Special! 16-PAGE SECTION ON TAPE RECORDERS

ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED
JULY 1966 • 50¢

EXTRA! ☞ **Wayne (Nice Guy) Green, W2NSD/1, Becomes Our Ham Radio Columnist !!!**

BUILD A CHANNELIZED HAM TRANSMITTER

*TRANSLATION "Why don't you DX me sometime?"... and do it with EI's 1-transistor short-wave converter! See p. 29.

COMPARE. You'll find—as have tens of thousands of NRI graduates—that NRI training gives you more value. From the delivery of your first lessons in the remarkable NRI Achievement Kit we send you on enrolling, to "bite size" easily-read texts carefully programmed with custom-designed training kits . . . NRI can't be beat. Text for text, kit for kit, dollar for dollar —your best home-study buy is unquestionably NRI. (And NRI training costs you less than one semester's tuition at most colleges.)

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NOW 10 WAYS to Train at Home with the Leader

1. TELEVISION-RADIO SERVICING—Learn to fix black-and-white and color sets, AM-FM radios, stereo hi-fi, etc. A profitable field for part or full-time business of your own.

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4. FCC LICENSE*—Specifically designed to prepare you for First Class FCC Radiotelephone License exams. You begin with Electronic fundamentals, advance to required subjects covering equipment, procedures.

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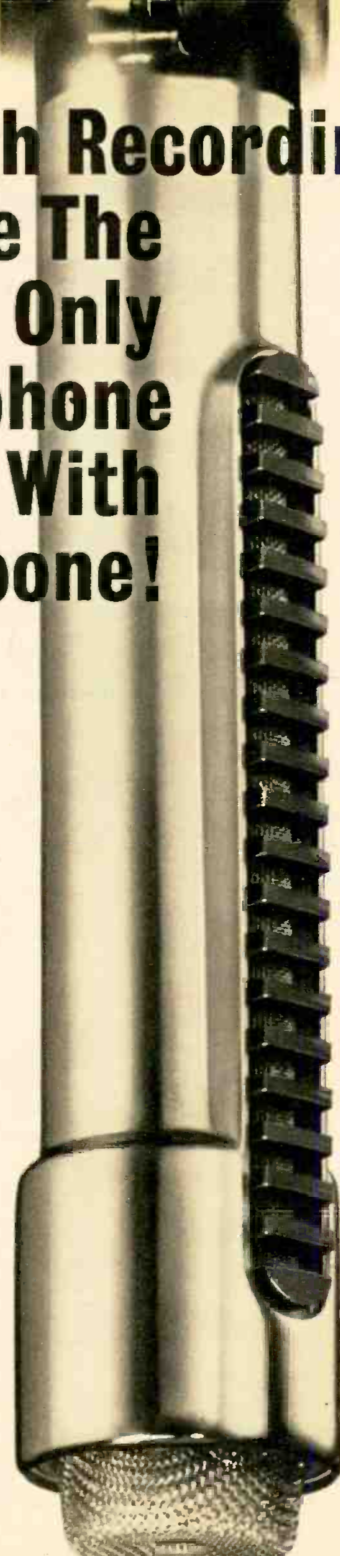
9. MARINE COMMUNICATIONS*—Covers transmitters, direction finders, depth indicators, Radar, Sonar, other equipment used on commercial ships and pleasure boats. Prepares you for FCC License exams.

10. ELECTRONICS FOR AUTOMATION—Not for beginners, but for men with some fundamental knowledge of Electronics who want an understanding of Automation. Process control, ultrasonics, telemetering and remote control, etc.

*NOTE: You must pass your FCC License exams (any Communications course) or NRI refunds in full the tuition you have paid.

For Tough Recording Jobs Choose The Only Microphone With Backbone!



ELECTRO-VOICE
MODEL 676
DYNAMIC CARDIOID

The backbone of the Electro-Voice Model 676 is no mere decoration. It's visible proof of the most exciting idea in directional microphones — Continuously Variable-D (CV-D)™.

And it takes a directional microphone to solve your tough recording problems: bad acoustics, audience noise, poor balance between performers.

Here's how CV-D works. We attach a very special tapered tube to the back of the microphone element. This tube automatically varies in effective acoustic length with frequency. It's a long tube for lows — a short tube for highs. All this with no moving parts! The tube is always optimum length to most effectively cancel sound arriving from the back of the microphone, regardless of frequency.

This ingenious solution* is years ahead of the common fixed-path designs found in most cardioid microphones. The 676 offers significantly smoother response at every point — on or off axis — plus more uniform cancellation to the rear. It is also less sensitive to wind and shock. There is almost no "proximity effect" . . . no boosted bass when performers work extra close.

Long life and smooth response are guaranteed by the exclusive E-V Acoustalloy® Diaphragm. And the 676 has unusually high output for a microphone so small. Of course you get dual output impedances, high efficiency dust and magnetic filters — all of the hallmarks of Electro-Voice design that have made E-V a leader for years.

But that's not all. The 676 has an exclusive bass control switch built in. Choose flat response (from 40 to 15,000 cps) or tilt off the bass 5 or 10 db at 100 cps to control reverberation, reduce low frequency feedback and room rumble.

Write today for complete specifications, or visit your E-V sound specialist's to see this remarkable new microphone. And when difficult recording problems must be faced squarely, stand up and fight back with the microphone with a backbone (and CV-D) — the new Electro-Voice 676 dynamic cardioid!

Model 676 Satin Chrome or TV Grey, $100.00 list; in Gold, $110.00 list. Shown on Model 420 Desk Stand, $20.00 List. (Less normal trade discounts.)

ELECTRO-VOICE, INC., Dept. 7621
622 Cecil St., Buchanan, Mich. 49107

*Pat. No. 3,115,207

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ELECTRONICS ILLUSTRATED

JULY, 1966 A Fawcett Publication Vol. 9, No. 4

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

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

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

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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.

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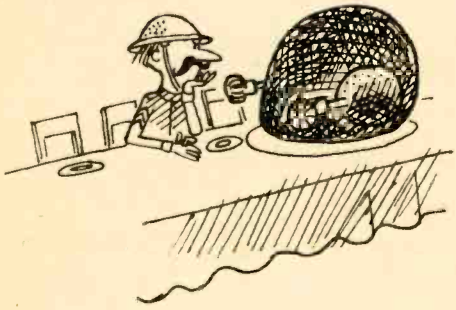
FEEDBACK

from our readers

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

SLIGHTED



I never knew about boondoggles and then I read what you put in your mag (CB's BIGGEST BOONDOGGLE, May '66 EI). Our Annual Ragchewers Reunion & Reminisce was worse. Not one RRRer except me showed up.

J.B. Brown
Bronx, N.Y.

Left you a lot to chew on, eh?

HO-HO HUES

Interesting, I think, that in the very story where you speak of tape coming up red and eagles coming up blue you should see fit to color your vulture green (THE FANTASTIC FLIGHT OF THE BLUE EAGLE, May '66 EI). One might think you have color TV on the brain.

C.C. Martens
Baltimore, Md.

SOLVED

I want to build your flea-power transmitter (THE FLEXIBLE FLEA, May '66 EI) only I can't find the tube. Can you tell me where I can get one? (It's a 6AK6.)

Paul Hahn
Reno, Nev.

The 6AK6 appears under the special-purpose-tubes listings in catalogs by Allied, Lafayette, Newark and other mail-order firms. Net price is about $1.40.

BOUQUETS

Thank you for sending me EI's DX CLUB's OFFICIAL COUNTRIES LIST (Jan. '66 EI). This list represents considerable work and you are to be congratulated.

H.L. Chadbourne
La Jolla, Calif.

MISSED

I would like to call your attention to an oversight in your report on the Knight-Kit KG-415 stereo tape deck (Mar. '66 EI). You state that no instructions are provided for installing the completed unit in the walnut base, though such instructions appear on page 12 of the Operator's Manual.

David S. Gunzel, Manager
Manual Department
Knight Electronics Corp.
Maywood, Ill.

We goofed. Sorry about that, Dave.

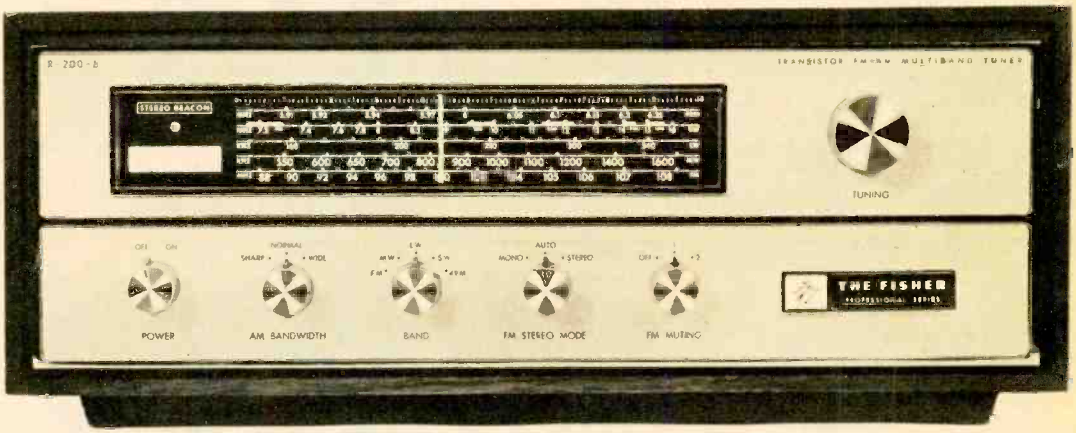
BOOM-BOMBED

Thanks to an article in your magazine, I now have an ultimate weapon against my frugging neighbors. The Dave Clark Five at 2 a.m. is a bit much so I built one of your little big boom boxes (BIG BOOM BOX, May '66 EI) and blasted them clear out of my hearing range with a lovely little ditty called Atom Bomb Sounds.

Arthur Silverton
New York, N.Y.

Direct line to the world

with the world's first high fidelity multi-band tuner.



No matter where in the world the excitement is, the Fisher R-200-B will bring it right into your living room. Noise-free and with pleasure. Because the R-200-B is the first multi-band tuner built to high fidelity standards.

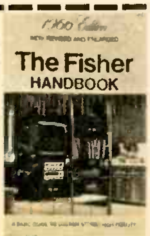
The R-200-B is an accomplished world traveler. With its three AM bands it can receive long-wave, medium-wave and short-wave broadcasts. Everything from local news and weather to live broadcasts from concert halls throughout the world. Wide-band for full concert fidelity, regular bandwidth for normal broadcasts, narrow-band to eliminate interference.

But the R-200-B is also an elegant stay-at-home. It includes a magnificent FM-stereo tuner with automatic mono-stereo switching and the famous Fisher STEREO BEACON* multiplex decoder.

Behind the remarkable Nuvistor front end, the R-200-B is completely solid state. And completely reliable. Because Fisher is the largest and most experienced manufacturer of high fidelity components.

You would expect a tuner this fine to be very costly. But the price of the Fisher R-200-B is surprisingly modest. Only $349.50. That's really not much to pay for a direct line to the world.

The Fisher R-200-B



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

FREE! $2.00 VALUE! Send for your free copy of the new 1966 edition of *The Fisher Handbook*. This revised and enlarged version of the famous Fisher high fidelity reference guide is a magnificent 80-page book. Detailed information on all Fisher components is included.

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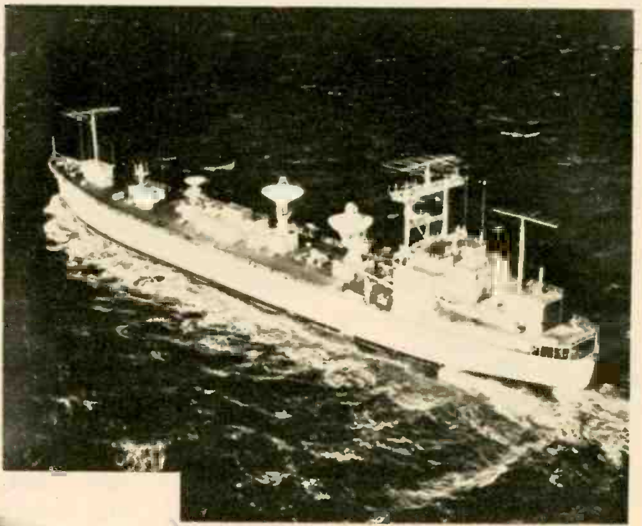
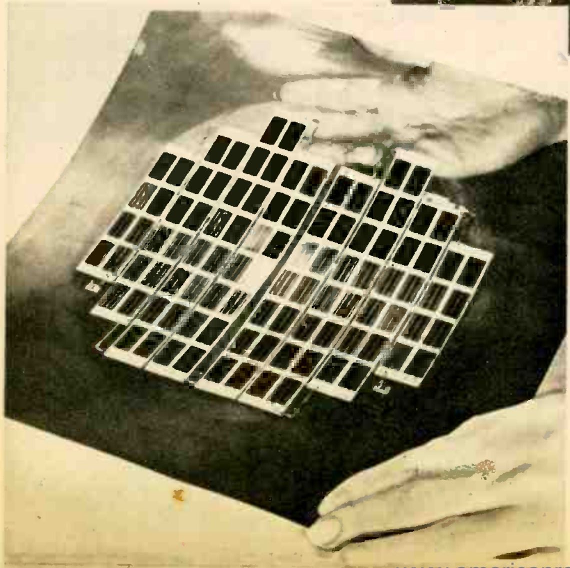
SPECK DETECTOR . . . With transistors becoming smaller than a gnat's toenails, the problem of detecting impurities in the materials used in their manufacture is cause for some head-scratching now and again. Faced with this perplexing situation, the people at a British subsidiary of ITT came up with the speck detector in our photo. Showing the nature, extent and position of impurities and magnifying them up to 500,000 times, the detector employs a high voltage to attract atomic particles to a screen (lower left) from heated specks of matter a mere 1/50,000th of an inch small.

...electronics in the news



Lunar Link . . . Designed to give the go/no-go order to an orbiting spacecraft on its way to the moon, the good ship Vanguard recently began her sea trials from the Quincy, Mass., shipyards of General Dynamics. Equipped with eleven major electronic systems, the Vanguard should have no difficulty tuning in on each little wiggle of a spacecraft and each flutter of an astronaut's pulse during the trip to the lunar surface. The would-be lunar link—first of three Apollo instrumentation ships—was formed from the bow and stern of a WW II tanker.



Slenderest Solar Cells . . . Weighing a mere 60 milligrams and measuring just .004 in. in thickness, the world's thinnest silicon solar cells now are producing energy from light. And if the people at Electro-Optical Systems have set a shrinking trend abrewing, hobbyists some day well may be able to paint nearly anything exposed to the sun with a coat of volts and amps. Though efficiency of the slender cells is less than that of their stouter counterparts, engineers have hopes of improving their performance.

...electronics in the news

Bottle Knocker . . . Many's the bottle that's given up the ghost with but one well-placed blow. To see why and how bottles break, the Glass Manufacturers Institute of New York rigs bottles with strain gauges and places them in an impact tester. The hammer on the machine in

our photo delivers blows to various points on the bottle while gauges record stresses and strains.

Future Phone . . . The dial goes up and down, not round and round. That must have been the theme Dr. Erich Haeussermann had in mind when he designed the telephone in our photo. A

West-German inventor, Dr. Haeussermann reasons that his telephone is an improvement over conventional types because of its redesigned dial. Thinking is that current telephones require a difficult-to-control twisting motion of the dial that causes an alarming number of mistakes. New scheme requires only a series of straight-line pulls.

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Model 232 Peak-to-Peak VTVM. A must for color or B&W TV and industrial use. 7-non-skip ranges on all 4 functions. With Uni-Probe.® **$29.95 kit, $49.95 wired.**

New Model 779 Sentinel 23 CB Transceiver. 23-channel frequency synthesizer provides crystal-controlled transmit and receive on all 23 channels. No additional crystals to buy ever! Features include dual conversion, illuminated S/RF meter, adjustable squelch and noise limiter, TVI filter, 117VAC and 12VDC transistorized dual power supply. Also serves as 3.5 watt P.A. system. **$169.95 wired.**

New Model 3566 All Solid-State Automatic FM MPX Stereo Tuner/Amplifier. "Very satisfactory product, very attractive price"—Audio Magazine. No tubes, not even nuvistors. Delivers 112 watts IHF total to 4 ohms, 75 watts to 8 ohms. Completely pre-wired and pre-aligned RF, IF and MPX circuitry, plus plug-in transistor sockets. **$219.95 kit** (optional walnut cabinet $14.95), **$325.00 wired including walnut cabinet.** UL approved.

Model 460 Wideband Direct-Coupled 5" Oscilloscope. DC-4.5mc for color and B&W TV service and lab use. Push-pull DC vertical amp., bal. or unbal. input. Automatic sync limiter and amp. **$89.95 kit. $129.50 wired.**

New Model 712 Sentinel 12 Dual Conversion 5-watt CB Transceiver. Permits 12-channel crystal-controlled transmit and receive, plus 23-channel tunable receive. Incorporates adjustable squelch & noise limiter, & switches for 3.5 watt P.A. use, spotting, & Part 15 operation. Transistorized 12VDC & 117VAC dual power supply. **$99.95 wired only.**

Model ST70 70-Watt Integrated Stereo Amplifier. Best buy of highest ranked stereo amplifiers according to independent testing. **$99.95 kit, $149.95 wired.** ST40 40-Watt Integrated Stereo Amplifier, **$79.95 kit, $129.95 wired.** ST97 Matching FM MPX Stereo Tuner, **$89.95 kit; $139.95 wired.**

Model 324 RF Signal Generator. 150kc to 435mc range. For IF-RF alignment and signal tracing of TV, FM, AM, CB and mobile. Built-in and ext. modulation. **$32.95 kit, $44.95 wired.**

New Model 753 The one and only SSB/AM/CW Tri-Band Transceiver Kit. "The best ham transceiver buy for 1966"—Radio TV Experimenter Magazine. 200 watts PEP on 80, 40 and 20 meters. Receiver offset tuning, built-in VOX, high level dynamic ALC. Unequaled performance, features and appearance. Sensationally priced at **$189.95 kit, $299.95 wired.**

FREE 1966 CATALOG

EICO Electronic Instrument Co., Inc. E1-7
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Send me FREE catalog describing the full EICO line of 200 best buys, and name of nearest dealer. I'm interested in:

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- ☐ ham radio
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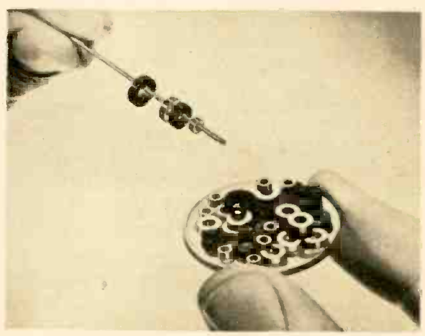
1945-1965: TWENTY YEARS OF LEADERSHIP IN CREATIVE ELECTRONICS

...electronics in the news

Final Stage . . . Though ITT's orbit-seeking satellite guidance and propulsion package may look like a model of a big-city office building, it's destined to look down on the earth rather than be planted on it. Our photo shows a technician

transporting a stand-mounted mock-up of the package whose solar cells look for all the world like the panes of No. 666 White Collar Row. Complete with satellite, the final-stage package will go into orbit after separating from a booster. Nestled under the aluminum-honeycomb skin of the high-flying unit will be two solid-fuel rocket engines capable of supplying enough oomph to orbit a 200-lb. payload.

Wee Washers . . . There's no getting around the fact that the transistor boosted the trend toward gnat-size components. Not to be outdone, many types of transformers took on a new space-saving form called a toroid. Part of the toroid's secret lies in its core, which gives these little



doughnut-shaped wonders efficiencies, permeabilities, frequency ranges and Q-figures conventional transformers can't duplicate. The half dollar in our photo reveals how far the people at Pittsburgh, Pa.'s Arnold Engineering have been able to shrink their toroid cores.

...electronics in the news

Cinemagic . . . Variously reported by news services and newspapers recently was something that sounded a mite too good to be true. According to the publicity, a gadget called the Robo-Pen

was supposed to have the magic power of taking dictation from anyone who simply spoke to it. But EI's sleuthing soon revealed that the Robo-Pen was less a pen of the present than of the future. Put together by the Parker Pen Co., the dictation-taking pen will be seen in a Stanley Kubrick film called 2001—A Space Odyssey, which will depict life as the film's script writer imagines it will exist 35 years from now.

ITEMS . . . Part 15 License-Free Banders—mainly children whose parents have given them walkie-talkies—have increased at such a rapid rate in recent years that they well may qualify for a population explosion all their own. Anyone tuning the 26.97- to 27.27-mc Part 15 band readily understands why these operators remain a problem to the FCC. Interfering not only with each other but with TV reception as well, Part 15ers even have been cautioned officially to stop use of profanity. Should such warnings prove insufficient, the FCC is empowered to put offenders off the air.

Electronics, being the versatile hobby and industry that it is, now is tackling the job of providing the resident doctors at Los Angeles County General Hospital with a dummy patient. Unlike other manikins, the dummy will respond to ten different drugs, have a pulse and, at appropriate times, dilate its pupils, open its mouth, extend its tongue and even change color. The computer-controlled dummy—an anesthesiological training aid—is being developed with the cooperation of Aerojet-General Corp. by the University of Southern California under a grant from the Department of Health, Education and Welfare.

EI Classified

Starts on

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ELECTRONIC MARKETPLACE

SNAP-LOADING . . . Shutter bugs lately have become acquainted with the advantages of loading cameras via a cartridge. Among the first portable tape recorders to incorporate

this convenience, the Wollensak 4100 makes loading literally a snap. The solid-state 4100—weighing only 3 lb.—manages even to sport capstan drive. $99.95. 3M Co., 2501 Hudson Rd., St. Paul, Minn. 55119.

Newsy . . . Like a news hot line, the FM Alert receiver keeps hobbyists a hop, skip and jump ahead of newspapers and broadcast stations. The

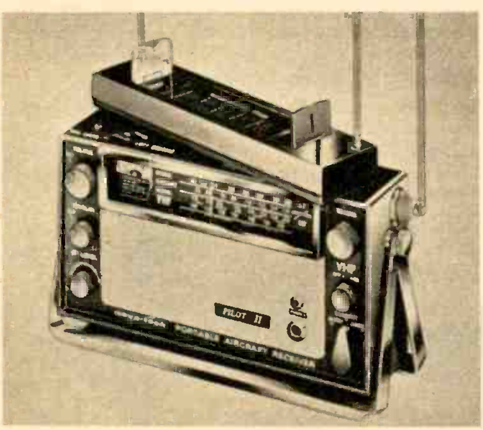
receiver's tuning range—30 to 50 or 152 to 174 mc, depending on model—is squarely in the middle of the action on fire, police and Civil Defense bands. $89.95, less speaker. Squires-Sanders, Inc., Martinsville Rd., Liberty Corner, Millington, N.J. 07946.

MARKETPLACE

Hybrid . . . The Raven CB transceiver comes in a handsome black-leatherette cabinet that'll match most any automotive interior, and the rig offers something unusual on the technical side as well. Its circuit employs both vacuum tubes

and transistors with a two-Nuvistor cascode front end that promises low-noise reception on all 23 channels. The receiver has a sensitivity of 0.2 μv for 10db of quieting; adjacent-channel interference is 80db down. Designed for mobile use, the glove-box-size Raven works off any 12-VDC source. $269. Browning Laboratories, Inc., 1269 Union Ave., Laconia, N.H. 03246.

Versatile . . . A portable receiver that doubles as a navigational aid, the Pilot II runs off internal batteries, external dry cells, regular house



current and even an optional solar pack while it tunes aircraft, marine, police and weather broadcasts in addition to the standard BCB. A rotating antenna and null meter make it easy to obtain bearings from most any signal source. $129.95. Nova-Tech, Inc., 1721 Sepulveda Blvd., Manhattan Beach, Calif. 90266.

MARKETPLACE

Convertible . . . Most unique feature of the SX-146 is the way it can be changed from an amateur-band receiver to a general-coverage rig. Addition of auxiliary oscillators converts the normally-ham-band-only SX-146 to a communi-

cations receiver tuning all the way from 3.4 to 30 mc, save for a small gap at 9 mc. Other features of the 9-tube, single-conversion SX-146 include a calibrator, switchable automatic noise limiter and a pre-selector. Outputs for headphones and an external 3.2-ohm speaker have been provided, as have crystals for the 80- through 10-meter amateur bands. $269.95. Hallicrafters Co., 5th and Kostner Aves., Chicago, Ill. 60624.

Regulated and S-Metered . . . An AC power supply for a CB rig seems a strange place to find an S-meter, but the people who make the Master power supply put it there, anyway. Purpose is to enable owners of the company's 23er and S5S CB transceivers to operate these normally

S-meter-less mobile rigs at the base. The unit's heavy-duty transformer, solid-state rectifier and regulator components supply 13.8 VDC; voltage variations are held to within ± 0.2 V even though input voltage ranges from 105 to 125 VAC. $39.50. Squires-Sanders, Inc., Martinsville Rd., Liberty Corner, Millington, N.J. 07946.

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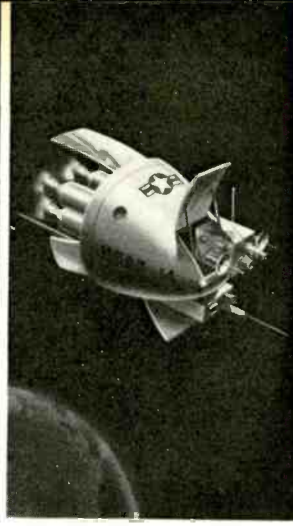

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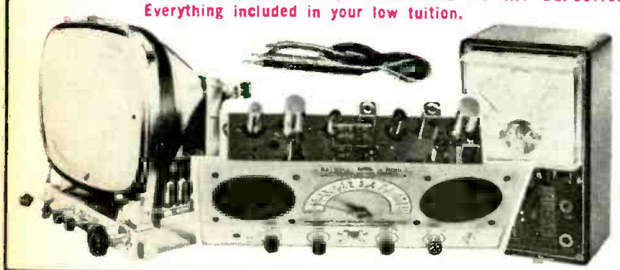

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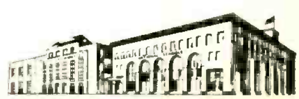

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MARKETPLACE

Compact . . . When it comes to CB jamborees and the like, people just don't respond to tonsils alone the way they do when a public-address amplifier helps with the talking. The PA-625,

a compact and mobile PA amplifier, lets bystanders know without a doubt that the man with the mike has something to say. This 4-lb., 25-watt solid-stater works on 6 or 12 VDC (positive or negative ground) and drives 4-, 8- or 16-ohm speakers. Price is $59.95. Lafayette Radio Electronics Corp., 111 Jericho Tpke., Syosset, N.Y. 11791.

Toneful . . . Even if an opera star volunteered to help check an audio amplifier by singing a crystal-shattering note into a microphone, the effort would be a waste of breath. A test instrument such as the EICO 378 audio generator sings

a mite better tune in this case. The 378—with a wider range than a soprano and a basso profundo combined and an almost limitless capacity for holding unwavering notes—provides 100 frequencies between 1 cps and 100 kc. $49.95, kit; $69.95, factory-wired. EICO. Inc.. 131-01 39th Ave., Flushing, N.Y. 11352.

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.

CRYSTAL SETS, Lionel train, other items. Will exchange for SW receiver. Don Bartone, 62 Mill Rd., East Longmeadow, Mass.

STEREO AMPLIFIER, turntable, other items. Will swap for 50-cc motorcycle and Army mine detector. Frank Kotil, 2235 S. Spaulding Ave., Chicago, Ill. 60623.

ADMIRAL record changer. Will exchange for tuner and/or speaker in enclosure. M. Nytransky, 22-14 23rd St., Astoria, N.Y. 11105.

WEBCOR 56-1 record changer, RCA headphones, other items. Interested in stereo, test and CB equipment. Kim L. Ground, 1620 Jefferson Blvd., Hagerstown, Md. 21741.

HALLICRAFTERS S-94 receiver. Will trade for 12-V CB rig or binoculars. James Shoemaker, 625 E. Vance St., Laurinburg, N.C.

TUBES, vibrators. Want ham gear. J.L. Jacobs, 2068 S. Kennison Dr., Toledo 9, Ohio.

HALLICRAFTERS HT-40 transmitter. Want saxophone or 8-mm movie camera. Bill Beveridge, 930 Evergreen, Amarillo, Tex. 79107.

KNIGHT Star Roamer, Ross tape recorder. Want SWL receiver and Heath Q-multiplier. Ronald G. Isaacs, 175 Hagaman St., Carteret, N.J. 07008.

KNIGHT Space Spanner, CPO with key. Will swap for anything of equal value. Ronald Hayes, Rte. 2, Grant, Ala. 35747.

R-27 Command receiver. Will swap for BC-453 or R-23 Command receivers. Mark Meyer, Box 346, Ipswitch, S. Dak. 57451.

REGENCY UHF converter, AIWA tape recorder. Will trade for FM tuner or SW receiver. J.D. Linton, G-1402 W. Downey Ave., Flint, Mich. 48505.

ATWATER KENT model 40. Need test equipment. Harald Mynster, WN6PSD, 2208 Beachwood Dr., Ceres, Calif. 95307.

ZENITH receivers and back-issue electronics magazines. Will exchange for DX bulletins and electronics magazines. Don Erickson, 24360 Myers St., Sunnymead, Calif. 92388.

WEBCOR wire recorder. Need disc recorder. Martin Balk, WB2SZW, 353 Webster Dr., New Milford, N.J.

TRIPLETT 310 VOM, walkie-talkie, other items. Interested in 2-meter transceiver and ham gear. Steve Morgan, 2415 Suffolk Ct., Dayton, Ohio 45420.

RADIO PARTS including early tubes. Want 78-rpm disc recorder. Kenneth M. Martin, Rte. 1, Hoyt, Kan.

PETERSON transmit CB crystals. Will swap for ham crystals. Bruce A. Heimlich, 8-09 Plymouth Dr., Fair Lawn, N.J. 07412.

COMMAND 80-meter receiver. Will exchange for 2- or 40-meter transceiver. Gustavo Albizu, Urb. Villa Contessa P-19, Bayamon, P.R. 00619.

KNIGHT Space Spanner, Royal typewriter. Want ham equipment. Steve Holmberg, 5700 York Ave., Edina, Minn. 55410.

HEWLETT-PACKARD 2020 low-frequency oscillator. Will swap for Knight R100A or HQ-100AC. John Harding, 24 Bertram St., Beverly, Mass. 01915.

POP RECORDS and albums. Will swap for Heath DX-40 or Knight T-60. Paul Mayo, 2409 Ocean Pkwy., Brooklyn, N.Y. 11235.

HALLICRAFTERS R-47 speaker. Will trade for headphones. George E. Matthews, 1304 Shannon Dr., Wadesboro, N.C. 28170.

LAFAYETTE HE-20C CB transceiver, Heath GW-30 walkie-talkie. Want Hallicrafters SX-140 or 2-meter receiver. Alton Sugg, 215 N. West Ave., Ayden, N.C. 28513.

GENERAL MC-6 CB transceiver. Will exchange for ham receiver. Robert Manson, 17 Summer St., Dover Foxcroft, Me.

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ELECTRONIC

SWAP SHOP

Continued from page 19

DECCA record player, chemistry equipment. Will trade for VHF receiver and ground plane antenna. P. Hicks, 11565 Richmont, Loma Linda, Calif.

TS-34/AP Navy surplus oscilloscope. Need CB transceiver or ham transmitter. Richard Adams, 2906 Poole Rd., Raleigh, N.C. 27610.

OUTPUT TRANSFORMER, TV rabbit ears. Need schematic for 11-tube, 550-kc to 16.5-mc E.H. Scott receiver. Marion Faris, Peconic Trailer Park, Box B-3, Riverhead, N.Y. 11901.

HALLICRAFTERS S-38 SW receiver. Will swap for anything of equal value. Jese H. Wessel, 405 S. Jefferson, Goldsboro, N.C.

KNIGHT C-100 CB walkie-talkies. Need tape recorder. Lee Harris, 512 W. 11th St., Juneau, Alaska. 99801.

MAYFAIR tape recorder, Lionel train set. Will swap for Novice 2-meter equipment. Steve Fetter, WN8-QBW, 378 Moull St., Newark, Ohio, 43055.

KNIGHT X-10 crystal calibrator. Want 2-meter converter. Dick Lochowitz, 2165 Fairhaven Blvd., Elm Grove, Wis. 53122.

HEATH CB-1 transceiver, other items. Want 2-meter gear. Rick Kirschbrown, WN6QHE, 4421 Worden Way, Oakland, Calif. 94619.

GENIAC computer. Will exchange for Heath CB-1 transceiver. Richard Beatie, 1904 E. 114th Ave., Tampa, Fla., 33612.

BC-455-BM Army surplus receivers. Will swap for record changer. Rex Townsend, 6215 Calle Redonda, Scottsdale, Ariz.

PE-73 24-V dynamotor, other items. Interested in SW receiver. Gregory Peacock, WA6IUX, 3082 Lake Hollywood Dr., Los Angeles, Calif. 90028.

ELECTRONICS COURSE. Will trade for walkie-talkie. Edward T. Zebrowski, 159 Walnut St., Holyoke, Mass. 01041.

CLARICON tape recorder. Want 4CX250B tube and air socket. Dave Joblon, WB2UEV, 2041 Raritan Rd., Scotch Plains, N.J. 07076.

HALLICRAFTERS S-120, old tubes. Will exchange for HQ-100A or books. Bruce Zuckerman, 3 Suburban Rd., Clark, N.J. 07066.

NOVICE transmitter. Will swap for SW receiver. Ralph Irace, 4 Fox Ridge Lane, Avon, Conn. 06001.

LAFAYETTE HA-70A walkie-talkies. Will exchange for Knight Ocean Hopper receiver. Steve Roy, 126 Thurber Ave., Brockton, Mass. 02401.

RADIO & TV servicing course. Will swap for 2-meter transceiver. Arthur Castrup Jr., Rte. 2, Bretz St., Huntingburg, Ind. 47542.

MAJESTIC SW receiver, Lafayette Explor-Air. Will exchange for Lafayette HA-230. Jonathan Oman, Rte. 2, Box 124A, Ironwood, Mich. 49938.

COMIC BOOKS. Will swap for Allied C-555 walkie-talkie. Gary Bennett, 1014 Pemberton Dr., Fort Wayne, Ind. 46805.

HALLICRAFTERS S-120 receiver, TBX-8 transceiver. Will swap for anything of equal value. Abraham Lung, 823 E. 147 St., Bronx, N.Y. 10455.

HALLICRAFTERS S40-A SW receiver. Want VHF receiver. William Wozniak Sr., 5215 Daley Pl., Gary, Ind. 46403.

KNIGHT Span Master, other items. Will swap for VHF receiver. Gary S. Lescota, 72 7th Ave., Newark, N.J. 07104.

ELDICO TR-75TV transmitter, old tubes, Thomson wattmeter. Want SW receiver. Alex Lukeman, 733 Huntington Ave., Boston, Mass.

ESSCO R/C receiver. Need Geiger counter. Carl Hartman, Box 57, Hinckley, Ill. 60520.

SIX-CHANNEL R/C rig, other CB gear. Will swap for GE or Motorola VHF equipment. Paul Brazil, 77 Fairfield Ave., Norwalk, Conn. 06854.

STANDARD ELECTRONICS boat transceiver with accessories. Want test equipment. Clayton L. Philbrook, Matinicus, Me. 04851.

MASCO 60-watt PA amplifier, APN-12 transmitter/receiver. Will trade for CB, test or ham gear. William B. Dopp, Glasco, Kan.

RF AMPLIFIER components including 100THs, coils, capacitors. Will swap for BC-455. Barney Linet, 2945 Euclid Heights Blvd., Cleveland Heights, Ohio 44118.

HALLICRAFTERS S-38 receiver, CB gear, other items. Need 2-speed tape recorder, aircraft radios. C. Bechtel, Box 813, Crystal River, Fla.

NATIONAL HRO communications receiver, Johnson 6N2 converter. Want Heath Sixer or Twoer. Kenneth Kaplan, WB2ART, 11 Babylon Rd., Merrick, N.Y. 11566.

POLAROID 150 camera, accessories. Want 15-watt amplifier, speaker, stereo-FM tuner, record changer. Harry Gursh, 2935 W. 5th St., Brooklyn, N.Y. 11224.

WALKIE-TALKIES, transistor tape recorder. Will swap for Novice transmitter. Sam Greb, Box 976, Frederick, Okla. 73542.

KNIGHT Span Master receiver. Will trade for Knight Star Roamer or Heath GR-91. Neil Klein, 700 Scarsdale Ave., Scarsdale, N.Y. 10583.

ZENITH Explorer receiver, Lafayette RK-142 tape recorder. Will trade for ham transmitter. Paul Dujmich, 1104 Prescott St., McKeesport, Pa. 15131.

KUHN 316A converter. Will swap for anything of equal value. J. J. Lamping, Box 92, Main Post Office, Warren, Mich.

RAY-TEL TWR-2. Will swap for reflex camera. John L. Harding, Rte. 1, Grant, Ala. 35747.

TUBES, walkie-talkies, other items. Want CB rig. Bob Francis, Lincoln St., Duxbury, Mass. 02332.

CAR RADIOS, BCB receivers, other items. Will exchange for test equipment or SW receiver. Steve Taylor, 4034 Proctor, Flint, Mich. 48504.

CAR RADIOS, Model-T ignition coil. Will exchange for test equipment. Thomas Mayfield, Box 446, Yarnell, Ariz. 85362.

HALLICRAFTERS CB-3A. Will swap for NC-121 receiver. Bill Mahaffey, Rte. 2, Ennis, Tex.

TELESCOPE. Will swap for anything of equal value. David Chamberlin, 1215 Stratford Ave., Nashville, Tenn. 37216.

OLD TUBES, parts. Want antique radios, diagrams, crystal sets. Stanley Bazylar, 8477 Eleven Mile Rd., Warren, Mich. 48093.

RCA 17-in. portable TV. Need tape recorder, 8-mm movie projector, FM tuner, other items. Dave DeMaw, 16 Prospect St., Meriden, Conn. 06450.

LAFAYETTE KT-320 receiver, HE-48 speaker. Want Knight T-150A. David Weintraub, WN2RSC, 29 Wyman Ave., Huntington Station, N.Y. 11746.

INSTRUCTION MANUALS for BC-610, VRC-2, BC-779. Want instruction manuals for Millen 90501 frequency standard, RMS DB22-A preselector. Howard L. Roberts, W7GOJ, 2108 E. 12th St., Cheyenne, Wyo. 82001.

