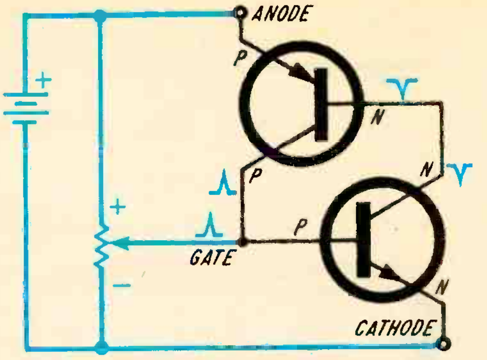


Fig. 2—Positive voltage on gate is amplified and fed from top transistor to lower transistor's base. This keeps the SCR on after the input is removed.

the gate voltage reaches 2 V. This means the SCR will be turned on later in the positive half of the cycle. The result is less power through the load.

Operating the SCR on AC enables the gate to regain control. Here's how. On the second half of the AC cycle the anode is negative and as in any diode, current cannot flow. There is neither a positive voltage on the anode nor the gate. The SCR is reset and awaits just the next positive half cycle.

The circuit just provides half-wave control since the SCR controls only the positive portion of the AC cycle. A lamp connected to the SCR can be adjusted from off to brightness of only about 30 to 40 per cent. More complex SCR circuits, which use additional diode rectifiers, are used for full-wave and consequently full range, control. The circuit shown can also be used to control a soldering iron to reduce heat when working on delicate printed circuits.

Do not use this circuit on transformer-

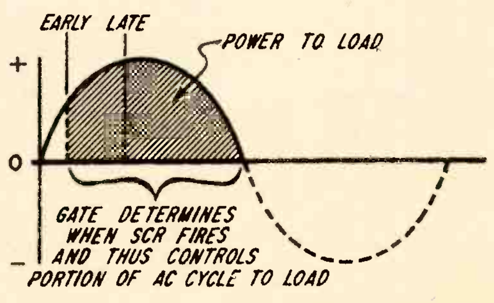


Fig. 3—If R2 in Fig. 6 is set near R1, gate voltage reaches 2 V at beginning of positive half of cycle, causing most of power to go to load.

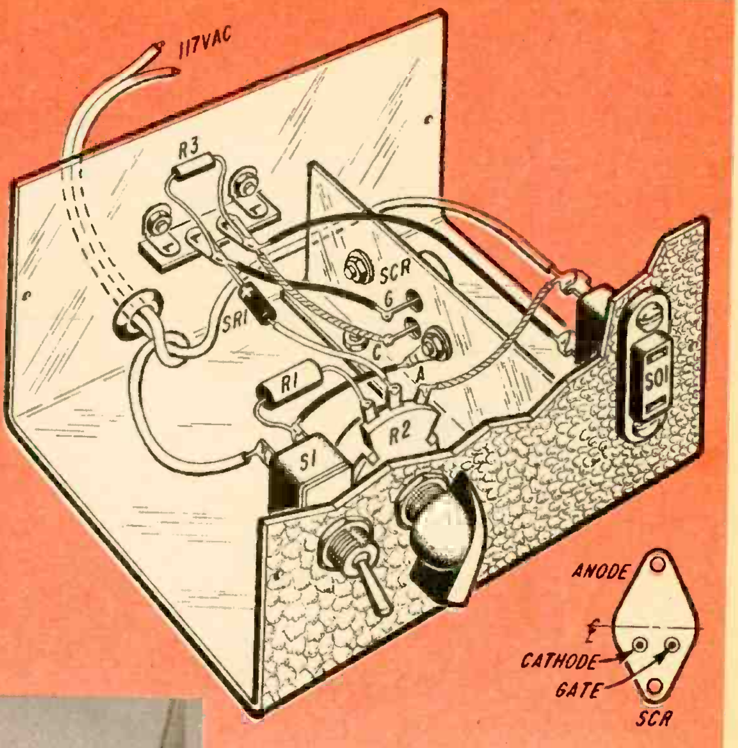


Fig. 4—Construction of light dimmer/motor speed control in U-section of 3 x 4 x 5-in. Minibox is straightforward. SCR is mounted on vertical aluminum plate which serves as the heat sink. Be certain the SCR is insulated from the heat sink with hardware supplied with it. Because the SCR's case has line voltage on it, it should be kept inside the cabinet to prevent shock hazard.

