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ELECTRONICS ILLUSTRATED ®

By the Publishers of MECHANIX ILLUSTRATED

NOVEMBER 1967 50¢

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* Direct-Reading Audio Wattmeter
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* In-Line Modulation/Power Meter for CB
* 1-mc Crystal Calibrator for SWLs
* Remote Antenna Switcher for Hams
* EI-8x Full-Range Speaker System

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NEW FINCO® COLOR SPECTRUM T.M. antennas are "signal customized" for better color reception...

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Check this chart for the FINCO "Signal Customized" Antenna best suited for your area.

STRENGTH OF UHF SIGNAL AT RECEIVING ANTENNA LOCATION	Strength of VHF Signal at Receiving Antenna Location				
	NO VHF	VHF SIGNAL STRONG	VHF SIGNAL MODERATE	VHF SIGNAL WEAK	VHF SIGNAL VERY WEAK
NO UHF		CS-V3 $10.95	CS-V5 $17.50 CS-V7 $24.95	CS-V10 $35.95	CS-V15 $48.50 CS-V18 $56.50
UHF SIGNAL STRONG	CS-U1 $9.95	CS-A1 $18.95	CS-B1 $29.95	CS-C1 $43.95	CS-C1 $43.95
UHF SIGNAL WEAK	CS-U2 $14.95	CS-A2 $22.95	CS-B3 $49.95	CS-C3 $59.95	CS-D3 $69.95
UHF SIGNAL VERY WEAK	CS-U3 $21.95	CS-A3 $30.95	CS-B3 $49.95	CS-C3 $59.95	CS-D3 $69.95

NOTE: In addition to the regular 300 ohm models (above), each model is available in a 75 ohm coaxial cable downlead where this type of installation is preferable. These models, designated "XCS", each come complete with a compact behind-the-set 75 ohm to 300 ohm balun-splitter to match the antenna system to the proper set terminals.

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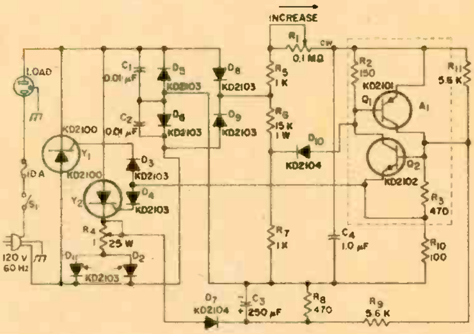

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ELECTRONICS ILLUSTRATED

NOVEMBER, 1967 A Fawcett Publication Vol. 10, No. 6

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Feedback from Our Readers

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

● THOUGHT PROVOKING

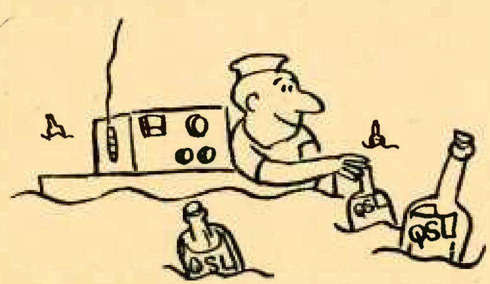
Whose side are you guys on, anyway? I don't care how Radio Americas gets its money [Radio Americas and the CIA, Sept. '67 EI], it's still the one loud voice raised against Castro in the Caribbean. I mean anyone who would try to bring a live chicken into his hotel room like Castro did in New York can't have all his buttons. I read somewhere that Radio Americas or Radio Swan has told the Cuban people that the Russians are adding something to Cuban milk so that all their children will turn into Communists. That should really make them stop and think!

Roger Rundeldt
Bloomington, Ind.

It sure should.

● BOTTLED UP

Last night I had a QSO with a sailor who is marooned on an island in the Pacific. He told me that there is no sea or air service connecting with the outside world and I offered to contact the Navy so that they could rescue him. But he says the breadfruit tastes great and there's this Polynesian girl that has been real nice to him and all and he doesn't want to come back. Wouldn't that make him a deserter if he's in the Navy? Maybe I should



notify them anyway. I'd hate to do that because he has offered to send me a QSL card and that surely would be a real catch. What should I do?

D.D.B.
La Jolla, Calif.

Wait until you see the postmark on the QSL card.

● TAKE YOUR PIC

I would like to get in touch with a fellow who's planning to build the guitar reverb unit [Sept. '67 EI]. I built your electronic bongos [March '67 EI] and they work great. Now I want to make it a duo. If you can send me

pictures of the guys you know who are building the reverb I can pick out which one. If you want, I can send a picture of me.

Myrna Smirnoff
Astoria, N.Y.

Electronic dating services may be all the rage, Myrna, but this is ridiculous!

● THERE ARE MORE THINGS . . .

Have been reading with interest your scathing references to flying saucers. Having reached 70, I have a more tolerant attitude toward so-called unbelievable happenings. From 1906 almost until 1917 radio hams had to endure the ridicule of supposedly well-informed editors in many publications.

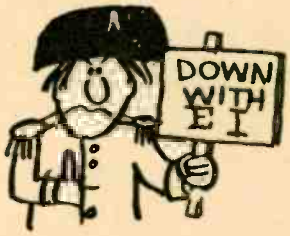
R. C. Rome
West Fork, Ark.

[*Continued on page* 8]

Feedback from Our Readers

Continued from page 6

● TO EACH HIS OWN



I'm writing to let you know how much I enjoy EI. You really do the best job of editing in the field. Many thanks! I can't help saying, though, that I do sometimes get pretty annoyed at the wise-cracks in Uncle Tom's Corner.

M.N.
Des Moines, Iowa

Your coverage of the SWL scene in general and the Radio Americas business in particular has been great. So why do you let that idiot Wayne Green take up space in your magazine?

G.R.
Taos, New Mexico

I enjoy your many fine CB articles and always read CB Corner. But who does this joker Alan Levesque think he is?

L.L.
Green Bay, Wis.

So Nick Rosa has given up hamming? Good riddance!

D.R.
Lowell, Mass.

Let's see—who's left?

● PEST CONTROL

Every time I go to the beach some thoughtless individual comes along with a transistor radio, blaring away, and parks nearby. Surely there must be some small device with a short range (say, 100 yd.), battery-operated and cheap to build that can be used to jam transistor radios.

Wm. J. O'Neill
Weston, Ont.

In some civilized parts of the world (the Isle of Capri is one) they have passed laws against the irresponsible use of radios in public places. Also against jamming radio stations.

Uncle Tom's Corner

By Tom Kneitel, K2AES/KQD4552

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

★ *Radio Americas is anywhere* but *on Swan Island. Let us refrain from caustic commentaries which can develop upon differing points of view.*

Ralph Irace, Jr.
Avon, Conn.

Radio Americas really is aboard a flying saucer, operated as a secret plot by the CIA and the Lithuanian Secret Police. Okay?

Oops Dept. A few months back we attended a huge press demonstration of a gadget that produced something known as the Christofv Effect. It was touted loudly as the answer to fatigue experienced by U-2 pilots and astronauts. A week later we received a Letter of Modification. The Christofv Effect, the letter said, is *not* used in the U-2 or space programs and it *doesn't* reduce fatigue. It's used to detect atomic explosions. Sorry about that.

★ *Oh, prophet of the future, can you offer any pearls of wisdom on the future of the hi-fi industry, especially recordings? I'm strictly a monophonic fan—am I headed down the road to extinction?*

Bill Fernandez
Miami, Fla.

Yup, and in a bucket. A few issues ago I complained about the arbitrary premium prices being charged for stereo discs. The major manufacturers promptly fixed *that* by upping the mono price to the stereo level as a first step in the gradual phasing-out of one-eared recordings. Next step may be wide-spread use of the compatible stereo-mono record as a transition to stereo-only.

★ *In your opinion, which nation has the best spy network?*

Elwood Burr
Seattle, Wash.

Undoubtedly it's Switzerland. The Swiss Federal Dept. of Justice each year quietly keeps tab on some 8,000 suspected foreign agents within Switzerland's neutral borders. Rather than arresting the agents, the Swiss permit them to ply their trade in exchange for duplicate copies of the information they collect. By the way, the 8,000 spies equal one spy for each 500 Swiss citizens.