NATIONAL 270, Elmac AF-67, PMR 6A, other items. Want SSB transceiver or transmitter. Roland Kulish, WN5LTV, 5075 Heisig St., Beaumont, Tex. 77705.

GE MS-2000 stereo amplifier, other items. Want 3-in. scope. Barry Goldman, 135-30 Grand Central Pkwy., Kew Gardens, N.Y. 11335.

KNIGHT T-60 transmitter, Lafayette HE-80 receiver. Will exchange for Drake 2B or equivalent. WA3CUJ, 2639 Waldo St., Harrisburg, Pa. 17110.

HALLICRAFTERS S-38 receiver, Western Electric push-button phones. Want stereo tape deck, preamp and stereo amplifier. George Cohn, 1614 E. 1st St., Tucson, Ariz.

HALLICRAFTERS S-120. Looking for Heath Twoer and PTT mike. David Burns, 20 Barbour Dr., Newport News, Va. 23606.

HALLICRAFTERS S-119. Want Heath GR-64. Steven Thibodeau, 20 Wyndemere Rd., Bloomfield, Conn. 06002.

HALLICRAFTERS HT-17 transmitter. Will exchange for 6-meter transceiver. Gary Albeck, 12 Dey St., Danville, Pa. 17821.

HALLICRAFTERS S-120. Will swap for anything of equal value. William F. Hall, 6146 Haverford Ave., Philadelphia, Pa. 19151.

KNIGHT R-100 receiver, Heath DX-60. Want ARC-5 transmitters, CB walkie-talkies or other gear. Brad West, 1208 S. Garner St., State College, Pa. 16801.

SURPLUS transmitter. Want Johnson Messenger I or II. Alan Cetel, 6001 Arden Ave., Highland, Calif. 92346.

KNIGHT Span Master. Will exchange for 30- to 50-mc receiver. George B. Kelly Jr., 1517 W. Firth St., Philadelphia, Pa. 19132.

REGENCY MR-33 receiver. Want Hallicrafters S-118, S-120 or tape recorder. Steve Smay, 2829 N. Missouri, Springfield, Mo.

FISHER 80C master audio control and 80AZ amplifier. Will exchange for tape recorder. Louis Frau, 5430 14th St., Hialeah, Fla. 33012.

PHILCO portable TV, Westinghouse hi-fi record player. Will swap for all-channel CB transceiver.

[*Continued on page* 23]

Hallicrafters' new CB-19 transceiver is about as sleek and trim and compact as an infantry boot.

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Now this "talk power" is yours for CB communication with the new Johnson Messenger "350" single sideband transceiver. The Messenger "350" will give you up to 30% more range than ordinary CB communication. Under severe skip and noise conditions, the "350" can deliver up to 3 times the range previously possible. Maximum legal power input with single sideband provides output equivalent to 3 times ordinary AM talk power.

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ELECTRONIC SWAP SHOP

Continued from page 20

Ron Lehlbach, 2506 W. Hamilton Ave., Tampa, Fla.

CAR RADIOS, amplifier, record player. Will swap for CB rig, 6-meter converter, ham equipment. Finis Gream, WA9PVN, Box 144, Bluford, Ill. 62814.

LAFAYETTE Big Ear listening device, dynamic mikes, phono amplifier. Will trade for Knight Star Roamer. Paul Jay Yudell II, 425 W. Sierra Madre Blvd., Sierra Madre, Calif. 91024.

HEATH DX-100 and Knight T-150 transmitters, Knight R-100 receiver. Want Hallicrafters SX-62 receiver. R. Smucker, Rte. 3, Box 42, Huntingdon, Pa. 16652.

HAMMARLUND HQ-129X, Heath Q-multiplier, Globe Scout 680-A. Want guitar amplifier, other items. David Ford, Box 546, Patagonia, Ariz. 85624.

LAFAYETTE HE-98, 30- to 50-mc FM receiver. Will trade for Sonar CB transceiver. James Worthington, 2 Grier St., Warminster, Pa. 18974.

EICO 740 walkie-talkies. Will swap for 6-Volt CB transceiver. Leon H. Cranson, Rte. 1, McGraw, N.Y. 13101.

THREE-ELEMENT BEAM for 10, 15 and 20 meters. Will trade for oscilloscope. Larry Sala, Box 801, Redmond, Ore.

WIRE-RECORDER and record-player combination. Will exchange for SW 30- to 50-mc receiver or typewriter. R. J. Monson, Rte. 1, Box 484, Lancaster, Va.

PACO C-20 resistance/capacitance bridge. Will trade for grid-dip meter. Stanley F. Schenfeld, 105-10 65th Ave., Forest Hills, N.Y. 11375.

TRITRONIC RX-127 Rangexpander, Knight 10-2 tester. Will swap for tape recorder or battery eliminator. Jerry Rathborn, 22 W. Main St., Alexandria, Ohio. 43001.

HALLICRAFTERS S-38E receiver. Will exchange for 6-meter receiver or power meter. Chuck Massie, 35 Sherry Dr., Syracuse, N.Y. 13219.

ARBORPHONE antique radio. Want bass guitar, walkie-talkies. Nick Szgatti, 21 Harold Ave., Welland, Ont.

RCA Senior VoltOhmyst, Judson electronic magneto. Want hi-fi equipment. John A. Kimm, 934 Judson St., Evansville, Ind. 47713.

B&O 53 ribbon mike. Will exchange for Winegard AP-375 FM booster and fittings. Bill McQueen, 1419 S. 14th St., Lafayette, Ind. 47905.

GE analog computer, RCA 45-rpm changer. Will swap for anything of equal value. Lee Pollack, 5054 Culver St., Skokie, Ill. 60077.

BOGEN Challenger PA amplifier, 1959 Ford auto radio. Looking for oscilloscope or signal generator. Fred Perman, 3690 Shore Pkwy., Brooklyn, N.Y. 11235.

KNIGHT Star Roamer, Heath GR-81. Will swap for ham equipment. Jimmy Atkins, WN4BGL, 141 Laura Ave., Winston-Salem, N.C. 27105.

JOHNSON Adventurer transmitter and Knight Ocean Hopper. Will swap for Globe DSB-100. Richard Stark, K7BON, 419 Russell Dr., Billings, Mont. 59102.

DAVID WHITE 35-mm stereo camera. Want test equipment. Henry Semp, All Angels Hill Rd., Wappingers Falls, N.Y. 12590.

EXPERIMENTER'S lab kit. Will exchange for SW receiver. Don Bartone, 62 Mill Rd., E. Long Meadow, Mass. 01028.

SYLVANIA 21-in. TV chassis, BC-457A transmitter, BC-455B receiver. Looking for Knight T-60 transmitter and ham receiver. Fred Holub, WV6TWH, 578 Buckeye, Vacaville, Calif. 95688.

EMERSON 560 portable radio, model train transformer, headphones. Will exchange for CB transceiver or walkie-talkie. Howard Lehrman, 113 Bergold St., Brentwood, N.Y.

KNIGHT KG-620 VTVM, Heath QF-1 Q-multiplier. Interested in Hallicrafters SX-101. Charles Vostry Jr., 143 St., Mokena, Ill. 60448.

HALLICRAFTERS S-72 four-band portable receiver, EMC test equipment, DM-28R dynamotor. Want AM/FM or SW receiver. Thomas A. Berry, Box 338, Lot 38, Niceville, Fla. 32578.

KODAK enlarger, contact printer, other items. Want Q-multiplier or preselector. Jerry Posner, 629 Sunset Rd., Teaneck. N.J. 07666.

HALLICRAFTERS S-38C receiver, 7 x 50 binoculars. Will trade for 2-meter transceiver. Alan Spitz, 99 Gregory Ave., Passaic, N.J.

LAFAYETTE HE-30 receiver. Will trade for tape recorder or CB transceiver. Owen R. Frager, 45 Ferncroft Rd., Waban, Mass. 02168.

TWO-METER, 120-watt transmitter. Will swap for Heath Apache transmitter, 2-meter transceiver or other ham equipment. Robert Bean, Box 541, Wilton, Me. 04294.

AUDIO GENERATOR, transistor amplifier. Will swap for neon transformer. Hank Lanford, Rte. 1, Woodruff, S.C. 29388.

ARGUS C-3 camera. Will exchange for communications receiver. John O. Hehn, 378 Main St., Little Falls, N.J.

WALL TELEPHONE. Will swap for SW receiver. Voyl A. Murphy, 133 Winston Dr., Williamsburg, Va. 23185.

WILCOX-GAY 3C10 tape and disc recorder. Will trade for anything of equal value. John Palencak, 3714 Keyes, Flint, Mich. 48504.

BARKER AND WILLIAMSON 426 low-pass filter. Want CB gear or stereo tapes. George N. Raybin, 1367 Sheridan Ave., Bronx, N.Y. 10456.

HALLICRAFTERS SX-62A. Will trade for portable radio. Walter E. Lee, Rte. 2, Elkton, Md. 21921.

BC-645A surplus transceiver. Want Heath Twoer or Sixer. F. G. Godfrey, 7240 Broadway, Fort Edward, N.Y. 12828.

WRL SB-175 transmitter, HG-10 VFO, power supply. Will trade for anything of equal value. James G. Doyle, 1403 Woodridge Circle, Hurst, Tex. 76053.

REGENCY ATC-1 SW converter. Stan Putra, 1429 Lawndale, Racine, Wis. 53403.

DRAFTING EQUIPMENT and drafting course. Will exchange for oscilloscope or other test equipment. Larry Griffith, 3010 Lillie St., Fort Wayne, Ind. 46806.

RCA color-TV course. Will swap for anything of equal value. N. H. Hoffman, 5120 Unaka Ave., Charlotte, N.C. 28205.

EICO CB transceiver. Will swap for 100-watt PA amplifier. Milford H. Zeiders, 391 Knickerbocker Ave., Brooklyn, N.Y. 11237.

LAFAYETTE HE-45b six-meter transceiver, Saturn 6 Mobilizer antenna, Lafayette KT-135 SW receiver. Will trade for 12-in. hi-fi speakers. Rob Gollihur, 871 Falesky St., Rahway, N.J. 07065.

FEDERAL enlarger, other photo equipment. Want oscilloscope, VTVM or other test gear. Bill Lee, 218 Sergeant, Joplin, Mo., 64801.

MERIT 1,000-V plate transformer, 811A transmitting tube. Want GE X4 and X1 SCRs, 2N2160 and other semi-conductors. Ron Sparks, 2472 A&M Ave., San Angelo, Tex. 76903.

Q-MULTIPLIER. Will exchange for 100-mw walkie-talkies or preselector. Richard Hardt, 8016 Taft St., Crown Pt., Ind. 46307.

BCB radios and tubes. Want Novice transmitter. Larry Horne, Rte. 1, Box 210, Iron City, Ga.

SURPLUS BC-604 and BC-684 with power supplies. Looking for EICO 720K, Ameco TX-62, Hammarlund HQ-100AC. John Harding, 24 Bertram St., Beverly, Mass. 01915.

KNIGHT T-60 transmitter, R-55A receiver. Need TV camera without Vidicon. Mike Ferguson, 939 Juanita Terrace, Prescott, Ariz. 86301.

JACKSON oscilloscope TV set. Will trade for color bar, dot and cross hatch generator. Diane MacKay, Drawer GGG, Wickenburg, Ariz.

HAMMARLUND HQ-129X receiver, Heath QF-1 Q-multiplier. Want Heath HW-12 transceiver. Bob Johnson, Box 2133, Southern Station, Hattiesburg, Miss.

ALLEN-DUMONT oscillograph. Will trade for ham gear. Lane Robinson, Box 37, Bastrop, Tex. 78602.

KNIGHT Ocean Hopper, Philco 37-10 receivers. Will swap for 35-mm camera, Craig TR-404 tape recorder or 7 x 35 binoculars. David Barlow, Rte. 8, Box 5, Roanoke. Va. 24014.

GE portable TV. Will trade for walkie-talkies. R.L. Wilkes, Rte. 2, Campbell River, B.C.

HALLICRAFTERS SX-99 receiver, Globe Scout 680 transmitter, other items. Will exchange for Clegg 99er or other SW or VHF equipment. Bruce Hildebrand, 6090 Upland Terr., Seattle, Wash. 98118.

HEATH GR-91 receiver, QF-1 Q-multiplier, walkie-talkies, other items. Make swap offer. Melvyn C. Rouse, Rte. 1, Box 313, La Grange, N.C. 28551.

KNIGHT T-60 transmitter, Heath VF-1 VFO. Will trade for Health Twoer with DC supply. O.B. Shore, WA9MVL, 277 Lakeview, Roselle, Ill. 60173.

KNIGHT Span Master receiver, KN-4515 desk mike. Want CB transceiver or test equipment. John Paida,

[*Continued on page* 24]

ELECTRONIC SWAP SHOP

Continued from page 23

2840 S. Kenneth Ave., Chicago, Ill. 60623.

HEATH GR-91 receiver. Will swap for a pair of CB walkie-talkies. Raymond Bock, 4827 Linwood Dr., Pontiac, Mich.

FISHER MPX-100 multiplex adaptor, Hallicrafters S-108 receiver. Looking for oscilloscope or CB equipment. Ron Pickenhelm, 5 Maple Ave., Highland, N.Y.

SURPLUS BC-455B and R4/ARR-2 receivers, power supply. Will swap for 2-meter rig. Stephen Weatherspoon, Box 134, Martin College, Pulaski, Tenn.

HEATH CB transceiver. Want Heath Twoer. Roger Attwell, WN7CYY, Rte. 4, Box 500, Everett, Wash.

RCA Senior VTVM. Need D-104 mike. Richard Mulhr, 1021 4th Ave., Gadsden, Ala. 35901.

HALLICRAFTERS S-38C. Will swap for ham gear. Roger L. James, Rte. 1, Centertown, Ky. 42328.

JOHNSON Messenger III. Will exchange for ribbon mike. Thomas Zoss, 1319 E. Washington Ave., South Bend, Ind. 46617.

HAM receivers (40 & 80 meters). Will trade for CB transceiver or a pair of walkie-talkies. Bob Chappel, 222 Columbia Ave., Meadville, Pa. 16335.

HALLICRAFTERS S-38B, Binolux binoculars. Will swap for other communications receiver. Stephen Falk, WB2UFN, 178-01 69th Ave., Flushing, N.Y. 11365.

LYSCO VFO, 4-65 transmitting tube. Will exchange for 80- or 40-meter receiver. Roy D. Lincoln, WA4DOU/4, 602 Southard St., Key West, Fla. 33040.

SURPLUS BC-342 receiver. Want CB or ham transceiver. John L. Chapin, Jr., K3TWJ/O, 3161 S. Yale St., Wichita, Kan. 67210.

HEATH Sixer, GW-11 CB rig. Will trade for grid-dip oscillator and Heath HO-10 signal monitor. Michael Lega, 234½ Ninth St., Jersey City, N.J. 07302.

CW TRANSMITTER (4-band). Will swap for 30- to 50-mc FM transmitter or tape recorder. Eric R. Olsson, 35 Ridge Rd., Wallingford, Conn. 06494.

SURPLUS test and ham equipment. Want Heath CB and ham gear. Stan Kasper, 1742 Petersburg Rd., Burlington, Ky. 41005.

DELTRONICS transistorized crystal calibrator, assorted tubes. Want transistorized tape recorder. Francis Merat, Frenchville, Pa. 16836.

LAFAYETTE HE-90 CB transceiver, Drake low-pass filter. Will exchange for Heath DX-60A or other ham transmitter. Mitchell Weinberger, 4 Stuyvesant Oval, New York, N.Y. 10009.

KAY K-102 electric guitar. Want Mosley CM-1 or SW receiver. Sam Champie, Box 73, Slidell, Tex. 76267.

KNIGHT Span Master receiver, Mayfair tape recorder, Realtone transistor radio. Make swap offer. John Kimble, 345 Fourth St., Winnsboro, S.C. 29180.

HALLICRAFTERS CRX-2 monitor receiver, B&K Cobra CB rig, M-81 antenna. Will swap for CB gear. Bill Marple, 7002 Abbottswood Dr., Palos Verdes Peninsula, Calif. 90274.

HI-FI equipment. Need SW receiver. J.V. Fulda, 5623 Clearspring Rd., Baltimore, Md. 21212.

SAM'S PHOTOFACTS (180 sets). Will swap for anything of equal value. Ben L. Seeber, 1510 Rose St., Irving, Tex. 75060.

TAPE RECORDER, transistor radio, other items. Want Knight or Lafayette aircraft-band receiver. Ronnie Dixon, Rte. 1, Box 110, Houston, Mo. 65483.

PHILCO SW/BC receiver (1930 model), old tubes. Want Heath Novice gear, 2- or 6-meter beam. Bill Sorsby, 1443 Springdale Dr., Jackson, Miss. 39211.

LAFAYETTE Explor-Air receiver. Will swap for anything of equal value. Gene Baldassari, 620 Kuser Rd., Trenton, N.J. 08619.

TRUTONE transistor tape recorder, car radios, other items. Make swap offer. Boyd L. Bartholomew, Rte. 1, Erie, Kan. 66733.

SILVERTONE tape recorder. Will exchange for signal generator, grid dip oscillator or other test equipment. Don Cohen, 2513 Bolch, Shreveport, La. 71104.

NATIONAL NC-77X, Ameco AC-1 transmitter. Will trade for 2- and 6-meter equipment. R. Stone, WB6OJA, 3017 Future St., Los Angeles, Calif. 90065.

KODACHROME 35-mm film (80 rolls). Will exchange for SW receiver. Dick Russell, 5201 49th St., Sacramento, Calif. 95820.

ASSORTED tubes and transistors. Will swap for anything of equal value. Ricky Southand, 1896 Rockville Dr., Baldwin, N.Y. 11512.

BROADSIDES

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

Many hi-fi buffs have need of a piece of furniture to store prized audio gear more attractively, and plans for a professional-looking **wall shelf** designed specifically for this purpose now can be had. For your copy, write Acoustic Research, Inc., 24 Thorndike St., Cambridge, Mass. 02141.

A 24-page booklet called What You Should Know About Laser Safety qualifies as must reading for any hobbyist interested in **laser** experimentation. Prepared by a company engaged in laser research, the pamphlet can be obtained by writing Martin Co., Orlando Div., Box 5837, Orlando, Fla. 32805.

The 28-page **Encyclopedia of Connectors** enables any electronics hobbyist in search of an electrical connector to find most any one he needs from among the hundreds of available styles and types. The catalog explains how connectors can be selected from a stock of six brands through one easy-to-use and fully explained code number. A copy can be yours on request from Spacecraft Components Corp., 14137 Chadron Ave., Hawthorne, Calif. 90250.

Before the tape buff knows it, gadgets like **tape editors, splicers and connectors** become necessary to get the most from a tape recorder and keep track of who and what are on which reel. Rounding up this gear can be a bit of a chore but catalog 659C makes it easy by presenting only accessories of particular interest to audiophiles. For your free copy, write Robins Industries Corp., Consumer Products Div., Flushing, N.Y. 11356.

Professional Electronic Projects—a catalog of enough plans and kit-style projects to burn up half a dozen soldering irons—should be of value to most hobbyists. Among the **165 projects** included in this ninth edition are such novelties as an auto skid warning device and a smoke detector. Copies are available for 25¢ from Henry Francis Parks Laboratory, Box 1665, Seattle, Wash. 98125.

The National Aeronautics and Space Administration now makes available a booklet describing design and construction of a device called an **electromagnetic hammer.** The report, numbered NASA SP-5034, may be obtained by sending your request and 25¢ to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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've developed an interesting idea which I think has commercial value. It's similar to a home tape playback machine, except it uses optical sound track recordings on motion-picture film instead of magnetized tape. I find that it offers better fidelity than regular tape, it can't be erased accidentally and the playback machine is no more complicated than a tape deck. How do I go about presenting my idea to a manufacturer?*

Terence Donlevy
Boston, Mass.

Sounds like you've got a worthwhile idea there, Terry. Hope you've got it patented because (in case you haven't noticed) we just presented it to the world.

★ *Here's a project for you to work on. I'm trying to find a device that will receive a radio frequency signal and re-emit it in the audible range.*

John Russell
San Jose, Calif.

What's wrong with a radio?

★ *I sometimes wonder if you give wise-mouth answers to questions because you don't know the proper answer and are only trying to get yourself off the hook.*

Arleigh Weldon
Elkins, W.Va.

Gives you something to think about, doesn't it?

★ **License Plate Dept.** I say shame on the state of New Jersey for being the only state still refusing to issue license plates bearing ham radio calls. Knowing a vehicle is owned by a ham operator has proven of value in many emergencies, and issuance of the plates also has become a way of saying thanks to hams for volunteering their equipment and services in the public interest. Most recent states to give out the plates were long-time hold-outs Massachusetts and New York; anyone know any way to pull the Garden State into line?

★ *I play a guitar in a small band and I'm trying to get a certain sound out of my amplifier. I'm looking for a fuzzy sound from the speaker to make my guitar sound like a saxophone. I heard this sound on Phil Baugh's One Man Band record, so I know it can be done.*

Richard Bambenek
Winona, Minn.

Try sax lessons.

★ *Thinking back, it seems to me I've been reading your articles for about ten years now. After spending all this time on your efforts, I don't feel that I know any more about electronics now than I did ten years ago.*

Hank Paul
Tulsa, Okla.

That makes two of us.

★ *I am interested in what would be the best device to use in a home to prevent radiotelephone operators from attempting to carry on a conversation with people while they are asleep.*

H. K.
Seattle, Wash.

Get an unlisted head.

★ *Perhaps you can help me locate a station I have been hearing on the short-wave bands. Judging from its call-sign I've really nailed a rare one. Only problem is that it isn't listed anywhere and the prefix is supposed to belong to the United Nations. My rarie is station 4UY26 heard on 16200 kc with CW transmissions. They pack a strong signal.*

Harlan Singleton
Babylon, N.Y.

I would think that they not only would pack a wild signal but also likely lift the headset off you, seeing that the station is only a few miles away from you in Centereach, N.Y. They operate on 16232 kc with 6,000 watts, beamed to Geneva, Switzerland. Don't let the weirdo call-sign fool you—these UN stations are all over the place.

★ *During the recent flying saucer scare, I was listening to a supersonic receiver at 71 kc. I heard some queer noises and something that sounded like people talking, only backwards. Can you explain this?*

L. S.
Los Angeles, Calif.

I was waiting for someone to write to me about flying saucers. They are nothing more than humbug and people that see, talk to, hear, smell or sense them are a few steps away from the funny farm. If anybody can prove to me that these things actually exist, I'll send a bottle of Jack Daniel's along with my retraction.

★ *My car is a 1960 Ford and I'm being radio-noised to death, both in my transistor broadcast receiver and in my CB rig. As soon as the engine starts up the racket is fierce. Everyone says that Fords are notorious for this. Any suggestions, O great white father?*

Sonny Jenssen
St. Cloud, Minn.

Start at the voltage regulator. Connect a 10-ohm, 1-watt resistor from the field terminal to ground. This might end your problems. If not, install a 500μf, 12-volt electrolytic capacitor between the generator's output terminal and ground (the negative lead of the capacitor goes to ground). Stay clear of those clip-on spark-plug noise suppressors. I always found that they cut down on engine performance. After listening to some of the trash being palmed off as music and some of the antics on CB, I personally feel the static might be a welcome relief.

Kodak
TRADEMARK

Plain Talk from Kodak about tape:

Giving your tape library a longer prime of life

How long can you keep a recorded tape? As of today, nobody knows for sure. Recording companies have tapes dating back to the late 1940s that are still in fine shape. Actually, the aging problem for tape is somewhat akin to the ones faced by movie-makers. Their problems are tougher, though . . . movie-makers have to worry about latent chemical reactions, greater mechanical strains, etc. And yet, we can see movies made more than a half century ago if the films have been given proper care and expert duping. Like photographic films, many audio tapes are made on acetate base. Ours is Kodak's famous DUROL Base, the stronger, tougher triacetate (we also make KODAK Tapes with a tempered polyester base for extra toughness or for long-play applications). Lab tests show that DUROL Base holds up as well as photographic film. So . . . tape wise, there's no reason your great grandchildren won't be able to enjoy your present efforts.

T.L.C. makes the big difference. Tender loving care is a must when saving anything worthwhile. The same goes for tapes. One obvious safeguard is to keep tapes away from strong magnetic sources like large electric motors or transformers which could demagnetize a recording.

Keep it clean. Tapes hate dirt just as much as regular records do. Thanks to sturdy, one-piece construction, Kodak's new "library décor" box helps keep dirt out... won't fall apart over the years as conventional tape boxes sometimes do. And this new box looks better. Play it clean too, of course. Clean your recorder heads, capstans, rollers and guides regularly with a cotton swab moistened with one of the commercial cleaners sold for that purpose. Use a degausser periodically to remove any magnetization of recording heads.

Keep it cool. Tapes should be kept away from extremes of temperature and humidity. High temperatures may affect the plastic support and increase the possibility of print-through...the transfer of magnetic signals from one layer of tape to the next.

Keep it "backwards". For truly valuable recordings, a good trick is to keep your tapes in the "tails out" format rather than rewinding them. The uneven winding induced in the tape by fast rewinding can cause physical warping of the tape over a period of time. Here too, you're better off with KODAK Tapes because KODAK 5" and 7" Thread Easy Reels are of dynamically balanced, one-piece construction. This gives you freedom from wobbles and pulsations on both "record" and "rewind" . . . keeps the tape under smoother tension . . . just what the doctor ordered for long tape life. The need for smooth winding can not be overemphasized.

Last but not least, it's a good idea to dupe your really old tape recordings onto fresh KODAK Tape in order to standardize on KODAK Tape quality. That's an interesting subject all by itself, and we'll try to devote a "Plain Talk" to it soon! KODAK Tapes on DUROL and polyester bases are available at electronic, camera and department stores. To get the most out of your tape system, send for free 24-page "Plain Talk" booklet which covers the major aspects of tape performance. Write Department 940, Eastman Kodak Company, Rochester, N. Y. 14650.

EASTMAN KODAK COMPANY, Rochester, N. Y.

1-Transistor Short-Wave Converter

Now you can DX the world's short-wave stations on any broadcast radio!

"COME up and see me sometime," Mae West once said. Thanks loads, Mae, but that invitation's so old it has a beard. Besides, our Japanese, Swedish and Spanish girl friends have given us a more modern challenge—to DX them. We've taken them up on it and found it much more fun—and stimulating, too.

And our gals have lots of friends in other countries who also keep asking us to DX them. Doubt it? Then build EI's one-transistor short-wave converter and find out for yourself. You'll be surprised at the number of female announcers there are on the air. And each one sounds more intriguing than the next.

EI's converter turns any broadcast radio into a short-wave receiver so you can tune from 5 to 15 mc—the most-popular short-wave frequencies. And you don't have to make connections or modifications to the radio since the converter *radiates* its output signal to the BCB radio. The converter includes a band-spread capacitor that opens up those crowded short-wave bands. A 9-V battery supplies power.

By
CHARLES GREEN
W3IKH

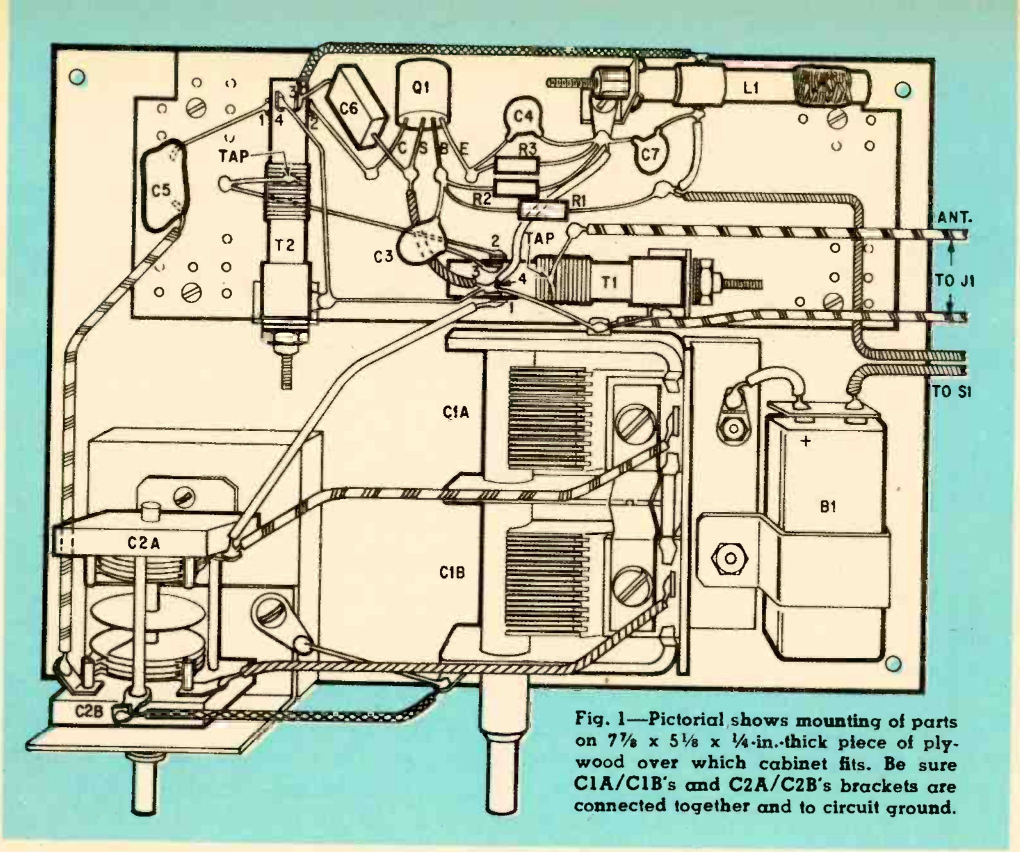

Fig. 1—Pictorial shows mounting of parts on 7⅞ x 5⅛ x ¼-in.-thick piece of plywood over which cabinet fits. Be sure C1A/C1B's and C2A/C2B's brackets are connected together and to circuit ground.

1-Transistor Short-Wave Converter

Construction

The converter can be housed in either a wooden cabinet or a commercially-made Bakelite box. The 8½ x 5¾ x 2½-in. cabinet shown on the first page of this article is made of ¼-in.-thick walnut veneer. The tuning (C1A/C1B) and bandspread (C2A/C2B) capacitors, battery and circuit board are mounted on a 7⅞ x 5⅛ x ¼-in.-thick piece of plywood which becomes the cabinet's base.

If you want to build your converter in the Bakelite box shown in Fig. 5, mount the aforementioned parts on the bottom of the box. The box's cover then becomes the top on which the radio is placed. The construction notes that follow are for the Bakelite box. Building the converter in a wooden cabinet is practically the same.

Begin by cutting a 6½ x 2¼-in. piece of perforated circuit board. Cut ⅜-in. squares out of two corners on one of the long sides, then mount all parts where shown in Fig. 1.

Drill and countersink four holes in the bottom of the box and mount the board with 1-in.-long flat-head machine screws to keep the board ¼ in. above the bottom of the box.

Tuning capacitor C1A/C1B is mounted with a 1¾ x 2¼-in. bracket made from a 2¼ x 2⅝-in. piece of scrap aluminum. After you make the bracket put C1A/C1B on the bottom of the box to determine the location

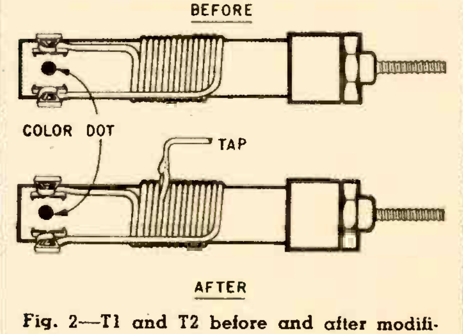

Fig. 2—T1 and T2 before and after modification for tap. (Fine-wire winding is not shown.) T1 is tapped three turns from left side of winding and T2 is tapped four turns from the left side of the winding.

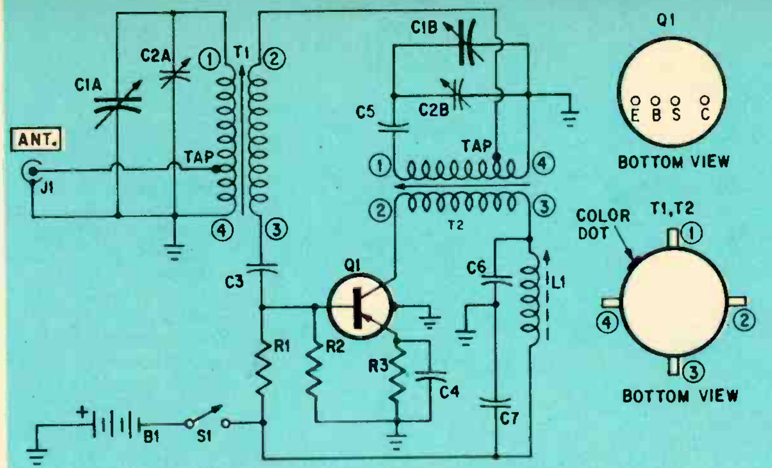

Fig. 3—Signal from antenna is tuned by T1-C1A and capacitively coupled to base of oscillator/mixer transistor Q1. T2, in oscillator portion of circuit, is tuned by C1B. As C1A/C1B are ganged, frequency of oscillation (above tuned signal) remains fixed. L1, which is in Q1's collector circuit, radiates the difference frequency to radio.

PARTS LIST

B1—9 V battery
C1A, C1B—10-365 μμf, 2-gang variable capacitor with 6:1 ratio planetary drive (J.W. Miller 565-8. Allied 60 J 088, $3.15 plus postage. Knob: J.W. Miller 565-26. Allied 60 J 089, 51¢ plus postage. Not listed in catalog)
C2A, C2B—3-15 μμf, 2-gang variable capacitor. Bud LC-1660 (Allied 13 Z 555, $3.30 plus postage. Not listed in catalog)
C3, C4, C7—.005 μf. 500 V ceramic disc capacitor
C5—5,000 μμf, 5% silvered mica capacitor
C6—470 μμf, 5% silvered mica capacitor
J1—Phono jack
L1—Loopstick antenna coil: Q=250 (J.W. Miller 6300. Lafayette 34 R 8705)
Q1—2N1180 transistor (RCA)
R1—5,600 ohm, ½ watt, 10% resistor
R2—2,700 ohm, ½ watt, 10% resistor
R3—1,000 ohm, ½ watt, 10% resistor
S1—SPST switch
T1—5.5-15 mc antenna stage RF coil (J.W. Miller C-5495-A. Lafayette 34 R 8751. Modified, see text)
T2—5.5-15 mc RF. stage RF coil (J.W. Miller C-5495-RF. Lafayette 34 R 8717. Modified, see text)
Misc.—6¾ x 5¼ x 2¼-in. Bakelite Box (Lafayette 19 R 2002), cover for box (Lafayette 19 R 3702), perforated board, flea clips, knobs, aluminum for brackets.

of the hole for its shaft in the front of the box. (Note: In the Bakelite box, C1A/C1B's plates will open only to 90 per cent of maximum. Don't worry about this. You still will be able to tune up to 15 mc.

Then drill holes in the bracket for C1A/C1B's three mounting screws and drill and countersink two holes in the bottom of the box for the bracket's flat-head mounting screws.

Next, make a 2 x 2-in. shield out of a piece of 3 x 2-in. scrap aluminum for C2A/C2B. This shield is required to minimize detuning from hand capacitance when you adjust C2A/C2B. Cut a ⅜-in.-dia. hole in the center of the shield for C2A/C2B's shaft bushing. Cut a hole in the front panel for C2A/C2B's shaft and slip the bushing through the shield *and* the cabinet. Do not use too much force when tightening the mounting nut or the box may crack.

Transformers T1 and T2 have to be modified as shown in Fig. 2. First, remove the 18-in. length of plastic-covered wire supplied on L1 and set it aside. Carefully unwind three turns of the heavy-wire winding on T1, starting at the end of the winding near lug 4. Cut off the unwound wire, discard it and solder a 1-in. length of #22 tinned wire to end of the remaining turns. Then solder a few inches of the plastic-covered wire removed from L1 to the same point. Wind three turns of the plastic-covered wire close together (in the same direction as the remaining turns of wire) around T1 to replace the three removed turns. Solder the wire to pin 4. Repeat the procedure for T2 but tap the coil at the fourth turn.

Make two brackets for mounting T1 and T2 and put solder lugs under each bracket's mounting screw. Put flea clips in the board under lugs 1 and 2 on T1 and T2 for added support. Solder lugs 1 and 2 to the flea clips. Solder nuts on T1's and T2's slug-adjustment screws to make alignment easier. Mount L1 on the board with the bracket supplied with it and put a solder lug under the mounting screw.

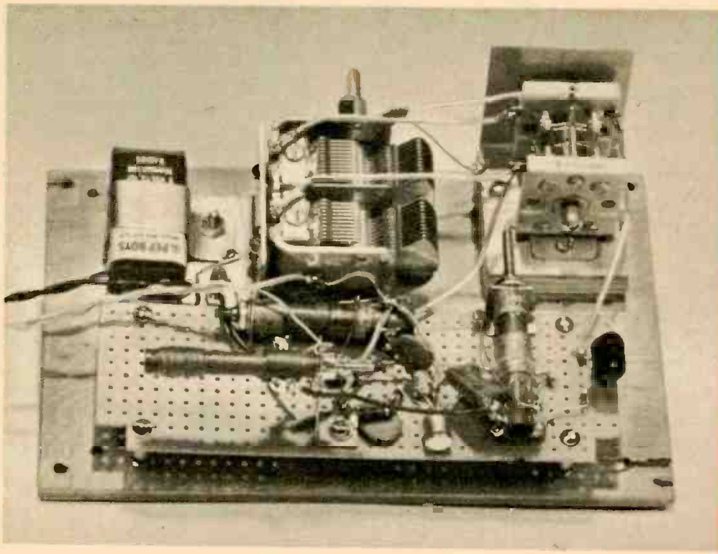

Fig. 4—Photo shows completed converter ready for installation in cabinet. C2A/C2B (right) is mounted on ⅝-in.-thick wood block so shaft will be on same level as C1A/C1B's shaft. Author's model originally was built in Bakelite box; hence, notches in corners of circuit board to clear corner posts in box. Mount L1 (lower left) high so it will be near the top of the cabinet.

1-Transistor Short-Wave Converter

Connect C1A/C1B, C2A/C2B, J1 and S1 as shown, keeping all leads short and direct. Bend a piece of aluminum around C1A/C1B's outer, or larger, shaft and make a pointer on the other end.