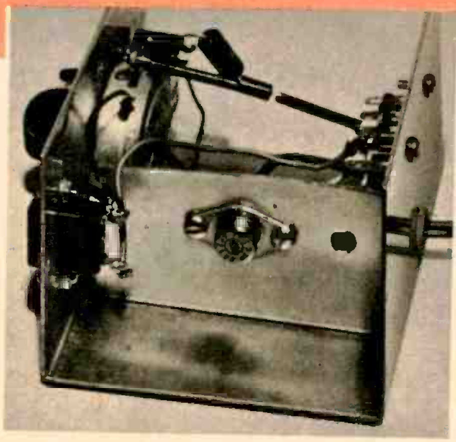


Fig. 5—SCR must be mounted on piece of aluminum to dissipate heat. Use mica and plastic washers supplied to insulate case from plate.

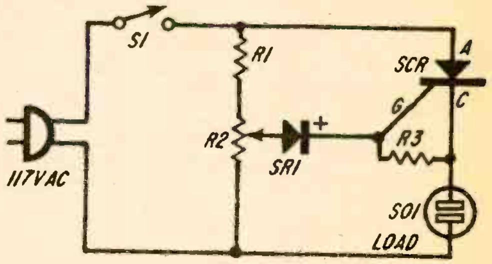


Fig. 6—Schematic of light dimmer/motor speed control. Diode SR1 is necessary in the circuit to rectify AC so only DC will be fed to the gate.

PARTS LIST

R1—2,200 ohm, 2 watt resistor
R2—1,000 ohm, wirewound potentiometer
R3—1,000 ohm, ½ watt resistor
S1—SPST toggle switch (5 A minimum rating)
SCR—2N3228 silicon controlled-rectifier (RCA)
SR1—Silicon rectifier; minimum ratings: 400 PIV, 200 ma
SO1—Chassis mount AC socket
Misc.—3 x 4 x 5-in. Minibox, knob, terminal strip, AC line cord.

operated devices such as a soldering gun or fluorescent lamp. Incandescant lamps or AC/DC motors may be controlled if their current does not exceed 5 A.

As in any semiconductor device, there are maximum ratings which should not be exceeded. Important characteristics of the 2N3228 are shown in the chart. The forward current (I_{FRMS}) determines the amount of power that can be safely handled by the SCR. Since it is 5 A, the 2N3228 can be used with resistive loads to almost 600 watts (at 117 V.)