★ *Since the area code dialing system offers 999 different numbers for direct long-distance dialing why doesn't the phone company give us code numbers for overseas points?*

Sal Terone
New York, N.Y.

Whoa! Don't let all those numbers dazzle you, old buddy. If you examine the current crop of area codes you'll see that the first digit is never a 0 or a 1, the second is *only* a 0 or 1, the last is never a 0. That means a maximum of only 144 combinations, minus combinations ending in 11 (reserved for official Telephone Company offices). So that leaves only 136 possible area codes, with about 120 already assigned.

TV or Not TV Dept. Reddest faces in Washington of late are at the National Center for Radiological Health (a division of the Public Health Service). Its main reason for existence is to check out equipment on the market to see that harmful radiation levels are not being emitted. The NCRH was a bit shook up when General Electric recalled some of its large-screen color sets because GE thought they were emitting too much radiation. For one reason or another, the NCRH had overlooked checking out any of the GE sets, manufactured over a nine-month period. If GE hadn't detected the error it might well have gone undiscovered indefinitely.

[Continued on page 12]

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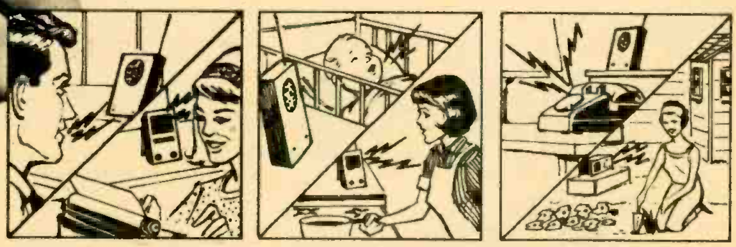

You can broadcast voice, music, any audio signal through any AM (or FM) standard radio, tuner or car radio. Pocket-size, easily concealed—makes ideal wireless intercom, security/surveillance and public address system.

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UNCLE TOM'S CORNER

Continued from page 10

★ *I have a DX-40 transmitter. When I key it the plate current reads about 50 mils and then gradually builds up until it hits 150 mils. Then the 6146A starts flickering on and off. What is the problem?*

Scott Whittaker, WN2AMN
Ramsey, N.J.

The problem appears to be the plate current building from 50 to 150 mils and then the crazy 6146A flickering. So much for the problem. You'd better find a solution before you blow yourself to Timbuktu.

★ *I'm trying to crack into this electronics writing game. But I'm wondering about the sincerity of publishers. I'd hate to send out these stories and then have them stolen.*

S. G. Hamil
Lincoln, Nebr.

While the majority of publishers are on the level we've come across a few whose sincerity could fit into a gnat's navel and still leave room for three caraway seeds and an editor's heart.

★ *I am 10 years old and recently got an antique radio that needs a Type 37 tube replaced. The tube isn't in any catalog and I can't find one. What about you?*

Peter Prun
Highland Park, Ill.

I'm 113 years old and I can't find one, either.

★ *How about giving us the lowdown on stereo components? I'm planning on assembling a stereo console using a $15 amplifier, $15 turntable, $8 speakers and a $30 cabinet. I know that specs mean a lot and people have told me that I'm wasting my money. How about it?*

Richard C. Albers, Jr.
Cincinnati, Ohio

Ever seen a $30 cabinet? Eucch!

★ *My friends and I are planning to start a short-wave club and want to know if you can give us some advice on how to improve it and where we can get some schedules and*

[*Continued on page* 14]

UNCLE TOM'S CORNER

Continued from page 12

programs. Please answer by personal letter because I don't read EI very often.

Thomas Dellacorino
Binghamton, N.Y.

Maybe if you did you wouldn't have to bother me about it.

International Intrigue Dept. A few issues back we pointed out that one of the biggest untapped sources of confidential intelligence could be cracked by anyone with a shortwave receiver and a list of radio stations transmitting overseas telephone calls. The point of reminding you of this is that Israel recently admitted using the method to get a tape of the conversation between Nasser and King Hussein in which they agreed to implicate the U.S. and England in the Mid-East War. You can get your own international spy station fired up by purchasing the inexpensive List of Fixed Stations Operating International Circuits from the International Telecommunications Union, Geneva, Switzerland. Confidential note to the CIA: Papa Mao ragchews with Hanoi on 6995, 9810, 9845, 13600, 14548, 17430 and 18380 kc.

★ *Can you give me any information on a shortwave broadcaster calling itself Radio Peace and Progress? It's not listed anywhere.*

Sam Mandros
APO San Francisco, Calif.

Radio Peace and Progress is a new tool of the Moscow propaganda mill. It spends 85 hours per week in violent anti-Mao speeches intended to encourage so-called democratic elements within China.

Big Brother Dept. Residents of New York, California, Maryland, Massachusetts, Nevada and Oregon who feel that the recent Supreme Court anti-bugging decision has taken them out of the mainstream of Big Brotherism have another guess coming. Police in those states still are free to dig into your life with items such as shotgun microphones, long-range parabolic mikes, automobile bugs and tailing devices, body microphones and transmitters worn by undercover agents and numerous types of conduction devices (stethoscopic mikes, suction-cup bugs, etc.). Phone taps may still by used if they don't require installation in your home.

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Almost without realizing it, the NRI discovery method gives you the professional's most valuable tool—practical experience. You learn maintenance, installation, construction and trouble-shooting of Electronic circuits of any description. Whether your chosen field is Industrial Electronics, Communications or TV-Radio Servicing, NRI prepares you quickly to be employable in this booming field or to earn extra money in your spare time or have your own full-time business. And you start out with training equivalent to months—even years—of on-the-job training.

NRI Has Trained More Men for Electronics Than Any Other School

—By actual count, the number of individuals who have enrolled for Electronics with NRI could easily populate a city the size of New Orleans or Indianapolis. Over three-quarters of a million have enrolled with NRI since 1914. How well NRI training has proved its value is evident from the thousands of letters we receive from graduates. Letters like those excerpted below. Take the first step to a rewarding new career today. Mail the postage-free card. No obligation. No salesman will call. NATIONAL RADIO INSTITUTE, Electronics Division, Washington, D.C. 20016.

L. V. Lynch, Louisville, Ky., was a factory worker with American Tobacco Co., now he's an Electronics Technician with the same firm. "I don't see how the NRI way of teaching could be improved."

G. L. Roberts, Champaign, Ill., is Senior Technician at the U. of Illinois Coordinated Science Laboratory. In two years he received five pay raises. Says Roberts, "I attribute my present position to NRI training."

Don House, Lubbock, Tex., went into his own Servicing business six months after completing NRI training. This former clothes salesman just bought a new house and reports, "I look forward to making twice as much money as I would have in my former work."

Ronald L. Ritter of Eatontown, N.J., received a promotion before finishing the NRI Communication course, scoring one of the highest grades in Army proficiency tests. He works with the U.S. Army Electronics Lab, Ft. Monmouth, N.J. "Through NRI, I know I can handle a job of responsibility."

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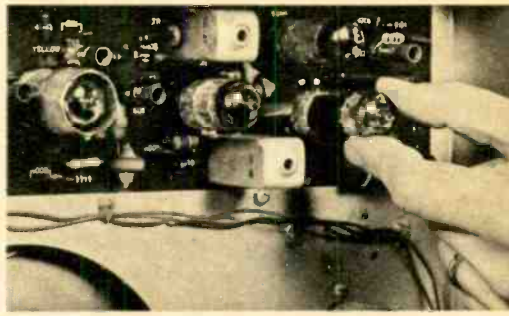

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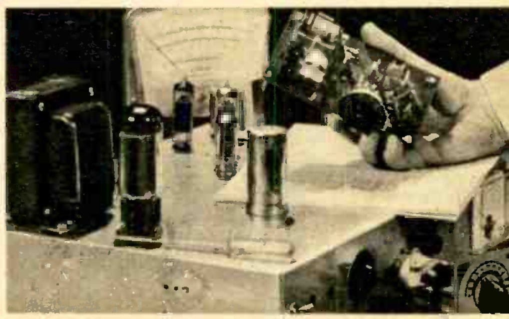
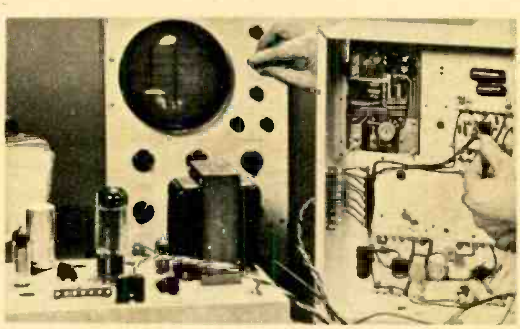


COMMUNICATIONS EXPERIENCE

comparable to many months on the job is yours as you build and use a VTVM with solid-state power supply, perform experiments on transmission line and antenna systems and build and work with an operating, phone-cw, 30-watt transmitter suitable for use on the 80-meter amateur band. Again, no other home-study school offers this equipment. You pass your FCC exams—or get your money back.