Alignment & Calibration

Turn T1's slug-adjustment screw so it's about ¼ in. out of the form. Turn T2's slug-adjustment screw so it's ¾ in. out of the form. Connect the hot lead of a signal generator through a 300-ohm, ½-watt resistor to J1 and connect the ground lead to J1's shell. *Close* C1A/C1B's plates and *open* C2A/C2B's plates.

Place a transistor radio near L1 and turn on the radio and the converter. Tune the radio to a quiet spot on the dial between 540 and 1200 kc. Set up the signal generator for a modulated output at the frequency to which the radio is tuned and adjust L1 for maximum volume from the radio.

Set the signal generator to 5 mc and adjust T1's and T2's slugs for maximum volume. Set the signal generator for 15 mc and open C1A/C1B's plates until the pointer is at approximately the same position as the 15-mc point on the dial shown on the first page of this article. Adjust C1A/C1B's trimmer capacitors for maximum volume. Repeat the 5-mc and 15-mc alignment and then calibrate C1A/C1B's dial with the signal generator.

Fig. 5—The 2 3/16 in. height of Bakelite box will prevent C1A/C1B's plates from opening all the way. However, unit will still tune up to 15 mc.

Operation

Write the converter's output frequency on the back of the cabinet so you can set a transistor radio to this frequency quickly.

You may be able to pick up signals without an antenna. However, for best reception, a 25-ft. antenna and a good ground are a must. To listen to short wave, put the radio as close to L1 as possible, tune it to the converter's output frequency and tune with C1A/C1B. To hear a particular station in a crowded band tune with bandspread capacitor C2A/C2B

HI-FI TODAY

By John Milder

✓ *Speaker stuff & nonsense*

✓ *Diversification ditties*

EVER so often, I run into someone who advocates—with perfectly straight face and evident conviction—the old saw that it takes a big speaker to produce big sound. And the chap making this solemn pronouncement invariably argues that proof is a matter of simple physics. Compare speakers and symphony orchestras, he suggests, and it's obvious that it takes a big speaker really to emulate a 105-piece ensemble.

About ten years ago, the same kind of theoretician listened to the first acoustic-suspension speakers. And though these jobs pumped out fundamental enough at 30 cps to make his knees buckle, he steadfastly denied with complex equations the simple evidence his ears were offering. His brand of Alice-In-Wonderland thinking couldn't survive too easily, so he eventually shifted to another (and current) proposition. Story goes that while a bookshelf speaker can reproduce actual bass frequencies full-strength, it can't reproduce the sensation of bass instruments, the breadth and sweep of the real thing.

If you've been exposed to this kind of theorizing, let me offer a few easy replies for the time you next run into it. First, *all* speakers—including the biggest in captivity—are small in comparison with the radiating surfaces of a symphony orchestra (or even three or four bass fiddles, for that matter). Second, the actual span in size between bookshelf speaker mechanisms and so-called big speakers is small; the biggest variable is the box the speaker is in, not the radiating area of the actual speaker diaphragm.

Third, and most important as far as I'm concerned, is that the breadth and sweep of a symphony orchestra isn't a function of bass at all. Instead, it's the highs that provide the air and the hall sound of recordings and these, of course, depend on the smallest of speakers, the tweeter.

In my own listening I alternate between a small acoustic-suspension speaker and one of those huge, full-range electrostatics. And if either sounds bigger on all-out orchestral material, it's the acoustic-suspension bookshelf speaker. (It strainlessly will reproduce levels that the electrostatic, due to amplifier limitations, will distort.)

Strong trend in audio these days is for manufacturers to make components other than their original specialties. Among the newest converts is Ampex, which now produces speaker systems and headphones (see cut) in addition to its line of recorders. Also on the diversification kick is Audio Dynamics (ADC), which began with pickups, added speakers and now is producing a transistor receiver and amplifier. These two join a list of make-practically-everything hi-fi manufacturers that includes, among others, Electro-Voice, Fisher, KLH, Scott and Sherwood. I think we have every reason to believe that we can expect more.

One of the things I've noticed about the new generation of transistor tuners is that practically all the better ones have beautifully steep limiting curves. This means that if the new tuners can get a station at all, they get it with an almost completely quiet background. Time was when many tuners with apparently good sensitivity ratings took an exasperating amount of signal to come up with a really listenable brand of reception. Those days, it now would appear, are gone forever.

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SPECIMEN

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THE HAM SHACK

BY
WAYNE GREEN
W2NSD/1

ABOUT THE AUTHOR

In his quarter-century as a ham, there's one thing W2NSD/1 has not done. That is sit quietly and watch the QSOs go by. Wayne Green is a vocal, unquiet doer who, more than nearly any other person, has in recent years wakened the amateur radio ranks and put new interest into a nodding hobby. What Wayne says often leads to controversy but he doesn't write or speak to be popular but for what he believes to be for the good of the hobby. With this issue W2NSD/1 becomes the Ham Shack's new proprietor. We welcome him. Wayne once was editor of CQ magazine and later founded his own magazine, 73, which he now publishes at Peterborough, N.H. He currently is DXing like gang-busters on 20-meter fone (200 countries in the last year), experimenting with a new antenna on 432 mc, working on 2 meters with a full gallon and 336-element beam, setting up a ham TV station and, when he's not busy, planning a DXpedition to Africa. Every so often he is known to ski, skin-dive, ride horses and drive fast sports cars. As we said, he's nobody's Grandpa Moses. And that's for sure.

MONEY . . . Is ham radio expensive? It can be. Others watch the dollars and achieve results with shrewdness rather than lavish applications of the checkbook.

The object, to me, is to put out a sizable signal. On most bands this means a kilowatt and a beam. I know—who can afford anything like that? Most anyone, that's who. The main thing is the desire to do it. Then you find the way.

Working out on CW isn't hard but sideband presents more of a problem. Probably the best bargain is the Heath HW series of transceivers at $120. If you shop the ham ads you can find them assembled for reasonable prices. Those in desperate straits can convert a junked AM rig to double sideband and few will notice.

You need a linear. These are in the ham ads or can be made easily.

The beam has to be up there about 70 ft. Towers cost $2 a foot. You can cut this in half with a TV tower but be sure to guy it. Or if you have contacts with phone or power people you may be able to big-deal a pole. If you have lots of lettuce they have delightful crank-up towers for only $1,000. Which would you rather have, leg muscles from climbing or arm muscles from cranking?

Quads can be put together reasonably and they do put out good signals. You probably will get a little more zap from a three-element beam but the $70 price tag means a lot of magazine subscriptions or whatever you do for hobby money. Do not settle for dipoles, verticals or such if you want an outstanding signal.

If you have the long green you don't do badly to buy new. This way you can use it for a couple of years and trade in for new

[*Continued on page* 110]

The scene at W2NSD/1 shows, up on the desk, a Galaxy V transceiver and remote VFO, TR-44 rotator by CDR, Waters patch. At lower left is a Henry 2K linear amplifier. Wayne says the globe was modeled from the original by some chap name of Hammond and a little old lady, Ma Bell by name, brought the telephone to his door late on a rainy winter afternoon and he couldn't tell her no. The desk was made from a dead tree, he claims.

SLOT-CAR LAP TIMER

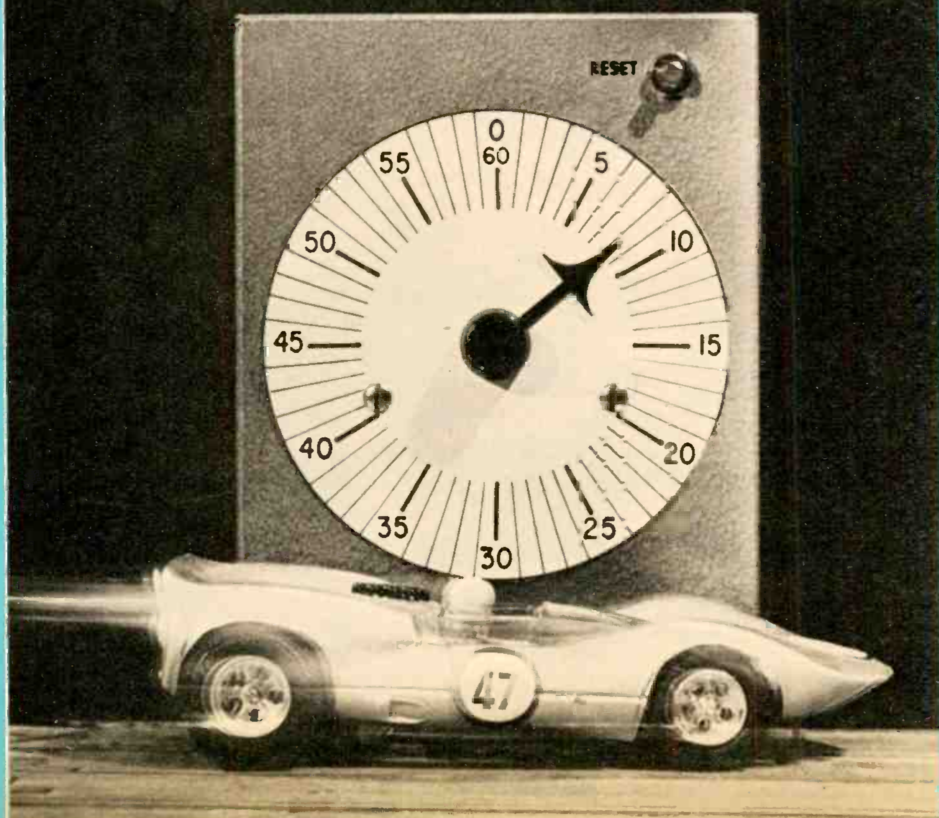
Now you can worry just like Jim Clark and Dan Gurney about how to get your lap time down to minimum!

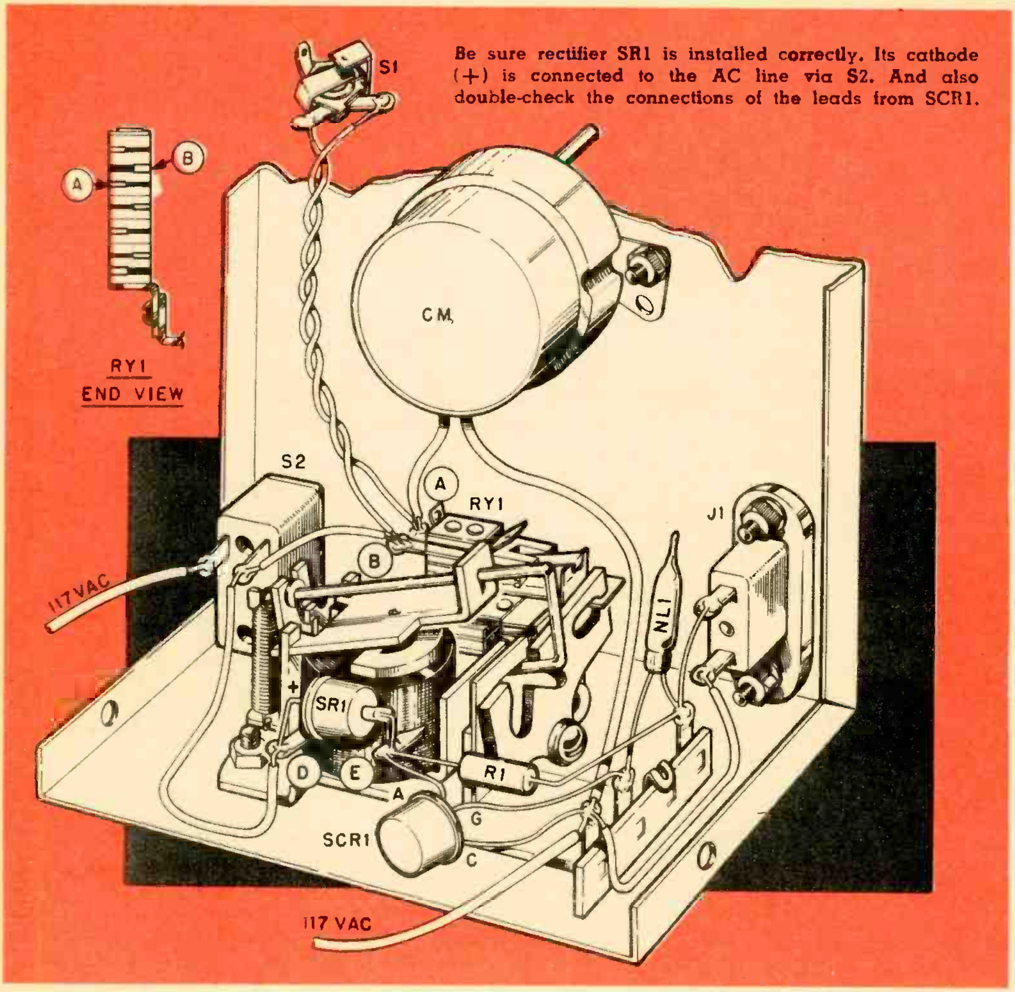
By AL TOLER

YOU could be running absolutely flat-out on your HO or 1/32nd track at home or wheeling with the best on the big banks at a slot parlor but all the soup-ups, tune-ups and skillful driving won't mean a thing unless you can *prove* it. And the way to do that is to race against an accurate clock.

You might win heat after heat but no one will know who really is the Jim Clark of the house until you use the same kind of measuring stick that they employ on the oval and road courses—lap times. Clark holds many lap records. So do Graham Hill and Dan Gurney. Who holds the lap record at your house or slot parlor? Now you can build EI's Lap Timer and find out!

While you *can* time slots with a stopwatch, the split-second pauses at the start and finish become a mighty large error when you consider that the average lap time is but a few seconds. But our timer is controlled by





SLOT-CAR LAP TIMER

the cars themselves—as on regulation tracks.

The timer starts when the car breaks the beam of light across the track. When the car comes around and breaks the beam again the timer stops. Since the timer is light-controlled, there are no mechanical connections to slow or throw the cars. In addition, the timer can be set up anywhere—curve or straightaway. Take it to a friend's layout or even take it down to your slot parlor on competition nights.

Construction

The timer consists of three units: control box, remote-pickup box and light-source box. All component values are critical. Do not make substitutions.

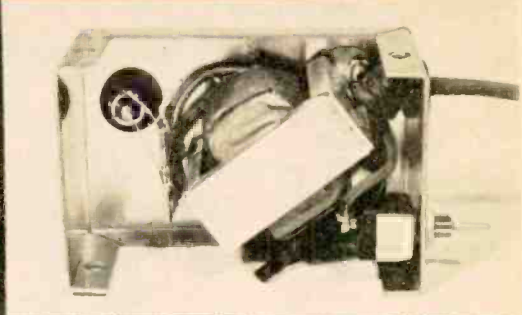
The control box is built in the main section of a 3 x 5 x 7-in. Minibox. You must mount impulse-relay RY1 on the bottom as shown. If it's installed on the side or the top RY1 may trip slowly—causing timing errors—or may not trip at all.

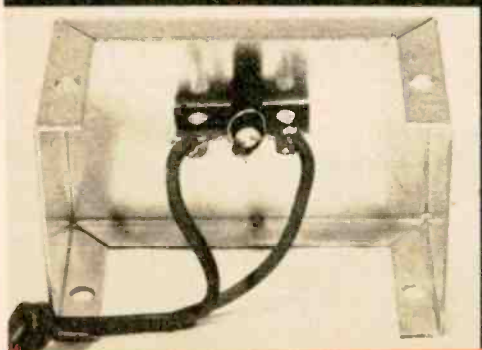
RY1 is supplied with two sets of DPDT contacts but only one set is used; it doesn't matter which as long as one lead is connected to the wiper (B in pictorial).

The specified clock motor (CM) makes a 360-degree sweep in 60 seconds; it was selected because it costs only $1.19 and because our car takes slightly less than one minute to get around our track. While a 60-second sweep will be adequate for many tracks, you

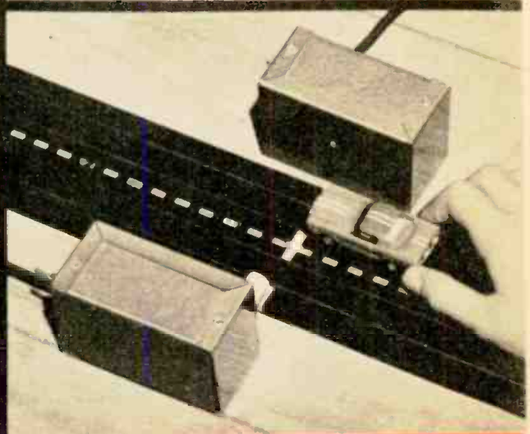
Interior of control box. Our motor was mounted 3¼ in. from top of 3 x 5 x 7-in. cabinet to allow room for a 4½-in. dial and for relay RY1.

Light-source box. Push pilot lamp through grommet so edge of lamp's base is flush with side of grommet. We added a switch for convenience.





Pickup box. Cover photocell with tape so tape extends ½-in. beyond cell's face. Fit cell through ¼-in.-dia. hole so tape protrudes ¼ in.



Light source and pickup boxes on track. Light from pilot lamp to photocell must be high enough to be broken by body, not just wheels.

might prefer a slower or faster sweep.

Motors are available which turn as fast as 1 revolution per second or as slow as 1 revolution in several minutes. The choice is yours and depends on track length and speed of your car. Our chart lists some other clock motors and their prices.

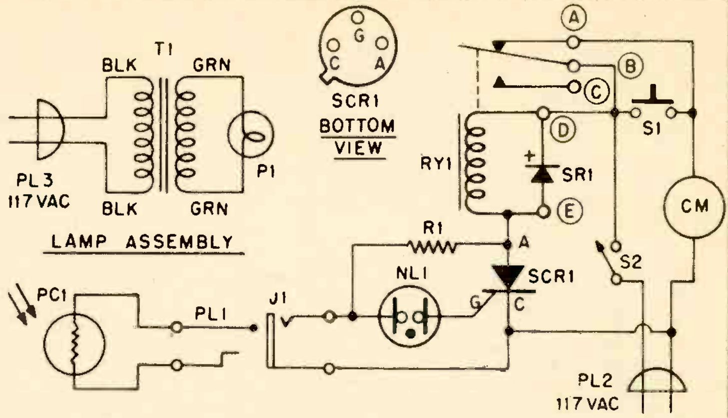
Position the motor in the cabinet so the largest possible dial can be used. Since the motors are equipped with only a shaft, drill a tight-fitting hole in a block of plastic or wood and cement it on the motor's shaft after the motor is installed. Draw a dial on a piece of stiff paper, glue the paper on the cabinet and then cement a pointer to the shaft block with epoxy.

The pickup box is a 3¼ x 2⅛ x 1⅝-in. Minibox. Place a car on the track and measure the distance from the *table*—not the track—to the center of the side of the car. Then drill a hole in main section of the Minibox the same distance from the edge. This is important because if PC1 is mounted too low the car's wheels will interrupt the beam and produce two pulses—instead of one—each time the car passes.

Drill a ¼-in. hole and then mount a three-lug terminal strip directly behind the hole. Wrap three turns of plastic electrical tape around PC1 forming a tube so that the face of PC1 is recessed ½-in. from the front of the tube. Then wrap two turns of tape around the back of PC1 so it is light shielded.

Position PC1 in the hole so only ¼-in. of tape tube protrudes from the front of the cabinet. Secure PC1 by wrapping several turns of wire around it, then solder the wire to the center lug of the terminal strip. Make

Schematic of light source is in upper left corner. Control-box circuit is at right. When beam of light on PC1 is broken by car, SCR1 fires, causing RY1 to trip and clock motor CM to start. Because RY1 is latching-type relay, its contacts remain closed after light beam comes back on. When car returns and breaks beam a second time, SCR1 fires and energizes RY1, causing its contacts to open and motor to stop.



PARTS LIST

CM—1-rpm clock motor (Olson Electronics MO-113). See text
J1—Phone jack
NL1—NE-23 neon lamp (Allied 7 U 950, 16¢ plus postage. Not listed in catalog)
P1—No. 47 pilot lamp
PC1—Photoconductive photocell; Clairex type CL-603A (Allied 7 U 462)
PL1—Phone plug
R1—100,000 ohm, ½ watt, 10% resistor
RY1—Impulse relay: 115 VAC coil, DPDT. Potter & Brumfield type PC11A. (Allied 76 U 500 or equiv.)
S1—Pushbutton switch
S2—SPST toggle switch
SCR1—GE type C6B silicon controlled rectifier. (Allied No. C6B. $2.07 plus postage. Not listed in catalog)
SR1—Silicon rectifier: 750 ma, 400 PIV. (Lafayette 19 R 4202)
T1—Filament transformer; secondary: 6.3 V @ 0.6 A.

SLOT-CAR LAP TIMER

the pickup box's connecting lead long so it can be located a distance from the control box.

The light-source box is the same size as the pickup box. Drill a ½-in. hole in the box the same distance from one edge as you did for PC1 in the pickup box. Then install a ½-in. rubber grommet and push P1, a No. 47 lamp, into the grommet from the *inside* so the base just touches the grommet. Solder T1's secondary leads directly to P1's base and the center terminal.

Checkout

Plug the pickup box into SO1. Turn on the light source and put it about 6 in. away from PC1. Then turn on the control box with S2. The clock motor may or may not start—it doesn't make any difference. Also, RY1 may or may not *click* when S2 is closed. If RY1 buzzes turn off the power and check to see that PC1's plug is making good contact in J1. If the connection checks out, look for a wiring error. (*Note*: RY1 will buzz if the light doesn't fall directly on PC1.)

Break the light beam with your finger. If RY1 fails to click in, check that SR1 is not installed in reverse and is not defective. If SR1 is all right and is installed correctly and RY1 still fails to operate, cover PC1 with your finger and see whether NL1 is glowing. If it is not, check the wiring of R1, PC1 and the SCR's gate (G) lead.

[*Continued on page* 116]

TIMING MOTORS

RPM	Sec. per revolution	Mfgr.	Price	Source
¼	240		$ .59	Olson Electronics MO-115
1	60	Ingraham	1.19	Olson Electronics MO-113
4	15	Hurst Type SM	10.68	Lafayette 30 R 3802
6	10	Hurst Type SM	10.68	Lafayette 30 R 3803
30	2	Synchron	4.95	* Herbach and Rademan HI-14
60	1	Synchron	4.95	* Herbach and Rademan HI-18
150	0.4	Synchron	4.95	* Herbach and Rademan HI-21

* 1204 Arch St., Philadelphia, Pa. 19107.

HIS RADIOS NEVER DIE!

Proud owner of what just may be the world's finest private collection of old radios, Milwaukee's Eugene Kerns lays claim to more than 100 sets from the days when grandpa was young. Every one of the vintage sets has been restored painstakingly to what Mr. Kerns refers to as speaking condition.

TIME-SIGNAL IDs . . . Most SWBC stations can plead guilty to over-modulating on time signals, which fact in itself is no cause for rejoicing. Thing is, this little quirk can prove a boon for hard-working DXers. For though a station doesn't become any louder when it over-modulates, it does spill over into adjacent channels. Such spill-over will be distorted and pretty well useless when the transmission is voice or music. But let a time signal over-modulate and the sound frequently will emerge reasonably clear and intact on nearby frequencies.

As a case in point, take the BBC's new relay at Francistown, Bechuanaland (put on the air especially for Rhodesia). It begins transmitting on 7295 kc at 2300 EST, a time when QRM on this channel in North America is horrendous. Such interference comes both from R. Free Europe and (mostly) from Communist jamming aimed at RFE. So heavy is the barrage that it usually blankets 7295 at 2300.

Fortunately, the BBC relay transmits six beeps every hour on the hour (the sixth occurs exactly on the hour). And these beeps, somewhat lowered in pitch, can be received under just average conditions on both 7290 and 7300 kc (see our illustration). Of course, merely logging that time signal doesn't make for a report; at least two more items would be required. But you'll know your target is there and this should spur you on to greater effort.

Incidentally, certain interval signals (identification chimes, bells and the like) also over-modulate and produce accurate patterns on adjoining frequencies. Further, a long interval-signal transmission, timed *exactly*, can be used to prove reception.

Another QSL Hurdle . . . Getting QSLs out of Latin American stations often proves a real challenge, though some approaches seem more fruitful than others. Understand, of course, that miracles are out of the question. Fact is, no matter what method(s) the DXer uses, he never will get anywhere near a 100 per cent return for a variety of reasons.

Best time to report is when a station first comes on the air, changes frequency or boosts power. Needless to say, this is when reception reports are appreciated most. Then, too, reports written in Spanish (Portuguese for Brazil) have a better chance than those written in English. Several clubs—the ASWLC, IRCA and NRC are three—will provide sample Spanish-language forms to members. Trouble is, all letters from members of the same club then will read exactly alike.

One way out is to put only program details in Spanish. They can be listed in the following manner:

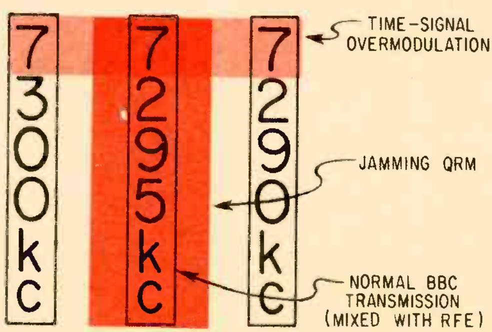
8.12—propaganda de Coca-Cola.

8.14—propaganda de Esso.

(Naturally, you'll need an English/Spanish dictionary if you're to know that *propaganda*, for instance, is the word for advertisement.) You also should add the following sentence in Spanish: *Me seria grato recibir de Uds. una tarjeta o carta confirmando mi recepcion de su emisora* (meaning, I would be pleased to receive from you a card or letter confirming my reception of your station).

Always send your reports via air mail and always include return postage—either via International Reply Coupons (obtainable at any post office) or uncanceled stamps (from a dealer) of the target nation.

If no reply has been received after three months, send another report. Should you be unable to pick up the station at that time, send a copy of your original report and add the following: *Hace algun tiempo le escribi una carta sobre le recepcion de su gran emisora. He esperado la contestacion, pero todavia no ha llegado, tal vez por extraviarse en el correo.* (Some time ago I wrote you concerning my reception of your fine station. I have waited for your reply, but it has not yet come, perhaps because it was lost in the mail.)



Time-signal over-modulation permits reception of BBC relay on 7295 kc, though station is on same frequency as R. Free Europe. See text for details.

THE DAY TAPE WAS BORN

By **BOB SWATHMORE**

TUESDAY, October 24, 1944, had been a cold, foggy day in London. And the wee hours of the 25th were, if anything, even colder and damper. But Jack Mullin, serving with the U.S. Signal Corps at a base just outside the city, probably didn't notice. The state of the weather also probably was lost on Ernst Haas, a technician working at Radio Frankfurt's temporary headquarters at Bad Nauheim, Germany. Each found himself far too caught up in more compelling matters to pay much attention to anything outside the window.

That morning, as on many other occasions, Mullin was tuned to Radio Frankfurt, fascinated by a concert of symphonic music which seemingly was being broadcast live. Catch was, who in his right mind would keep a symphony orchestra around at 3 o'clock in the morning simply to provide interludes to news broadcasts and the taunting words of Lord Haw-Haw?

(It then was much easier to tell when a program was canned. Standard procedure in those days was to cut a broadcast on a 33⅓-rpm, 16-in. acetate disc. Record surfaces 20 years ago weren't what they are today and the sound of a canned program could be identified even by an untrained ear. Sounds were tubby and there was plenty of background hiss.)

These were the exact sounds Mullin missed in the Nazi broadcasts. Too, Allied intelligence had been puzzled for some time by what seemed to be live broadcasts by Hitler from Luxembourg when he was supposed to be at a meeting in Nuremberg or from Munich when he reportedly was reviewing troops in Hamburg. Intelligence officers had used the same evidence Mullin had—the lack of hiss and muffled tones typical of transcriptions—to pinpoint Hitler's presence in the broadcast studio. But even Der Fuehrer couldn't be in two places at once—or could he?

Mullin thought no more about the 3 a.m. concert mystery until the following spring, when he was reassigned to Paris. His new job: to scour the battlefields after the Germans had been routed in search of electronic gear that might be of use to the Allies. Mullin was one of perhaps a score of engineers who were paired off in reconnaissance teams with instructions to send back two of everything of value they found. Such gear would be shipped to research facilities in New Jersey, where it would be checked and evaluated for possible use by the U.S. Government.

Until the teams began to cross into Germany pickings were slim. The Germans destroyed the studios of Radiodiffusion Francaise in Paris before pulling out and damaged as much equipment as they could preceding their withdrawals

THE DAY **TAPE** WAS BORN

from elsewhere in France, Belgium and The Netherlands.

But Mullin proceeded to follow the advancing Allied armies across France, into Belgium, into Luxembourg and eventually into Germany. Then, one day in July 1945—two months after the end of the war—his path crossed that of Radio Frankfurt technician Ernst Haas. Much had changed since that wartime morn when Mullin unknowingly had listened to Haas' airing of the 3 a.m. symphonic ensemble.

To escape Allied bombings Radio Frankfurt had packed up its microphones, turntables and personnel and beat a retreat 20 mi. north to the resort town of Bad Nauheim. There were no military targets in the vicinity and, so long as the Allies didn't learn of Radio Frankfurt's presence in an appropriated castle, the station was likely to be safe.

But Allied troops poured up the Rhine valley from France and overran the Germans. Before long, Haas' station had been taken over by the Armed Forces Network and the tones of Elmer Davis and Edward R. Murrow replaced Goebbels' diatribes. Where once the Munich Philharmonic played came now the sounds of Glenn Miller and Bix Beiderbecke. AFN announcers took over jobs deserted by their German counterparts and AFN technicians operated the controls.

In one room of the castle was found a big black box and a wall full of gadgets that went with it, though only one person still in Bad Nauheim understood what it was or what it was supposed to do. He was none other than Ernst Haas and he devoted the bulk of his time to maintaining the transmitter, the turntables and consoles and performing odd jobs.

That day in July when he ran into Haas, Mullin recalls today, was a warm one. Those Germans who could afford to and Americans who had the time were sitting outside cafes guzzling beer. Mullin had spent most of the morning touring the facilities at Radio Frankfurt but had seen nothing of particular interest.

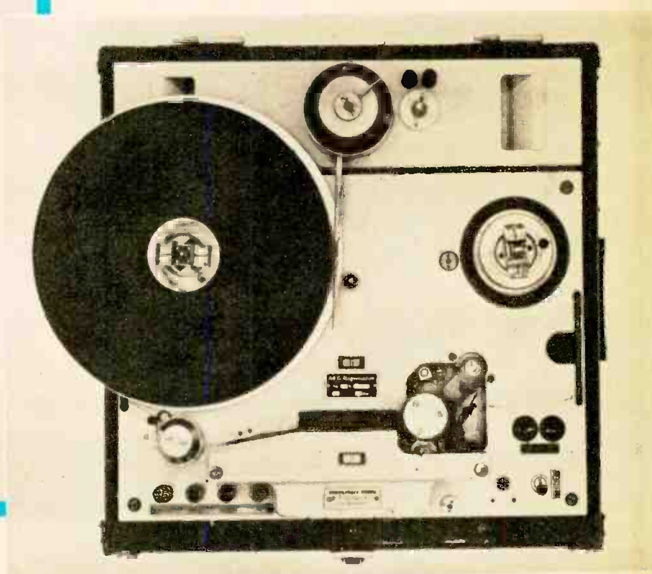
A whole symphony is frozen on this 1,250-ft. length of metal-coated paper tape, crowed the press in the days when tape was new. The date: April 1947.

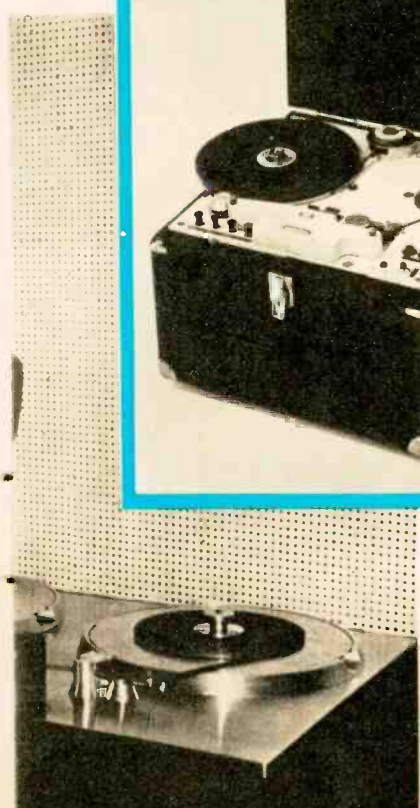
"Then," says he, "after a leisurely lunch we went back and they showed me the room with the black monster." Mullin asked what the gadget was for and Haas was brought in to demonstrate it. From one of the boxes along the wall he selected a reel and placed it on one of the arms of the machine.

"He pressed a button and a whole new world opened up for me," Mullin says. "The tape he had selected was one of those symphonic broadcasts I'd been listening to in London. It had life, color . . . just like a live performance."

In a sense, the finding of the first operating Magnetophon, that day in July 1945, was the beginning of tape recording as we know it. To be sure, magnetic recording dates from 1899, when a Danish inventor and electrical engineer, Valdemar Poulsen, filed a patent claim for a workable device using the then-new principle. Poulsen's invention, however, employed steel wire. To improve sound quality, Poulsen added DC bias in 1907. From that point until Marvin Camras experimented with AC bias on wire recorders during World War II, there were few basic changes in magnetic-recording devices.

The few changes there were came from such German firms as AEG and I.G. Farben, the latter succeded by Badische Anilin und Soda Fabrik (BASF). In 1931 the Germans developed the Blattnerphone, which the BBC promptly acquired for on-the-air tests. As BBC engineer Linton Fairchild recalls, "The Blattnerphone looked like two ancient Irish spinning wheels joined together—and from one to the other ran the recording tape made of steel and 6mm wide. The machine arrived at the BBC studios in the care of a German engineer, Von Heusing by name. There was only one machine, there was only one engineer and both were extremely temperamental. We knew that what is important in





All modern tape recorders are direct descendants of the amazing Magnetophon (above), perfected in Germany during World War II and first demonstrated to a U.S. audience by Jack Mullin of San Francisco's W.A. Palmer & Co. in 1946. Ampex, a small electric-motor manufacturer founded in 1944, displayed the first U.S.-made tape recorder in the summer of 1947. Photo at left shows a smiling Jack Mullin (left) standing before the original Ampex 200 while Murdo MacKenzie, production manager for the machine's initial customer, singer Bing Crosby, looks on.

THE DAY **TAPE** WAS BORN

recording is that the machine should run at the same speed when it is being played back as it does when it is recording. This the Blattnerphone flatly refused to do."

Editing the steel tape or wire was difficult. Both types of machines used DC bias, which restricted frequency response sharply. And both were subject to print-through (leakage of the magnetized signal from one coil of wire to the next, or one layer of steel tape to the next). So both types of recording were limited to dictating uses or information storage. And because American forces also had been using lo-fi wire recorders there was little interest in the wartime discovery of what the Germans called a Tonschreiber (though this device did use plastic tape).

But the Magnetophon was another story. When Mullin got back to Paris he found that other teams had turned up Magnetophons and bits of Magnetophons as well. The Signal Corps, following its practice of saving two of everything, proceeded to scrap the extras. Mullin went to work on the scrapped units with the aid of a patched-up instruction book. In a few days, he had reduced two scrapped recorders to a pile of parts which easily could be packaged and mailed home.

Journal of the Audio Engineering Society

Now employed by the 3M Co., Jack Mullin recently was given the Emile Berliner Award for his role in introducing the German Magnetophon to the U.S.

By the time Mullin had been mustered out and returned to the States all of his Magnetophon parts and tapes had arrived. He spent his first few weeks of civilian life reassembling the machines and experimenting with them. Then, late in 1946, he was ready to demonstrate his recorders for the Institute of Radio Engineers (now the IEEE) at a San Francisco meeting.

That meeting was to be nearly as important to Mullin as his brief encounter in Germany with Ernst Haas. For in the audience was a product engineer named Harold Lindsay, who was searching for something his company, Ampex, could make now that the war was over. When he heard the sound from the Magnetophon he became as enthusiastic as Mullin himself. And a Bing Crosby staffer saw in the machine the answer to an immediate and pressing problem.

Like Jack Benny, Bob Hope, Fred Allen and other stars of that period, Crosby found himself broadcasting the same script live twice and sometimes three times—a monotonous, time-consuming practice at best. Performers might begin broadcasting live from a Hollywood studio at 6 p.m., then (because of the time differential between East and West Coasts), repeat the program at 9 p.m. for West Coast listeners. Many even were forced to do a third show at 7 or 8 p.m.

Significantly, the fledgling American Broadcasting Company had persuaded Crosby to leave NBC and join it by permitting him to go on the air canned—that is, the show could be recorded at his convenience, then played on the air at the appropriate times. Crosby's engineers used conventional 33⅓-rpm acetates to record, say, an hour and 30 minutes of program, then cut it down to an hour in the only way they knew—by dubbing from one disc to another. Trouble was that the original lacquer disc had the distinctive canned sound and each subsequent dubbing only increased the canned quality.

Crosby's sponsors, concerned about the inferior sound quality of the show and its possible effect on ratings, specified that if ratings dropped below a certain level Crosby would have to go back on the air live. Mullin's Magnetophon appeared at a point when Crosby's ratings were sagging dangerously near the cutoff point.

[*Continued on page 113*]

A PRO TAKES A LOOK AT CONSUMER TAPE RECORDERS

New York's Robert Gaulin has spent almost his entire career with tape and tape-recording equipment (our photo shows him with an Ampex 350 at Magno Sound, Inc., where he is employed). It is this lifelong association with professional recorders that eminently qualifies him to speak his mind on machines in the consumer field.

EVERY YEAR dozens of magazine articles tell you how to buy or what to look for in a tape recorder. Almost without exception these articles are prepared by professional writers, men who earn their keep by stringing words together, and sometimes by rewriting each other's articles. They almost never seek the advice of a man who makes his living from tape. I can tell you things look mighty different from the pro's side of the table.

When you come right down to it, a tape recorder is something like a car. There was a time when a car was merely a gadget that got you from here to there. Then manufacturers got the idea of adding fins and chrome. The cars didn't get you from here to there any faster with fins and chrome but Detroit sure did sell a heck of a lot of cars.