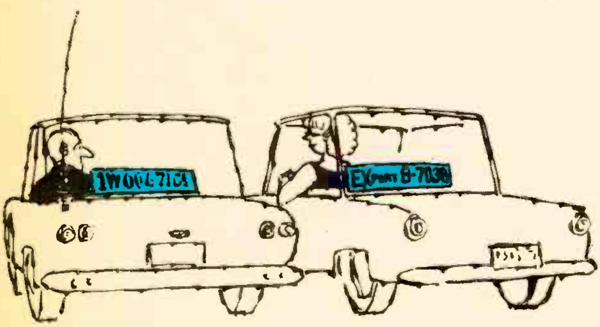
—*H. B. Morris*

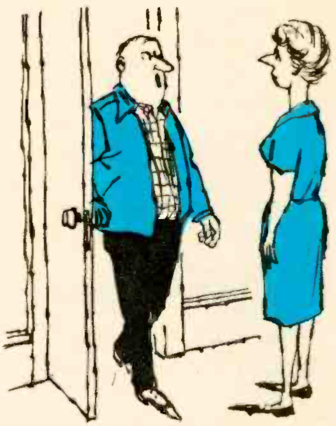
OVER AND OUT

BY Rodrigues

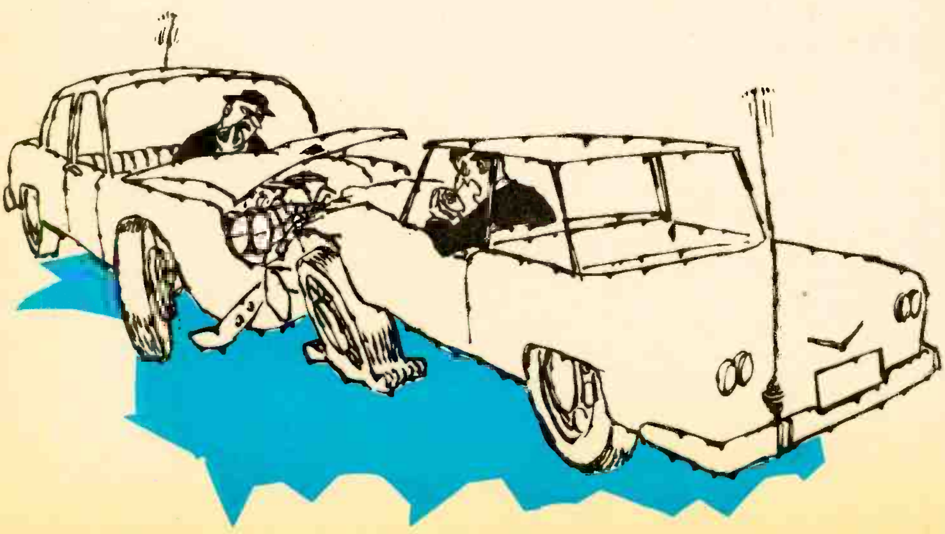
"Here's a push-to-talk designed with the ladies in mind. The button needs a 20-pound pressure to keep it open."

"I'm having quite a time with the FCC. They can't figure out what to call me: mobile, base or base/mobile."





"I finally found out why my mobile can work only 65 yards. It's a 12-volt set working off a 6-volt battery."



Stereo Tape Deck

Continued from page 33

the Viking transport. It has two motors—one for capstan drive and another for fast-forward and rewind. There are no pressure pads on the heads themselves—which means less head wear and longer head life—and in their place is a single pad at the left of the erase head. This, in conjunction with the capstan and pinch roller, maintains tape tension across the heads. In the rewind and fast-forward modes, lifters raise the tape from the head surfaces. This, too, increases head life.

Concentric knobs control operations. The inner knob has three positions. At the position marked *cue off* the reels are disengaged from the drive mechanism, yet the tape is held tightly against the heads. This permits the reels to be turned slowly by hand to position the tape for editing.

The middle position of the knob is *neutral*, or off. The right position is for both *play* and *record*. But a safety interlock makes it necessary to push in a button at the same time the knob is turned to the right in order to record. The outer knob has three positions—for *off*, *rewind*, and *fast-forward*.

As for the KG-415's electronics, there are playback, mike and line level controls. (The line level control is for high-level input sources, such as an FM tuner or equalized phono.)

The KG-415 has a professional feature that lets you A-B the input and recorded signals. To balance the recorded signal level and the input signal level for headphone monitoring, there are source-level and playback-level controls. The former varies the level of the input signal and the latter controls the recorded signal level from the playback head.

In addition, there is a 3¾-7½ ips equalization switch and provision for sound-on-sound and echo effects. A master selector switch sets the operating mode of the amplifiers. That is, you set it to record or play stereo or to record or play mono on the left or right tracks. And, of course, there's a digital counter and automatic shut-off.

Our KG-415 met or exceeded all Knight's specs. At 7½ ips the left-channel play response was 3db down at 40 cps and flat within ± 1db from 70 cps to 15 kc. The right-channel play response was 3db down at 55 cps and flat within ± 1db from 80 cps to 15 kc.