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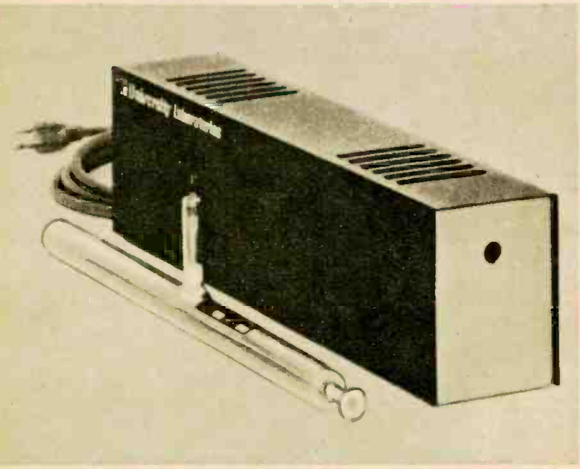
can be instantly demonstrated by you on completing the NRI course in Industrial Electronics. As you learn, you actually build and use your own motor control circuits, telemetering devices and even digital computer circuits which you program to solve simple problems. All major NRI courses include use of transistors, solid-state devices, printed circuits.

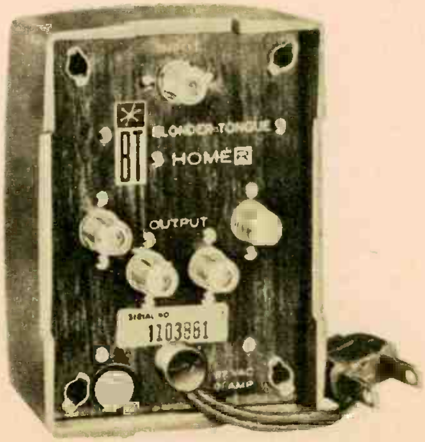
COLOR-FULL . . . A new addition to a handsome line of quality service gear, the Model 1242 color generator, features circuit stability and precision patterns at moderate price. Controls are simple. Amplitude control, coupled to the power switch, delivers color subcarrier at anywhere from 0 to 200 per cent of normal modulation (100 per cent is at the 12-o'clock position) for checking color sync lock. Pattern selector switches dot pattern (0.25-μsec. dot width), crosshatch, horizontal and vertical lines and color bar. It is factory-tuned to channel 3, with channel 4 also available. $99.95. B&K Div., Dynascan Corp., 1801 W. Belle Plaine Ave., Chicago, Ill. 60613.

Electronic Marketplace



Budget Beam . . . Hobbyist-experimenters lacking research-laboratory budgets have reason to wince at the high cost of lasers. The helium-neon laser, Model 200, is about as wince-free as they come—due (says the manufacturer) to a new process for aligning and sealing the reflectors in the laser tube and simplified controls (on/off switch only). Produces 0.3 mw at 6328 angstroms in the visible range with built-in collimation. Uniphase wave-front (TEM_{00}) mode. $195. University Laboratories, Inc., 1740 University Ave., Berkeley, Calif. 94703.

Amplified Coupler . . . Homer is the name of an antenna coupler—perhaps because it's intended for use in the home although it matches 75-ohm coax leads, often associated with community antenna systems. Four TV or FM sets can be operated from the unit which contains an RF amplifier described by the manufacturer as having an Inductive-Coupled Emitter-Feedback circuit providing 6db of gain for each of four sets and 9db with two. Five solderless cable conectors are supplied. $27.50. Blonder-Tongue Laboratories, Inc., 9 Alling St., Newark, N.J.



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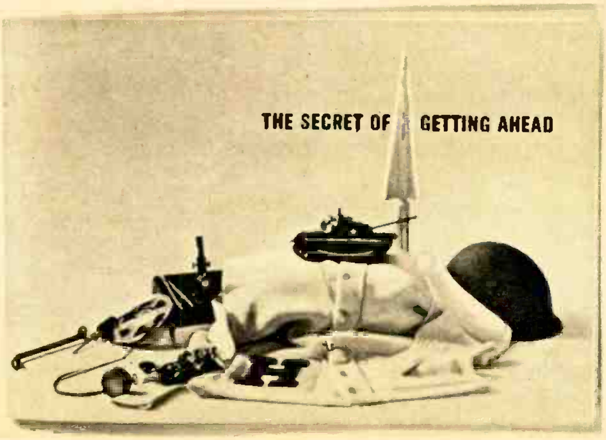

Electronic Marketplace

VHFer . . . The SSB-1 is a converter available for monitoring any single frequency between 30 and 175 mc. The compact unit—about the size of a man's hand—is connected to the auto radio and battery by means of two plug-in cables.

Among its design features are squelch and FM noise limiters. $44.95. SSB Electronics Co., Box 367, Rockville Center, N.Y. 11571.

No Wires . . . The Model 6433 FM wireless microphone is a low-cost rig that can be tuned to any frequency from 90 to 106 mc in the FM broadcast band and picked up on a standard tuner. In one 4-oz. box are contained mike element, 9-V battery and transmitter circuit. Input

also is provided for an external low-impedance dynamic mike. Frequency response is listed as 100 to 10,000 cps. Where FM is used for background music the mike can be tuned to broadcast frequency and used for break-in announcements. $34.95. Channel Master Corp., Ellenville, N.Y. 12428.

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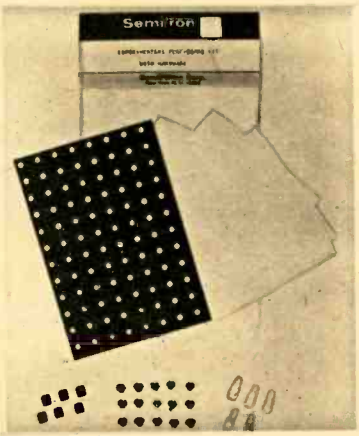
Electronic Marketplace

Phone Away from Phone . . . You can select either a conventional microphone or the push-to-talk handset with the Companion IV mobile CB transceiver. The unit features touch tap selection system for switching channels at the press of a button. Other features include squelch,

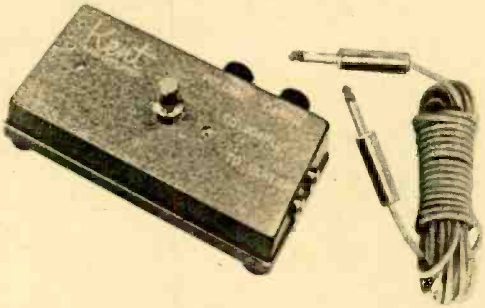
electronic switching, transmit-indicator light, automatic limiting, L-C filter, public-address jack and front and bottom speakers for flexibility in choice of mounting position. Channel 9 crystal included. 3¾ lb.; 2½ x 8½ x 6⅜ in. wide. $139.90. Pearce-Simpson, Inc., Box 800, Biscayne Annex, Miami, Fla. 33152.

Breadboarder . . . A new perf-board design gives project-makers the option of either soldering their connections or clipping them together for easy alteration. The 4 x 6-in. panels have holes spaced ½ in. apart. Brass eyelets, fitting these



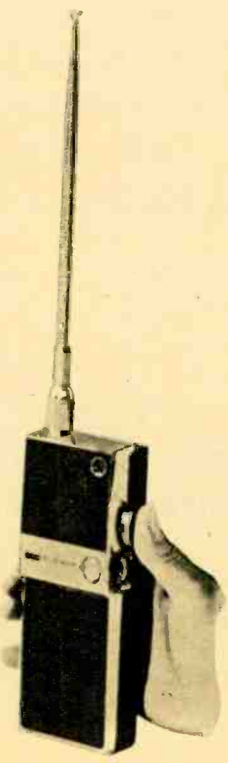
holes, are large enough to accept several soldered leads. When quick changes may be necessary, spring connectors supplied with the kit are used. Graph paper helps in laying out the project. 89¢. Semitronics Corp., 265 Canal St., New York, N.Y. 10013.