By the same token, a tape recorder is supposed to be a mechanism that pulls a strip of plastic coated with iron rust past an electromagnet which puts sound on the tape. But somewhere along the line manufacturers discovered a world of wondrous things—sound on sound, automatic reverse, four-track stereo. They didn't get sound on tape any better but they sure sold a lot of machines. Ever since, the tape-recorder industry has been particularly susceptible to gadgetry. Almost any luxury item is subject to gadgetry and a tape recorder (in the home) is largely an oversold luxury. What are some of these gadgets? Which ones do you really need or, to put it another way, which can you do without?

A PRO TAKES A LOOK

It's true that many people buy tape recorders for specialized purposes and require specialized features. A businessman may need a recorder that is small and light, has remote controls and can be used for dictation. A camera buff may need a machine with facilities for photo synchronization. A language student may need sound-with-sound, to enable him to practice his French. The features needed for these specialized purposes, however, are of no use to the serious home user, the man to whom I address most of my remarks.

The serious home user is a chap who's interested in quality sound reproduction, who uses his recorder to record and listen to music (or other program material) seriously. He'll want to edit and arrange his material in a sequence useful to himself or to others who may use his collection. He's not a semi-pro. A tape professional of any sort is a man whose recorder makes money for him and whose primary reason for owning a recorder is to make money. The demands of our serious user are quite different from those of the professional, making necessary use of a quite different kind of machine.

One of the biggest pieces of chrome of them all is four-track recording. While the pack-rat archivist or background-music aficianado may find it useful, it's nothing but a tape-waster to our serious user. Besides having a poorer signal-to-noise ratio than two-track and vastly exaggerated tape-motion problems, four-track recording permits no editing unless you use only one set of tracks—thereby losing all the so-called advantages. Cutting material out of one recording means you'd be cutting material out of the set of tracks recorded in the opposite direction. This results in incredible tape waste.

Even stereo recording is a piece of chrome in most cases, unless you're going to record stereo music that's broadcast live by an FM station. The reason is that it takes the skill of a professional to record live, at-the-scene stereo properly—to select just the right microphones for the job, place them properly and obtain the right balance. Besides, you've got the manufacturer of your recorder working against you. Usually he supplies you with a little lozenge on a string—only one—that is supposed to serve for live recording. If you want another you have to buy it.

In any case, chances are that these mikes are only half as good as your recorder, no matter how cheap the recorder. In fact, I'd be tempted to say that if the recorder comes with a microphone it's probably not a particularly good recorder and it's definitely a lousy microphone. So if you insist on doing live recording you'd be better off finding a recorder which doesn't come with its own microphone, then going out and buying one or two decent microphones to go with it.

Recording from discs is nonsense, too. Unless the disc is a particularly valued recording you're likely to get tired of it and want something else. Besides, you won't be able to make as good a copy of it as the original. So if you want quality you're better off sticking to a disc and treating it nicely—as you would any valued friend. It's true that tape is one of the best things ever to happen to background music because of its long, uninterrupted playing time but it's also one of the worst, most stupid ways ever developed of reproducing music in the home. It's much more difficult to find a specific selection on a tape than it is on a disc, and tape is harder for most people to handle than records. Most commercially prerecorded tapes contain more imperfections of one sort or another than a good record. They cost more and the selection of titles is terrible. Tape has the great advantage, however, of enabling the serious user to build an archive of sound to suit his own taste. This may be anything from satellite launchings to Toscanini broadcasts.

How many motors should we look for and what kind should they be? For the average user the hysteresis-synchronous motor has been as oversold as automatic headlight dimmers. The fact is that for home applications a properly-designed, six- or even four-pole motor will do just as well. And you don't need three of them, either. Three motors are a disadvantage because they add to the heat, weight and cost of the recorder. A single good motor is quite adequate to pull the tape past the heads at uniform speed with proper tension and motion. Hysteresis-synchronous motors show off to best advantage when you're recording on magnetic coated movie film which has sprocket holes. The sprocket holes and the motor guarantee that the speed and position will be absolutely constant with other such machines or recordings. But home recording doesn't have synchronization problems so the real advantage of the hysteresis motor is lost.

The only advantage of three motors is in providing high-speed rewind for professional equipment. While high-speed rewind is necessary and desirable for the professional, who shuttles a given reel of tape only a few times (and who must be able to do so very rapidly), it's undesirable for the serious home user, who may shuttle his tapes many times. High speeds put unnecessary tensions on tape and fast winding produces rough edges on tape which are particularly harmful to four-track tapes—especially if they're stored as rewound. In fact, any home unit which rewinds 1,200 ft. of tape in less than two minutes is too fast for our serious user.

Three heads are almost as useless as three motors to our home user. They add to the cost and complexity of the machine and may make servicing costs higher. Professional tape recorders utilize three electromagnets—one to erase a recording already on tape, a second to record material and a third to play back what just has been recorded.

Because the three heads are arranged in this order from left to right, the third head can be used for instant monitoring. It can also be used for trick effects such as echo. In professional machines it's absolutely necessary because it shortens the calibration time for different batches of tape and overall maintenance time, factors not really significant at home. Most home machines, however, combine the functions of record and playback into a single head, largely to save money. Two-head machines usually cost less than three-head machines of comparable quality and produce just as good sound.

Let's assume you buy a machine with a third head. Chances are you don't want to add echo to a broadcast of the Boston Symphony so you'll use it to monitor the recording as you make it. All of a sudden, something goes wrong during the third movement of Leinsdorf's reading of the Brahms First Symphony—a sputtering, then silence. It's all over, fellow. The third head has done you no good and you now are paying for a feature you can't take advantage of.

True, you know there's something wrong. But Leinsdorf won't back up and do it over again for you so your recording is ruined. If something goes wrong while you're taping from discs you can back up and do it over again. But you don't need the third head to tell you. The VU meter provides all the information you need about signal, record level and your recorder's performance. Playback checks the rest.

The VU meter is a vital piece of equipment, in my opinion. Cat's eyes and neon bulbs can't provide the same degree of accuracy as a needle swinging against a numbered scale. The numbers on the scale give you a point of reference so you can match volume levels. It's awfully difficult to estimate just how brightly a neon bulb glowed a few minutes ago when making new volume adjustments.

A PRO TAKES A LOOK

What about pressure pads? In my experience, properly designed machines don't use them but pads in themselves are not a damning feature. If they exert just the right amount of pressure against the head and aren't used to overcome some defect in design pressure pads can provide better head wrap and can make better recordings than machines where tape tension is used to provide head contact. Head wrap and pressure are the criteria here. You want the maximum of the first and minimum of the second. All things being equal, however, pressure pads do tend to get in the way when you're editing and they provide one more mechanical linkage which must be serviced. The best pressure pads I ever saw were on an early Grundig machine. They consisted of polyurethane wheels which rotated against the head as the tape passed.

Selective erase, better known as sound-on-sound or sound-with-sound, is a classic example of fins on a tape recorder. Generally, when one or both of these features are built into a tape recorder they're built in badly and add to the price and the servicing problems. They are of no value whatever to our serious user, though they may have value for a student of French or the piano. And there are other fins, all of which add to the cost of the recorder but nothing to the fidelity or convenience of operating it:

- *Automatic shutoff*. This isn't necessary because our serious user always will be in the same room with the machine. However, it's easy to build in and adds little to the overall cost of a machine.
- *Automatic reverse*. This adds tremendously to cost, servicing and complexity of a recorder. It's a big and silly fin.
- *Automatic head demagnetizer*. Solid chrome! Seldom in my career have I run across a magnetized head that wasn't accompanied by magnetized tape guides or a magnetized erase head. Treating one head does nothing and to take care of all these problems is both expensive and impractical. It's like putting one blowout-proof tire on a car. In all of my 18-year professional career I haven't run across enough magnetized heads to make me take off my shoes to count them.
- *Automatic threading*. Depends on how it's done. If it doesn't damage the tape it can be handy for four-track use.
- *Voice control*. This is at the bottom of my list of things necessary in a good tape recorder.
- *Tape duplicating facilities*. Bah! Humbug!
- *Footage counter*. These are of no earthly use because they are too inaccurate and when you change even one short selection on a reel all the other positions

[*Continued on page* 112]

Tape Compressor

By WALT HENRY TAPING the monthly meeting of the debating club isn't just a matter of setting the recorder's level control when the first member starts speaking. Reason is, the discussion may get quite heated before you realize it. Then others, trying to emphasize their point, begin to move closer to the table and mike. Several people start talking at once, then suddenly everyone's shouting. By this time the record-level indicator's needle is pinned.

Or, after setting the recorder's level control for one person you discover some other members speak softly. When you play the tape back you find it's difficult to hear them. One solution is to get the moderator to adjust the record-level control constantly. But this would distract him and is not a particularly fast or reliable way to maintain a constant-level signal.

EI's tape compressor is like having an extra hand there to ride gain all the time. You connect the mike to the compressor and feed its output to the recorder's mike input. Next, you make a test tape of the quietest speaker sitting a normal distance from the mike. While you do this you set the recorder's level control for optimum record level.

Then you start talking loudly and simultaneously increase the compression to pull the record-level indicator's needle back into the safe area. You're all set for the great debate. And no matter who speaks, you can rest assured that the meek will be heard and the loudmouths will be gagged. The compressor also can be used with a PA system. This will permit the speaker to move away from the mike or shout until the rafters ring. The sound level in the room always will be the same.

Or suppose you want to record a fading short-wave program. The compressor will put a constant-level signal on the tape. The same is true if you want to tape the Citizens Band or Aircraft Band. A strong signal that comes blasting through will come out of the compressor no louder than weak or moderate-level signals. Your gain-riding days are over.

There are several other applications for the compressor. For example, it can be used between your mike and a CB or ham transmitter to produce a modulating signal whose amplitude remains constant regardless of changes in the level of your voice. This means more talk power, which makes your signal sound as though your RF is much greater than it actually is.

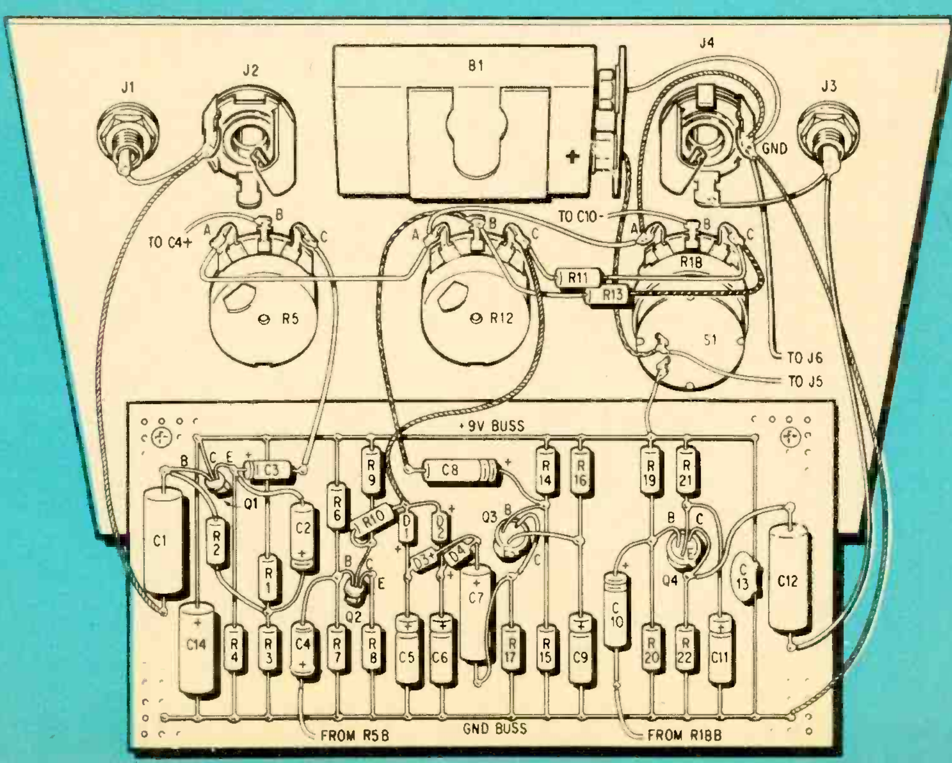
Our compressor has all the features of commercial models. The compression is variable from zero to a maximum of about 26db. The noise level is −60db. A preamp stage and a gain control enable the compressor to be used with almost any program source. There's plenty of gain (25db) which means a dynamic mike can be used with it. The compressor will handle inputs up to 5 V peak-to-peak (1.77 V rms).

The circuit has a fast attack time (time required for the compressor to reduce the level of a strong signal). The hold (decay) time required for the gain to return to maximum after the input signal is removed is

PARTS LIST

B1—9 V battery (Burgess 2MN6 or equiv.)
C1, C12—.47 µf, 200 V tubular capacitor
C2, C8, C10—30 µf, 15 V electrolytic capacitor
C3, C4—5 µf, 15 V electrolytic capacitor
C5, C6, C9, C11—50 µf, 15 V electrolytic capacitor
C7—100 µf, 10 V electrolytic capacitor
C13—.02 µf, 500 V ceramic disc capacitor
C14—150 µf, 15 V electrolytic capacitor
C15, C16—.015 µf, 500 V ceramic disc capacitor
D1, D2—1N914 diode D3, D4—1N270 diode
J1, J3—Phono jack J2, J4—Phone jack
J5, J6—Insulated tip jack (H.H. Smith type 241 or equiv.)
Q1, Q2—2N3393 transistor (GE)
Q3, Q4—2N414 transistor (GE, RCA)
Resistors: ½ watt, 10% unless otherwise indicated
R1—22,000 ohms R2, R3, R15—56,000 ohms
R4, R9—2,200 ohms
R5—10,000 ohm, linear taper potentiometer
R6, R20—120,000 ohms R7—15,000 ohms
R8—120 ohms R10, R22—3,300 ohms
R11—8,200 ohms
R12, R18—50,000 ohm, linear taper potentiometer (SPST switch on R18)
R13, R17, R21—1,000 ohms
R14—22,000 ohms
R16—560 ohms R19—33,000 ohms
R23, R24—10,000 ohms
S1—SPST switch on R18
Misc.—Perforated board, flea clips, 5 x 7 x 3-in. aluminum chassis (Premier ACH-428GH), 5 x 7-in. aluminum chassis bottom plate (Premier ABP-423GH).

Fig. 1—Inside the compressor. First thing to do is mount all parts on a 3 x 5¾-in. piece of perforated board, as shown, using flea clips for tie points. Then install other parts on 5 x 7-in. chassis cover plate. Use two small angle brackets to attach circuit board to panel about 3¼ in. from the edge near J2 and J4. Mount jacks J5 and J6 underneath the circuit board. Note that several ground leads are tied together and connected to the ground lug on J4.



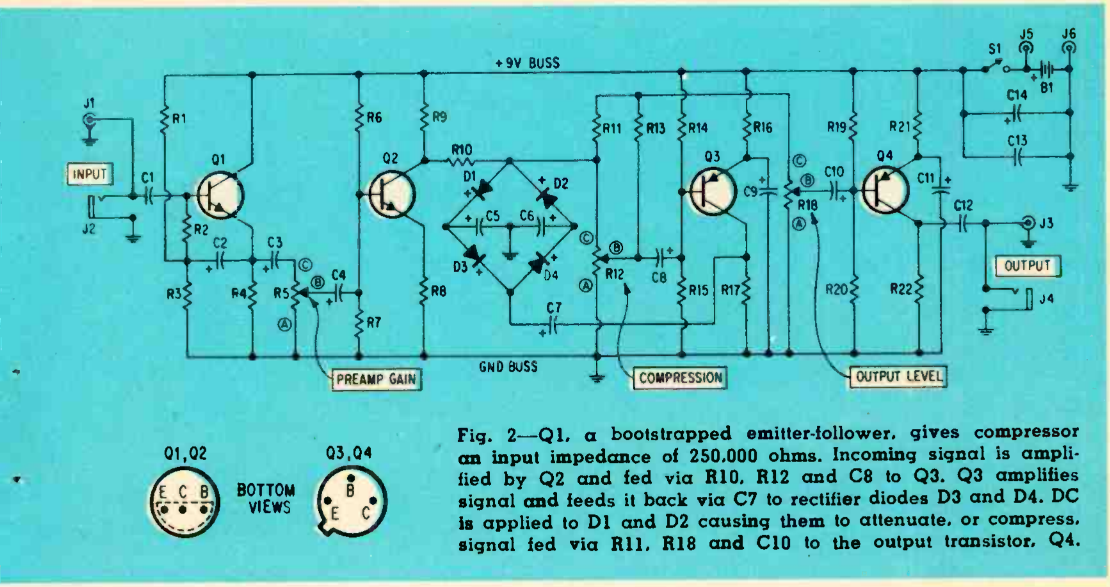


Fig. 2—Q1, a bootstrapped emitter-follower, gives compressor an input impedance of 250,000 ohms. Incoming signal is amplified by Q2 and fed via R10, R12 and C8 to Q3. Q3 amplifies signal and feeds it back via C7 to rectifier diodes D3 and D4. DC is applied to D1 and D2 causing them to attenuate, or compress, signal fed via R11, R18 and C10 to the output transistor, Q4.

about one second. The compressor does not clip or limit the audio signal—it reproduces it without distortion.

An output stage (Q4) and an *output level* control (R18) permit you to adjust the level of the output signal to match it to the input of any tape recorder, amplifier or transmitter. Since the current drain is only about 10 ma, the battery will last a long time. As a bonus we've included a four-component circuit (Fig. 4) that will turn the compressor into a 1,000-cps oscillator for checking audio equipment.

Construction

Circuit layout is fairly critical; therefore, try to duplicate ours. All components except for the input, output and battery-test jacks, the controls, R11 and R13 are mounted on a 3 x 5¾-in. piece of perforated circuit board on which flea clips are used as tie points. Note in Fig. 1 that several ground wires must be attached to the ground lug on J4. This is important to keep hum and noise low.

Our compressor was built in a 5 x 7 x 3-in. aluminum chassis. The battery, circuit board, controls and jacks are mounted on the chassis' cover plate. The cabinet could be plastic or wood; however, we recommend that it be metal to shield the circuit to prevent pickup of hum and noise.

Note that we put jacks (J5 and J6, not shown in Fig. 1) on the front panel so that the battery voltage can be checked without disassembling the unit. If you want to use a separate supply, any well filtered source of 6- to 9-V DC will do.

Checkout

After construction is finished, double check your wiring. Then, turn the *preamp-gain* (R5) and *compression* (R12) controls full counterclockwise and turn on power. Measure the DC voltage from the emitter of Q1 to ground. It should be between 3 and 6 V with a new battery. Next, measure the voltage on Q2's collector. It should be between 4 and 7 V. Measure the collector voltage on Q3 and Q4. It should be between 3 and 6 V. If any of these voltages do not fall within these ranges, they can be corrected by changing the values of R3, R6, R15 and R20, respectively.

Using the Compressor

As we said, the compressor will handle up to 5-V (peak-to-peak) input signals. However, with a signal this large R5 must be carefully set to prevent the input stage from being overloaded and to prevent distortion. (R5 has little effect on compression characteristics.) The preamp stage is simply a variable-gain amplifier which was included to boost low-level input signals to get full compression.

Here's the way to adjust the controls by making a test tape or with a pair of high-impedance phones plugged in J4. Turn R12 full counterclockwise. When the input signal

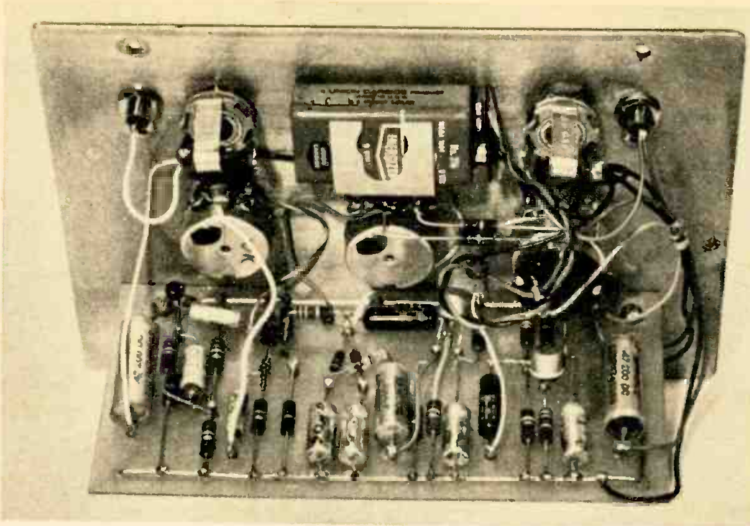


Fig. 3—Inside of compressor. Author's model is built on fiberglass board, but perforated board will be suitable. Because of high-gain stages, try to duplicate our layout. Buss wires at top and bottom of board facilitate connections to ground as well as to the 9-V supply.

is at its highest permissible level, increase R5 until the signal becomes slightly distorted. Then back off on R5 until the distortion disappears.

Once R5 is adjusted with a high-level input signal, it need not be changed again. Now, set R12 for the desired compression. (It may be necessary to readjust R18 when compression is changed.) When recording speech, R12 should normally be set full clockwise. Generally speaking, the compressor should not be used when recording music since loud and soft passages are an important part of musical expression.

To use the compressor as an oscillator set R12 full clockwise. Set R18 for the desired output level, and turn R5 clockwise until the circuit just begins to oscillate.

How It Works

Input stage Q1 is a bootstrapped emitter-follower which gives the compressor an input impedance in excess of 250,000 ohms. Preamp stage Q2 provides a voltage gain of about 20db so that low-level signals can be compressed. Gain control R5 compensates for different input-signal levels.

The circuit that automatically controls compression is a push-pull diode attenuator which consists of D1-D4, C5 and C6. Since the resistance of diodes D1 and D2 depends on the DC current through them, they function as variable attenuators. Here's what happens: An input signal fed to Q2 appears at the junction of R10, D1 and D2 and the base of Q3.

Q3 amplifies a portion of the signal and feeds it to D3 and D4 where it is rectified and then filtered by C5 and C6. The DC is then fed to gain-control diodes D1 and D2. When the input-signal level increases the output of Q3 increases causing more DC to flow through diodes D1 and D2. D1 and D2 reduce the overall circuit gain (compress) by lowering the level of the signal to Q3 and to (via R11, R18 and C10) output transistor Q4. *Compression* control R12 permits you to vary compression up to about 26db.

The external plug-in oscillator circuit (Fig. 4) is simply a Wien-bridge network. When it is connected from the input to the output, the compressor becomes an audio oscillator. The part values shown produce approximately a 1,000-cps frequency. You can experiment with other values for different frequencies. If desired, the oscillator circuit can be built in. Simply connect R24 directly to J3. Use a SPST switch to connect the junction of R23, C15 and C16 to J1 and J2. Be sure to disconnect any other inputs when using the unit as an oscillator.

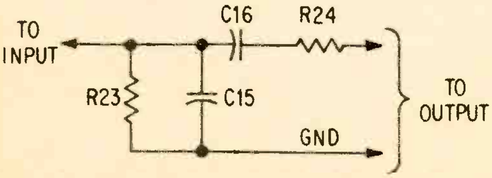


Fig. 4—Connect this Wien-bridge circuit from the input to the output and the compressor will be converted into a 1,000-cps audio oscillator.

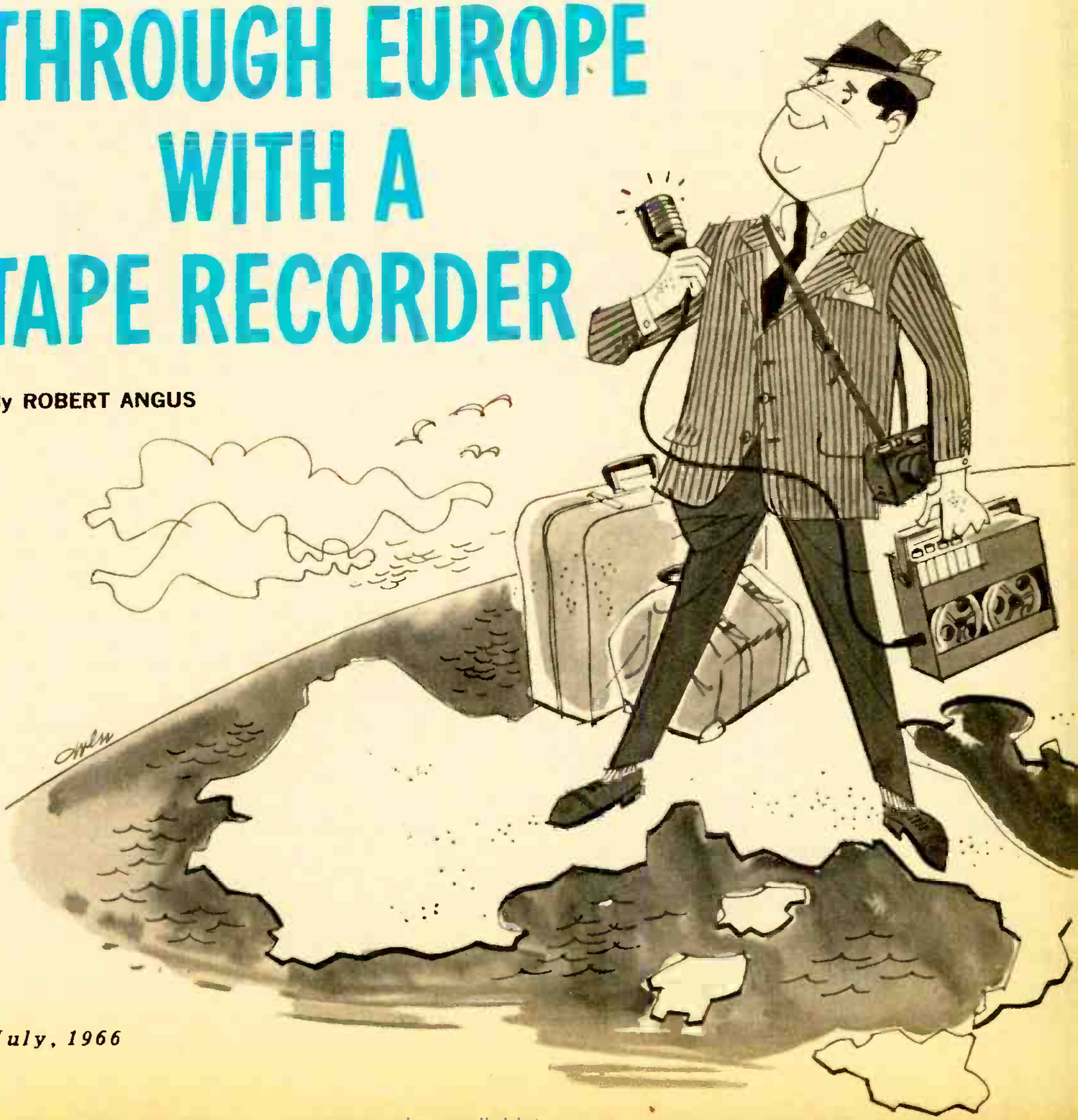
MY wife had a word for it. "You're crazy," she said, "and that thing will only get in the way. We'll lug it all over the place and when we get back we won't have a thing to show for it." This outburst came shortly after I announced that we were going to Europe for our vacation (unbounded joy) and that our battery-operated tape recorder was going with us (opposite reaction).

Fact is that the three of us spent a month touring southern Europe and northern Africa (accompanied by a good 35mm camera). We came back with plenty of slides our friends would be bored with were it not for the fact that these slides are different. For this time we have the sounds that go with them. Sounds like the gurgling of a fountain in Granada, a royal fanfare for the King of Morocco, a taxi driver cursing pedestrians in Lisbon, the staccato of dancing gypsy feet in southern Spain, the calm British accents of a policeman directing traffic in Gibraltar. And more.

But I'm getting ahead of my story. Perhaps I should expain that, as a

THROUGH EUROPE WITH A TAPE RECORDER

By ROBERT ANGUS



Granada. Streetcar.

London. Sounds of the skyline.

Granada. Flamenco dancers.

THROUGH EUROPE WITH A TAPE RECORDER

free-lance writer, I've been to Europe before —occasionally with assignments from broadcasters for taped interviews or from record companies for unusual sounds or music. This trip, on the off-chance I might stumble onto something that would require high-fidelity equipment, I determined to take along a recorder of broadcast quality—the Uher 4000L, which offers a choice of four speeds. You can record at 7½ ips with a frequency response comparable to that of a good home recorder or you can cram six hours of uninterrupted sound onto a 5-in. reel of triple-play tape at 15/16 ips.

The Uher weighs about 8 lbs. (including its power source), roughly half what earlier professional-quality battery portables used to weigh. It occupies about the same space as an extra-thick telephone directory and can be carried reasonably conveniently. Power can be supplied by five 1½-volt flashlight batteries, by a rechargeable alkaline battery or directly from an AC outlet through a converter/charger which can be adjusted to accommodate various European and North American voltages. I elected to use flashlight batteries. One set proved quite adequate for all my recording needs.

As for how much and what kind of tape to take along, previous experience had shown that it pays to take tape from the U.S. because, generally speaking, European tapes are more expensive. To conserve space, I settled on half a dozen reels of Kodak's tensilized, triple-play tape, offering a total recording time in excess of 9½ hrs. (at 7½ ips). Since Kodak tape is back-printed, it's easy to tell whether you're recording on the first or second track (and this is something easy to forget when you're traveling).

I had determined not to do any editing until our return home. Tourists simply can't be bothered while on the road and the gear occupies space in the suitcase. Material intended for professional use, therefore, was recorded on one track only so that the tape could be edited at a later date. In the case of lower-fi material, recordings were made in both directions (usually at 3¾ ips), with a view to transferring the material to another tape which could be edited.

The microphone I packed was dictated by the nature of one of my assignments. I knew I would be recording some school children in a particularly noisy neighborhood in London so my microphone would have to have a sharply defined pickup pattern if it were to capture only those sounds I wanted. The answer seemed to be an Electro-Voice Sound Spot (model 644) which promises a cardioid pattern. This model may not be practical for the casual recordist—it looks like a small rifle and occupies much more space that most microphones. But it proved adequate for all my recording needs with the exception of one interview in a stiff London breeze (the voice in this instance being lost in a roar which sounds like an express train).

Two final pieces of equipment included a Channel Master AM/FM transistor radio and a patch cord to facilitate taping off the air.

Best place to start a sound documentary of any vacation is at the beginning. For us, this was New York's Kennedy Airport, where we were scheduled to leave aboard Pan American's flight 154 to Lisbon, Barcelona and Rome. We taped the public-address announcement of the flight, then picked up the recorder and our hand luggage and strolled

Granada. The Alhambra.

Rabat. Afternoon prayers from mosque.

London. Voice of a bobby.

aboard. Naturally, we taped our stewardess' friendly welcome-aboard as well as the roar of the jet engines on take-off. Early next morning found us winging over the Iberian peninsula—setting down in Barcelona under a warm Spanish sun. What to record? We found out almost immediately.

Dinner in Barcelona isn't served until well after 9 p.m. so we fortified ourselves with fried shrimp bought at a lunch counter in a small carnival near the waterfront. The recorder picked up sounds which are almost international—balls thudding against a canvas backdrop in vain attempts to knock over a row of milk bottles, the crack of an air rifle, the calls of candy butchers and pitchmen, the sizzling of sausages, the sounds of people having fun.

The dinner hour came and we made our way down a narrow, twisting side-street to an outdoor restaurant with a reputation for some of the best seafood in Europe. No sooner had I tucked the recorder under the table than a strolling musical trio made their way along the streets to serenade diners. Dressed in the flowing velvet robes a Don Juan might have worn, they played Catalan folk melodies on the unlikely instrumental combination of flute, guitar and mandolin.

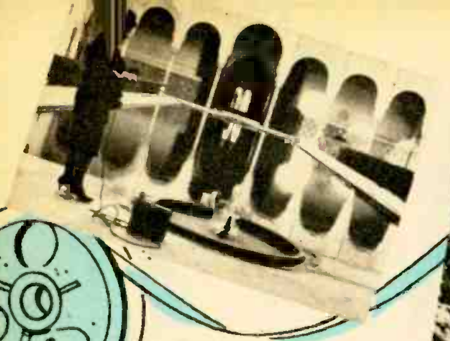
After disposing of a Spanish brunch the next morning (which was Sunday), we heard sounds coming from the steps of the city's massive Gothic cathedral—sounds, however, unlike any we ever had heard. We hurried over to find the municipal band in the midst of a program of Catalan music. What made for the unusual sounds was the instruments the band was using—reed-like affairs that looked like clarinets and oboes but with brass rather than wooden bells. A spectator explained that these were coblas, trombos and tiples. The sounds they produced were louder and slightly less reedy than those from oboes or bassoons. (Yes, we put them on tape.)

Though Madrid had more to offer our camera than our recorder, the colorful street market, just off the Plaza Mayor in the center of the city, proved rich in both sights and sounds. Here butchers proclaim the quality of their lamb or rabbits; fishmongers announce the availability of squid or snails or mussels; greengrocers display a colorful array of bananas, onions, apples, grapes, oranges, lemons and lettuce; farm girls sell garlic, and somewhat more sedate shopkeepers offer ample stocks of Manchego cheese or olive oil.

In Granada we were met by a friend who offered to show us and our tape recorder around town. Fortunately our host, Don Horacio del Arbol Navarro, has the soul of a romantic and the ear of a musician. "The sound of Granada," he said, "is the sound of water—laughing, playing, rushing, quiet, even sad."

To prove his point, he took us first to the Alhambra, the delicately beautiful mountaintop palace built by the Moorish caliphs and seized by Ferdinand and Isabella in 1492. Between them, the Moors and the Spanish rulers created nearly 1,000 pools, waterfalls and fountains within the palace grounds, all fed by melted snow pumped from the nearby Sierra Nevada mountains.

Though Sr. Arbol never had used a tape recorder, he managed to solve a problem that had plagued us in Madrid. It had been our practice to carry recorder in one hand, microphone in the other, aiming the mike at subjects as we found them. Result was to attract a crowd and thereby cut off whatever it was we wished to record. Sr. Arbol, showing us through the street market in Granada, simply grabbed the recorder, cable and microphone all in the same hand and ambled nonchalantly through the market. Here and there he'd stop,



Granada. Fountain in Alhambra.

Seville. Bird market.

Granada. Lottery-ticket seller.

THROUGH EUROPE WITH A TAPE RECORDER

next to a gypsy girl singing the praises of her home-grown garlic or a butcher haggling with a customer. Results, somewhat to our surprise, were excellent. Moral: it pays to experiment.

Every visitor to Granada, the guidebooks assert, must visit the Sacro Monte, or gypsy quarter, to see the gypsy caves and authentic flamenco dancing. The guidebooks also warn tourists to be careful of their money and jewelry and imply that gypsies are somewhat less than clean and trustworthy. Not so, Sr. Arbol protests. "Gypsies are honest, industrious people and everybody in Granada loves them."

In any event, he led us to a cave, which proved to be both clean and comfortable, and asked the lady of the house whether we could record a performance. Permission granted, we settled back in chairs lining one wall of a long room while friends and relatives began streaming in with their guitars and castanets. Before long, we were engulfed by the sounds of flamenco dancing and singing—including the traditional songs of a gypsy wedding ceremony.

It had grown dark during our sojourn with the gypsies but our day of Andalusian music-making and recording was not yet over. Since the dinner hour—10 p.m.—fast was approaching, Sr. Arbol escorted us back downtown to a charming little restaurant behind the cathedral, where an instrumental trio was providing music consisting of Spanish popular songs, a few light classics and folk tunes. With permission of the management, we parked our recorder beside the mandolinist-conductor and settled down to a meal of Andalusian specialties.

Granada is built in a valley and on the sides of several hills. Public transportation is provided on the level by buses and along some of the narrower, more winding streets by tramcars reminiscent of the Toonerville Trolley. Sr. Arbol explained the following morning that the trams must be short, light and narrow to negotiate some of the sharper curves—yet they must be powerful, because their routes stretch as far as 20 miles out into the countryside. The groan of one of these midgets starting its journey downtown and the screech as it rounded a curve going up a steep incline were added to our tape collection before we left town.

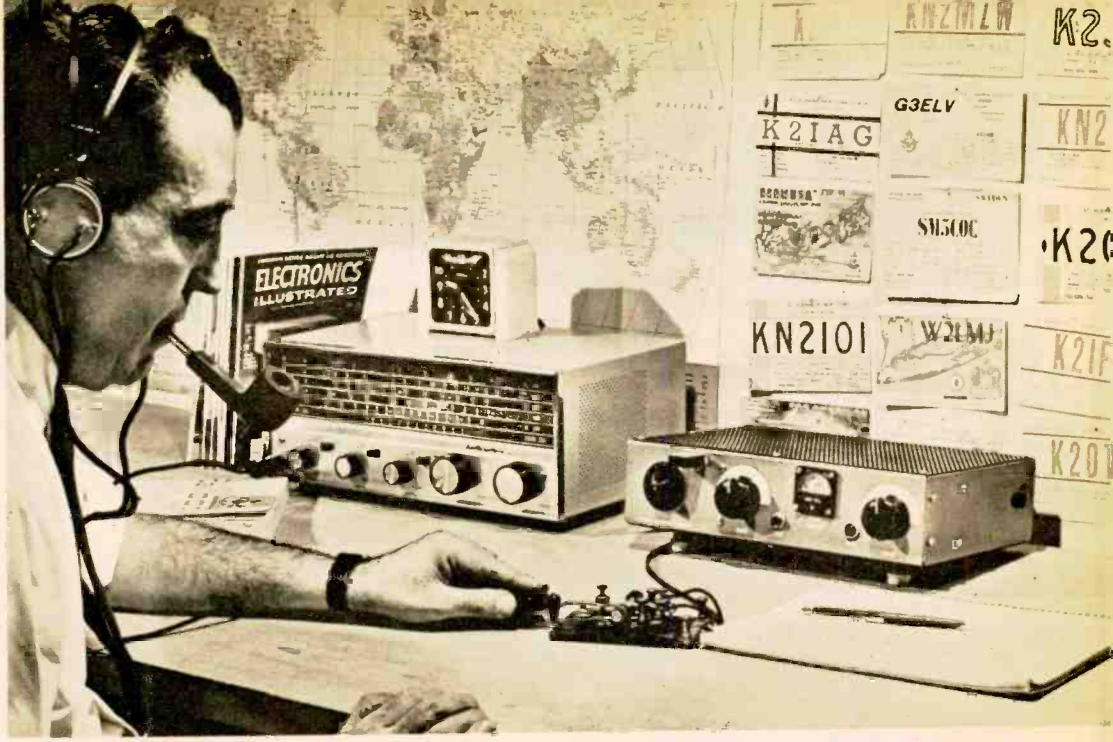
Next port of call was Algeciras, a town strategically located between Gibraltar and Tangier. Gibraltar proved to be only 7½ mi. from downtown Algeciras, while Tangier is 25 mi. and 2½ hrs. by ferry.