As for the record/play response (which is measured by recording a signal and evaluating the output from the monitor head and monitor amplifier), frequency response was 3db down at 45 cps and flat within ± 2db to 18 kc. At 3¾ ips we found the response was the same as that claimed by Knight—flat within ± 2db from 50 cps to 15 kc.

Harmonic distortion (record/play mode) was 1½ per cent and crosstalk (play mode) was 52db down. The signal-to-noise ratio (in record/play mode, erasing a 100 per cent modulated track at 1 kc) was 48db for the left channel and 47db for the right channel—both only a shade under the 50db figure claimed by Knight. (Ours may have been a more severe test.) Flutter was inaudible.

The record bias must be set for the particular tape you are going to use. The setting is critical and affects both high-frequency response and distortion. Switch to another type of tape and the bias must be reset. Adjustment of both the record bias and erase currents is facilitated by a built-in 1-kc oscillator and step-by-step instructions.

Super-Speed Strobe

Continued from page 66

or SO3. Operation is the same as that of any other strobe but exposures are different. In order to achieve such high speed we've sacrificed light output. As a result, the power rating of the strobe is 5 watt-seconds.

The extremely fast flash affects film differently than does the longer flash of conventional strobes or flashbulbs. This means negatives will have less contrast. Thus, film should be developed from one and a half to two times the normal time for comparable contrast.

The photographs on the first page of this article were taken with a Rolleiflex and Tri-X pan film, using an ASA guide number of 20. The shot of the graduate was made with a piece of white translucent screen 6 in. behind the graduate. The strobe light was placed one foot behind the screen and the camera was 12 in. in front of the graduate.

The shot of the drop of milk was taken with the camera and light side by side 12-in. away. In both cases, the diaphragm was set at f.22. The film was developed in Microdol-X for about 22 minutes.

Life Goes On and On at 40

Continued from page 48

edge as well as the lighter, all-aluminum voice coil. Elsewhere, more sophisticated and accurate ways of controlling tolerances during manufacture have been devised, also contributing to better speakers.

The most dramatic change, however, has come not in the speaker itself, but in the box that holds it.

"Not long ago," says Scott's Brociner, "really enormous complicated and expensive horn speakers were considered necessary for reproduction down to 40 cycles. Today we can do better in a 2-cubic-foot cabinet."

One of the pioneers in cutting speakers down to size is Edgar Villchur of Acoustic Research. In 1955 Villchur introduced his now-famous line of AR speakers, in the process launching a controversy still not resolved.

High-quality, low-frequency speakers before the AR were of two types: the horn, a monstrous device of high efficiency dating back to the early days of the dynamic speaker, and the so-called infinite baffle assembly, another sound-maker enclosed in a huge box.

Both the horn and the infinite baffle use speakers in which the cone is supported by a springy mounting around its edge. When a signal pushes the cone away from the center, the springy suspension brings it back. Villchur designed a speaker that instead had a suspension so flabby it hardly could move the cone at all. Then he mounted the speaker in a small, airtight box. The springiness of the air trapped in the box was used to return the speaker to center.

This so-called air-spring or acoustic-suspension speaker not only *could* be housed in a small box, it wouldn't work unless it *was*. You won't be surprised to learn that even the acoustic-suspension idea wasn't new. For though Villchur was the first to build a commercial model, the concept was explained in a book by RCA's famous audio pioneer, Harry F. Olson, in the 1930s.

Villchur, of course, made sacrifices to get big performance from a little box. The price was efficiency. An acoustic-suspension system might take 20 watts to crank out the amount of sound that a high-efficiency horn would produce with a watt or two. And this brings up a crucial point: the real breakthrough in speaker design in recent years

[*Continued on page* 98]

Some plain talk from Kodak about tape:

The meat of the matter... and some boxing news

Undistorted output from a tape—as from any other link in the chain of audio components—is at the very heart of high fidelity enjoyment. Distortion (or the lack of it) is simple enough to evaluate in theory. You start out with something measurable, and you reproduce it. Everything added (or subtracted or modified) by the reproduction, that can be measured or heard, is distortion. Since most kinds of distortion increase as you push any component of your system closer to its maximum power capability, you have to label your distortion value to tell whether you did this while coasting or at a hard pant.