Zounds . . . For pop-rock guitar fans there's a new distorter on the market. (A distorter, for the squares in the audience, is a gadget that takes the output of an electric guitar and alters the waveform for added pizzazz.) The 6400 can be switched in by hand or foot and has two additional controls—for signal level and distortion



depth. The transistorized circuit is contained in a cast aluminum case. Phone jacks accept interconnects to guitar and amplifier. A shielded interconnect is included. 6 x 3 x 1 in. $39.95. Kent Musical Products, subsidiary of Buegeleisen & Jacobson, Inc., 5 Union Sq., New York, N.Y. 10003.

Handy . . . The Pace-Mate is a hand transceiver designed, as the manufacturer says, for mobile and personal use as part of a CB communications system. It operates on three channels with a power rating of 2 watts. A total of 18 transistors are used in the transmitter and double-conversion superhet receiver. Other features include a 6-section tuned IF filter, automatic noise limiting, tapered squelch control, AGC, shaped push-pull audio. It's equipped with a detachable helical coil antenna and operates on pen-light cells or Nicads. $99.95. Pace Communications Corp., 24049 Frampton Ave., Harbor City, Calif. 90701.



Broadsides

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

HOBBYISTS, especially collectors of antique equipment, will be interested in contacting a company that says it can supply **schematics and service information** for almost any TV, radio, changer or stereo made since 1930. Usual charge, says the firm, is $1 for radio and $1.50 for TV, per set. For more information write Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. 60035.

Power controls and extensions fill a free 12-page catalog of what the manufacturer describes as instant wiring products. There are models with separately-switched outlets, circuit breakers, voltage regulators, timers and speed controls. Some are for mounting in 19-in. racks. Write Waber Electronics, Inc., 2000 N. Second St., Philadelphia, Pa. 19122.

A booklet titled Magnetism and the Critical Dimension describes the process of manufacturing **recording tape.** Also included are technical data on electromagnetic and physical properties of the tape. You can get a free copy by writing Audio Magnetics Corp., Box 140, Gardena, Calif. 90247.

Catalog 64 describes **chemical sprays used in servicing.** Among them are products for cleaning, cooling, lubricating and providing an insulation coating. Also, you'll find mention of solder and cleaning aids. Free from Chemtronics Inc., 1260 Ralph Ave., Brooklyn, N.Y. 11236.

A booklet summarizing stylus force requirements for dynamic **stereo phono cartridges** includes a representative listing of cartridges from various manufacturers and tells something of how tests were used to determine the recommendations. There's also a section devoted to record care hints. Available free from Acoustic Research, Inc., CS Dept., 24 Thorndike St., Cambridge, Mass. 02141.

A recent brochure describes manual, semiautomatic and automatic **antenna rotators** as an aid in achieving optimum reception of all those great color shows from Batman to the ball game. Copy free by writing Channel Master Corp., Napanock Rd., Ellenville, N.Y. 12428.

Brochure BA-125 describes **nickel-cadmium batteries** in terms of discharge and recharge characteristics and physical design. Free copy from Sonotone Corp., Battery Div., Elmsford, N.Y. 10523.

A flyer containing specs on **zener diodes** also includes a quick-reference rating table. Available free from Semitronics Corp., 265 Canal St., New York, N.Y. 10013.

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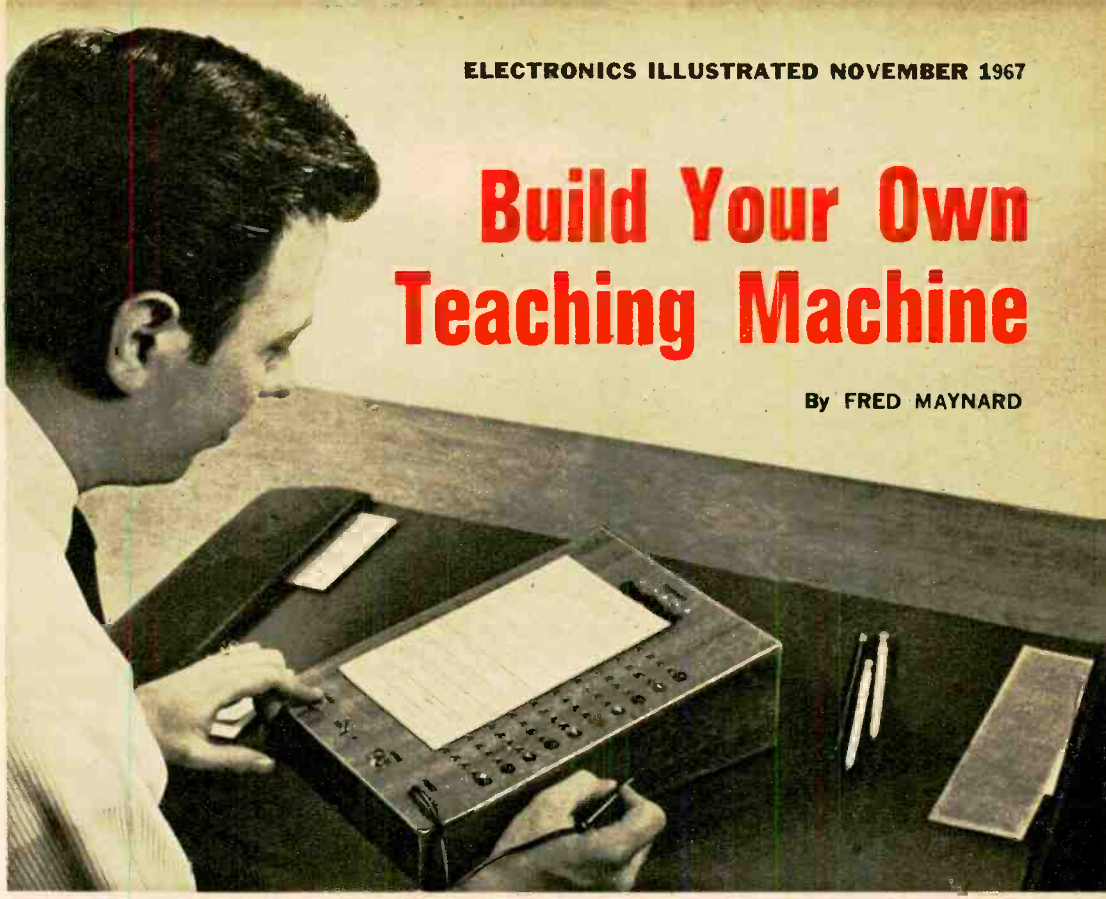


Build Your Own Teaching Machine

By FRED MAYNARD

You'll learn it better and faster and remember it longer with a machine.

LEARNING a new subject is always slow and discouraging at the start. But with the aid of a teaching machine, it's possible to speed up the process and make it easier—and more enjoyable, too. In addition, you retain longer what you learn from a teaching machine.

Our teaching machine, which administers a multiple-choice test, is easy to build for the use of other members of your family (or, if they make up the tests, you can teach yourself). The machine works this way: you place on the top of it a card with ten questions, each of which has a choice of four answers but only one of which is correct (see Fig. 5). You touch a probe to the contact corresponding in position to what you think the right answer is. After you've finished the test you press a *read* button. If the lamp opposite the question comes on, your answer for that question is correct. If there's no light, the answer is incorrect.

Release the button and all the lamps go off. Press again, even after a long period of time, and they come on again.

To learn the correct answers to the questions you missed, simply hold the *read* button down and touch each of the contacts opposite a question until the lamp comes on. Press the *erase* button and the Machine is cleared for another test.