We headed first for Gibraltar, whose main street is a fascinating collection of shops selling everything from Arab rugs and novelties to German lenses and tape recorders. Merchants there hail from India and Pakistan, London's East End, North Africa, even Singapore and Hong Kong. Here stood a policeman in the full uniform of the London bobby—and we couldn't resist recording his British tones as he directed traffic.

Forsaking the shops temporarily, we found a congenial taxi driver whose desire to explain the sights and specialties of Gibraltar outstripped his command of English. His "Looka da ri' " and "Looka da lef' " may not mean much to our friends but for us it's an invaluable souvenir of our day on The Rock.

Not so many years ago, Tangier had the reputation of being an international center of intrigue and vice. Today, the intrigue is gone

[*Continued on page* 114]



Channelized Ham Transmitter

Now! The convenience of instant positive tuning to preselected frequencies!

By RUSS ALEXANDER, W6IEL

MANY'S the ham who can recall when he was clobbered by what sounded like a kilowatt transmitter on his roof. Like as not, the interruption occurred in the middle of a DX QSO or during a local rag chew. Most of the time the only solution is either to close up the shack or to hunt around for another crystal that likely has fallen behind something or other.

By the time the vital rock is located and inserted and the rig retuned, the QSO is long gone. Our 40-watt Channelized Ham Transmitter will solve this problem. Designed for instant frequency changes that can be made with the ease and convenience of channel-switching on the (pardon the expression) Citizens Band, it lets both Novices and Generals enjoy the delights of 40-meter DX with the stability only crystals can offer. With ten rocks inside and another on the front panel, this neat brief-case-size rig sports an 11-position rotary switch that permits you to pick a new operating frequency as quickly as you could with a VFO. A spot switch enables you in a second to find your operating frequency with your receiver and also aids in finding the right crystal for answering a CQ.

The rig's high-voltage supply is worthy of note, too. A solid-state voltage doubler is the key to this two-tuber's light weight and trim size. There's no plate transformer. Shock hazard—a sometimes unpleasant aspect of voltage-doubler circuits—has been eliminated by including a keying relay which isolates the key from the chassis.

Construction. The secret to the rig's trim appearance lies in the way it's built in a standard 12 x 8 x 3-in. aluminum chassis. The first step is to remove an 8 x 11-in. piece of aluminum from what normally would be the top of the chassis with a nibbling tool or by drilling holes and hacksawing.

Next, form part of the removed metal into an L-shape subchassis as shown in Fig. 3. The main part of the subchassis on which the tubes are mounted is 2⅞ x 7½ in. The side of the subchassis is 2⅞ x 2½ in. A 5/16-in. lip should be formed along the edges and

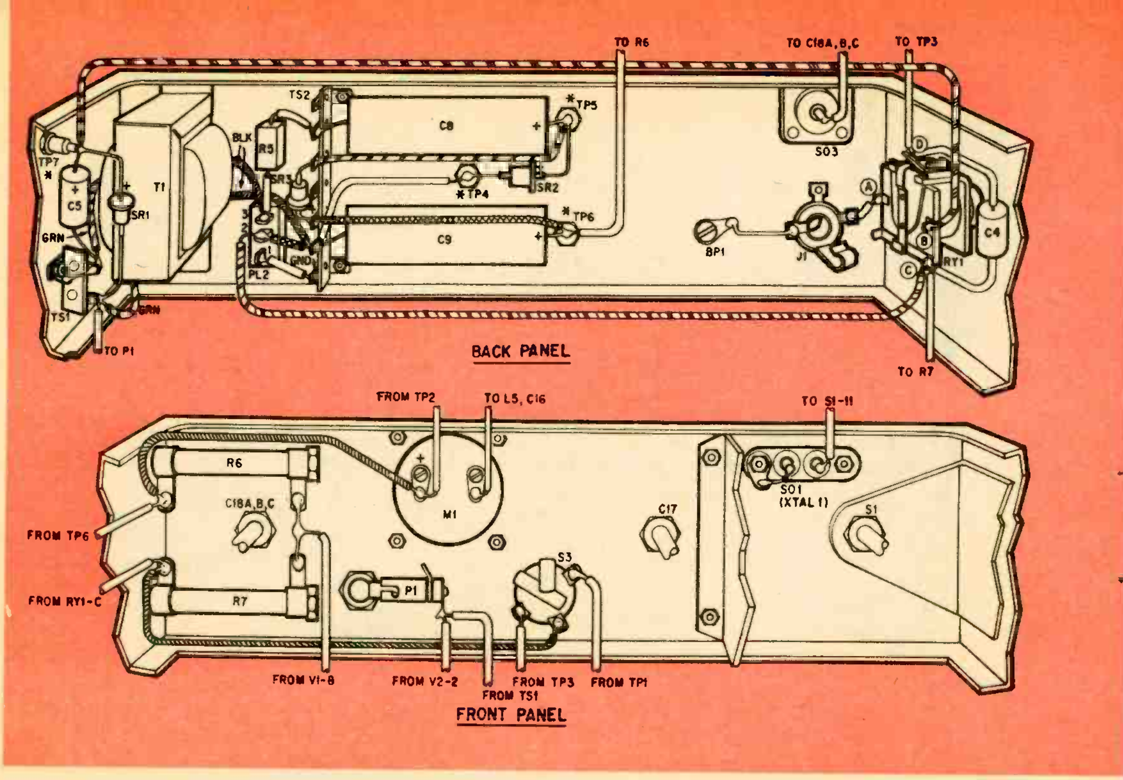


Fig. 1—Head-on views of rear (top) and front (bottom) panels show component locations. Install all parts before mounting subchassis. C17's and C18's extension shafts pass through panel bearings (Allied 44 U 096). Portion of home-brew bracket for crystal sockets and S1 is shown at right of front panel.

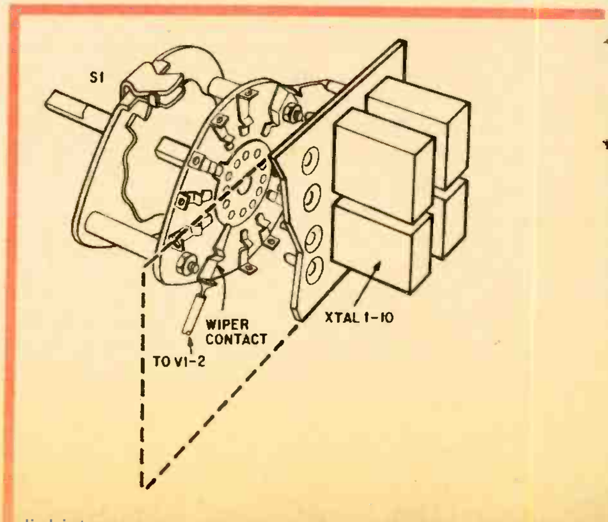
Channelized Ham Transmitter

½-in. lips should be left on the ends of the subchassis to fasten it inside the main chassis.

Looking at the underside of the subchassis in Fig. 4, drill a ⅝-in.-dia. hole 1⅛ in. from the left side for tuning-capacitor C17's shaft. Also drill a ⅝-in.-dia. hole 1¼ in. from the right side of the chassis for loading-capacitor C18's shaft. After the holes have been drilled the subchassis should be held in its mounted position and a pencil passed through each of the shaft holes to the back of the center of the panel. The pencil marks will locate the holes for the capacitor shafts in the front panel. Drill holes in the front panel and insert the shaft bearings in them. Mount the capacitors on the subchassis and locate the tube sockets between them. Mount the tube sockets, terminal posts TP1-TP3 and L3. Wire the subchassis following the schematic (Fig. 5) and pictorial (Fig. 4).

The crystal-selector switch bracket shown in Figs. 1 (bottom panel) and 2 should be made next. It is made by bending a U-shape bracket from metal left over from the piece cut out of main chassis or from other scrap aluminum. The side of the bracket on which the crystal sockets are mounted is 2⅝ x 3¼ in. The part of the bracket that separates the front and back of the bracket is 2 in. long. The shape of the bracket through which S1 is mounted is triangular (see Fig. 1). Mount the switch and ten crystal sockets on the

Fig. 2—Part of bracket on which crystal sockets are mounted is 2⅝ x 3¼-in. Front of bracket (not shown) fits between S1's bushing, front panel.



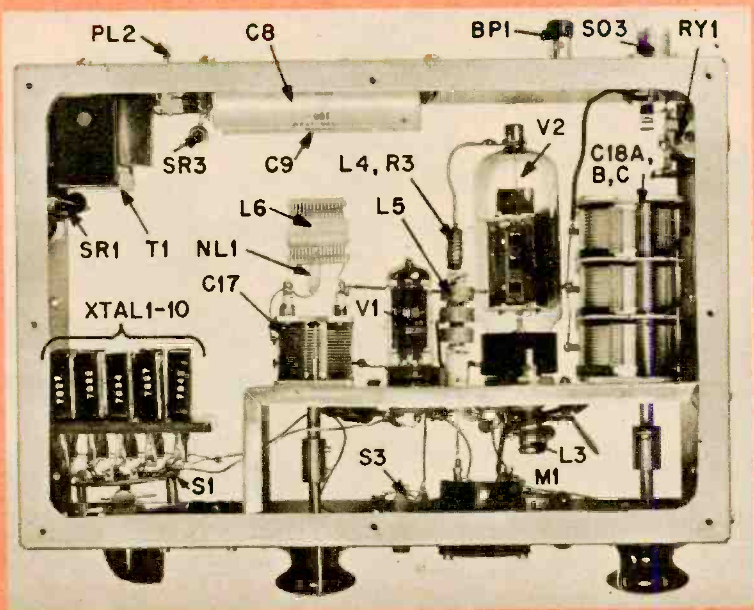


Fig. 3—View into top of transmitter shows location of major components. Leads from underside of subchassis to back panel and to S1 pass through grommeted holes. Note especially position of L5, L4/R3 combination, NL1 and L6. Lead from L4/R3 should be long enough to permit installation of clip on V2's cap.

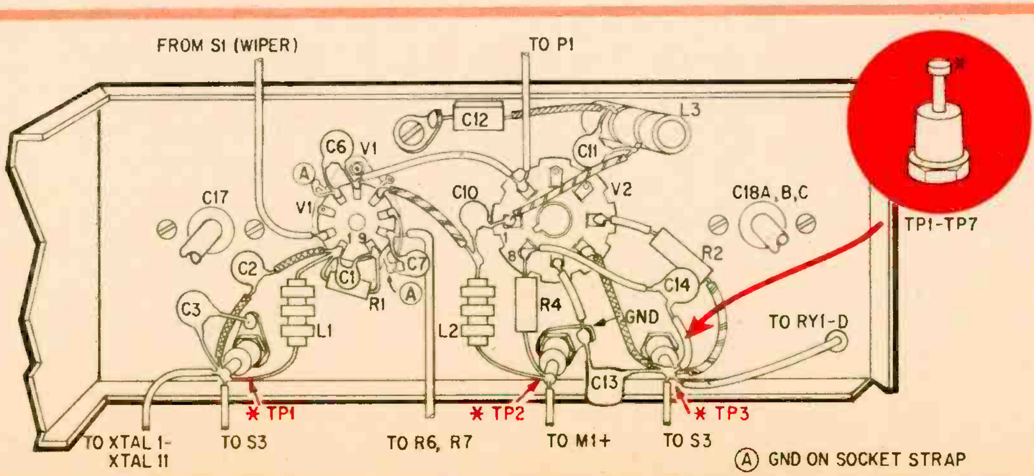
bracket and connect the sockets to the switch. With this completed mount the assembly in the left front corner of the chassis as shown in Figs. 1, 3 and 6.

Next, install all parts on the front and back panels. After the power supply and the front panel have been wired, install the subchassis and wire it into the circuit. The shaft extensions for C18 and C17 should be installed next and the knobs tightened.

The L4/R3 combination should be prepared by winding 9 turns of No. 22 enameled wire around R3. Solder the ends of the wire to R3's leads. This component (a parasitic choke) should be installed by soldering one of R3's leads to the top of L5. Solder a piece of hookup wire to the other resistor lead and solder V2's plate cap on the other end of the hookup wire. The wire should be made long enough so the plate cap can be removed. Install the crystals and tubes.

Checkout. Before the final can be checked

Fig. 4—Underside of 2⅞ x 7½-in. subchassis. Mount parts where shown and keep all leads short and direct. Wire from meter (not shown) passes through grommeted hole under C12's ground lug and connects to L5's bottom lug (not shown, but visible in Fig. 3). Lead from R7 also goes through hole in lower right corner.



Channelized Ham Transmitter

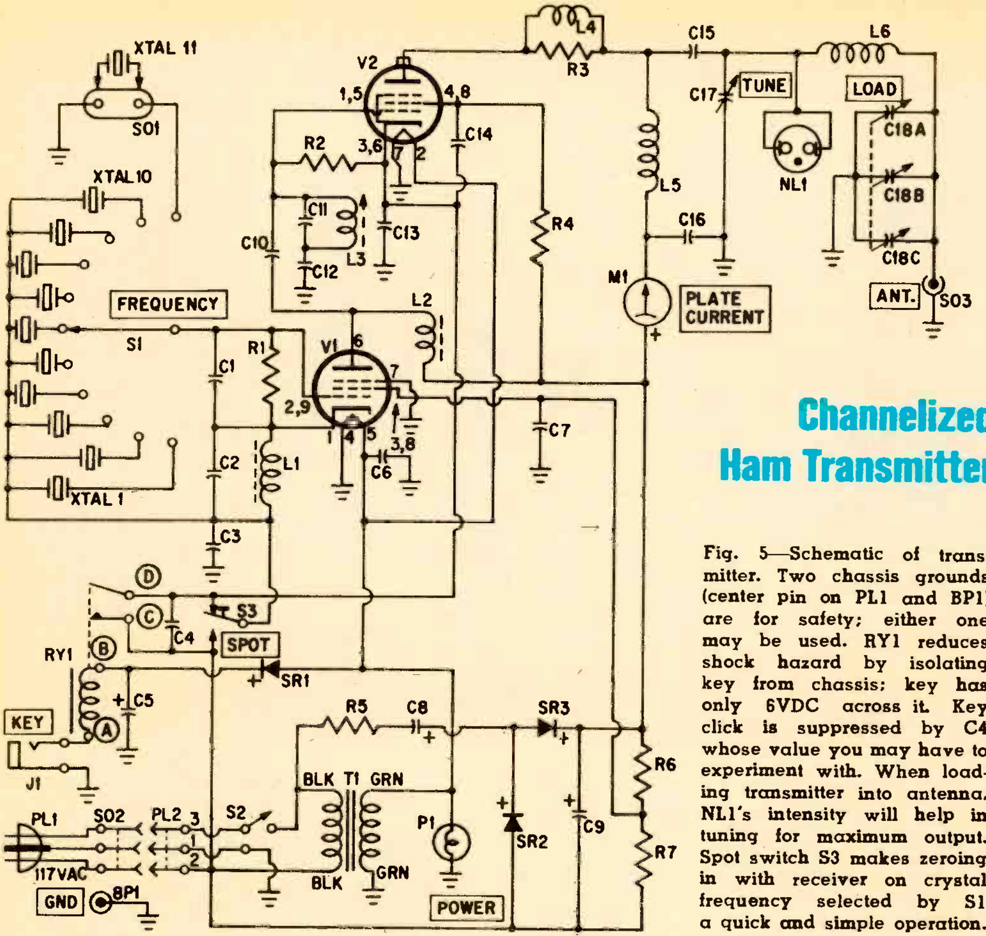


Fig. 5—Schematic of transmitter. Two chassis grounds (center pin on PL1 and BP1) are for safety; either one may be used. RY1 reduces shock hazard by isolating key from chassis; key has only 6VDC across it. Key click is suppressed by C4 whose value you may have to experiment with. When loading transmitter into antenna, NL1's intensity will help in tuning for maximum output. Spot switch S3 makes zeroing in with receiver on crystal frequency selected by S1 a quick and simple operation.

it is necessary to tune the grid circuit. This is done best with a grid-dip oscillator (GDO) tuned to the center of the 40-meter Novice band (7175 kc) and held near L3. While watching the GDO, adjust L3's slug for a dip.

If you don't have a GDO, plug a crystal, whose frequency is near the center of the band, into the front-panel socket and fire up the transmitter (but do not press the key). Tune your receiver to the crystal's frequency. The receiver's BFO should be turned on, the AF gain should be turned up and the RF gain should be just cracked. Press *spot* switch S3. You should be able to hear a tone from the receiver. (If it isn't clean, reverse the AC plug.) Adjust L3's slug for maximum volume.

Tune Up. The transmitter's final now is ready to be tested. Connect a 40-watt light bulb to SO3. The receiver setup used in the preceding step again should be used. Be certain not to touch anything inside the transmitter since high voltage is present. Plug a key into J1 and close it. You should see an indication of plate current on the front-panel meter (M1) and hear a loud tone from the receiver. While holding the key, quickly adjust *tune* capacitor C17 for maximum brilliance of neon lamp NL1 and the lowest indication on M1. Then adjust *load* capacitor C18 for the brightest glow of the neon and 40-watt lamp. Repeat this procedure of dipping with C17 and increasing lamp brilliance with C18 until the meter indicates about 140 ma.

On the Air. Ground BP1 (or else the center pin of SO2) and connect your antenna to SO3 with 52-ohm coax. Tune and load the transmitter the same way as you did with the light bulb. Neon lamp NL1 (near L6 and C17) should serve as a guide in tuning the antenna. After tuning the rig you're ready for your first CQ. You'll soon appreciate the performance of this transmitter. It's quiet when the key is up and scoots around the band at the quick twist of a switch. Good DXing!

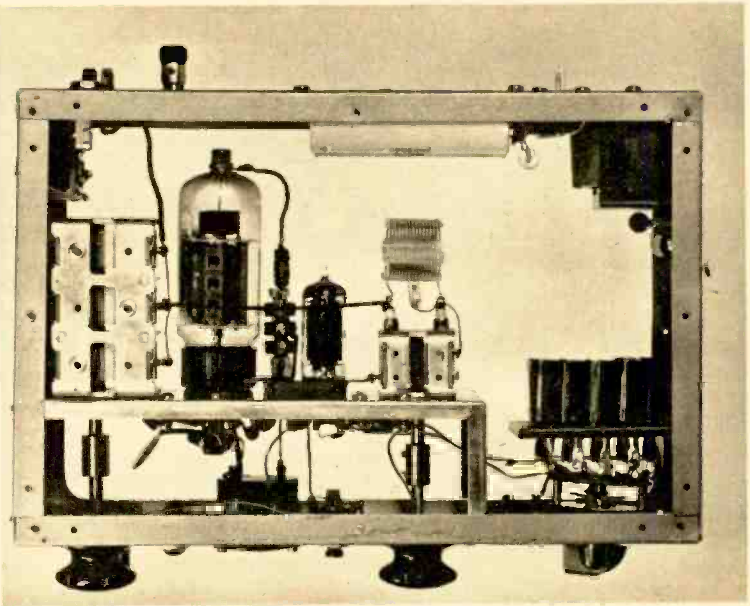


Fig. 6—View into bottom of transmitter is mirror image of top view in Fig. 3. One part that can be seen better in this view is capacitor C15 at base of L5 and V1. Author used surplus mica but you can use a mylar. Note No. 16 enameled wire connecting C18 (extreme left) to L6. Capacitor C16, barely visible, is at the base of L5 (between the tubes). Mount rubber feet on corners of bottom cover. Install top and bottom covers before putting transmitter on air.

PARTS LIST

Capacitors:
C1—20 μμf, 1,000 V ceramic disc
C2—220 μμf, 1,000 V ceramic disc
C3—.005 μf, 1,000 V ceramic disc
C4, C6—.01 μf, 1,000 V ceramic disc
C5—100 μf, 25 V electrolytic
C7, C10, C16—.001 μf, 1,000 V ceramic disc
C8, C9—100 μf, 350 V electrolytic
C11—40 μμf, 1,000 V ceramic disc
C12—390 μμf, 500 V, 5% silvered mica
C13—.05 μf, 600 V mylar
C14—.0047 μf, 1,000 V ceramic disc
C15—.005 μf, 1,600 V mylar
C17—10-365 μμf variable (Lafayette 32 R 1103 or equiv.)
C18A,B,C—12-367 μμf, 3-gang variable (Allied 13 U 522 or equiv.)
J1—Phone jack
L1, L2—2.4 mh, iron-core RF choke (J.W. Miller 4666. (Newark Electronics Corp., 223 W. Madison St., Chicago, Ill. 60606. Stock No. 59F304; 75¢ plus postage.)
L3—Adjustable RF coil, nominal inductance: 15 μh (J.W. Miller 21A155RB1. Lafayette 34 R 8906)
L4—Choke, 9 turns No. 22 enameled wire wound on R3
L5—2.5 mh RF choke (National R-300S. Allied 61 Z 515. $1.12 plus postage. Not listed in catalog)
L6—15-turn air-wound inductor. Made from 1-in. dia., 16-turns-per-in., No. 20 wire, Barker & Williamson No. 3015 Miniductor (Lafayette 40 R 1624 or equiv.)
M1—0-300 ma DC milliammeter
NL1—NE-2 neon lamp
P1—No. 51 pilot lamp and socket
PL1—AC plug with ground lug
PL2—3-contact plug (Cinch-Jones P-303-AB)
R1—47,000 ohm, ½ watt, 10% resistor
R2—27,000 ohm, ½ watt, 10% resistor
R3—22,000 ohm, 1 watt, 10% resistor
R4—8,200 ohm, 1 watt, 10% resistor
R5—10 ohm, 5 watt, wirewound resistor
R6, R7—25,000 ohm, 10 watt, wirewound resistor
RY1—SPDT relay; 6-V, 85-ohm coil. (Phillips Advance No. 15-6-1C. Newark Electronics Stock No. 60F1747. $1.50 plus postage.)
S1—1-pole, 11-position, non-shorting rotary switch. (Centralab No. 1403. Newark Electronics 22F439. $2.52 plus postage.)
S2—SPST toggle switch
S3—SPDT pushbutton switch
SO1—Crystal socket (11 reqd. National Type CS-6, Lafayette 40 R 3713 or equiv.)
SO2—3-contact cable-clamp socket (Cinch-Jones S-303-CCT)
SO3—SO-239 coax connector
SR1—Silicon rectifier, minimum ratings: 100 ma, 100 PIV
SR2, SR3—Silicon rectifier, minimum ratings: 750 ma, 750 PIV
T1—Filament transformer, secondary: 6.3 V @ 6 A (Allied 62 U 325 or equiv.)
TP1-TP7—Solder terminals (Cambion No. 1947-2, Newark Electronics 40F1842 or equiv.)
V1—6CL6 tube V2—6DQ5 tube
XTAL 1 to XTAL 11—40-meter crystals. (Available for $1.50 ea. from Jet Crystal Lab, 24248 S. Crenshaw Blvd., Torrance, Calif., and others.)
Misc.—12 x 8 x 3-in. aluminum chassis, 9-pin and 8-pin (octal) tube sockets, ¼-in. extension shafts and couplings, terminal strips (TS1, TS2), Binding post (BP1), rubber feet (4 reqd.), 12 x 8-in. perforated aluminum (2), sheet-metal screws.

Dr. Zener's Diode

ASK most people what the function of a diode is and they'll say rectification—in either a detector or a power-supply circuit. Right they are so far. But there's one diode, called a zener diode, which does more than just rectify. Its primary purpose is to regulate a voltage. The device takes its name from Dr. Carl Zener (pronounced zee-ner), who discovered what now is known as zener action or zener effect.

Voltage regulation once was the job of gas-filled tubes, neon lamps and vibrating mechanical contacts. But today the zener diode, a rugged solid-state device which does not require a complicated circuit, does the job. Let's see how it works and how you'd design a circuit to operate a 9-V transistor radio from a car's 12-V electrical system. You'll also be able to tailor-make your own regulator circuit for other applications.

Up to a point, the operation of a zener diode is practically identical to that of a conventional solid-state diode. Fig. 1A shows what goes on in a conventional forward-biased diode and even a zener diode if it were connected the same way. The positive battery terminal connected to the P-type semiconductor material repels positively charged holes and pushes them toward the junction. The negative battery terminal similarly pushes free electrons in N-type material toward the junction where the holes and electrons combine quickly. The combining of holes and electrons constitutes a current flow through the diode and external circuit.

In a reverse-biased diode (Fig. 1B) the positively charged holes and negatively charged electrons are attracted to the negative and positive terminals, respectively. Thus, there are no electrons and holes at the junction to combine and, hence, there is no current flow.

Fig. 1C shows what happens with a zener diode. The diode is connected the same way as a reverse-biased diode. Let's see what happens now if we keep increasing the reverse-bias voltage. At first the zener behaves just like a conventional reverse-biased diode.

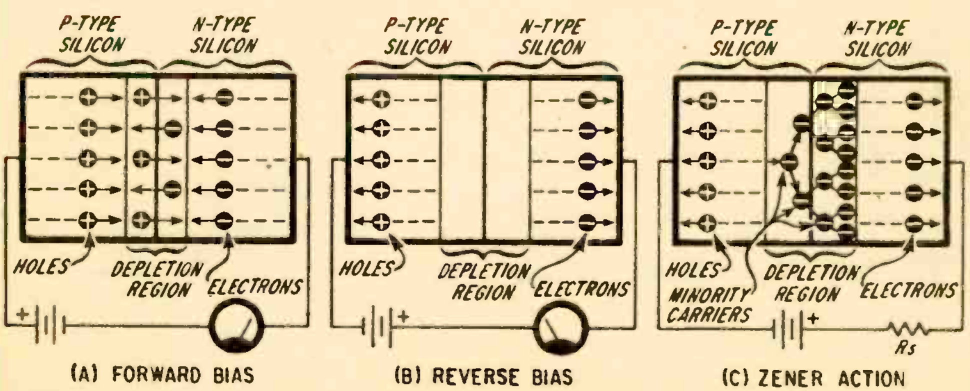


Fig. 1—Actions of conventional and zener diodes. In A, holes and electrons combine at junction: current flows. In B, holes and electrons are pulled from junction: no current flows. In reverse-biased zener (C), high negative voltage on P-type material forces minority carriers (electrons) across junction: they dislodge more electrons, current flows. Voltage across diode is constant.

That is, it appears as a high resistance in a circuit. Reason for this is there are no free holes and electrons combining.

But when the voltage finally reaches the zener voltage, something new and different happens. In the P-type material a few injected electrons pick up energy from the high negative voltage. Under the influence of this high negative voltage these electrons, which are called *minority* carriers, become active and cross the junction.

Let's sidetrack for a second to see what minority carriers are. First, let's review some semiconductor theory. In N-type semiconductor material the majority carriers are electrons. In P-type semiconductor material the majority carriers are holes.

However, in N-type semiconductor material there also happen to be a few holes. And in P-type semiconductor material there are a few electrons.

These electrons and holes, which are not where you'd expect them to be, are called minority carriers. Their flow in a reverse-biased diode constitutes something called reverse-saturation current. The current is of the order of microamperes and usually is disregarded. (Refer to Fig. 1B and you'll see that majority carriers are now out of the picture since they're away from the junction.)

The minority carriers (electrons in the P-type semiconductor material) get pushed across the junction and collide with atoms in the N-type material. A chain reaction takes place in which the collisions knock loose some fixed electrons, which in turn knock loose more fixed electrons. This causes a substantial current flow through the diode. The process is known as electron multiplication.

That resistor R_s—let's see what its purpose is since it is found in all zener-diode shunt regulator circuits. If the battery voltage is increased, more current will flow through the diode and R_s. However, the voltage drop across the resistor will increase but it will *not* increase across the diode. In other words, R_s absorbs all voltage that is greater than the diode's zener breakdown voltage. This is *the* important characteristic of the zener diode: an increase in voltage above the zener voltage causes a proportionate increase in voltage across R_s but *not* across the diode. Therefore, you simply connect the load across the zener diode where the voltage is constant.

But voltages and currents must remain within limits. Zener diodes are rated in catalogs according to zener voltage (V_z), the voltage at which reverse breakdown starts.

The wattage rating of the zener diode is the maximum power the diode will handle safely at its zener voltage. Zener diodes are available in 150, 250, 400, 750 mw and 1, 10 and 50-watt sizes. Zener voltage tolerances are 5, 10 or 20 per cent.

Let's look at our practical circuit to see how you go about selecting the zener diode and how to determine the value of R_s. Fig. 3 is the schematic of a shunt-type regulator which reduces 12 V to 9 V. Not only does the circuit reduce voltage, it stabilizes it as well to prevent annoying volume changes as the car voltage shifts from 12 to 15 V.

First, we must solve this formula for R_s.

$$R_s = \frac{E_{in} - E_z}{I_z + I_l}$$

E_{in} in input voltage to the regulator—the voltage supplied by the car. Since a car's voltage can rise to as high as 15 V, we will use 15 V for E_{in} in the formula.

E_z is the diode's zener voltage. You know

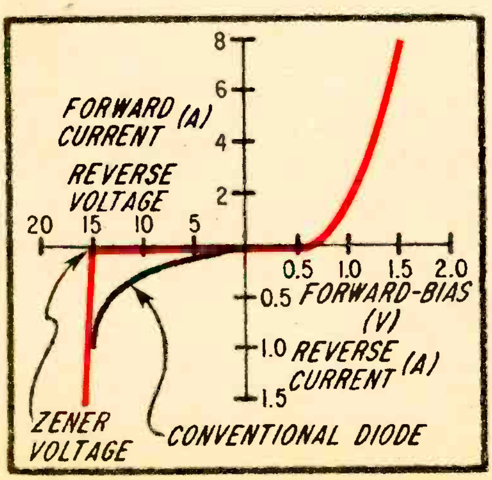
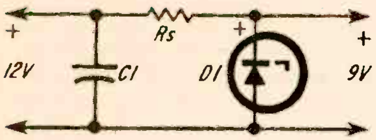


Fig. 2—Zener-diode characteristic curve (color). When forward biased (top right quadrant) the zener diode behaves like a conventional diode. When reverse-biased (lower left quadrant) no current flows until zener voltage is reached. Then the current increases rapidly. The result of this is that the voltage drop across the zener diode will remain constant even if the current through the diode is increased. A conventional diode behaves similarly except its reverse-bias curve (black, lower left quadrant) slopes and is rounded. The sharply-defined breakdown point in the zener diode is produced during manufacture, at which time carefully controlled impurity concentrations are added to the semiconductor material.

Dr. Zener's Diode



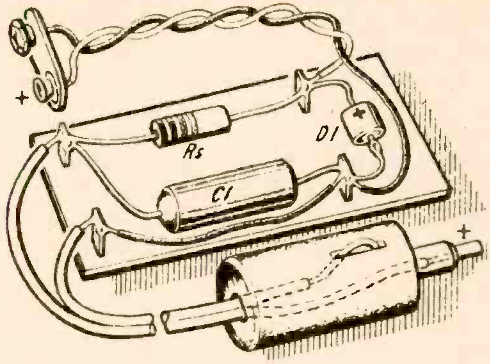


Fig. 3—Zener-diode shunt-regulator circuit, top. Be sure that the diode's cathode is connected to positive buss. Voltage in excess of zener voltage is dropped across Rs. Pictorial of an adaptor that will drop 12 V from car's electrical system to 9 V for transistor radio is shown at right.

what it is—it's the voltage required by the load. Since our transistor radio is powered by a 9-V battery, the zener diode should have a 9-V rating. The diode we used had a 9.1-V rating. (International Rectifier type No. 1ZF9.1T1O, Allied Radio, $1.12 plus postage. Not listed in catalog.) A zener with a power rating of 1 watt will easily handle the low power consumption of the radio.

I_z is the zener's maximum current-handling capability in amperes. If you don't find this rating listed in a catalog, compute it by dividing the zener's wattage rating by its voltage rating. In the case of our diode, the maximum current would be equal to 1 watt/9.1 V which is about 100 ma. But this is a maximum current rating and is not used. To be on the safe side, the zener is normally operated at about 20 per cent of its maximum current. Thus, in the formula we will use 20 ma (or .02 A) for I_z.

I_l is current consumed by the load (in this case, the radio) in amperes. You'll have to measure this with a VOM. Easiest way to is to connect a milliammeter in series with one of the battery's leads. The average current of two of our radios was 10 ma. Therefore, I_l is 10 ma, or .01 A.

When we put these values in the formula and solve it we get

$$R = \frac{15-9.1}{.02+.01} = \frac{5.9}{.03} = 196 \text{ ohms}$$

Thus, resistor R_s should be 196 ohms. A close standard value of either 180 or 220 ohms can be used. The power rating of R_s is determined by multiplying the voltage drop across it by current through it. These values can be taken from the formula above: E = 5.9 V and I = .03 A. The answer is .177 watts; therefore, a half-watt resistor will do the job.

Construction details are shown in Fig. 3. Polarities are important. If your zener diode is not marked with the symbol shown, connect the lead which is *insulated* from the case to *negative* side of the circuit. You can connect the 9-V output to the transistor radio with a battery clip from a discarded 9-V battery. Connect the regulator to the car's electrical system with a cigarette lighter plug. The .02 μf capacitor kills noise from the car ignition system. —*H. B. Morris*

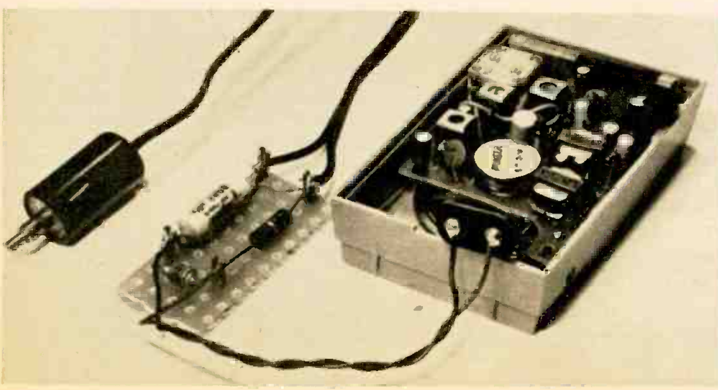
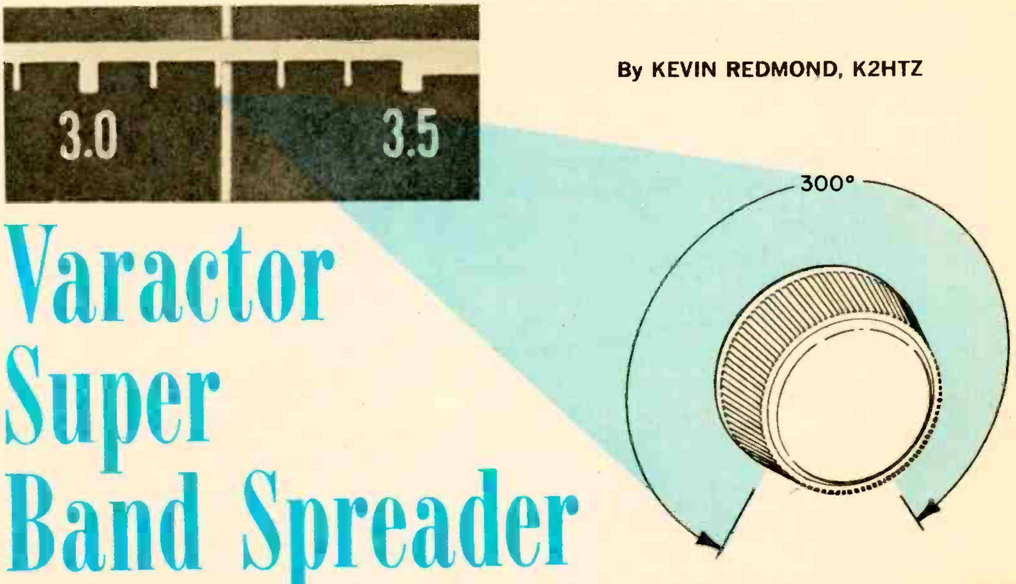


Fig. 4—Photo of adaptor next to 9-V transistor radio. A .02 μf tubular capacitor is included in regulator circuit to suppress interference from the car's electrical system. Be sure to get connections in cigarette-lighter plug and connector that couples regulator to radio correct or the radio or the zener is likely to be damaged.



Varactor Super Band Spreader

By KEVIN REDMOND, K2HTZ

$4 in parts makes any spot on your dial as broad as the side of a barn.

MOST short-wave receivers nowadays include bandspread. Good thing, too, for if they didn't it would be practically impossible to tune in stations that are packed together on the dial.

But frequently a receiver's conventional bandspread doesn't sort out the pile-ups as much as you'd like. Think back to the number of times you wanted to be able to bandspread the bandspread—especially when you are trying to tune SSB!

And if you happen to own a short-wave receiver that has no bandspread (like the Lafayette HA-226 below) then reach for your soldering iron fast.

Adding bandspread to either type receiver doesn't require a system of pulleys and belts. There's a better and easier way to do it electronically—with varactors.

What are varactors? Simple—solid-state diodes that work like and are used as variable capacitors. By applying a reverse bias voltage to a varactor (positive voltage on cathode, negative voltage on anode) you change the capacitance between its leads.

For example, when the reverse-bias voltage across a 1N3182 silicon voltage-variable capacitor (varactor) diode is -4 V, the diode resembles a 33-$\mu\mu$f capacitor. Change the DC voltage and the capacitance changes. In our application, we connect several diodes in parallel with the oscillator section of the receiver's tuning capacitor. When we vary the reverse DC bias on the diodes, the diodes' capacitance changes. Consequently, the receiver's oscillator frequency changes. Varying the receiver's oscillator frequency then shifts the receiver's tuning. You can make the frequency shift any amount you want—it depends on the size of capacitor C1 and the number of diodes.

To see how much standard and super bandspread can be obtained with varactors, look at the table on the next page which shows what happened to a Lafayette HE-30 (superseded by the HA-230) communica-

Fig. 1—Lafayette HA-226 short-wave receiver does not have bandspread and can use it. Control we added is at left between phone jack and switch.