Cry "uncle"

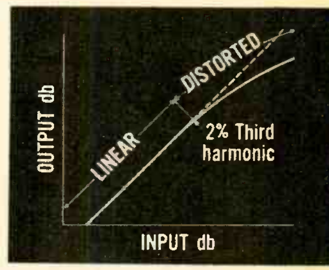
To make the distortions contributed by the tape itself big enough to measure and control, we simply drive the tape until it hollers "uncle" and use that power reference as our benchmark. Here's the procedure. Record a 400-cycle signal (37.5-mil wavelength at 15 ips) and increase its level until in a playback, which is itself pristine, you can measure enough 1200-cycle signal (third harmonic) to represent 2% of the 400-cycle signal level. This spells "uncle!" We use 400 cycles for convenience, but insist upon a reasonably long wavelength because we want to affect the entire oxide depth.

The more output level we can get (holding the reproduce gain constant, of course) before reaching "uncle," the higher the undistorted output potential of the tape. Simple, what?

"Wadayamean—undistorted output at two percent?"

That's what makes a Miss America Contest. Two percent third harmonic is a reference point that we like to contemplate for a picture of oxide performance. Since distortion changes the original sound, it becomes a matter of acumen and definition how little a change is recognizable. If you're listening, two percent is a compromise between a trained and an untrained ear. If you're measuring, it comes at a convenient point on the meter.

Because undistorted output helps to define the upper limit realism of the recording, the higher the undistorted output, the easier it is to reproduce the massed timpani and the solo triangle each at its own concert hall level. And this is just another area where Kodak tapes excel . . . our general-purpose/low-print tape (Type 31A) gives you up to 3 decibels more crisp, clean output range than conventional tapes.



2% third harmonic distortion represents the practical limit to linear recording.

The great unveiling—Kodak's new library box with removable sleeve!

Kodak tapes—in the five- and seven-inch sizes—now *look* as good as they sound. We've put the package identification on a removable sleeve and designed a tape library box with a smart new look. This new box features durable one-piece construction, full index space, plus detailed tape use instructions on the inside. *Kodak* Sound Recording Tapes are available at most electronic, camera, and department stores.

New 24-page, comprehensive "Plain Talk" booklet covers all the important aspects of tape performance, and is free on request. Write: Department 8, Eastman Kodak Company, Rochester, N. Y. 14650.

EASTMAN KODAK COMPANY, Rochester, N. Y.

Life Goes On and On at 40

Continued from page 96

didn't come in speakers at all. It came in amplifiers.

Years ago, amplifier power was limited sharply. Engineers, consequently, had to wring as much sound as they could from available audio power. Since horn speakers were the most efficient they were used almost universally.

High-power amplifiers now are commonplace and speaker designers can waste as much power as they like. This makes other important advances possible: Engineers, for example, can design extra-long voice coils that stick out of the magnetic gap on either end. No matter how far the cone moves, the gap still is full of voice coil. This technique wastes power but it also helps produce linear cone movement and a sweet sound.

And so the fight for fidelity reels onward. Though no one has altered the basic design of the dynamic loudspeaker in two generations, it remains undisputed champion. And as audio experts continue to refine and improve its performance, this fantastic sound-making machine, this fugitive from the 1920s, likely will stay on top for the forseeable future.

The Syncopated Metronome

Continued from page 79

put transistor Q6. The combination of these two pulses provides emphasis upon every second, third, fourth, etc. pulse as shown in Fig. 2.