The Machine contains 30 cheap (40¢) transistors. The circuit consists of ten identical memory flip-flops FF-1, FF-2, etc. (See Fig. 1). There are also ten lamp amplifiers (LA-1, LA-2) and read-out lamps, (P1, P2) etc. The first two and the last circuits are shown in pictorial style in Fig. 3. The additional seven circuits are represented by part numbers as they are the same as the first two and last circuits. The rest of the Machine consists of five DPDT slide switches (S1-S5) and 40 contacts arranged in 10 rows of four contacts each. The circuit also includes a normally-open pushbutton switch (S6) for *readout*, and normally-closed pushbutton switch (S7) for *erase*. Two C or D cells in series and an SPST switch (S8) complete it.

Teaching Machine

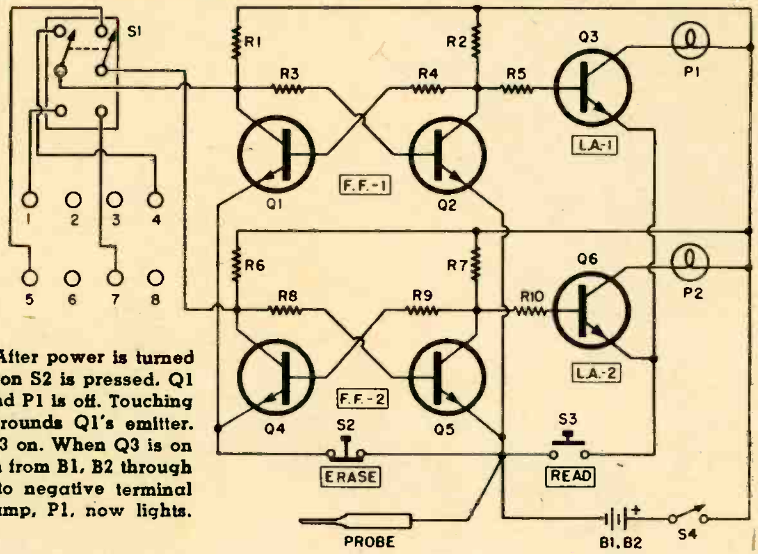


Fig. 1—Simplified circuit. After power is turned on (S4) and erase pushbutton S2 is pressed. Q1 is off, Q2 is on, Q3 is off and P1 is off. Touching probe to, say, contact 4 grounds Q1's emitter. This turns Q1 on, Q2 off, Q3 on. When Q3 is on it forms low-resistance path from B1, B2 through P1 (with S3 closed) back to negative terminal of battery B1. The pilot lamp, P1, now lights.

How It Works

Take a look at the simplified schematic in Fig. 1 and assume that power is on. Since transients caused by turning on power can set up some of the flip-flops incorrectly, S2 resets them to the proper state. Pressing S2, which opens the emitter circuit of Q1 and Q4 puts them in the non-conducting, or off, state. This causes Q2 and Q5 to conduct and puts their collectors at ground potential. Forward bias, therefore, will not be applied to lamp amplifiers LA-1 and LA-2. Both lamps, P1 and P2 will be off. Okay? So far Q1 and Q4 are off and Q2 and Q5 are on.

Assume S1 is in the upper position, as shown by the arrows. This activates contact 4 in the top row and contact 5 in the bottom row. When the probe touches contact 4, the collector of Q1 is grounded. This causes Q1 to conduct and Q2 to stop conducting. (Touch the probe to contact 5 and you will set up FF-2 in the same way.)

Since Q2 is not conducting, its collector voltage rises. This high voltage is fed through base resistor R5 to Q3 and forward biases Q3. There is now a low-resistance path from Q3's collector to emitter. The collector of Q3 goes to indicator lamp P1 which is connected to the positive buss. (The emitters of all the lamp amplifiers are connected to a line which goes to the normally open *read* pushbutton, S3). When S3 is closed, the emitter of Q3 is connected to ground and current flows through Q3 causing P1 to light. (If S1 were set in the down position, the active contacts would be 1 and 7.)

The remainder of the Machine consists of 32 additional contacts, eight flip-flops, eight lamp amplifiers and eight lamps. The differences are only in the way the contacts are wired (the contacts are wired to the switches) and this choice is up to you.

With five programs switches, there are 32

PARTS LIST

B1,B2—1.5-V battery (C or D size)

P1 through P10—No. 48 pilot lamp (2 V, 60 ma)

Q1 through Q30—Motorola MPS2926 transistor (Newark Electronics Corp., 500 N. Pulaski Rd., Chicago, Ill. 60624. 40¢ plus postage. Not listed in catalog)

R1,R2; R6,R7, etc. through R46,R47—220 ohm, ¼ watt, 10% resistor (20 reqd.)

R3,R4,R5; R8,R9,R10, etc. through R48,R49, R50—1,500 ohm, ¼ watt, 10% resistor (30 reqd.)

S1 through S5—DPDT slide switch

S6—Normally-open pushbutton switch

S7—Normally-closed pushbutton switch

S8—SPST toggle or slide switch

Misc.—Test prod, battery holders, test contacts (40 reqd.)

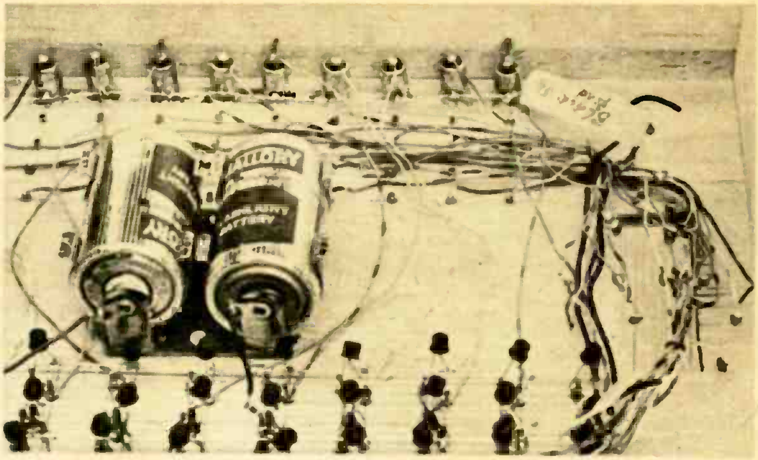
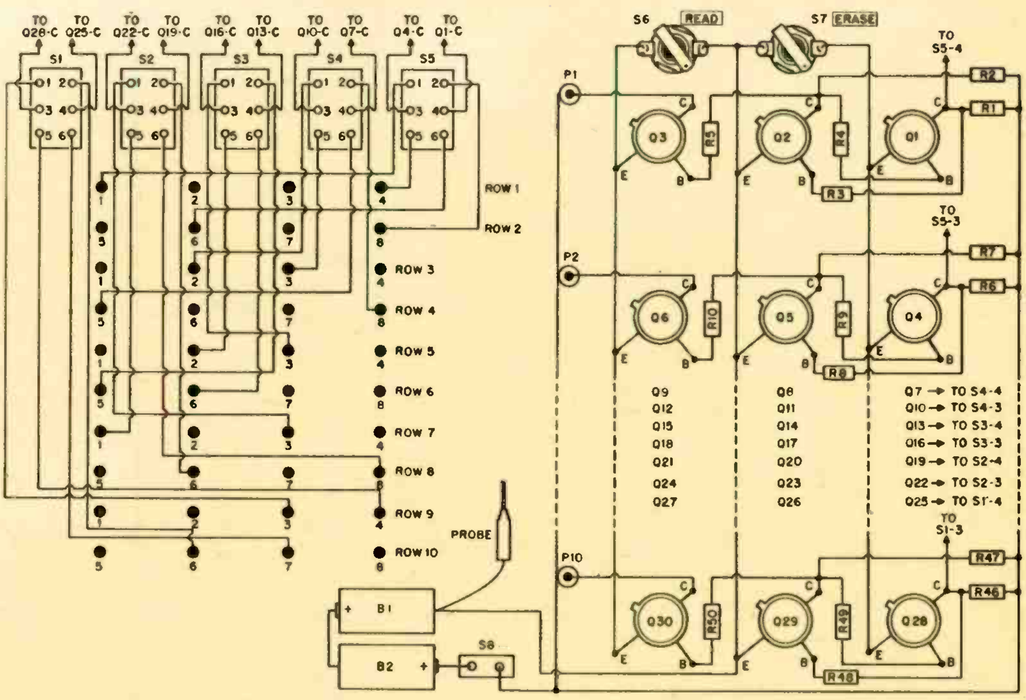


Fig. 2—Underside of author's model, which was built on simple ¼-in. plywood base. Note how pilot lamps at top are simply friction-fit in mounting holes. Transistor leads are soldered to finishing nails connected together with buss wires. Switches fit in cut out at the right.

different contact combinations possible for a 10-question test. This mean 32 problems can be set up, each with 10 questions, and the contacts where the correct answers appear will be in a different place each time.