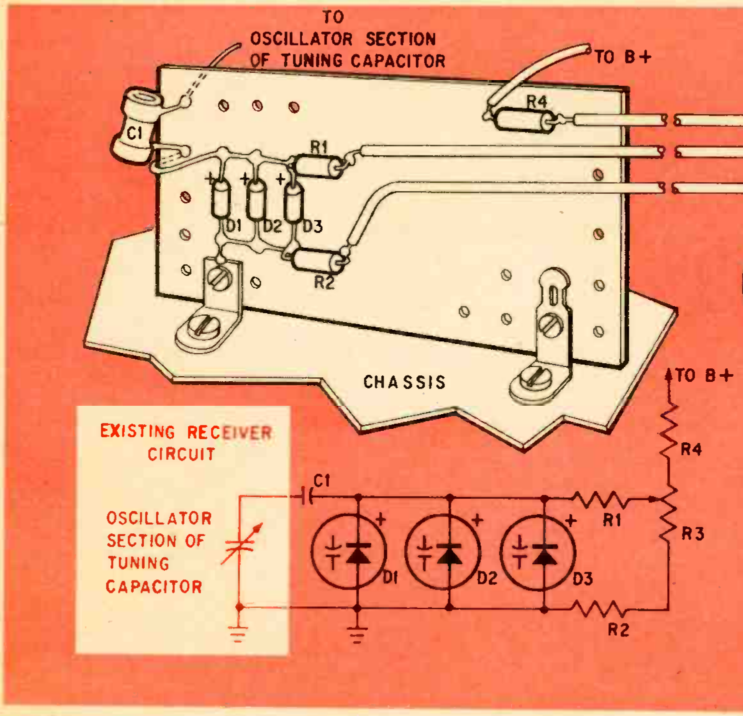


Fig. 2—Components fit on small piece of perforated board which should be installed close to oscillator wafer on bandswitch. C1's lead should go to wiper lug on switch. This lug also has lead to oscillator section of the tuning capacitor. Keep lead to ground short.

Band Spreader

tions receiver which already had bandspread. The figures show the maximum frequency shift obtained with conventional bandspread, varactor bandspread and with super-varactor bandspread. All frequencies are in kilocycles.

FREQ. TO WHICH RCVR. WAS TUNED (KC)	WIDTH OF BANDSPREAD IN KC		
	With Conventional Bandspread	With Varactor Bandspread	With Super Varactor Bandspread
1600	10	10	1
4800	32	31	3
14500	100	98	10
30000	200	196	20

Varactor bandspread added to the Lafayette HA-226 receiver produced the frequency shifts shown below when we turned the potentiometer 300 degrees. Again, all frequencies are in kilocycles.

FREQ. TO WHICH RCVR. WAS TUNED (KC)	WIDTH OF BANDSPREAD IN KC	
	With Varactor Bandspread	With Super Varactor Bandspread
1600	20	2
4300	50	5
11900	100	10
30000	375	38

PARTS LIST

C1—10 μμf, 500 V ceramic disc or mica capacitor (see text)
D1-D3—1N3182 varactor diode. Amperex (Newark Electronics Stock No. 21FX2660. 88¢ plus postage. $2.50 minimum order). Newark Electronics Corp., 223 W. Madison St., Chicago, Ill. 60606
R1—120,000 ohm, ½ watt, 10% resistor
R2—560 ohm, ½ watt, 10% resistor
R3—10,000 ohm, linear taper potentiometer
R4—68,000 ohm, ½ watt, 10% resistor
Misc.—perforated board, knob.

Construction. Our bandspread circuit was built on a 3 x 1¼-in. piece of perforated board. Before you start to build the circuit shown in Fig. 2, two or three points must be considered. The number of diodes and the capacitance of C1 determine the amount of bandspread. In a tube receiver, a 10 μμf capacitor for C1 and three diodes produce about the same amount of bandspread as could be obtained with the existing bandspread control in, say, the Lafayette HE-30 or a Hallicrafters S-38B receiver. The circuit we show, therefore, would be the one you would want to add to a receiver that has no bandspread, such as the Lafayette HA-226.

If your receiver already has bandspread

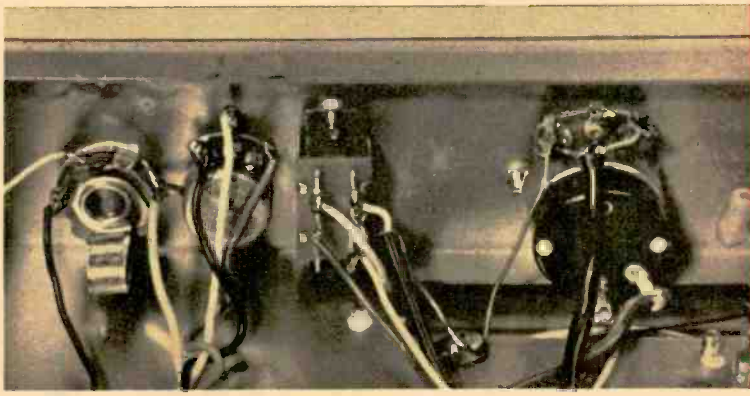


Fig. 3—Close-up of underside of HA-226 shows installation of potentiometer R3 between phone jack and CW/phone switch. Leads to R3 can be long since they carry DC but keep them close to chassis and away from the RF section.

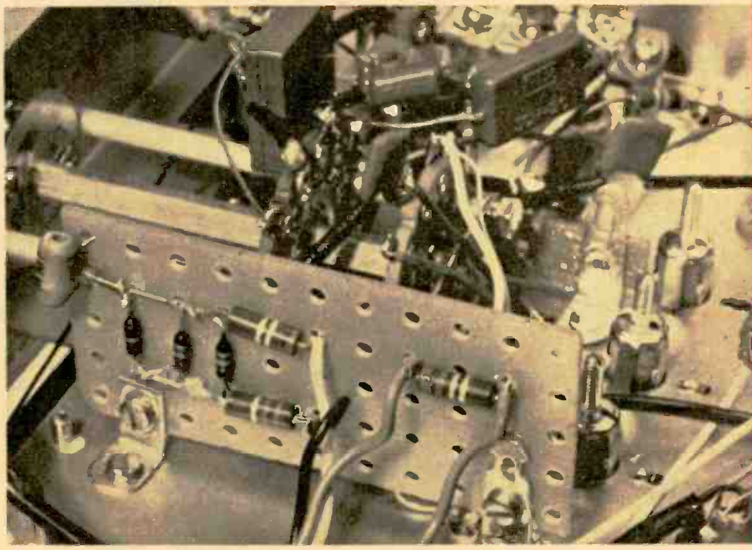


Fig. 4—Close-up of board mounted in HA-226. C1 is located in uppper left corner of board. Its lead goes through board and directly to wiper lug on oscillator wafer of bandswitch, which is 1 in. to the right of C1 in photograph.

you naturally would want to add super-bandspread to be able to produce with a 300-degree turn of R3 about 10 times the bandspread you presently get. To do this, use a 2 $\mu\mu$f capacitor for C1 and three diodes. An alternative is to eliminate two diodes and use a 10 $\mu\mu$f capacitor for C1.

Next thing to do is measure the RF voltage across the oscillator section of the tuning capacitor. You'll need an RF probe for your VTVM or scope to do this. If the voltage is greater than 15 V you'll have to use a smaller-value capacitor for C1. This is because C1 is part of a capacitive voltage-divider network (which includes the capacitance of the varactors) that reduces the oscillator voltage across the varactors.

If the RF oscillator voltage is too high the varactor will be driven into forward conduction and will load down the oscillator. When driven into reverse breakdown the diodes will be damaged. But on most receivers this won't be a problem. The oscillator voltages (rms) in our S-38B and HA-226 were 15 V and 9 V, respectively.

Below is a table that relates receiver B+ voltage, oscillator voltage, the number of diodes to use and the value of other parts. C1 is 10 $\mu\mu$f and R3 is 10,000 ohms.

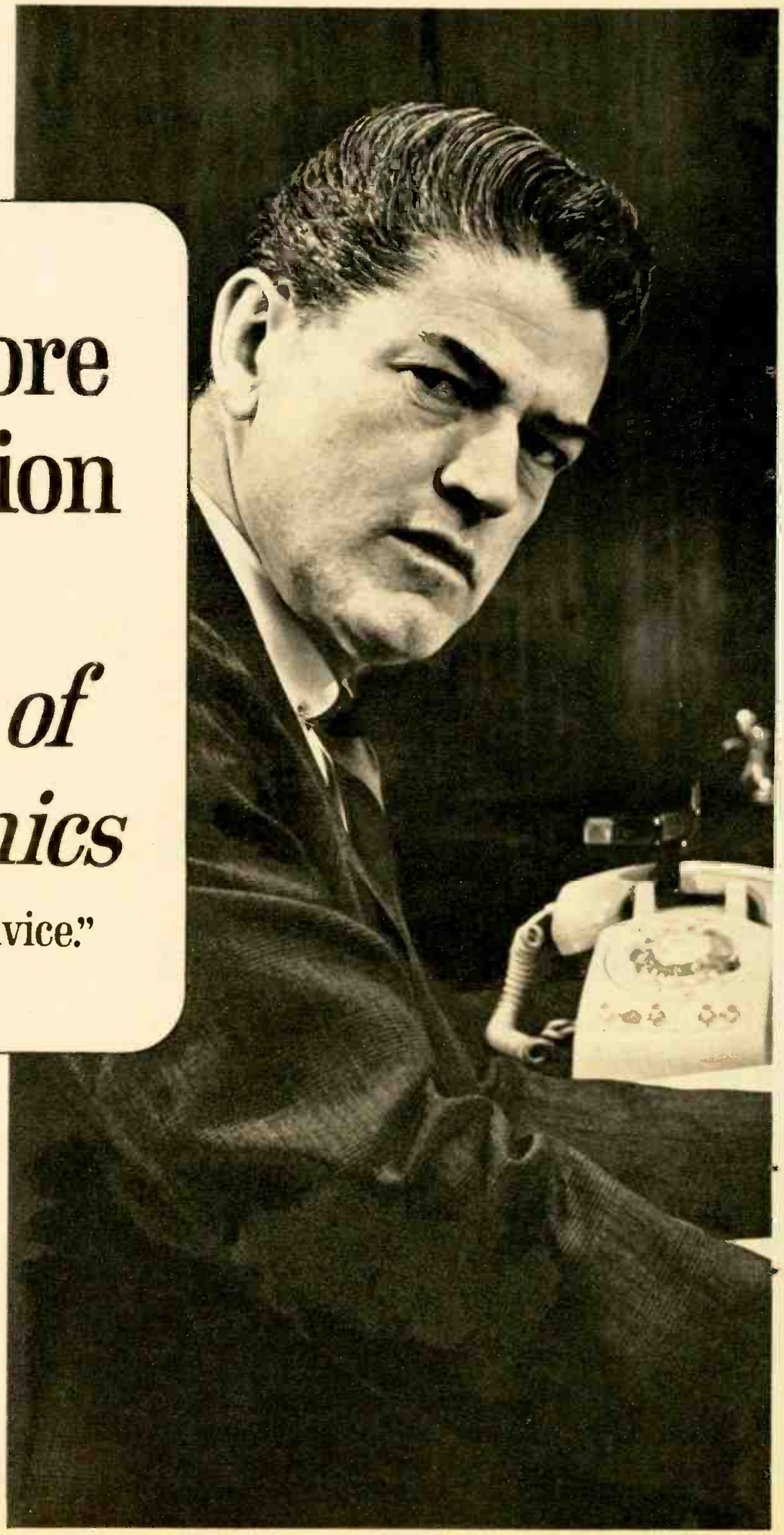
RCVR. B+ VOLTAGE	RCVR. OSC. VOLTAGE	NO. OF DIODES	R2 (OHMS)	R4 (OHMS)
180	15	3	680	47,000
120	15	3	560	47,000
12*	2	3	6.8	—

* Transistor receiver: C1 = 47 $\mu\mu$f.

Wiring is critical at the point where C1

[*Continued on page* 110]

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



WORLD'S BIGGEST MAGNET

By J. K. LOCKE Slowly the pulsing, whirling cloud of dust, gas and space debris coalesced into a planet. As it formed, the heat of radioactivity grew. Gravity pulled the molten heavy elements—iron, nickel, chromium—toward the center of the sphere.

Then somewhere in the seething, liquid heart of the planet a small electric current sprang up. Chemical variations may have created a crude battery. A weak current may have been induced in a blob of flowing metal as it moved within a stray magnetic field. Or a thermoelectric junction where molten core met outer mantle perhaps sparked a current flow. Whatever the cause, the current began. And, as all currents do, it created a magnetic field around itself. The field was cut by still other masses of molten metal and still more currents—and more magnetic fields—were generated.

Gradually the currents built. The molten core of the planet and its 1,800-mi.-thick plastic outer mantle did not rotate at exactly the same speed. The magnetized rocks of the crust began to act like the field coils of a dynamo; the moving masses of metal within were armatures. As in a dynamo, the magnetic fields and electric currents were self-perpetuating, so long as the huge machine continued to move and radio-active heat within made the metal churn.

The planet, of course, is the earth. Its circulating currents create the world's biggest magnet—the world itself.

This gigantic self-excited electromagnet went into operation during the earth's formation but for more than 4 billion years this fact went unnoticed. Finally man evolved and discovered locestones—naturally magnetized rocks. According to legend, a Grecian shepherd named Magnes was tending his sheep on Mount Ida one day. He touched his iron-tip staff to a stone and, much to his surprise, couldn't pull it away. Thus in one stroke he discovered the lodestone and gave his name to its most important quality: magnetism.

The stone with the magic power both delighted and frightened the ancients. Many thought charms made of lcdestone would attract a lover, cure an illness or perform other miraculcus deeds. The ancient Chinese noticed that the rock, hung from a thread, always would turn itself in the same direction. And it soon was found that a delicate needle, magnetized by rubbing it on a lodestone, did the same job even better. That was the birth of the compass.

The small lodestones, or needles, the ancients felt, were pointing toward a mountain-size mother lodestone somewhere on the earth. This explains why ancient mariners were wary. Though they used the compass to navigate, they feared the great mountain of lodestone that their needles pointed toward would attract any ship that sailed too close, pull all the nails from the hull and dump everybody into the sea. History doesn't reveal how apprehension about encountering the mother lode may have affected explorers searching for a Northwest Passage, but Sinbad the Sailor was shipwrecked by Lodestone Mountain in The Arabian Nights.

To this day the lodestone-mountain legend is so strong (and, perhaps, teaching of the sciences so poor) that a surprisingly large proportion of our average citizens, when asked what makes the compass needle point the way it does, answer, "The lodestone." (To set the record straight: the needle only by coincidence is pointing at anything; it turns the way it does to align itself with the earth's lines of magnetic force, and this brings the N end around to point toward the imaginary Magnetic North Pole.)

In 1600, Sir William Gilbert, physician to Queen Elizabeth I, made a small lodestone globe. Noting that a compass passed over its surface behaved exactly as one moved similarly over the surface of the earth, Sir William correctly concluded that the earth was a giant magnet. He erroneously repeated the errors of the ancients, however, when he assumed that global magnetism came from a giant mass of magnetic material somewhere in the earth. Truth to tell, only within the last few decades have men begun to understand what does cause the mysterious, invisible field of force that cloaks the earth. And the discoveries have brought surprises.

For centuries scientists imagined that the earth's magnetic field was similar to that surrounding an ordinary bar magnet. Lines of force, according to this classical picture, circle symmetrically from pole to pole, enclosing the earth in a neat cocoon of magnetism. The strength of the field gradually diminishes as distance from earth increases. Theoretically, the field extends to infinity.

It's a tidy, orderly picture. But it's all wrong. Satellite-borne magnetometers—instruments that measure magnetic fields—recently have given scientists cause to discard ages-old concepts. Such devices show the earth's magnetosphere (its sheath of magnetic energy) is a turbulent area, battered by solar winds and storms. And this magnetic field, this blob of celestial Jello, shaking and quivering under the sun's repeated assaults, doesn't extend to infinity. It stops sharply at a point some 40,000 mi. from the earth on the side nearest the sun.

And it's not symmetrical. Instead, it is a vastly elongated teardrop with its blunt end toward the sun. Its tail flutters in the solar breeze on the earth's leeward side. (Our illustration on the opening pages of this article shows an artist's concept of what now is known about the earth's magnetic field. The quarter-moon-like areas on either side represent the Van Allen belts, held in place by the earth's magnetism.)

Above all, the earth's magnetic field is not static as has been pictured. Geophysicists now think that the movement of molten metal in the earth's core—the movement that gives rise to the magnetic field—is not smooth and steady. Instead, it's a series of turbulent eddies and churning currents. The magnetic fields generated by these eddies all add up to produce the planet's overall magnetic pattern. But each of the eddies has its own individual magnetic field, too. And these individual currents play strange tricks.

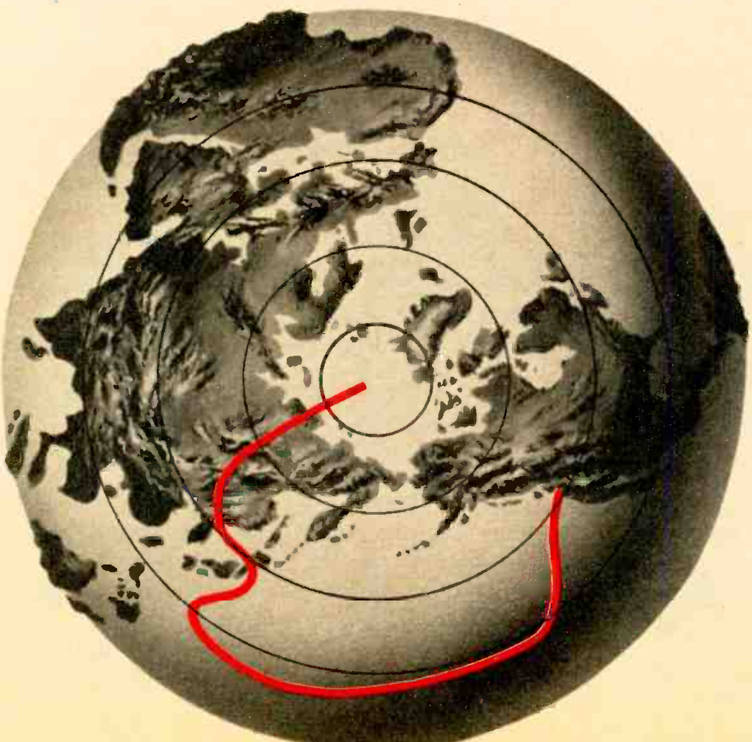
As every sailor knows, the magnetic compass points directly toward the magnetic North Pole at only a few spots on earth—places of so-called zero declination. In most areas, the needle points 5, 10 or even more degrees to the left or right. Anyone using a compass must compensate for this declination to get a true reading. What's more, the declination at any given point changes slowly over the years. The longest magnetic records extant have been kept at Greenwich, England. When the record-keeping was begun just before 1600, the compass needle at Greenwich pointed 11 degrees east of true north. In the next 200 years, the needle drifted west some 35 degrees and by 1810 was at 24 degrees west (current declination: about 15 degrees west).

The shifting currents deep within the earth cause the magnetic field on the surface to vary in strength as well as direction. In 100 years the magnetic intensity in South Africa has doubled. In other places it has weakened. While eddies in the earth's interior cause local declination and variations in intensity, the drifting of the molten core causes the entire magnetic pattern of the globe slowly to drift westward some 17 miles a year. This slippage between crust and core may account for another strange feature of the earth's magnetic field: the wandering of the poles.

The magnetic poles themselves, of course, are nothing but imaginary points on the surface of the globe where the magnetic lines of force surrounding the earth converge. One pole is arbitrarily called North, the other South. We think of the compass as pointing north but that's arbitrary, too. The Chinese who, after all, did invent the instrument, always have considered the compass needle as indicating south.

Interesting, too, is the fact that the *magnetic* poles do not coincide with the *true* poles. The position of the true poles is fixed by the earth's axis—the imaginary line around which the planet rotates. But since the location of the magnetic poles is determined by the shifting currents in the molten interior, they can be almost anywhere. Truth is, scientists now believe the magnetic poles have been on the move for hundreds of millions of years. The Magnetic North Pole, according to recent evidence, was somewhere near what now is the state of Washington 600 million years ago. It later took a looping tour of the Pacific, then cut up through Japan, China and Russia in making its way to its present position. And it's still moving. In 1831 the Magnetic North Pole was on Boothia Peninsula on the North American coast. During the next 116 years it drifted north 200 miles and was on Prince of Wales Island in 1947. Then it put on a spurt of speed and had moved another 200 miles by 1959. When last seen it was racing across Melville Island at better than 240 feet a day.

Paleomagnetism—the study of magnetic particles frozen in sedimentary rock laid down by ancient seas—shows that the poles even have flipped from time to time. Once every million years seems to be the flip frequency and some observers believe the poles may be readying for another flip right now. The

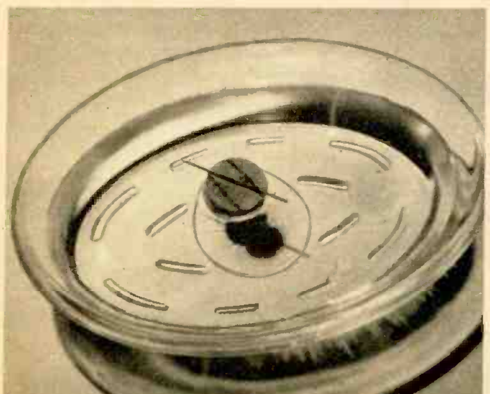


Colored line shows wanderings of magnetic north pole over period of 700 million years, based on magnetic properties of rocks found both in Britain and North America. Pole currently is located on Canada's Melville Island but is moving north-northwest some 240 feet a day.

total magnetic strength of the earth has dropped by about 10 per cent in the last century. Should this trend continue, some scientists think the field could pass through zero, then reverse its direction.

If this happens it will be quite a jolt to humanity. Compasses will cease to work. The aurorae borealis and australis (northern and southern lights) will disappear. Long-range radio channels will go out of business. The Van Allen belts, held in place by the earth's magnetism, will vanish. It even could mean the end of human life as we know it. A Canadian geophysicist, Professor Robert J. Uffen of the University of Western Ontario, believes previous magnetic field reversals may have altered life on earth drastically. Explanation is that the distintegration of the protective Van Allen belts allowed unusually high levels of cosmic rays and other radiation from space to hit the earth. This radiation according to Professor Uffen, could have set off waves of violent mutation among living things and thus might account for the relative rapidity of evolution. Should such radiation be allowed to reach earth again, life could be altered markedly.

As the possibility of extinction by magnetism faces life on earth, other less lethal magnetic phenomena are in progress. The entire atmosphere of the earth is subjected to twice-a-day tides, just as are the oceans. People living at the bottom of this restless sea of air don't feel fluctuations any more than fish at the bottom of the deep notice ocean tides. But a hundred miles above the earth they'd witness a continuous mile-high tidal wave of air.



Home-made magnet consists of magnetized needle mounted on cork floating in water-filled saucer.

Since the gasses of the thin atmosphere at this level largely are ionized by the sun's ultraviolet rays, they are excellent conductors of electricity. And when any conductor is moved across magnetic lines of force—in this case, the earth's magnetic field—an electric current is generated. Averaging more than 1,000,000 amperes, the current generated in the ionosphere creates its own magnetic field. Since the air is free to move rapidly, the field varies rapidly, too. Measuring instruments on the ground easily can detect the ebb and flow of the magnetic tide.

Fluctuations of the plasma-borne current circling the globe reach a dramatic climax during the most spectacular of the earth's magnetic shows—a magnetic storm. One of the most violent ever recorded began at 4:08 p.m. EST on Sunday, Feb. 9, 1958. A huge solar flare—a leaping, twisting tongue of flame—shot hundred of thousands of miles into space, spewing a dense cloud of plasma toward the earth. By 6:02, the flare had disappeared but the cloud now was speeding across space at better than 3,000,000 mph.

All day Monday magnetographs on earth continued to trace normal, relatively straight lines across their charts. Then at 8:26 that evening, the thin front edge of the cloud struck the earth's magnetosphere. Huge electric currents shot through the ionosphere, creating massive, pulsing magnetic fields. The tracing on the magnetograph at Fredericksburg, Va., suddenly drew a series of jagged lines. Badly disrupted, the ionosphere quit reflecting long-distance radio signals and began absorbing them. At 8:30, an operator at the American Telephone & Telegraph Co. in New York reported that radio circuits to Europe were acting up.

Simultaneously, a spectacular fiery aurora lit the Canadian sky from Atlantic to Pacific and started moving south. Minutes later, intense red and green arcs, rays and patches made a brilliant display over the northern United States. At 8:55, the full force of the cloud struck, and magnetic hell broke loose from pole to pole. At Fredericksburg the magnetograph tracing skittered crazily to the edge of the recording paper. In Fairbanks the tracing shot clear off the page. All radio contact between the Old and New Worlds stopped as though someone had thrown a switch.

The earth's magnetic field, collapsing before the onslaught from space, induced tre-

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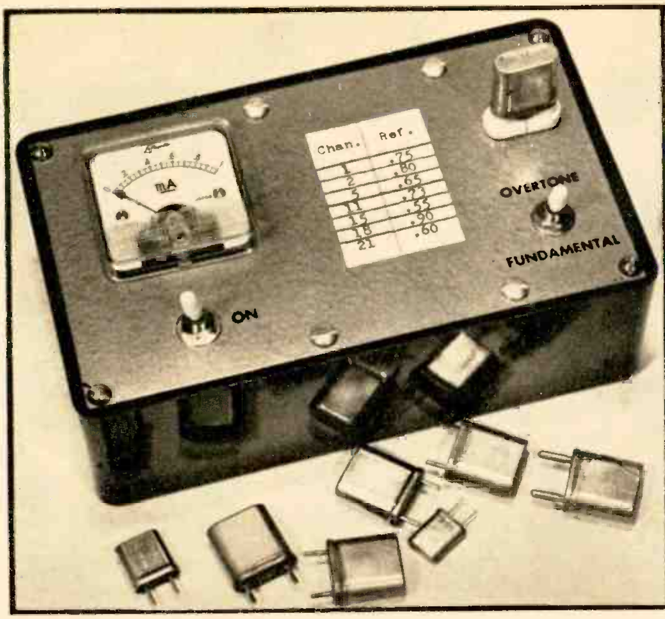


All Transistor Rock Checker

By
HERB FRIEDMAN
KBI9457

A BAD crystal often is the last thing a CBer thinks of when his rig's performance isn't up to snuff. But rocks do poop out. And the reason they do is because transceivers often pull the last drop out of the rock, leaving no reserve activity. And when a crystal's output falls the rig's output goes right down to the basement.

Or, due to a failing crystal, the receiver's sensitivity could get so bad you hardly could hear a shout from a station a block away. And a reduction in RF drive to the final—caused by a weak crystal—can affect modulation adversely.

On the flip side of the coin there are those CBers who suspect the crystal at the first sign of poor performance. This means many good crystals are consigned to the junk box that shouldn't be. But with EI's 1-transistor rock checker handy you'll know for sure whether your crystals are good or bad.

The checker will determine the condition of 99 per cent of all (6 mc and up) overtone and fundamental crystals used in CB gear. The meter indicates directly whether a crystal is bad, fair or good. You also can use the checker to keep track of a crystal's continuing performance. You simply jot down the meter indication when you check a new crystal, then compare it periodically with the indication after the crystal has been put in service.

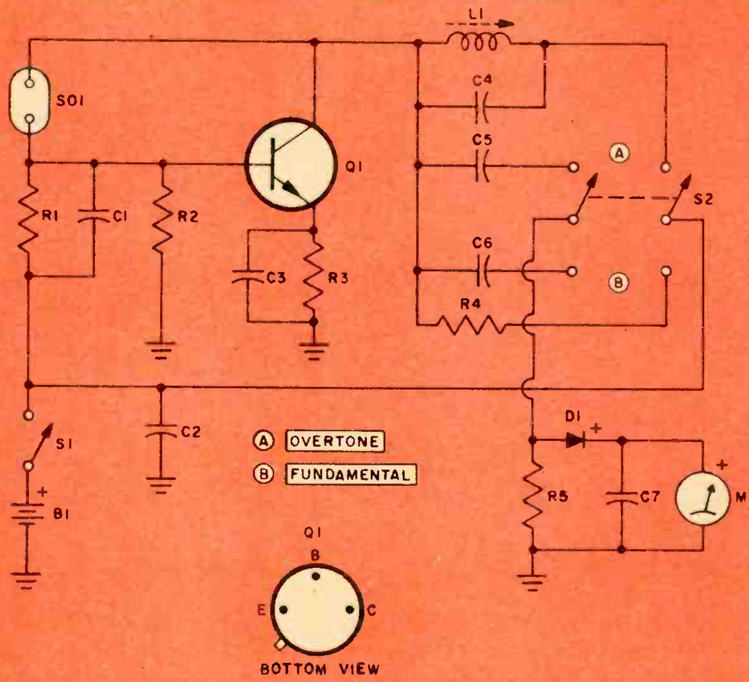
Construction. Parts layout and component values are extremely critical; therefore, follow the pictorial closely and use only the components specified. Make no substitutions.

Start off with L1, which is wound on a J. W. Miller No. 4400 coil form. Unlike the case with other coil forms, you must install the ring-terminal lugs and slug spring on this one. Take the slug spring—the triangular wire object—and slip it in the notch at the top of the mounting bushing. Slip one ring terminal on the form and slide it on until it is 5/32 in. from the end with the metal collar.

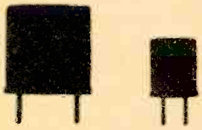
Next, tensilize a 4-ft. length of #22 enameled wire by clamping one end in a vise and pulling until the wire goes dead slack. (If the wire isn't tensilized the coil will unwind.) Attach one end of the wire to the mounted ring terminal and wind on 15 tight, close-wound turns. Then slide the other ring terminal up against the winding and solder and the wire to it. If the coil looks sloppy take it apart and wind it again. Set L1 aside.

Install all parts on a 2 7/16 x 3 3/8-in. piece of perforated board and mount the board on the back of the cabinet cover, using ¼-in. spacers between the board and the cover at each mounting screw. Flea clips should be used for tie points.

Note S2's wiring carefully. Capacitor C5 is switched into the circuit when L1/C4 are switched in. If C5 and C6 are reversed the meter will indicate, but incorrectly.



Schematic of checker. Circuit is simply an oscillator in which meter measures detected RF output voltage at collector of Q1. Since capacitors C5 and C6 form an RF voltage-divider network for the meter's calibration, they must be 5 per cent silvered micas because their values are critical.



Only an HC-6/U crystal socket is indicated because it is almost impossible to obtain sockets for wire-lead and close-pin crystals. If your rig uses miniature crystals solder two small alligator clips to short lengths of wire. Then, to test miniature crystals simply plug the clip leads into SO1 and connect the clips to the crystal.

Test and Alignment. Connect a milliammeter, set to measure at least 25 ma, in series with one of B1's leads and turn S1 *on*. Do not place a crystal in SO1. Current should be from 6 to 9 ma. If the meter indicates higher than 12 ma, turn off the power quickly and check for a wiring error.

Set S2 to the *overtone* position (L1/C4 in the circuit, R4 out of the circuit), plug a mid-band transmit overtone crystal in SO1 and adjust L1's slug for maximum dip on the test meter. While watching M1, adjust L1 for maximum indication. The adjustment may be broad. If it is, turn the slug to the midway point. If adjusting L1 causes M1 to go off-scale, you may have interchanged C5 and C6.

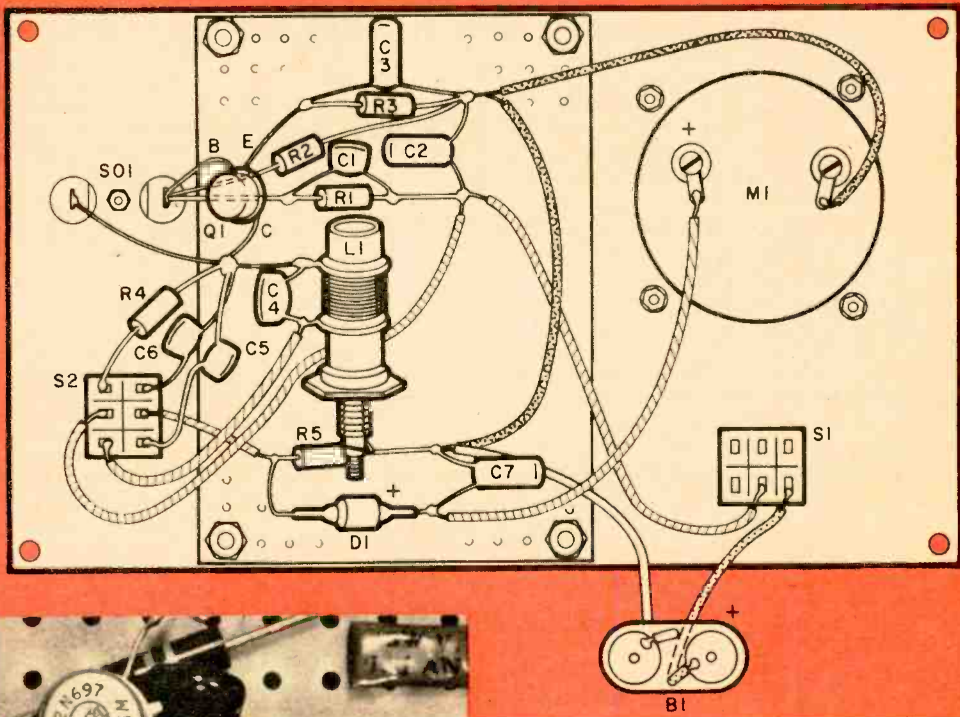
No adjustment to L1's slug is needed for fundamental crystals. Just plug the crystal into SO1, set S2 to *fundamental* and check to see that M1 indicates. If you don't get an indication check for a wiring error.

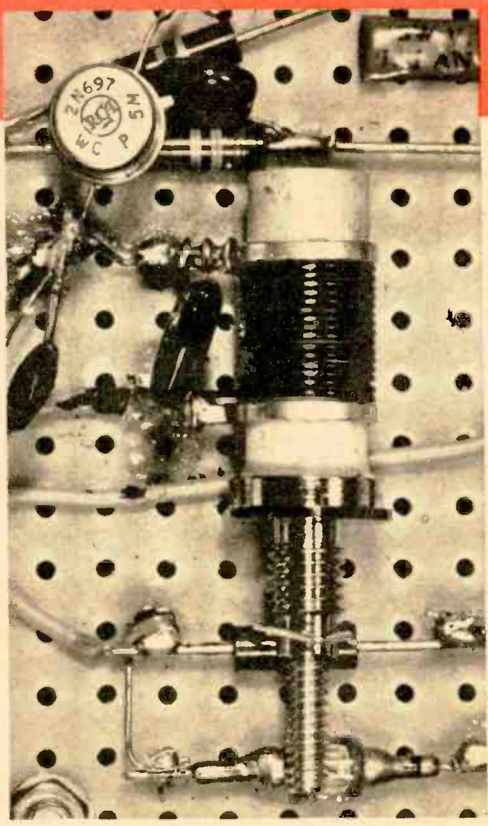
Using the Checker. For both overtone and fundamental crystals this is M1's calibration: *bad:* 0 to 0.25; *fair or questionable:* 0.25 to 0.5; *good:* 0.5 to 1.0. Naturally, the more active the crystal the higher the meter indication.

As a general rule, overtone crystals tend

PARTS LIST

B1—9 V battery (Burgess 2U6 or equiv.)
Capacitors: All 75 V or higher
C1—33 μμf C2, C3, C7—.01 μf
C4—100 μμf, 5% silvered mica
C5—10 μμf C6—22 μμf, 5% silvered mica
D1—1N34A diode
L1—Coil, wound on J.W. Miller No. 4400 form (Lafayette 34 R 8951)
M1—0-1 ma DC milliammeter (Lafayette 99 R 5052 or equiv.)
Q1—2N697 transistor
Resistors: ½ watt, 10%
R1—27,000 ohms R2—10,000 ohms
R3—10 ohms R4—470 ohms
R5—1,000 ohms
S1—SPST toggle or slide switch
S2—DPDT miniature toggle switch
SO1—Socket for HC-6/U crystal (National Type CS-7. Lafayette 40 R 3715 or equiv.)
Misc.—6¼ x 3¾ x 2-in. Bakelite box (Lafayette 19 R 2001), cover for box (Lafayette 19 R 3701), perforated board, flea clips, alligator clips.





Be sure D1 is under L1's slug against the board, not up in the air. If L1 is wound correctly its terminals should line up with two flea clips spaced two holes apart. Solder L1 directly to clips.

Circuit board just fits on cabinet cover. Layout is critical; therefore, mount D1 and associated parts at bottom of board. Install Q1 and its circuit at top of board. L1 goes between the two circuits.

to cause a meter indication of 0.7 or higher when they are new. Fundamental crystals will cause indications from about 0.4 to 0.7. To keep track of a crystal's performance, cement a chart on the front panel, showing the indication you get with a new crystal. Then you can check suspect crystals against reference values.

Overtone crystals also will produce an indication on M1 when S2 is set to *fundamental* while fundamental crystals might indicate when S2 is set to *overtone*. Readings taken with S2 in the wrong position naturally are meaningless. Always set S2 to the correct position before inserting a crystal.

Note: Some overtone crystals used in older CB rigs will not cause the checker's circuit to oscillate. It is easy to tell whether your crystal fits this group since it will perform in the transceiver but will not cause M1 to indicate higher than 0.1—if at all. If your crystal fails to start the oscillator, substitute a 130 $\mu\mu f$ capacitor for C4. This will permit you to test your hard-start crystals

Notes from EI's DX CLUB

St. Pierre and Miquelon Islands always have been classed as a comparatively rare game though there are at least two FP8s active on 20 meters. Saul Kaplan, WB2HIZ, reports working FP8DR, and Jerry Sokolowski, K8BZK, has worked FP8CK.

SWLs hoping to log E. Pakistan (which EI's DX Club counts separately from W. Pakistan) should watch for the transmitter at Dacca on 17890 kc. Station has news in English at 0835 EST.

That station at Elizabethville, Rep. of Congo, again is being logged in North America on 11866 kc. It now identifies as R. Interprovincial du Katanga and peaks around 1530 EST. Latest person to report it is Gerry Dexter of Wisconsin.

R. Republik Indonesia has shown up on a brand-new channel—9770 kc—for its 0545 PST English news. Station easily is the best bet for anyone on the West Coast desirous of logging Indonesia.

The international service of R. Kabul, Afghanistan, currently is installing a new 100-kw transmitter but should be back on the air by the time you read this. Watch for it on approximately 15225 kc around 1330 EST.

R. Nacional, Colombia, again is on 4955 kc, though its frequency varies slightly from night to night. Station puts out one of the strongest signals on 60 meters.

The Republic of Honduras is a surprisingly difficult logging for many, though HRST, R. Primero de Mayo, at Tela often squeaks through. Station can be heard on 4790 kc until sign-off at 2200 EST.