● **The Accentuate Control.** To achieve compound times such as 6/8 and 9/8, extra emphasis is added to every sixth or ninth pulse, respectively. This is accomplished by closing S1 which adds the output of Q5 to the output of Q1 and Q3. Q5, like Q3, is also a staircase counter, and pulses are accumulated on C6 in the same fashion as they were on C3. Control R10, labeled *accentuate*, is adjusted to provide compound accentuation upon every sixth or ninth, etc. output pulse generated by Q1. Fig. 2 shows the relative pulse amplitudes for 6/8 and 9/8 time. An enterprising musician can achieve many other combinations of emphasis than those shown, for new and off-beat music. Good playing!

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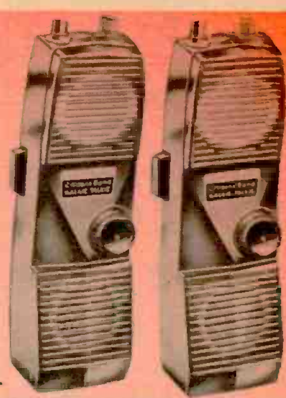

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Average No. Copies Each Issue During Preceding 12 Months: A. Total No. copies printed (net press run), 373,830. B. Paid circulation: 1. Sales through dealers and carriers, street vendors and counter sales, 128,479; 2. Mail subscriptions, 167,635. C. Total paid circulation, 296,114. D. Free distribution (including samples) by mail, carrier or other means, 2,244. E. Total distribution (sum of C and D), 298,358. F. Office use, left-over, unaccounted, spoiled after printing, 75,472. G. Total (sum of E and F—should equal net press run shown in A), 373,830.

Single Issue Nearest to Filing Date: A. Total No. copies printed (net press run), 378,009. B. Paid circulation: 1. Sales through dealers and carriers, street vendors and counter sales, 126,500; 2. Mail subscriptions, 178,140. C. Total paid circulation, 304,640. D. Free distribution (including samples) by mail, carrier or other means, 2,145. E. Total distribution (sum of C and D), 306,785. F. Office use, left-over, unaccounted, spoiled after printing, 71,224. G. Total (sum of E and F—should equal net press run shown in A), 378,009.

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

(signed) GORDON W. FAWCETT

Last Stand For Brass Pounders

Continued from page 51

telegraphy isn't dead yet. There are places where the best radiocommunication facilities available end up sounding like chowpy chowpy, chow-chowpy chow on the air. Machines clearly can't suffice under such circumstances. It takes warm-blooded people to pound out those chowpies, others to copy them.

For the foreseeable future, ships of all nations will communicate with each other and with shore by code. Reason is that ship radio installations by their nature basically are for safety and reliability. There still is no simple system that beats radiotelegraphy in this field. In the worst calamities, men have been able to lash together some means of getting out dots and dashes—even to the extreme of touching hand-held wires together.

Besides ships and government service, there are berths for licensed radiotelegraphers in communications stations, transmitter-tending and mobile and marine installation and service work. The need for brass pounders may recede but never quite disappear. Even so, we currently are witnessing the twilight of their era—the brass pounders' last stand.

Notes From El's DX Club

Continued from page 61

increase there will be a drop in the number of broadcast-band DX openings observed during the winter months. And though transatlantic medium-wave DX still will be possible, there will be fewer openings, particularly in April.

April also will witness a seasonal increase in short-skip propagation and this will result in more DX openings in the TV and FM bands than at any time since last summer.

Reception in the SWBC bands generally will be fair to good, except during periods of disturbed ionospheric conditions, which are at a maximum during the spring and fall months.

Best daytime reception will be on the 15-, 17-, and 21-mc bands. At night, reception from Europe and Africa will be best on the 6-, 7-, and 9-mc bands, while Latin American stations will be heard on 11 and 15 mc.