You could simplify the Machine by not using the program switches. To do this you simply wire the collector of Q1 to any one of contacts 1 to 4, and Q4's collector to any one of contacts of 5 to 8. This simplification would mean all answers from problem to problem would be on the same contacts mak-

Fig. 3—Underside of machine. We show only first two and last flip-flops and light-amplifiers. Seven circuits in between are the same. In our instructions for setting up a test, we refer to the contact numbers shown here. The position of numbers on contacts will be reversed, of course, when the board is turned over.



Teaching Machine

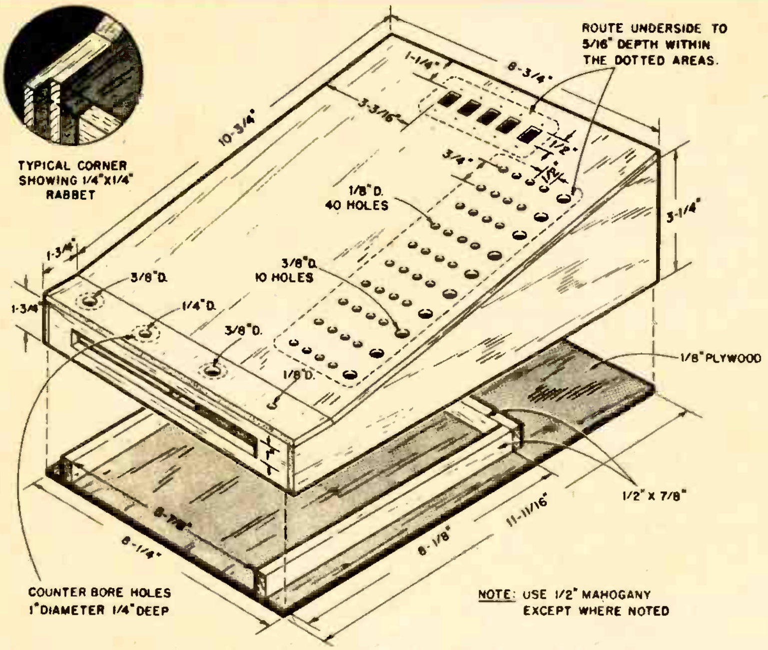


Fig. 4—Construction details for cabinet shown on our cover. Dimensions are flexible and may be changed to suit your requirements. Size of card for our machine is 8½ x 5½ in. Slit in front permits access to the card storage area.

IDENTIFY THE MISSPELLED WORD IN EACH SET:		(SET PROGRAM SWITCHES) ↑ ↓ ↑ ↓ ↑	
MODERN	DIVIDED	CRIES	PURFUME
AMOUNG	VISITED	PRIZE	CHANGED
BENEFIT	TRAGIDY	OPERATIONS	INDIVIDUAL
INTERFERE	LIBRARIAN	PERSONALITY	AMBITIUS
RARELY	INTERRIM	PATTERN	VOLUNTARY
REALIZED	ELABORATE	BOUQUET	CONDEM
INQUIRY	PARADISE	MECHANCIAL	ESSENTIAL
TEMPERTURE	PARTICULAR	CURIOUS	GRADUALLY
CAFETERIA	INTERUPT	SEPARATE	SUCCESSFULLY
EXPERIMENT	LAUNDRY	RELIGOUS	PRACTICAL

Fig. 5—Sample test. Arrows give switch positions.

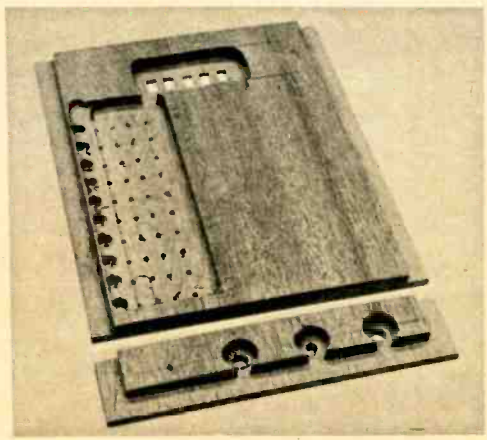


Fig. 6—Note how underside of top panel has been routed out to accommodate switches and contacts.

ing the set-up of the problems easier. However, you could easily learn this arrangement and be able to get the correct answers without knowing them.

So far, the Machine is subject to cheating regardless of the programming. You could cheat if you sweep the probe across all four contacts at each position. There is a simple protective circuit which can be added to indicate cheating.

To add a protective circuit, connect together all of the contacts *not used* and connect them to the collector of an eleventh flip-flop and an extra lamp amplifier. (These circuits would be identical to the other flip-flops and lamp amplifiers.)

If after a test is completed all of the answer lights come on as well as the error light, it means that in at least one place the person had touched a wrong contact *as well as* the right one. This does not prove sweep-across cheating, but if it happened every time, that would be strong evidence of it.

In other cases, where at least one of the answer lights does not come on and the error light does, it indicates that the person probably made an honest mistake.

If a person taking a test does not know an answer, he can learn it by holding *read* button S6 down and touching the contacts associated with that question, observing which causes the indicator light to come on. Referring back to the choices, he can determine the correct answer.

Construction

The machine we show on our cover was built in a cabinet whose dimensions and construction details are shown in Fig. 4. Your cabinet does not have to be this stylish. It may simply be built on a piece of ¼-in. plywood with 2-in.-high supports on each side. Matter of fact in the author's first model (which was built on plywood), small finishing nails were used for tie points, as shown in Fig. 2. The pilot lamps were simply force-fit in their holes. The contacts were rivets, although machine screws, or thumb tacks could also be used. But they must be long enough to come through the board so connections can be made to them from the rear.

We suggest after drilling the board you first mount the switches, then the rivets, and next, all the nails which are to be used for tie points in the flip-flop and lamp-amplifier circuits. After you've finished all drilling and hammering, install the pilot lamps. Then start making connections to them. Refer to Fig. 3, which is a view of the underside of the machine, as a wiring guide.

How To Prepare A Test

If you wire all the contacts as in Fig. 3, the table in Fig. 7 will give the active contacts for all switch combinations. Look at it this way: The first question on the test will be in row one. (See Fig. 5.) With switch S5 up, the correct answer on the test will have to correspond to contact 1. With S5 down, the correct answer will have to correspond to contact 4.

In the sample test we show in Fig. 5 the word *purfume* is spelled incorrectly (the correct spelling is *perfume*) in the top group. This means that the fourth contact must be active for this group. Therefore, switch S5 will have to be in the *down* position. Note that the arrows at the top of our sample test don't agree with this. This is because this card was intended to be used with a machine which was wired differently. The card simply shows you how to prepare your own.

For question 2 (row 2), with S5 set up, the correct answer will have to correspond to contact 8. With S5 down, the correct answer will have to correspond to contact 6. If you wish to use other contacts, wire the machine accordingly when you built it. The choice is completely up to you. For future reference, make up a table like the one shown in Fig. 7 so you can prepare other tests without wasting time determining the active contacts.

MACHINE PROGRAMMING

Row	Active Contact	Switch	Switch Position
1	1	S5	Up
	4		Down
2	8	S5	U
	6		D
3	2	S4	U
	3		D
4	8	S4	U
	5		D
5	3	S3	U
	2		D
6	5	S3	U
	6		D
7	3	S2	U
	1		D
8	6	S2	U
	8		D
9	3	S1	U
	4		D
10	6	S1	U
	7		D

Fig. 7—Based on pictorial in Fig. 3, this chart shows which contacts will be active for each position of programming switches S1 through S5.