Two New Guinea territory stations—R. Wewak on 3335 and R. Rabaul on 3385 kc—currently are being picked up on the West Coast around midnight PST. Both are weak and under heavy QRM, so be prepared for a battle.

At last report, both R. Mogadiscio, Somalia, and ETLF (R.V. Gospel), Addis Ababa, Ethiopia, were on 7120 kc at 2230 EST. Result is lots of QRM plus a chance to log both stations at once. Could this doubling on 7120 be an accident or are sinister forces afoot?

R. Tahiti has moved both its transmitters and now is operating on 6135 and 11820 kc. The latter sometimes can be heard early as 2200 EST, though the 6135-kc outlet ordinarily is blanketed by R. Habana Cuba until RHC's 0100 (2200 PST) sign-off.

Don't get excited if you hear Arabic on 4810 kc. Explanation is that R. Popular, Venezuela (of all places), has a program in this language just before 1900 EST.

According to European sources, R. Thailand is on 11945 kc with English at 0530 EST and perhaps 1200 as well. Anyone hear them on this new frequency?

Propagation: Short-wave radio conditions during daylight hours will be good to excellent in the 16- and 19-meter bands and good to fair in the 13-meter band. At night, the 25- and 31-meter bands will be best, though some DX will be possible on all bands between 49 and 19 meters.

TV and FM DX will remain fair to good in July, then taper off during August due to seasonal decreases in short-skip, sporadic-E openings.

Short-skip openings to distances up to 1,000 mi. will occur in the 10-meter amateur band as well as in the 11-meter Citizens Band during daylight hours—especially from 10 a.m. to 2 p.m., local time.

Broadcast-band DX will continue poor because of high nighttime noise levels.

WHY WE'RE SO WEATHER WISE

By LEO G. SANDS

JOHN Burroughs, an American scientist who died decades before our jet-age was dreamed of (in 1921, to be exact), once remarked that he was born with a chronic anxiety about the weather. Mr. Burroughs assuredly wasn't alone then—and he would be even less so now. We're still anxious. But for a different reason. Mr. Burroughs worried about the next day. Now we can be reasonably sure of what's coming tomorrow, the next day—or even the next. It's the day after that that worries us, especially if it's a week end.

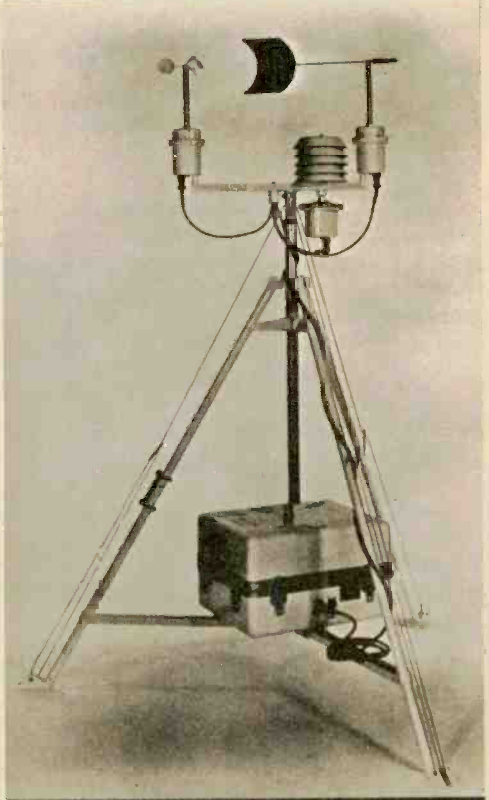
There's no getting around the fact that nowadays we are pretty weather-wise as compared to the good old days and the reason for this lies in a single four-syllable word: electronics. Far-seeing radar, earth-girdling satellites, nearly goof-proof computers and a host of electronic devices are making the weatherman's job easier and his forecasts more reliable. Stated simply, weather forecasting is being automated. And, chances are, reliable, computer-graphed weather forecasts soon will be available for viewing on television screens and in newspapers all over the world.

Should such a prediction ring true, automatic satellite-borne cloud-mappers whirling about the earth will observe cloud formations, computers will interpret and analyze their findings and the data will be transmitted round the world in a matter of minutes. The satellites will spot potentially dangerous storms and hurricanes and watch them for signs of movement, intensification or dissipation.

Simultaneously, additional weather information will be gathered by radar and other instruments, on land as well as on buoys in oceans round the earth. Once assembled, weather and oceanographic data will be transmitted to a central computer via earth satellites.

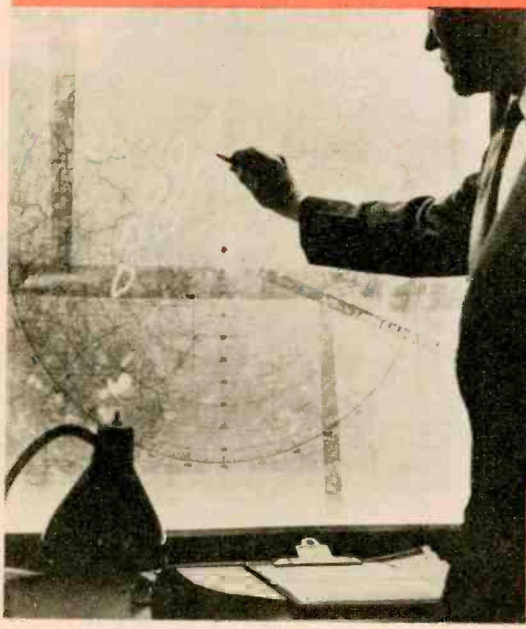
Already we've relegated to the past such weather signs as the color of the sunset and the direction of smoke flow. For centuries, a red sunset indicated that the morrow would be fair. Smoke spreading out horizontally rather than rising spelled rain. A halo around the moon augured snow. Fact or fiction, we can discard the whole lot—if we haven't done so right now.

To be sure, residents of California and Arizona will continue to believe with assurance that there will be no rain during summer



Portable weather station by Berkeley Instruments transmits data to distant computer, can be stationed most anywhere.

WEATHER-WISE



Hub of one of the world's most densely populated areas, New York City boasts one of the best-equipped weather stations going. Radar plots cloud forma-

months. There won't be—not until man manages to manipulate as well as outguess the weather. High- and low-temperature predictions will remain the only forecasts of interest to people in these regions during the summertime. Similarly, in areas where it rains every month—Seattle and environs, say—the natives rightly will continue to believe that it's about to rain when they can see the top of Mt. Rainier and raining when they can't.

Though a battery of space-age devices now is in on the weather, the barometer remains one of the meteorologist's basic tools. Thing is, the ordinary aneroid barometer must be read by a human. But a new electronic barometer developed by Lear-Siegler converts barometric pressure into digital signals which can be fed to a computer or a teletypewriter circuit for direct print-out.

And space-age forecasters aren't necessarily expensive, either. Temperature can be sensed by thermistors and the presence of sunshine or degree of overcast can be detected by solar cells and light-sensitive transducers whose output signals can be encoded.

Fog, in fact, already is being sensed by the backscatter of light from a xenon discharge tube which radiates a 1° beam in 1 millisecond flashes equivalent in brightness to 100 million candles. The density of the fog is determined by how much light the moisture particles reflect.

Also figuring in man's growing weather adeptness is the fact that conventional weather instruments such as the anemometer and weather vane have been combined with other devices in complete weather stations small enough to be portable. One, developed by Berkeley Instruments (see our photo on the first page of this article), already is in use by the Weather Bureau and other government agencies. Modern as a supersonic jet, it readily reports wind speed and direction, air temperature, barometric pressure, relative humidity, rainfall, nuclear radiation, solar energy and dewpoint in the form of encoded signals.

For a look at just how far electronic forecasting has come, take a gander at the nation's largest metropolis, New York City. There, Weather Bureau radar high atop the RCA Building scans a 45,000-sq.-mi. area

tions (photo at left), instruments chart precise nature of upper atmosphere (center) and computer-like devices spew out a wealth of meteorological data (right).

containing some 25 million people—more than 1/10 the population of the entire U.S.! Radar enables meteorologists to see cloud formations within a radius of 280 miles. And what they see is reported over the bureau's VHF FM station and is used for preparing weather forecasts for the public. The radar images also are transmitted by microwave to pilot briefing rooms at New York's three major airports where the cloud situation is viewed continually on CCTV (closed-circuit television) screens.

And while the Weather Bureau radar in New York and most other ground radars scan the skies horizontally, new hope lies in a cloud-height radar developed by Lear-Siegler that looks straight up. It operates at such a high frequency (around 35,000 mc) that its beam is reflected by moisture particles in the air. However, the radar beam penetrates the clouds and literally paints their picture as they pass overhead. Cloud height, density, length and time of passing are indicated on a facsimile recorder. The findings also can be encoded for transmission to a central computer.

Aircraft, too, are getting in on the latest in weather-wiseness. For though radar long has been used aboard aircraft for looking at the weather ahead, some air lines recently have installed new, more-sensitive radars that figuratively can see weather beyond the weather. According to RCA, the manufacturer, these new radars provide twice the usual airborne radar range. In addition, new weather-radar techniques developed by RCA permit us to see such meteorological phenomena as wind shear in clear air.

Wind shear results when two adjacent masses of air moving in different directions slide past one another, producing downdrafts, turbulence and other rough atmospheric conditions. According to RCA, the new radar techniques will enable weathermen on the ground to give pilots almost instantaneous information on wind-shear areas. Simultaneously, they will provide data on direction, velocity and vertical extent of wind field aloft and the location and severity of the turbulence.

Another part of the RCA scheme of things is plans for positioning a meteorological station as high as the plane which carries it can fly. Information will be transmitted continuously and with greater accuracy than afforded by the current radiosondes. Reason is that balloons presently sent aloft to gather information about wind fields, turbulence and other weather conditions must radio the information back to ground, where it then is interpreted. Hope is that the proposed airborne station would eliminate many of the pitfalls inherent in the balloon-to-ground-to-computer setup.

Also worth noting is our increasing reliance on weather satellites. Already in orbit for more than five years, these dutiful space-travelers have provided man with a window on the weather. As of this writing, more than 2,100 storm bulletins based on satellite observations have been issued to some 50 countries by the Weather Bureau. The TIROS satellites alone have observed about 165 hurricanes, typhoons and tropical storms. Matter of fact, during the past three years not one day has passed during which the satellites did not send out cloud-cover pictures for use by meteorologists.

As for the future, first of the new TOS satellites, which was launched this year, will provide global meteorological data to

[*Continued on page* 119]

GOOD READING

By Tim Cartwright

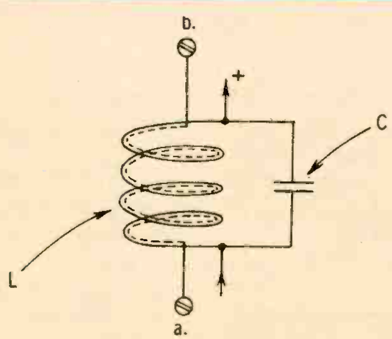
INVENTORS IDEA BOOK. By L. George Lawrence. Howard W. Sams & Bobbs-Merrill, New York & Indianapolis. 128 pages. $1.95

According to some old advice echoed at the beginning of this book, successful invention sometimes depends less on your skill at solving a problem than on your ability to find the right problem to solve in the first place. And that's what this little book is all about. It suggests some known needs of sorts and implies that a resourceful person might devise gadgets to meet many of them.

Thing is, we're not entirely certain all these needs can or should be satisfied. A flying-saucer detector (p. 59) might appeal to the nutty fringe, though they seem to be detecting a more-than-ample quantity without electronic help. Fusing the filament of an electronic vacuum tube (p. 53), another of the book's 185-odd suggestions for electronic and mechanical inventions the author feels are needed, likely would interest only those sweet souls who have been plugging for fuses in flashlights all these years. And a self-contained oscillator (p. 103) is something we always thought already was on the books, though the author seems to have a rather special oscillator in mind. Says he:

"A method for producing continuous, self-contained oscillation of LC-type oscillators that does not use vacuum tubes or transistors should be worked out. The substance of this problem is illustrated in Fig. 184.1 (see our illustration). Once triggered, the circuit will continue to oscillate if it is maintained at cryogenic temperatures. This is a cumbersome process due to the machinery involved. The new invention should therefore strive to approach this problem by special feeding methods (connected at a and b) based on solid-state inductance coupling."

Lamentable, we think, that this book wasn't around in Edison's time. He no doubt would have found a place for it on his library shelf beside Peck's Bad Boy.



Taken from the Inventors Idea Book discussed above, our illustration shows what the author refers to as a self-contained oscillator using inductance coupling.

VIDEO TAPE RECORDING. By Cris H. Schaefer, Cedric L. Suzman & Associates. Hobbs, Dorman & Co., New York. 104 pages. $12

The product of a group of students at the Harvard Business School, this is the kind of report you seldom see on a new area of technology. Rather than a technical treatise, it's an interesting look at the VTR from a socio-economic standpoint and an estimate of how much and how fast it's going to influence the way we live.

Considering the book's origin as a student research report, it's questionable whether the price of $12 (*yoiks!*) really is justified. Even so, the book does contain a lot of information for anyone whose interest in this branch of electronics goes beyond schematics.

DICTIONARY OF ELECTRICAL ENGINEERING. Compiled by K. G. Jackson. Philosophical Library, New York. 373 pages. $10

British spoken here! But once you get accustomed to translating valve into tube and earth into ground you have a useful and comprehensive dictionary that's just the right

[Continued on page 117]

KIT EI REPORT

Heathkit HD-10

LOW-COST ELECTRONIC KEYER

BRASS pounders become artists with the key after using an electronic keyer. Quite unlike the ham's old standbys, the J-38 straight key and the semi-automatic bug, an electronic keyer enables you to send perfect code every time. Hold its paddle to one side and it produces dahs continuously. Hold the paddle the other way and dits pour out without end. And you never have to worry about character duration and spacing—they're always perfect.

Up to now electronic keyers have been expensive accessories and regarded as luxuries around the ham shack. But the $39.95 Heathkit HD-10 has brought the electronic keyer into the ball park of practically any operator whose dream has been to send clean-as-a-whistle code effortlessly.

Eleven transistors, in a computer-like circuit full of flip-flops, put the HD-10 among the most advance-design keyers. Regardless of where the speed knob is set the spacing between and the length of the characters remain constant. The dits and dahs are self-completing. That is, even if you just tap the paddle to one side of the other, the dit or dah lasts for its full duration.

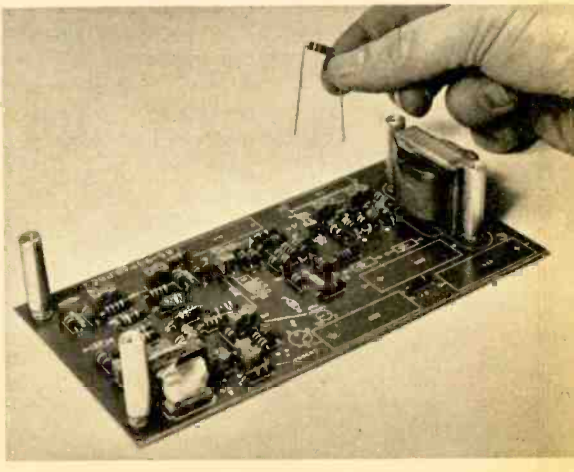
Building It

Construction includes two types of wiring: printed-circuit and point-to-point. The circuit board virtually eliminates all chances of error and saves much construction time. However, there's enough routing and soldering of cable-harness wires to give that real build-it-yourself feeling. It's about a ten-hour job to assemble the kit, plus a little time for puttering with mechanical adjustments.

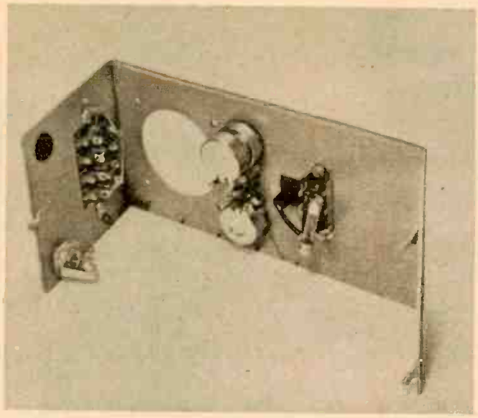
On The Air

It was with trepidation that we put this keyer on the air for the first time. Reason was that its design looked similar to a circuit we'd seen published somewhere before. We constructed that circuit, which worked beautifully until the transmitter was flipped on. Then RF fields occasionally caused false triggering and garble.

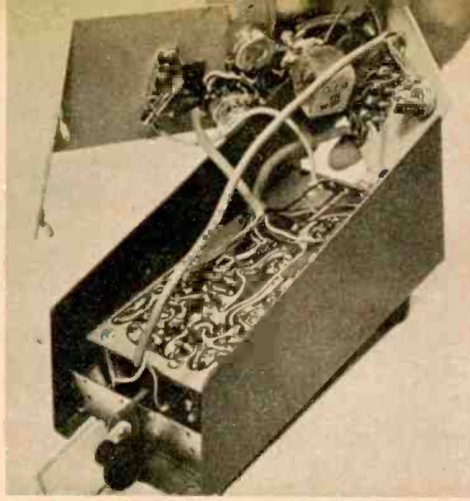
The problem did not exist with the HD-10. It keyed a 100-watt transmitter when it was about 15 ft. from the antenna (thus in strong



The keyer contains a lot of components but construction is not that difficult since most parts are mounted on an uncrowded printed-circuit board.



Controls in cover are connected to circuit board with cable harness. The dual pot is the speed control. Other pot is for the keying-monitor volume.



Final assembly step. Key lever is mounted on ballast plate, a heavy sub-chassis that prevents the unit from walking across table when operated.

LOW-COST ELECTRONIC KEYER

RF fields) without one misfire. A big feature of the HD-10 is that it has electronic (transistor) switching instead of a rat-a-tat-tat keying relay found in some other keyers.

If the keyer can be faulted at all it's for lack of flexibility in allowing selection of the basic speed range. Early in construction you must decide whether you want to send 10 to 20 wpm or 15 to 60 wpm. You then solder either a 10,000-ohm or a 68,000-ohm resistor on the board, depending on desired speed range. Neither range met all the requirements for our CW operator, an 18-to-25-wpm man.

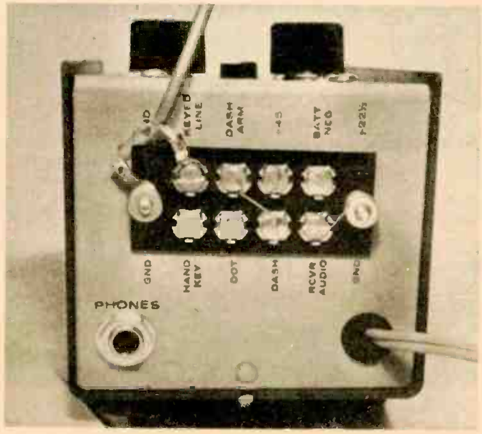
The high-range resistor did not permit the keyer to be slowed sufficiently for two important functions: working DX through heavy QRN/QRM conditions or working slower operators who could well provide a rare QSL, say, to get a worked-all-states certificate. Installing a low-range resistor, on the other hand, can cramp your style if you want to get over 20 wpm.

The back panel of the keyer permits hookup of a manual key for slow-speed work, but in a sophisticated instrument such as the HD-10 the addition of a speed-range switch would be a welcome feature.

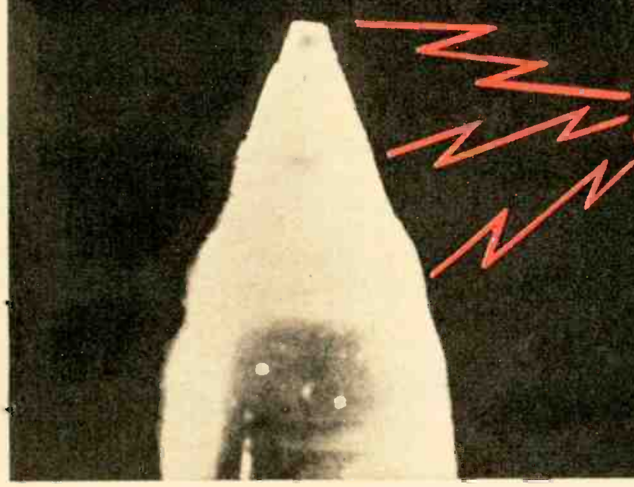
The keyer works with most transmitters but cannot be plugged indiscriminately into every key jack. Keyed current shouldn't exceed 35 ma and voltage across the key contacts must be under 105 V.

The manual gives a good checkout procedure plus a method for adjusting the dit-space ratio with a VTVM. Shown, too, are several possible hookups for listening to your fist through the keyer's built-in speaker or via your receiver.

Old-time hams like to caution beginners against any kind of speed key. You'll send faster than you can receive, goes the argument. We disagree. The statement is *almost* true since anyone who sends faster than he can copy has neither much fun nor success on CW. And he soon finds it out. An electronic key, on the other hand, provides a near-effortless method for sending remarkably clean code that others find a pleasure to copy. Getting the hang of the kev takes no great skill—just some practice.



Rear terminal board takes connections to transmitter for keying, to receiver for optional monitoring and has a jack for a conventional key.



SQUEEZE ME AND I'LL SHOCK YOU

By JOHN POTTER SHIELDS

STEREO sets, communications receivers and ultrasonic cleaners aren't the kind of gear their users normally would consider shocking, though all can be capable of a nasty jolt at times. Thing is, each of these items often as not incorporates a rock that packs a real punch. For squeeze that rock—called a *piezoelectric crystal* — and the result is bound to be shocking.

A thin slice of brittle material about the size of a fingernail, a piezoelectric crystal has the unique property of converting mechanical vibrations into corresponding electrical signals and vice-versa. As such, these little slivers represent one of our most intriguing and useful transducers—substances or devices capable of changing energy from one form to another. And though most familiar as phonograph and microphone elements, piezoelectric crystals are finding their way into all sorts of gear, ranging from the most sophisticated submarine detection systems to artificial heart mechanisms.

How it Started. Interestingly enough, piezoelectric crystals aren't new, being, we suppose, old as the rocks they're made of. But it remained for the Curies (of radium fame) to stumble across the fact that certain rocks, notably quartz, possess the peculiar quality of generating an electric voltage when squeezed. Incidentally, the word piezoelectricity is descriptive of what's going on, *piezein* in Greek meaning to press; hence, pressure electricity.

Though piezoelectricity was discovered before the turn of the century, there was little that could be done with it at that time. The vacuum tube still awaited DeForest so there was no way to amplify the rather minute electrical currents that piezoelectric materials generate.

Came DeForest with his triode, however, and things began to look up for piezoelectricity. First major applications were phonograph pickups, microphones and headphones. World War II saw development of an underwater detection system called sonar which relied on piezoelectric properties. And in the years after the war, piezoelectricity really came into its own, being incorporated into a wealth of devices from ultrasonic cleaners to bandpass filters. And as things now stack up, piezoelectricity is destined for applications limited only by the imagination of our engineers.

What It Is. All piezoelectric materials have two basic properties. They can convert a mechanical squeeze (pressure) into an electric charge (voltage). Or they can do just the reverse, i.e., convert an electric charge into mechanical movement. The phonograph pickup is a good example of the first property, while crystal headphones are representative of the second.

In the case of the phonograph pickup, the mechanical vibrations from the needle riding the record grooves apply pressure to the piezoelectric material, causing it to generate a corresponding electrical voltage. But with crystal headphones the piezoelectric elements operate the other way round. An applied electrical signal causes the elements to vibrate and these vibrations are coupled to the headphone diaphragms. The result is reproduced sound.

Exactly why piezoelectric materials act as they do is not precisely understood. Even so, scientists have a fair idea of what goes on inside a piece of piezoelectric material. Our explanation won't be a deeply scientific one but it should suffice to shed some light on the inner workings of these mysterious shockers.

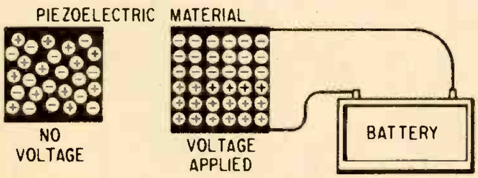


Fig. 1—Domains in piezoelectric material realign when voltage is applied, alter element's shape.

To begin, let's assume we are looking at a piece of piezoelectric material through a high-power microscope. Magnification permitting, we can see that the material contains minute electric-charge-bearing particles called *domains*. Part of the domains carry a positive charge, the others a negative charge. Of those domains appearing on the faces of the crystal some likewise are positive, some negative.

When pressure is applied to the crystal the domains realign themselves so that one face of the crystal becomes positively charged and the other negatively charged. Pressure removed, the domains snap back to their original configuration, and the charges on the faces of the crystal disappear.

However, let a voltage be applied across the faces of the same crystal and the domains again realign themselves. This realignment also causes a change in the physical dimension of the material as depicted in Fig. 1.

The amount of voltage which a piezoelectric material will generate depends on the amount of pressure applied to it—the greater the pressure, the greater the voltage. Explanation is that increased pressure causes more and more domains to realign themselves and, therefore, to increase the voltage present. And in much the same fashion, the larger the voltage applied to a piece of piezoelectric

SQUEEZE ME AND I'LL SHOCK YOU

material, the greater its physical change. Reason is that the greater the applied voltage, the greater the number of domains realigned; and the more domains realigned, the greater the physical deformation.

Natural and Man-Made. Quartz is the earliest known piezoelectric material and large quantities still are consumed in the manufacture of piezoelectric devices. Natural quartz is mined in the form of large crystals which must be sliced into wafers before they become usable as piezoelectric materials.

The widespread use of quartz as a piezoelectric element partially is due to its stable piezoelectric characteristics. The amount of voltage it will generate for a certain applied pressure or the amount of physical change for a given applied electrical voltage show little variation over long periods. Still another of quartz's advantages stems from the fact that it can be operated at relatively high temperatures without losing its piezoelectric properties.

Rochelle salt is another type of piezoelectric material in wide use. Unlike quartz, it isn't mined but rather is grown in large tanks. This growing is done by seeding a saturated Rochelle salt with a tiny crystal, the seed ultimately growing into a crystal several feet long. In essence, the procedure is the same as making rock candy from a saturated sugar solution.

As in the case of quartz, the large Rochelle salt crystals must be sliced into thin wafers in order to produce usable piezoelectric material. However, compared to quartz, Rochelle salt will generate a larger voltage for the same applied pressure. Similarly, it will provide a larger physical change for an applied voltage.

On the minus side of the ledger, Rochelle salt can't withstand the high temperatures

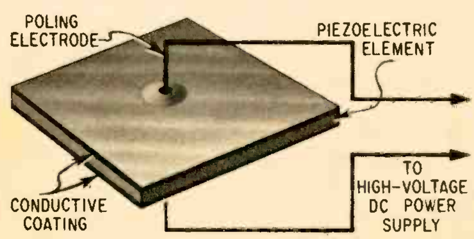


Fig. 2—Man-made piezoelectric elements are heated, then poled by application of DC voltage.

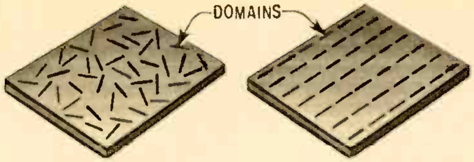


Fig. 3—Poling aligns domains within man-made ceramic element, imparts piezoelectric properties.

quartz can tolerate. Also, Rochelle salt readily absorbs moisture so it preferably must be waterproofed with a suitable coating if it is to retain its piezoelectric properties for any length of time. Nevertheless, due to its high piezoelectric activity, Rochelle salt is used extensively in such devices as phonograph pickups, microphones and headphones.

Both quartz and Rochelle salt are so-called natural piezoelectric materials. And, though other natural piezoelectric materials exist, quartz and Rochelle salt account for the bulk of natural piezoelectric elements in use.

During and after World War II, a number of man-made piezoelectric materials were developed. These new materials, which basically are special forms of ceramic, possess properties not obtainable in the natural variety of piezoelectric crystals. For example, ceramics can withstand much higher operating temperatures than any of the natural piezoelectric materials. What's more, they are not affected by humidity or moisture.

Another advantage of ceramics is that they can be molded into various shapes. Quartz or Rochelle salt crystals, in contrast, only can be sliced into wafers.

All is not entirely rosy with ceramics, however. Their piezoelectric abilities are not in the same league as those of Rochelle salt and they also are a bit more expensive to produce. And, unlike the natural piezoelectric materials, ceramics must be poled to impart piezoelectric properties to them.

This poling operation (see Fig. 2) consists of applying a high DC voltage (several thousand volts) across each ceramic element. Application of this poling voltage aligns the domains in the same direction (see Fig. 3). Poling is done with the ceramic heated to several hundred degrees. When the ceramic is cooled and the poling voltage removed, the domains stay aligned.

Much like permanent magnets which lose their magnetic properties when heated above a certain temperature, ceramics are stripped of their piezoelectric properties when subjected to heat. The reason for this is that above a certain temperature (known as the Curie Temperature or Curie Point) their domains drop out of alignment and assume the random pattern they exhibited before the elements were poled.

Putting It To Work. Most common application of piezoelectricity is the phonograph cartridge. Since it is comparatively easy to obtain a voltage from a slice of Rochelle salt by applying pressure to it, all that need be done to produce a cartridge is couple the vibrations from the needle to the Rochelle salt element. This will result in an electrical output from the Rochelle salt element which is a facsimile of the mechanical vibration impressed in the grooves of the record.

In practice, the needle is coupled to the Rochelle salt element in such a manner that it imparts a twisting motion. This provides a greater electrical output from the element for a given needle vibration. Frequently, two Rochelle salt elements are sandwiched together in such a way as substantially to increase the electrical output for a given twist.

Crystal microphones operate in much the same manner as the piezoelectric phonograph cartridges. Only change is that a diaphragm has been substituted for the needle assembly. The mike's diaphragm is coupled to the element (Rochelle salt or ceramic) via a yoke arrangement which imparts a twisting action to the element in accordance with sound waves striking the mike's diaphragm.

Crystal headphones are much like crystal mikes in their construction, though their function is just the reverse. Electrical impulses fed to the headphone's piezoelectric element cause it to twist in step with the applied signal. This twisting action is transmitted to the diaphragm, which radiates sound. [*Continued on next page*]

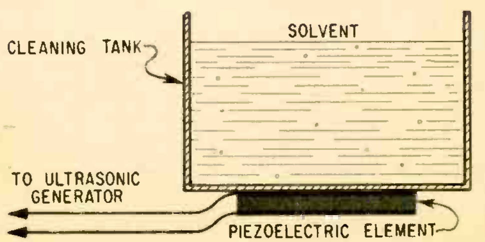


Fig. 4—Ultrasonic cleaner uses piezoelectric element to convert AC signal to mechanical vibrations.

Another big application of piezoelectricity is in the field of ultrasonic cleaning. Here, one or more piezoelectric ceramic elements are mounted on the bottom of a water- or solvent-filled tank, as shown in Fig. 4. When a high-frequency AC signal is applied the elements vibrate in step with the applied frequency. Vibrations are transmitted mechanically through the bottom of the tank and into the liquid, causing it to be agitated violently (people in the ultrasonic-cleaning industry refer to the action as *cold boiling*). Used in conjunction with the proper solvent, such intense vibrations cleanse small, delicate parts, such as watches and jewelry.

SQUEEZE ME AND I'LL SHOCK YOU

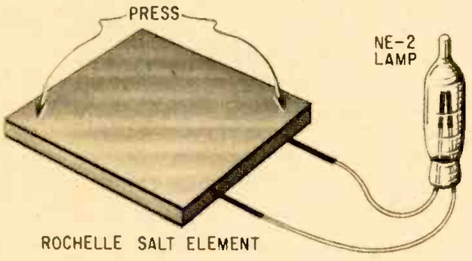


Fig. 5—Piezoelectric element flashes neon lamp when flexed, again when pressure is withdrawn.

Boating fans often find themselves with a piece of piezoelectric material on the hull of their boats in the form of a gadget called a depth sounder. In this case, a hull-mounted ceramic element sends out a series of pulses. When these pulses strike the water bottom, a log or other object, they bounce back to the same element which now is connected to act as a mike. The length of time it takes the reflected signal to reach the element after it was transmitted directly is related to the distance the signal has traveled.

Even teeth aren't immune to the workings of piezoelectricity. Not long ago a dental drill was developed in which the actual cutting was performed by a piezoelectric element vibrating at a high frequency. In this application, the drill operates at high efficiency and generates little heat, assuring minimum pain for the patient.

Perhaps the most dramatic use of piezoelectricity is a high-voltage generator. The device calls for piezoelectric ceramic rings to be stacked one on another, then squeezed by hydraulic pressure. As the pressure is increased, the voltage developed by the rings increases until a point is reached where the rings figuratively explode with a volley of voltage.

Piezo Probing. Those with a bent toward experimenting may wish to perform an experiment or two in order better to become acquainted with piezoelectricity and its properties. Only special piece of equipment required is a Rochelle salt element equipped with leads. An old crystal phonograph cartridge will suffice, though larger elements yielding up to several hundred volts are available from science-equipment sources. Elaboration on one or more of the following experiments might make an excellent Science Fair project.

For a basic demonstration of piezoelectricity, connect the leads from a large Rochelle salt element to an NE-2 neon lamp as shown in Fig. 5. Gripping the two opposite corners, flex the element gently back and forth, taking care not to fracture it. The lamp should flash each time the element is flexed and again each time the element is released.

The reason is that flexing the element beyond a certain point develops a voltage sufficient to ionize the neon lamp. This discharge effectively shorts out the charge developed across the element. When the element is released, a charge again builds up, though this second charge will be of opposite polarity.

Lacking a large piezoelectric element, a VTVM can be connected across a small crystal to give some indication of its behavior under stress.

The conversion of applied electrical energy

[*Continued on page* 116]

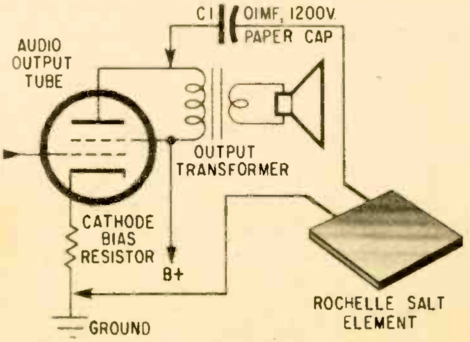
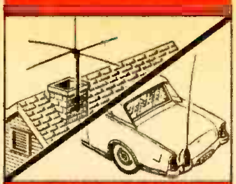


Fig. 6—Signal from amplifier flexes element connected as shown. See text for alternate circuit.



CB CORNER
BY LEN BUCKWALTER KBA4480

Down to the sea, But where's CB?

INDICATIONS are that most manufacturers of CB transceivers would rather walk the plank than actively bring CB to boating enthusiasts. Good example was CB's absence at the boat show in New York, held months in advance of the current boating season. The affair lured 300,000 people and was replete with electronic gadgetry—from a gleebie that tells when the rudder's centered to one that shrieks when the bilge can blow. But for all CB was in evidence it well could have gone down with the Spanish Armada.

Electronic exhibitors busily pushed their high-ticket marine radios. And at prices four times those of CB transceivers, who could blame them? When one was asked if he had CB equipment on display, he replied, "No," we make *marine* radio." (His company, in fact, does make CB gear.) Clearly, this head-in-the-sand attitude simply doesn't measure up to reality. Here's why.

If you think CB is crowded, tune in the standard marine bands (2000 to 3000 kc) during the boating season. What you'll hear sounds like Errol Flynn and his mates grappling on the poop deck. And if CB has been guilty of salty language, give a listen on the marine channels (ho-ho-ho). In any case, congestion has been so bad that a new VHF marine band recently was opened on 150 mc to sop up the overflow.

But how about boating's estimated 8 million enthusiasts? Not only is the cost of regular marine equipment prohibitive and spectrum space scarce, but high-powered marine rigs (which generally start at about 30 watts) don't sit well in the ubiquitous 16-ft. runabout. And as local waters boil with water skiers and Sunday pilots, the open sea looks ever so inviting. That's where two-way radio becomes a lifesaver.

We say CB has the answer. Even a 1- or 2-watt walkie-talkie, which needs no installation, power source or permanent antenna, goes bounding over the main with remarkable range. Regular 5-watters hop to the horizon and more, with ease. Sure, there's congestion on CB, but try waving for help from a small boat. (One boatman in distress did just that; passing boats simply waved back.)

Can you get help via seagoing CB? One Coast Guard auxiliary officer says there's no official monitoring but in many areas a call on channel 13 alerts other CB-equipped craft as well as shore-side monitors. CB, at least to this officer, is mighty effective and cheap.

Size-wise . . . Imagine a lusty, brawny 8-year-old who talks twice as much as anyone else in his family. That's CB. Though most anyone might guess that CB's grown like a leaking can of Crazy Foam, official figures for 1965 reveal precisely how the various radio services are divided numerically (see our chart).

As quickly is evident, youthful CB is about three times larger than ham radio, an aging uncle now passing the 50 mark. And adding all those license figures brings a grand total of more than 1½ million, of which CB alone claims over half.

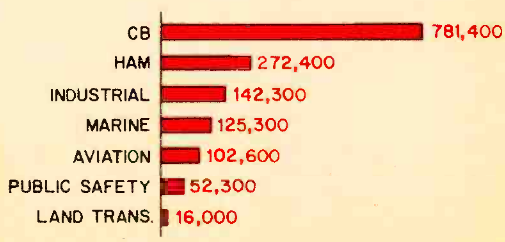
Armed Camp . . . "A dastardly act," mouths the Caped Crusader.

"Holy barracuda!" echoes the Boy Wonder.

That's what the Dynamic Duo surely would say if they got wind of a fresh battering for CB radio.

A press-service story picked up by newspapers and radio told how Citizens Radio is

[*Continued on page* 113]



Official FCC figures showing number of licensees in various radio services disclose a startling fact: CB, the youngest of the group, also is the largest.

BIG TROUBLES

By DON CARTER

THE 25-meter band rightfully can be said to reflect more of the fascinating chaos of today's world than any other SW spot. For international power politics, clashes between ideologies, brush-fire wars between small nations and that fight between international and regional broadcasters just for radio space itself all are moving to make 25 the trouble spot of the spectrum. Fact is, an SWL well could camp continuously on 25 and come up with a whole bagful of sizzling DX and equally red-hot listening.