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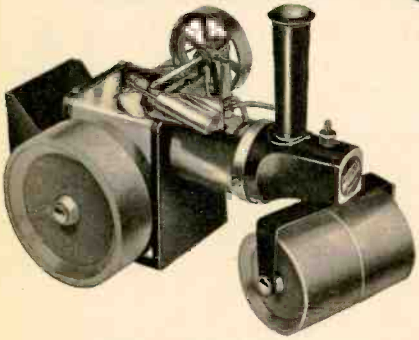

This is the workhorse companion to the traction engine. In construction and operation it is the same. The polished rollers and rear wheels are aluminum pressure diecastings. Axle caps are spring steel. It also develops 1/15 hp at 3000 rpms, and will also operate other stationary models. It is the forerunner of the present day diesel rollers, and is a real beauty. Made in England, $35.

Raises steam in 3 minutes, travels 1/3 mile in a 10-minute run, can be used to operate other stationary models

The English traditionally make fine models. This one, beautiful in gleaming brass and copper, has flywheel and other parts in green and red enamel. Everything works as original did in 1896. Brass steam whistle blows, cylinders and pistons are brass, steam pipes are copper, and fire box, scuttle, burner box, front forks, axles and shafts are of steel. You still see the old ones in the English countryside winching timber, hauling hay, and in stationary operations such as driving saws, threshing machines and the like. They were so versatile that specially adapted, they were even used as plowing engines in pairs, one either side of the field, winching the plow to and fro between them; in shipyards, they were fitted with cranes and were in fact the earliest type of mobile crane. It was a brute, and this is some toy! It develops a strong 1/15 hp at 3000 rpm, will haul a good size log, can be used to operate other stationary models. 1 ft. long. Uses alcohol. $35 and worth it!

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The Listener

Continued from page 34

which, as a matter of fact, aren't pink at all but white.

Under normal circumstances, one always should wait three months before sending a follow-up inquiry regarding a verification request. After all, large stations have tremendous volumes of mail to contend with; smaller stations often are short on personnel. Further, if your QSL is sent via surface mail, this, too, takes additional time.

Even after a three-month interval, it's advisable to ask yourself whether you really included enough program data to prove reception, though the question actually never should require asking. If the answer is yes and you can't draw up a second report based on fresh, up-to-date reception, only then should you send an intelligently planned follow-up.

Hi-Fi Today

Continued from page 52

R34, Stanton 800B, Thorens TD-150 and Weathers Townsend. Average price tag for the new generation of turntables is roughly $80, or about half what a top-flight transcription combination would have cost you in 1960.

If turntables are quieter than ever these days, so are tapes. Fact is, Ampex, Audio Devices and 3M recently have marketed new low-noise series of raw tapes; Ampex's is called the 500 Series, Audiotape's is dubbed Formula 15, while 3M labels theirs Dynarange and settles for 200 as a series number. According to 3M, the drop in background noise on their tape is such that you can record at 3¾ ips with the kind of fidelity once obtainable only at 7½ ips.

Audiotape says the intent is to provide a high signal-to-noise ratio under all recording conditions. As for Ampex, the claim of drastically lower noise seems well confirmed by the Ampex-processed prerecorded tapes I've heard over the past few months. Background noise on the best of the new commercial releases has dropped to the point where you can play them at threshold-of-pain volume with hardly a hint of tape hiss.

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CB Corner

Continued from page 56

plumping for 30-watt transmitters and the setting aside of two frequencies—27.235 and 27.245 mc—for HELP traffic.

At least one CB manufacturer already has announced a rig to meet the proposed power rating. The company is Squires-Sanders; the rig is Thor Eleven. Actually, the transceiver now can be used in the business band which overlaps the standard 27-mc channels. But it also indicates the company's confidence that HELP will loom large in highway communications.

Aside from crystal control on business-band frequencies, the receiver is tunable through the conventional Citizens Band. Its transmitter also can be equipped with crystals for the two proposed HELP frequencies.

If predictions are correct, prime users of this high-power equipment would be the nation's garages. The rig would provide them with a strong—30 watt—voice for communicating with the motoring CB public.


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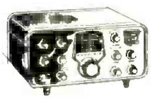

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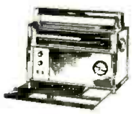

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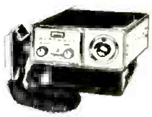

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