The Ham Shack

By Wayne Green
W2NSD/1

DEAR Mr. Green:
In QSL to your column in the July, 1967 issue of EI and the question of how to get more people involved in ham radio, the answer should be obvious. Force the FCC to get rid of the tests. Many of us simply don't have the electronic ability to pass them. The ARRL, FCC and old timers want only a selective few among the ranks, which leaves fellows like me to CB or nothing. I have gone to several schools and thrown good money after bad trying to reach the exalted status of ham operator. Now I have resigned myself to being a headset bender at best unless the FCC will drop the test of electronic ability and make it one on practical operation. Then you really would get many people involved.

P. A. Horner
Huntsville, Ala.

Reader Horner will be glad to hear that there is a move afoot by the ARRL to downgrade things so he can get a license without having to work for it. This is a surprising move by the organization that unleashed upgrading on us not long ago. Amateurs are now waiting nervously to see what monstrous offspring will be born to call the League Daddy.

Manufacturers and distributors of amateur equipment have been particularly hard-hit by the drop in new hams plus the slowdown in sales due to the near-saturation changeover from AM to SSB. So they got together and worked out a plan to increase interest (and sales) in amateur radio. They conceived a new Novice-type phone band on the top end of ten meters to encourage the CB gang to come on up and have some legal fun. They approached the League with the proposal and seem to have found a sympathetic ear.

Though I may seem a bit cynical I must hasten to say that I am not opposed to the idea. I have reservations because it has been my experience that something got for nothing usually is not valued. And I am fearful that CBers that might treat this band with the same disregard they lavish on the CB channels. On the other hand, this might be just the thing to acquaint the CB chaps with wonders of amateur radio and the fun of international contacts.

Ten meters is going to be a corker for the next few years, now the sun-spots count is up again. The top of ten has had little activity even during the best of openings so we should welcome the prospect of a few thousand stations settling there.

I hope, however, that they really are recruited from new blood and not just Novices enticed off their present CW bands. At any rate, since the plan doesn't seem to be particularly harmful and could generate a lot of interest, I'd like to see it go ahead.

The proposed upgrading worries me a lot, though. I see little good to come from it and lots of miseries. I do wish amateurs had taken a little more responsibility in this matter. Any problems we have could, I suspect, be cooled if we could get the FCC to change their license exams to the open book type—requiring understanding of the material rather than a blanket memorization of the ARRL License Manual. Is it too much to ask that those licensed show that they grasp the basics?

I'm one of those dreamy idealists, I suppose. I have utopian visions of the amateurs administering their own license exams, with at least three licensed amateurs present. This would put issuing of licenses into the hands of our radio clubs, thereby strengthening them. It would save the FCC a fortune. And it would make the exams available just about anywhere in the country.

Instead of petitioning the FCC for rule changes I'd like to see each of our clubs send a representative to a national convention every couple of years to discuss rule changes and vote on them for his club. We might all enjoy amateur radio a little more if we were more involved in its administration. Perhaps we would take misuse of our bands more seriously and feel prouder of being amateurs.

I have a few other ideas, too. But somebody might consider them controversial so I'll keep mum for the time being. I have no wish to add to the controversies stirred up by our beloved League.

Maybe you have some ideas on how to improve amateur radio. Why not drop me a line?

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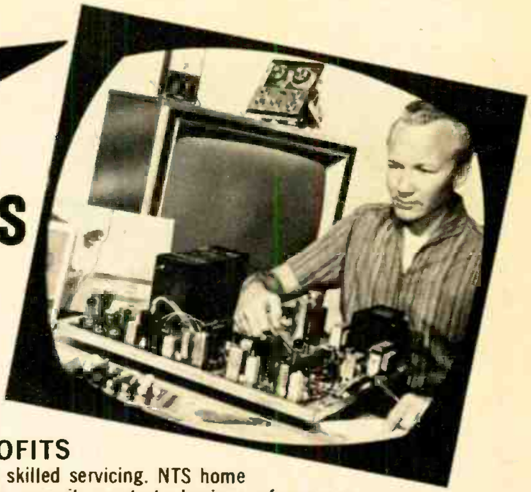

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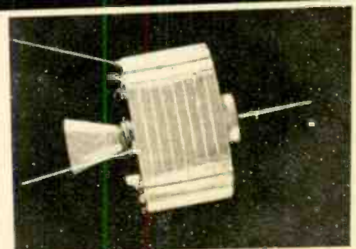

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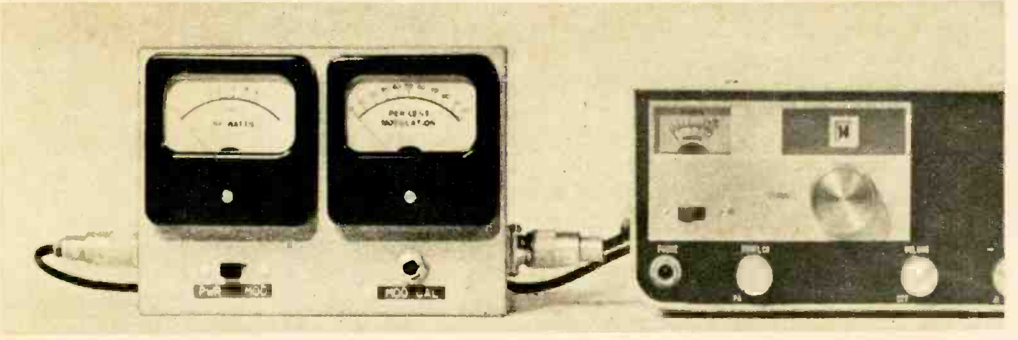


In-Line Mod / Power Meter for CB

By HERB FRIEDMAN, KBI9457 NOTHING can shatter the ego of a CBer as much and as fast as a report that the signal from his 5-watt transceiver sounds like it was coming from a 100-mw walkie-talkie half a mile away.

One reason for poor reports can be the fact that you may not be hitting 100 per cent modulation because those years-old tubes have reduced output power or modulation to a flea's whisper. That new speech compressor may not be giving you more talk power. Or you may be getting the same old modulation level but with added distortion. The solution to these and other problems about your rig's output can be found with our In-Line Mod/Power Meter.

Unlike other CB test sets, which are hooked up only when you think something's wrong with the rig, our meter is a full-time monitor. It is connected permanently between transceiver and transmission line. By just glancing up as you talk you can see the transceiver's RF output power, the percentage of modulation and carrier shift.

For example, during modulation the power meter (M1) should always remain rock-steady. If it starts to move downward or upward with modulation you'll know something's wrong—perhaps a bad tube, overcoupling or too much final input power. (Some CB transceivers always show a carrier shift though a properly designed transmitter should have none when modulated.)

Our meter will work with any 5-watt transceiver. The only restriction is that the antenna system's SWR must be 1.2:1 or less. If it isn't, the meter will not indicate correctly. If your antenna system's SWR is high you still can make RF power measurements but you must substitute a 50-ohm dummy load for the antenna.

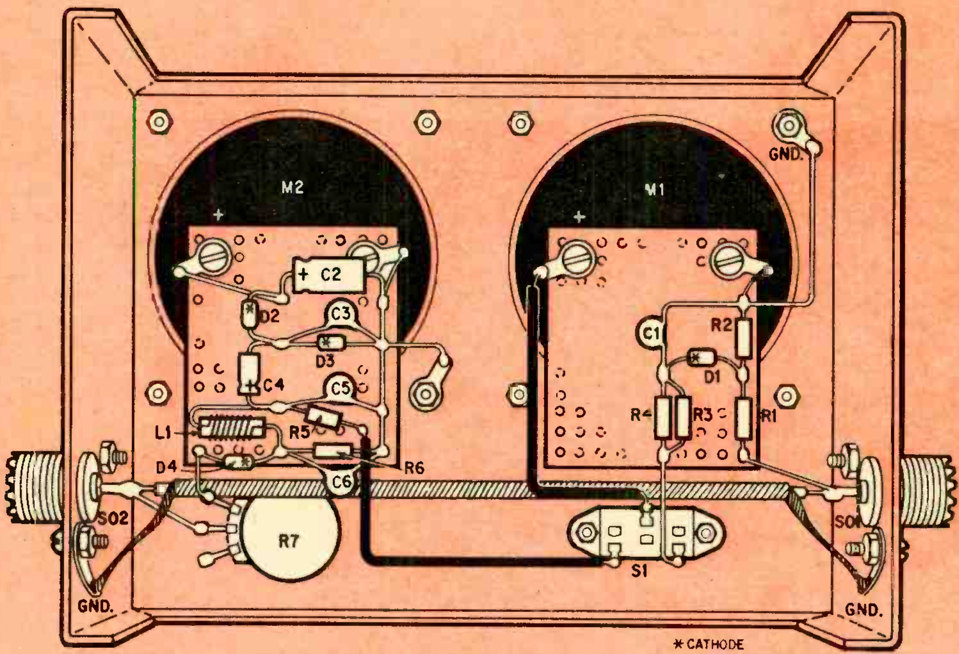
Construction. The parts layout is critical. Follow the pictorial as closely as possible. Component values also are critical and substitutions should not be made.