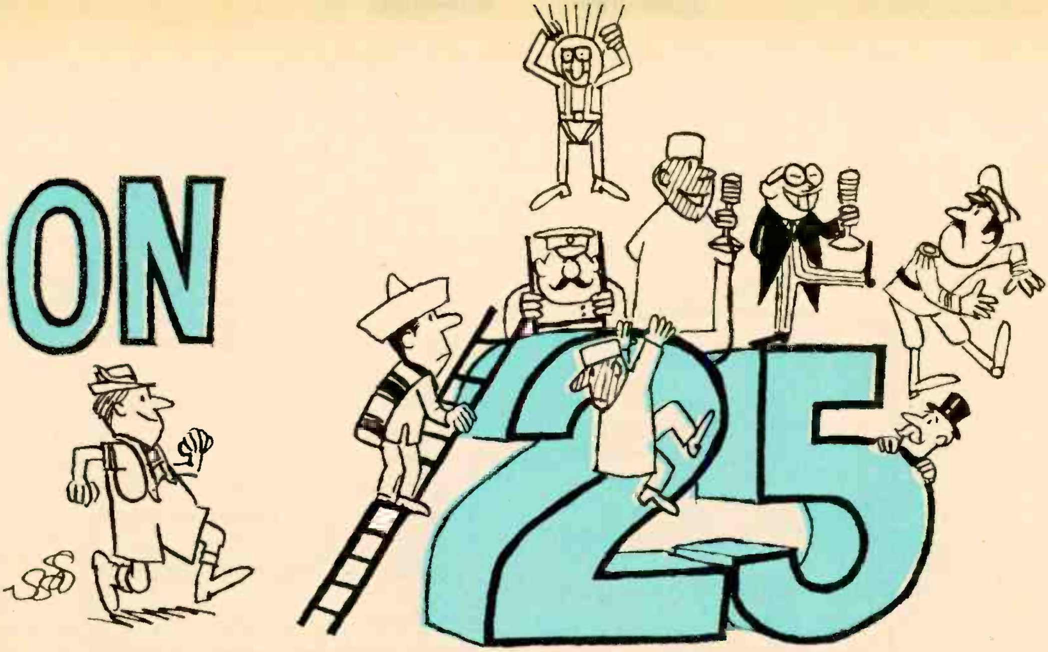
Two factors, in no way related one to the other, lie behind this unusual state of affairs. One is a resurgence of nationalistic spirit that makes all previous upheavals of the type pale by comparison. The other is the return, in increasing numbers, of spots to the surface of the sun (see SUNSPOTS ARE COMING!, Sept. '64 EI).

For with the sunspot count rising the lower bands are ceasing to be the best source of DX as they have been for the past few years. Twenty-five meters will take their place. But, interestingly enough, it is both high enough to permit use by international broadcasters and low enough to afford regional (DX) stations ample reason to scramble aboard. And with broadcaster after broadcaster zeroing in for the kill it's easy to predict red-hot propaganda wars on 25, especially from the Near East, Far East and Africa.

Generally speaking, the Far East and South Pacific are received best before noon and again starting around 1800 local time. Such information is of prime interest to SWLs in Eastern North America, where these areas sometimes are difficult to hear. Europe, Africa and the Near East (including Iran, Armenia and Uzbek S.S.R. but not Pakistan) are good from 1200 to 1800 EST. Latin America is strong from late afternoon into evening, though reception from this region generally isn't spectacular.

In official terminology, 25 meters runs from 11700 to 11975 kc but some of the most interesting action takes place just beyond those legal boundaries. Prime example is Peyk-e-Iran on 11697 kc, a Communist clandestine broadcasting primarily in Persian from 0800 until approximately 1330 EST. During these hours it also airs (though not as Peyk-e-Iran) programs in Arabic and Kurdish for Iraq. In the latter instances, the Reds would seem to be playing two feuding factions one against the other.

Some experts believe Peyk-e-Iran has its headquarters in East Germany. Whether this is the case or not, the 11697-kc transmitter itself definitely is not in East Germany but probably is located either at Tashkent (Uzbek S.S.R.) or in Bulgaria. If located in Uzbek, it would provide reception in Southern Iran and Iraq with other bands used to cover nearer target areas. Such a setup can be described as a regional operation, i.e., transmitter and target both are located in the same general area, in this case the Near East. While Bulgaria of course is a European location,



approximately the same distance factors apply.

What might be dubbed a counter-regional station also transmits on 11697 kc. It continuously plays one record, Honey Honey, and is an attempt to jam Peyk-e-Iran. As for location, Northeast Iran is a likely spot, though Iraq cannot be ruled out entirely as a possibility. Other regional stations occupying 25-meter territory include Elizabethville (formerly R. Katanga) and Leopoldville in strife-torn Congo, R. Diamang at Dundo, Angola, and R. Clube de Mozambique. (See our chart at the end of this article for frequencies and times.)

Incidentally, that station at Elizabethville

QSLs available to 25-meter devotees are both easy and not-so-easy to come by. Pictured are cards from R. Lebanon (difficult) and Mexico's XEBR (a widely-heard 25-meter broadcaster).

now is calling itself The Voice of African Fraternity and has been granted partial status as an international broadcaster by the Leopoldville government. It has English news at 1400 EST and, inasmuch as anything seems possible in the Congo (including another declaration of independence by Katanga province), this one definitely should bear watching.

Though regional transmitters may offer the best DX prospects, most 25-meter stations are of the international variety and these provide some really important programing. For example, R. Lebanon's English transmission at 1330-1400 EST on approximately 11775 kc well warrants tuning in. Lebanon is one of the few pro-Western republics in the Near East, which fact makes its views worth watching. Iran itself, another nation of the we-like-the-West camp, has English at 1500 EST via potent R. Tehran. Unfortunately, this station has been wandering all over the band but at last report it was on 11730 kc.

In Asia, the biggest battle on 25 meters takes the form of a three-corner free-for-all between Malaysia, Singapore and Indonesia, with Communist China waiting in the wings (though waiting perhaps implies more innocence on the part of the Chinese Reds than is their due).

R. Singapore (which nation recently broke away from the Malaysian federation) maintains an English-language overseas service on 11940 kc which is heard widely in North America around 0900 local time. R. Malaysia itself has English newscasts on 11900 at 0615 and 1745 EST. Sukarno's R. Republik Indonesia (which desperately wants to break up this Malaysian federation) airs our language on 11715 kc at 0600, 0900 and 1400 EST. Incidentally, multi-channel R. Peking may use 11940, too, or any other 25-meter frequency, for that matter.

Still another Asian station of major interest is R. Pakistan. That dispute over Kashmir could move from smoulder into flickering (or raging) flame again at any time and also could be a cause of the Karachi government's allying itself with Peking. R. Karachi's English news at 0835 EST often is heard throughout North America.

To return to Africa, R. Nigeria and R. South Africa potentially are the hottest international prospects. Matter of fact, with the possible exception of Franco's Spain, the Republic of South Africa is the only neo-fascist power left. During midday EST, R. South Africa has broadcasts to the rest of Africa on 11900. And at time of writing, word is that R. South Africa shortly will open transmissions to Europe with new, 250-kw transmitters. Even more significant is the fact that one of these powerhouses reportedly will be turned on North America.

As for still another hot topic of the day—subversion in Africa—sharp-eared SWLs often are informed of startling changes almost as they happen. During the space of two months there were four ultra-right coups in Africa—five if you count Rhodesia. First sweep took place in the Central African Republic, followed by governmental flips in Dahomey and Upper Volta. Later came the biggest eruption of all: Nigeria. But ultra-right is a pretty broad term and the incidents pose some challenging questions. Is there any connection between these four events? Is there some outside group (such as the people who formerly propped the Katanga affair) behind it? And exactly how far right are these new regimes?

For clues, SWLs might tune to the potent Voice of Nigeria on 11915 kc. English is scheduled at 1000, 1200, 1600 and 1700 EST; reception should be comparatively easy.

Finally, some nations use 25 meters for both international and regional purposes. R. Cairo relays two of its home services (Voice of Arabs plus a so-called main program) via potent transmitters on 11745 and 11940 kc while simultaneously using 11915 kc for transmissions to Europe at 1630 EST.

Also in this category is the Syrian Broadcasting and Television Service (once controlled by Egypt's Nasser) with a low-power regional outlet on 11750 kc. Station operates throughout daylight hours (EST) and also claims a North American service on 11915 kc starting at 1800. Mysteriously, reception of neither has been reported during the past few years though the NA beam (apparently) was noted one day only on 11670 kc.

EI'S HANDY GUIDE TO 25-METER DX

FREQ. (KC)	STATION	LOCATION	TIME (EST)	QSL INFORMATION
11674	R. Pakistan	Karachi	Mid-morning	Slow in answering
11685	R. Diamang	Dundo, Angola	1300-1430	Answers by QSL card
11697	Peyk-e-Iran	(see text)	0800-1330	Not available
11697	Honey Honey	(see text)	0800-1300	Not available
11745	R. Cairo (Home Service)	Egypt	Daylight	Answers erratically by QSL card
11775	R. Lebanon	Beirut	1330-1400	
11795	R. Leopoldville	Congo	1300-1700	
11800	R. Ceylon (Commercial Service)	Colombo	Before 1100	Answers by letter
11810	R. Lebanon	Beirut	1330-1400	Answers by QSL card
11820	XEBR	Hermosillo, Mex.	Daylight & Evening	
11872	R. Elizabethville	Congo	1300-1600	Answers by letter
11900	R. Malaysia		Mid-morning & 1900	
11915	R. Damascus	Syria	1100-1300	Answers by card
11940	R. Singapore	Singapore	From 1830	
11945	R. Thailand	Bangkok	Mid-morning	
11962	R. Clube de Mozambique	Lourenco, Marques	1200-1600	Answers by QSL card

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GRA-53-6, 51 lbs., economy walnut-finished cabinet $46.50

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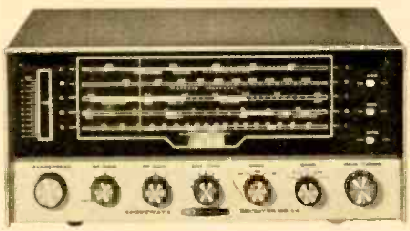

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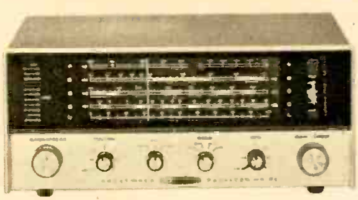

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WHAT TV TEST PATTERNS

THOUGH there are dozens of TV test patterns (each station transmits its own version), all are designed to let you know more than what station you're tuned to. Nearly any test pattern will enable you accurately to read off the quality of a) aspect ratio, b) vertical and horizontal linearity, c) line count and interlace, d) video frequency response and line resolution, e) contrast and f) low-frequency phase shift.

A test pattern is composed of a frame, a large dark circle, horizontal and vertical wedges, concentric circles and black-and-white bars. (Our photo shows the test pattern transmitted by New York's WPIX; others are similar.) Let's see what each measures and what can be done to improve picture quality.

Aspect Ratio, Linearity. The frame is transmitted with a height-to-width ratio (technically called an aspect ratio) of 3 to 4. Tied in as a supplementary measurement with the frame is the familiar large dark circle. It is transmitted perfectly round, perfectly centered, with the top and bottom touching the top and bottom center of the frame.

Try to position the picture so the center of the large circle is at screen center, then adjust vertical linearity to vary the top of the circle and vertical height to change the bottom of the circle (these adjustments interact somewhat, so it's best to rock both together for final adjustments). Adjusting horizontal drive, horizontal width and horizontal linearity will vary left and right sides of frame and circle. Properly adjusted, height and width of the frame will have a 3:4 ratio, all circles will be perfectly round and all wedges of equal length. If they are not, test the low- and high-voltage rectifiers, damper, horizontal and vertical output tubes.

Line Count, Interlace. A TV station transmits a picture contained in approximately 490 usable horizontal lines formed by a spot of light less than 1/64th-in. in diameter. The spot starts in the upper left corner of the screen and is drawn across to the right, then retraced over and over.

Unfortunately, a TV set can't make such a tiny spot, which means that the number of lines on the screen ordinarily is less than 490. And the fewer the lines the more picture details will blur.

You can determine the approximate number of lines on your TV by observing the horizontal, pie-slice wedges and noting the point where the individual black and white lines blend. The white dots in the center line indicate the approximate line count (see our drawing—we show only one wedge because both are identical). If interlacing is poor, lines will be blurred and jagged.

To some degree, you can improve line count by decreasing spot size (poor interlace best is left to a serviceman). Test the low- and high-voltage rectifiers, damper, horizontal output and picture tubes. Also, try adjusting the focus, horizontal drive, brightness and contrast controls while viewing the horizontal wedges. Each has some effect on spot size.

Video Frequency Response, Line Resolution. TV pictures are transmitted with a bandwidth of 4.5 mc, though many TVs are incapable of producing the entire range of frequencies. Some cut off as low as 2.5 mc, resulting in a picture with little detail. You can determine response by judging the blend point in the upper vertical wedges of the test pattern. (The lower vertical wedge checks line resolution and can be used as a supplemental guide when checking line count. Ringing at any frequency will be indicated by additional lines in the vertical wedges at that point.)

To increase frequency response, test the RF amplifier, mixer-oscillator, IF, video detector, video amplifier and output tubes. Also, adjust the fine-tuning

Really MEAN

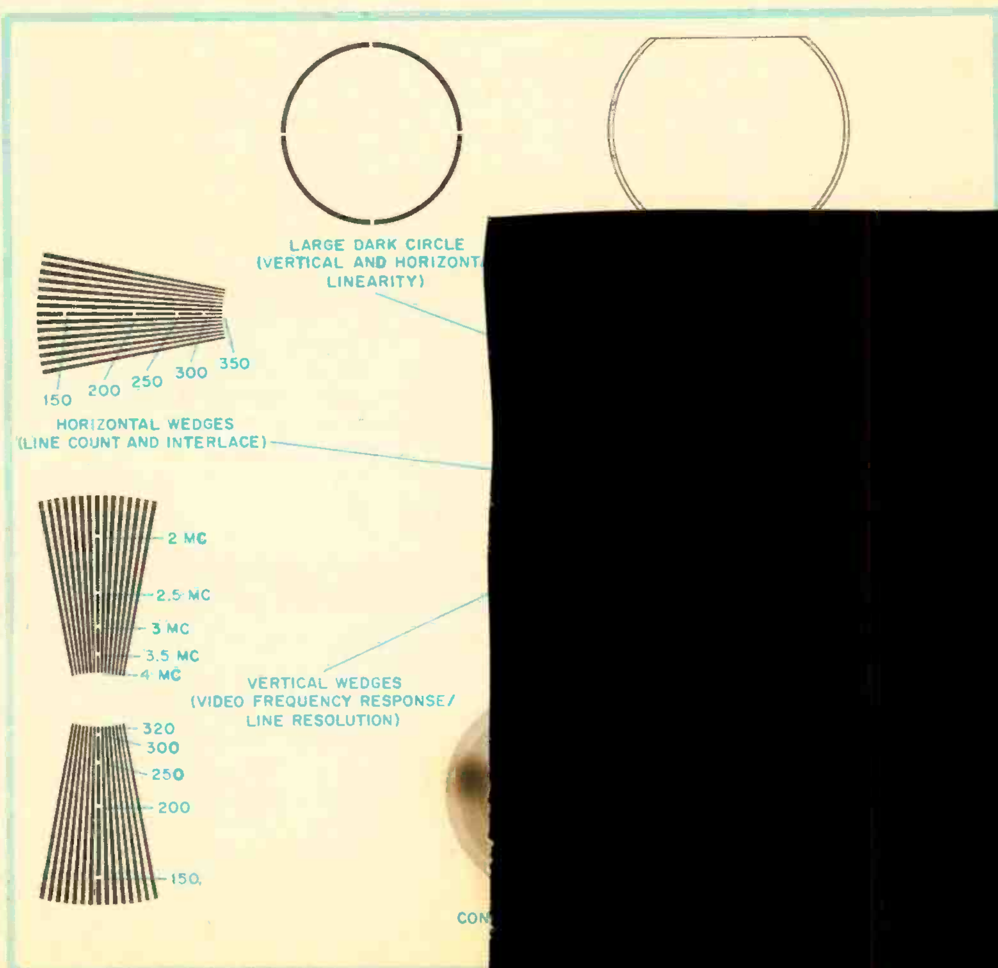
By ART MARGOLIS

and video-peaking controls (if possible) and finish with a full-dress alignment of the tuner and IF strip.

Contrast. Test patterns contain five shades—white, light gray, medium gray, dark gray and black—in concentric circles or blocks. All five shades should be available at some setting of the contrast control.

If they are not, first check the setting of the AGC control (contrast will be limited if it's set too high). Second, test the AGC tube, the video amplifier or output tubes, the video detector and the picture tube itself (a gassy tube will overload the picture to a degree, causing lack of contrast range).

Low-Frequency Phase Shift. Streaking or smearing of the black and white horizontal bars indicates excessive low-frequency phase shift. This often can be reduced by adjusting the video amplifier and output, video detector, IF stages, mixer-oscillator and RF amplifier.



Bandspreader

Continued from page 75

is connected to the oscillator section of the tuning capacitor. The connection should go directly to the tuning capacitor or to the lug on the oscillator wafer of the bandswitch that is connected to the tuning capacitor. The ground connection should go directly to the oscillator coils' ground point.

Checkout. The first check to make after the circuit is installed is of the DC operating point. Remove the oscillator (or mixer) tube or short the diodes by placing a 2 μf 50 V electrolytic capacitor across them. Measure the DC voltage across the diodes. It should vary from about 1 to 25 V (proportionately less in transistor sets) when R3 is turned from one extreme to the other. Replace the oscillator tube or remove the 2 μf capacitor.

Observe the signal across the diodes with your scope (using an RF probe) as R3 is turned. The addition of the RF voltage from the oscillator and the DC voltage should not cause breakdown or forward conduction. Both these conditions will appear as a flattening of the top and bottom of the sine wave. If there is flattening decrease the value of C1 or increase the value of R4.

Finally, disconnect C1 from the tuning capacitor and tune in a station at a high frequency. Set R3 at its midpoint, then reconnect C1. Adjust the oscillator trimmer capacitor (usually located on the oscillator section of the tuning capacitor or next to the oscillator coil) until the station again comes in at maximum volume. Repeat this procedure on all bands as each has a separate trimmer.

The Ham Shack

Continued from page 38

again and get most of your original money back. You can cut the mustard for about $1,500 complete. This means $150 a year if you figure it is worth zero in ten years. A $1,500 package which I bought a few months back (see photo) included transceiver, linear, tower beam, rotator, coax and accessories.

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A Pro Takes A Look

Continued from page 56

have to be renumbered. Actually, these counters tell you reel-turns, not feet.

- *Tone controls.* Desirable only for playback—and I don't like them there, either.
- *Solenoid construction.* Machines designed for home use which feature solenoid construction are over-designed (and, as a result, over-priced). They also create service problems.
- *Multiple speeds.* These days, 15 ips is impractical on home recorders because it doesn't yield sufficient quality improvement over 7½ ips to justify such rapid tape consumption. While 1⅞ ips is desirable for dictation, it's outside the normal area of the serious user (as is 15/16 ips). That leaves two speeds, 7½ and 3¾ ips, on our ideal machine.
- *Built-in mixer.* You need one *only* if you're going to be doing live recording.

This, then, gives us a full-track mono or two-track stereo recorder, sold without a microphone, operating at two speeds (7½ and 3¾ ips), with two heads, probably no pressure pads and certainly no automatic shutoff or reverse, no selective erase, no tape duplicating or mixer. The drive mechanism is a single good motor with a properly designed drive system—belt drive being a leader.

There are some positive things I believe a machine should have. One is a handle mounted in a convenient position for moving the bloody thing about or taking it with you when you want. For some reason, most manufacturers don't make their machines easy to get hold of. One of the best I ever saw was a British unit which had two little hand-holds right under the deck so that the whole thing could be lifted out easily. These days, I'm for solid-state construction, since I'd be hard-pressed to name any advantages for tubes. Horizontal operation generally is to be preferred to vertical because you don't need to hold the reels down. Personally, I approve of a variable bias control but I believe the user must be able to set his bias adjustment correctly and be told clearly in the instruction manual how to do so.

When it comes to controls and inputs, I think manufacturers could give more thought to the subject. I think the two should be as far apart as possible. I prefer a joystick control for record/play, forward/reverse because it's the easiest and most logical to use. My next choice would be piano keys, though these usually mean more complicated linkages which can break down and require servicing. I don't like knobs because you can't tell at a glance what's happening with them. For the few knobs which may prove necessary, I believe manufacturers should mount them against a numbered scale so you can set each knob at exactly the same place every time you play back a given tape. The recorder should have a fuse and a space for storing cords. The AC cord should be detachable.

There should be a high-impedance input for each channel and, if you plan to do live recording, a separate microphone input and volume control. Inputs should be mounted out of the way, preferably on the rear of the recorder.

Finally, a word or two about tape. A good recorder should be able to take a wide latitude of tapes, although it usually will perform best with one of them. The best way to select a recorder is to select it on the basis of what you want it to do, then select the brand of tape that will do that on your recorder. We don't use high-output tapes professionally because we have to recalibrate everything before using, then set everything back to normal after we've finished. No home machine is designed specifically to accept high-output tapes. Low-print tapes, too, usually aren't necessary for home recording unless long-term storage is involved—in which case you may need it, particularly if you're recording on thin-base tapes. Low-noise tapes, on the other hand, are beautiful. To get the most out of them, however, it's desirable to own a recorder that can be adjusted for proper biasing of these tapes. Your machine also should be capable of extremely high signal-to-noise ratio.

One thing you'll keep encountering in your search for the right tape recorder is manufacturers' specifications. I won't say that these are works of fiction but I will say that, with few exceptions, you can't have much faith in them. There are so many methods of measurement and so many weighting curves and/or reference points that the whole thing is senseless. A weighting curve is our method of getting rid of the things we don't like in our test readings and virtually everybody puts his best numbers forward.

Caveat emptor.

The Day Tape Was Born

Continued from page 52

"It became apparent immediately," a Crosby associate of the period remembers, "that tape was the answer. Mullin's machine had a live quality about it and the tapes could be edited and re-edited directly, with no need for shuttling back and forth between disc cutters." So Jack Mullin installed his two Magnetophons in an unused studio in NBC's Hollywood Radio City (though ABC now was an independent company, it still had no studios or facilities of its own).

"For weeks," Mullin says "I lived in that studio with those recorders. I even slept there and had meals sent in."

Mullin proceeded to record every Crosby show for the 1947-48 season. And in doing so, he and his Magnetophons proved to American broadcasters what German technicians already had proved to Hitler—that tape could be used to provide a lifelike quality to recorded radio programs, that programs could be edited quickly and conveniently, that one tape could replace an indefinite number of live broadcasts, that tape was capable of everything discs were—and much, much more.

Shortly thereafter, Ampex marketed its first broadcast recorders, engineered by Lindsay and sold by Bing Crosby Enterprises. Mullin concentrated on tape manufacture and today is an executive with Minnesota Mining & Manufacturing Co. And what happened to Ernst Haas? Nobody seems to know. He walked out of the story of tape recording the day after its birth 20 years ago, never to return.

CB Corner

Continued from page 99

causing big headaches at the FCC due to TVI and other assorted shenanigans. The culprits, went the report, were kids playing with transceivers given to them as gifts by unwitting parents. Thing is, only at story's end could one discern that CB wasn't its subject. The journalists really were talking about the little walkie-talkie sets, which operate under Part 15 of FCC regulations and have no more to do with CB than baby carriages with Boy Wonders.

Continued from page 64

and the vice consists primarily of small boys demanding payment for unsolicited services, such as guiding you or washing your car. By the time our boat had docked and we had checked into our ocean-front hotel, it was time for dinner (which occurs in Morocco at a much more American hour than in Spain).

Nestled deep in the Medina, or old city, is Hamadi's, a restaurant reputed to serve the best bstila (a spicy meat pie) in town to the accompaniment of an Arab orchestra and dancers. While we were enjoying our dinner the recorder—with the ensemble's permission—was capturing the four instrumentalists and barefoot dancing girls for posterity. Permission to record was granted with the tacit understanding that when the musicians passed the hat—as they do at regular intervals—we would be generous.

Our first experience with one of Morocco's more quaint customs involved a water-seller in Tangier. We asked his permission, took his picture, then offered a 20-cent tip. The coin was returned with loud protests; he demanded (and eventually got) 50 cents—a day's wages—for his picture. Fortunately for amateur tape recordists, the recorder is new to the Arab. It can be used without attracting attention and you can record just about anything in the street without fear of harassment.

The next morning, we set out for Rabat, some 170 mi. and 2½ hrs. to the south. Rabat is the capital of Morocco and at our hotel we found preparations in order for a state banquet that night at which King Hassan would play host to Habib Bourguiba of Tunisia. "It's the first time our hotel has been so honored," the excited desk clerk told us.

Late in the afternoon as we walked along a main shopping thoroughfare in the old city a voice suddenly burst out of the heavens, seemingly from all directions. Activity in the streets stopped and we discovered the sound was coming from the minaret of a nearby mosque. We switched on the recorder in time to get some of the afternoon prayers on tape. Once upon a time these prayers were chanted in person from the top of the towers. Nowadays precisely at 4 p.m. the cleric in charge uses a microphone and series of public-address loudspeakers to reach a larger audience (and, presumably, to save himself a long, tiring climb up a flight of stairs).

After a shopping tour and dinner we returned to the hotel to find the King's bodyguard and household band on duty across the street from the hotel. We stepped up to the curb, virtually on the doorstep of the hotel, and aimed the microphone at the band as it struck up the royal fanfare. The King and his guest finally arrived, waved to the crowd and passed into the hotel for their dinner.

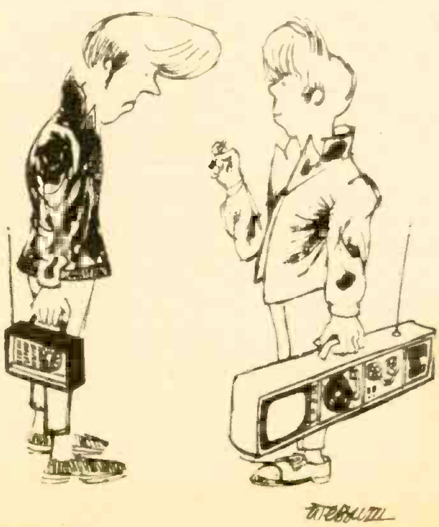
A few minutes later, we followed them, only to find an orchestra playing Arabic dinner music in the lobby. The recorder, of course, was able to capture it. Shortly after our entry, the string orchestra was relieved by a military band. Realizing we weren't likely to get much sleep in the middle of a band concert, we placed our recorder beside a potted palm and left it on till bedtime.

Soon we were on our way to Lisbon via Meknes, Fez, Tangier, Algeciras, Cadiz, Seville and Evora. Lisbon, a bustling seaport, presents at least as many opportunities for the recorder as does Morocco. Along the wharves there are the sounds of ships docking and unloading, the pitchmen outside the sailor's bars on the Rua Carvalho, the cries of seagulls and the clanging bells of buoys. In the city itself there are the small yellow trolleys, manufactured in Britain at the turn of the century and still in use because nothing better has been found to negotiate Lisbon's hills, narrow streets and sharp curves; the cries of newsdealers which start as early as 5 a.m. and last until nearly that hour the following morning; the whine of the passenger elevator just off the central square, built by Alexandre Eiffel (of Eiffel Tower fame); the bells of cathedrals, and the clicking of the roulette wheel at the casino in Estoril.

Next day found us winging our way to London, where a hectic 48 hrs. of sight-seeing and recording awaited us. We arrived at our hotel, the Carlton Tower, just in time for bed. Early next morning we persuaded one of the porters, Jimmy Power, to take us up to the Tower Suite, which commands a splendid view of metropolitan London. When the hotel was built in 1961 many Londoners protested the idea of a skyscraper overlooking Buckingham Palace. Now it's part of the landscape, along with Hyde Park, Battersea Power Station, Piccadilly, the U.S. Embassy, the Houses of Parliament and Big Ben. All of this Power dutifully explained to us and our recorder as we took photographs.

After getting the overall picture we set out for several locations to record specific sounds —first to Speaker's Corner in Hyde Park, where we recorded snatches of speeches urging unification of Northern Ireland with Ireland, calling for war on Rhodesia (by a vociferous African with an Oxford accent), attacking the use of chemicals in Britain's food and water and suggesting communism for Britain's farms. Then into the underground to capture the approach of a train, the guard's "Mind the doors!" and whistle before it pulls out. We got off near the Houses of Parliament and strolled out onto Westminster Bridge to try to record the sounds of commerce on the Thames while waiting for Big Ben to chime the hour. Then to St. Paul's Cathedral to tape church bells and the magnificent organ. The afternoon saw us pursuing London's street musicians, shopping and recording Londoners.

A similar round of sight-seeing, taping and shopping filled our last full day in Europe. Finally, reluctantly, we checked out of the Carlton Tower and told the cab driver we wanted the Pan Am departure building. We reached it with moments to spare, recording Pan American's last call for New York passengers. It provides a somewhat wistful ending to our tape-and-slide showings, I always feel



Slot-Car Lap Timer

Continued from page 46

If everything checks out—indicating the control-box circuit is put together properly—trip RY1 once by passing your finger in front of PC1 to stop the timer. Bring the timer back to zero by pressing and holding S2. Finally, make a tube about 1 in. long from stiff paper and fit it over P1.

Using The Timer

Place the pickup box on one side of the track and the light-source box on the other side of the track so P1 is shining directly at PC1. Then turn on power with S2. If the motor is running place your finger in front of PC1 to stop it. Then reset the timer to zero with PB1. Place the car(s) directly behind PC1 and let it go. The instant the car cuts the light beam, the timer should start. When the car comes around and cuts through the beam a second time the clock motor will stop and indicate the lap time. Reset on the second lap and then time the third. The timer will time every other lap.

Squeeze Me And I'll Shock You

Continued from page 98

to mechanical energy in a piezoelectric element easily can be demonstrated by connecting a Rochelle salt element to the output of an audio amplifier. Since the element presents a high-impedance load to the amplifier, it should be connected directly into the amplifier's plate circuit as shown in Fig. 6. Blocking capacitor C1 is required to isolate the DC plate voltage from the element.

If this approach is not convenient, an alternative method is to connect an output transformer in place of the speaker with its windings reversed (i.e., with secondary serving as primary and vice-versa).

Feeding a signal from an audio oscillator, microphone, phono cartridge, etc., into the amplifier will cause the Rochelle salt element to reproduce the applied input signal with surprising volume. The element in this hookup makes an excellent point source and thus affords an opportunity for demonstrating one of the more interesting aspects of high-frequency sound.

Good Reading

Continued from page 92

size (roughly 5 by 8 in.) for handy reference. The entries are fairly terse, which is just the way they should be; there's no attempt to get encyclopedic about things. Also outstanding is the quantity and quality of the illustrations, almost all of them line drawings with a kind of crispness and detail you just don't see much anymore.

HOW TO BUILD PROXIMITY DETECTORS AND METAL LOCATORS. By John Potter Shields. Howard W. Sams & Bobbs-Merrill, New York & Indianapolis. 128 pages. $2.50

Whether you're interested in making a home-brew burglar alarm (exotic variety) or in having a way to find all those things—like lunch boxes and bait buckets—that your 2-year-old throws out of your boat every summer, this volume contains all you need to build the right gadget for the purpose. The circuits for proximity detectors and metal locators range from ultra-simple to ultra-advanced and parts lists and instructions for every variety are quite complete. For lagniappe, there's a final chapter on our old friend, the theremin.

SEMICONDUCTOR CIRCUITS HANDBOOK. Techpress, Inc., Brownsburg, Ind. 191 pages. $2.95

Here are more than 70 semiconductor circuits for the hobbyist on DC amplifiers, low- and high-frequency amplifiers, AF and RF oscillators, multivibrators and flip-flops. All originally were designed for use in commercial and industrial equipment but all are open to cut-and-try modifications for your own purposes.

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World's Biggest Magnet

Continued from page 84

mendous multi-million ampere surges of current in the globe. Voltages in buried power cables soared wildly and circuit breakers, suddenly overloaded, popped all over the Northeast. Toronto and other cities were thrown into darkness.

Six minutes later, massive currents in the ocean floor began to wreck undersea cable communications. Western Union reported trouble at 9:01. AT&T, whose cable was farther north, recorded surges of 2,650 volts in its undersea cable—just short of enough to destroy it. Associated Press teletype machines around the country fell victim to the surging currents and began spewing gibberish. At 9:45 AT&T lost radio circuits to South America. Now the entire North American continent, except for occasional sputtering, unreliable contact by cable, was cut off from the rest of the world just as it had been in the days of the clipper ships.

Between 1 and 2 o'clock the next morning the traces at Fredericksburg began to calm down somewhat. But by now, the aurora was at its peak. Brilliant displays were seen over the entire United States. A ship's officer off Acapulco, Mexico, saw the bright rays in the sky from the southernmost position ever recorded. By dawn transatlantic radio was beginning to work again and by 10 o'clock Tuesday morning was nearly back to normal. Tuesday night there again were brilliant auroral displays and occasional radio blackouts. By Thursday the magnetographs had quit jiggling, the northern and southern lights had faded and the plasma cloud from the sun was speeding into space beyond the earth's orbit.

It was a spectacular show. And from it astronomers and geophysicists were able to learn more about the complex, turbulent magnetic field that envelops the earth. For though man now understands the main features of the earth's magnetism, many details are missing. And many of the current theories —such as the one at the beginning of this article about the original formation of the earth's magnetic field—still are unproved.

But research goes on. And from it comes an ever-clearer understanding of the mysterious universe that surrounds us.

Why We're So Weather-Wise

Continued from page 91

the Weather Bureau on a regular basis without interruption.

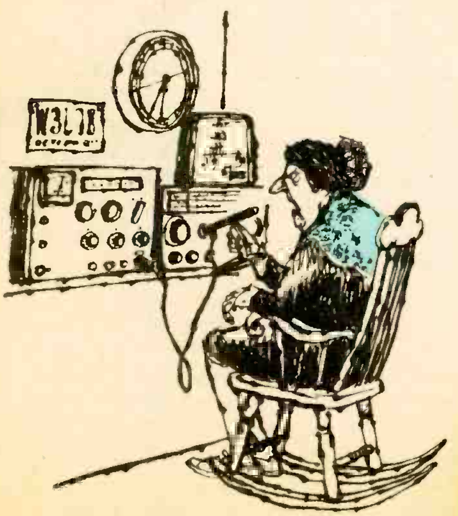
Satellite cloud photographs can be converted into digital form for a computer, then reproduced as Mercator projections. Other photo map projections can be obtained and distortions in the image that can be expressed mathematically can be corrected automatically during processing. The pictures are scanned by a light beam and changed into an electrical signal which is digitized and recorded on magnetic tape. An IBM 704 computer then transforms the picture elements in the Mercator view, which can be photographed on film.

Sign of the times is the fact that the U.S. Weather Bureau has installed VHF FM weather broadcasting stations in five major metropolitan areas. Intended for motorists, mariners, aviators, farmers and others who require up-to-the-minute weather information, these broadcasts emanate from stations in New York, Chicago, St. Louis, Kansas City and Los Angeles. Anyone in these areas wishing to tune in on the weather has only to possess an FM receiver capable of picking up the required frequency—162.55 mc.

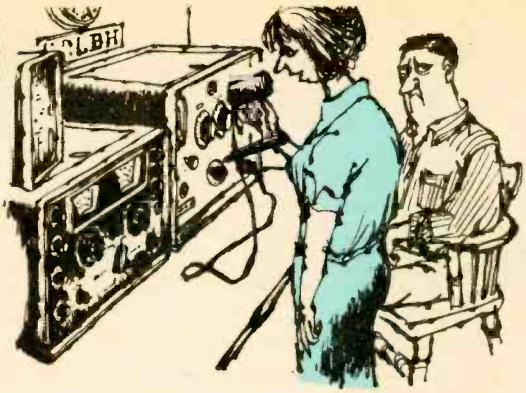
OVER AND OUT

by Rodrigues

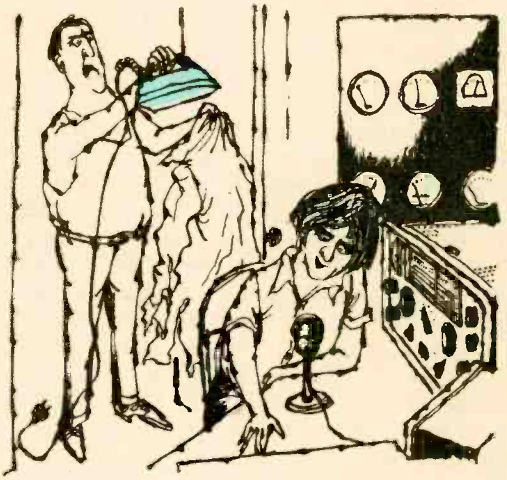
"He says he's an amateur, but I think he's just being modest."



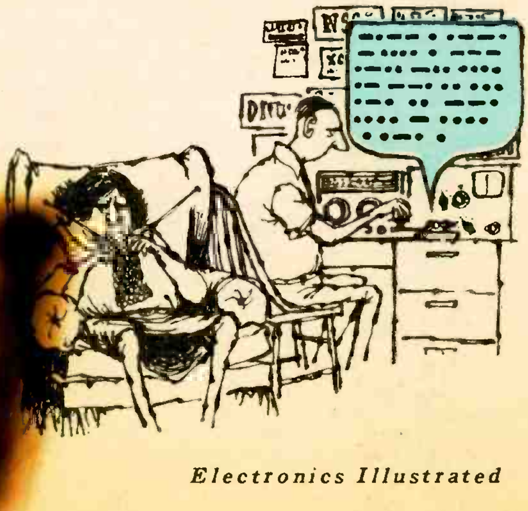
"Calling CQ DX, CQ DX, CQ DX . . . except Cuba, Russia, Hungary, Romania, Poland, Bulgaria, China, Albania, East Germany, Yugoslavia . . ."



"You asked about our rig, Helene. Well, for a receiver we're using a black radio with ten or 12 knobs and our transmitter is grey, about a foot and a half high and it has maybe six knobs."



"Hey! Here's another kilowatt you could modulate for a while."



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- ☐ [illegible]ssile Electronics
- ☐ Tele[illegible]nd Radio
- ☐ Micro[illegible]
- ☐ Radar
- ☐ Autom[illegible]lectronics
- ☐ Communications
- ☐ Computers
- ☐ Broadcasting
- ☐ Industrial Electronics
- ☐ Electronic Control

Name__________ Age_____

Address__________ Apt._____

City__________ Zone_____ State_____

☐ Check he[illegible] under 16 years of age.

HO[illegible] AND RESIDENT SCHOOL TRAINING [illegible]VAILABLE IN CANADA