For greatest accuracy 5 per cent resistors should be used, though 10 per cent tolerance will be adequate if you're not interested in precise measurements.

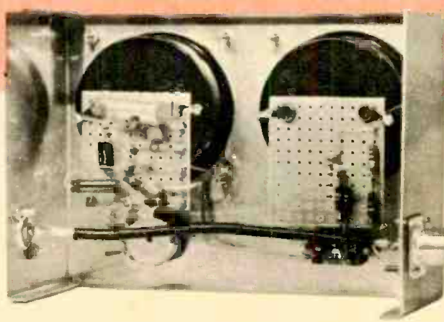
The first step is to cut holes in the main section of a 3 x 5 x 7-in. Minibox for M1 and M2. Position the meters so that they are ¼ in. from the sides of the cabinet and ¼ in. from the top. On the vertical centerline of each meter, midway between the bottom of the meter and the bottom of the cabinet, cut the holes for *power-mod.* switch S1 and *mod. cal.* control R7. R7 *must be insulated* from the chassis with fiber shoulder washers, which require a ½-in. mounting hole. If R7's shaft is not insulated from the chassis the internal capacity of the control to ground will cause excessive loss in RF power output.

Next, mount a coaxial connector (SO1, SO2) at each side of the cabinet as shown. The connectors should be positioned so the coax connected between them is directly over R7. (For clarity, the coax is shown out of position in the pictorial.)

Temporarily set the cabinet aside to install the new meter scales printed on the third page of this article. Remove the four screws on the back of each meter case and lift the front of the meter straight off the case. Re-



Inside of meter. For purpose of clarity L1, on left circuit board, is shown mounted flat. It should be mounted at right angles to board. Coax goes right behind R7 and S1 as shown in photo.



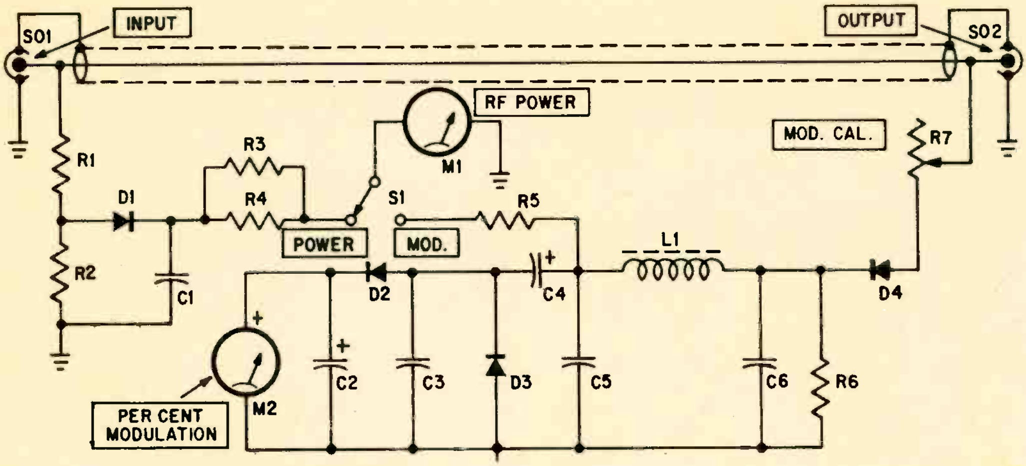
PARTS LIST

Capacitors: 15 V or higher unless otherwise indicated
C1—.001 µf ceramic disc
C2—300 µf, 3V electrolytic
C3,C5,C6—220 µµf ceramic disc
C4—6 µf electrolytic
D1,D2,D3—1N281 diode (GE)
D4—1N34A diode
L1—24 µh RF choke (J. W. Miller No. 4626. Allied 54 A 3839)
M1,M2—0-1 ma DC milliammeter (Lafayette 99 C 5040)
Resistors: ½ watt, 5% unless otherwise indicated
R1,R2—560 ohms
R3,R4—15,000 ohms
R5—5,600 ohms
R6—1,000 ohms
R7—3,000 ohm, linear-taper potentiometer, insulated shaft. (Mallory SU-8. Lafayette 33 C 1209)
S1—SPDT slide switch
SO1,SO2—SO-239 coax connector
Misc.—3 x 5 x 7-in. Minibox, fiber washers, perforated board, RG59/U coax

move the two screws holding the scale in place and carefully slide the scale up from under the pointer. Paste the new scales over the old meter face. For accuracy, make certain the *zero* mark on the new scale lines up with the *zero* mark on the original scale.

Install all parts on the two 2¼-in.-square perforated boards. Vector T28 terminals or flea clips should be used for tie points. The boards are mounted on the meter terminals with the nuts supplied with the meter. For clarity, the pictorial shows L1 lying flat against the board. Actually, L1 is mounted at right angles to the board. Before mounting the boards, make certain the polarity of all diodes, C2 and C4 is correct.

Mount the boards on the backs of the meters and then install a section of RG59/U



C1,D1,R1-R4 and M1 measure carrier's DC level. Other parts measure modulating waveform's DC level.

Mod / Power Meter

(or RG59A/U) between SO1 and SO2, grounding the shield *at both connectors.* Finally, complete the connections to the boards, the ground lugs and to S1 and R7.

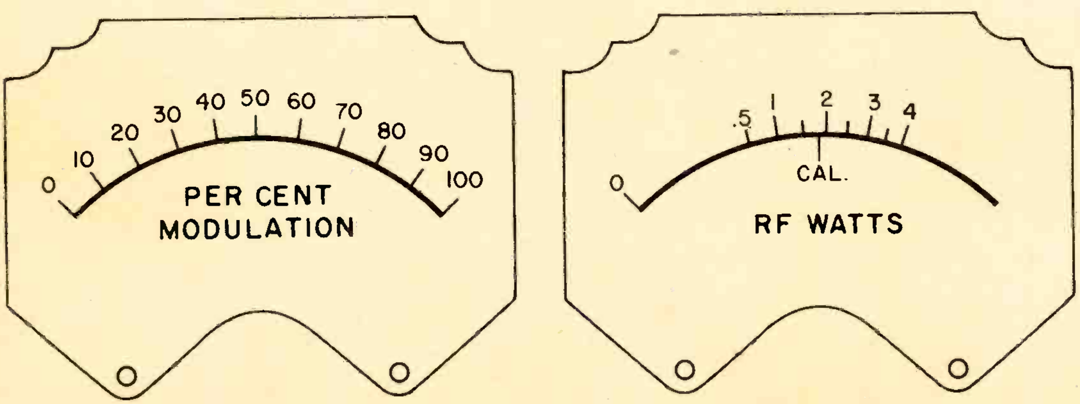
The total value of R3 and R4 is 7,500 ohms. For maximum accuracy we suggest replacing R3 and R4 with a 7,500-ohm 1 per cent resistor. However, you can try combinations of paralleled 15,000 ohm resistors (as shown) to come as close as possible to 7,500 ohms.

Checkout. Connect the transceiver to SO1 and a 50-ohm dummy load to SO2. (The dummy load can be two parallel-connected, 2-watt, 100-ohm resistors.) Set S1 to the *power* position and transmit. If the unit is wired correctly M1 will indicate the transceiver's output power. If M1 indicates in reverse, D1's polarity is reversed. When you modulate, M2 will indicate even through S1 is in the *power* position but M2's readings will not necessarily be correct.

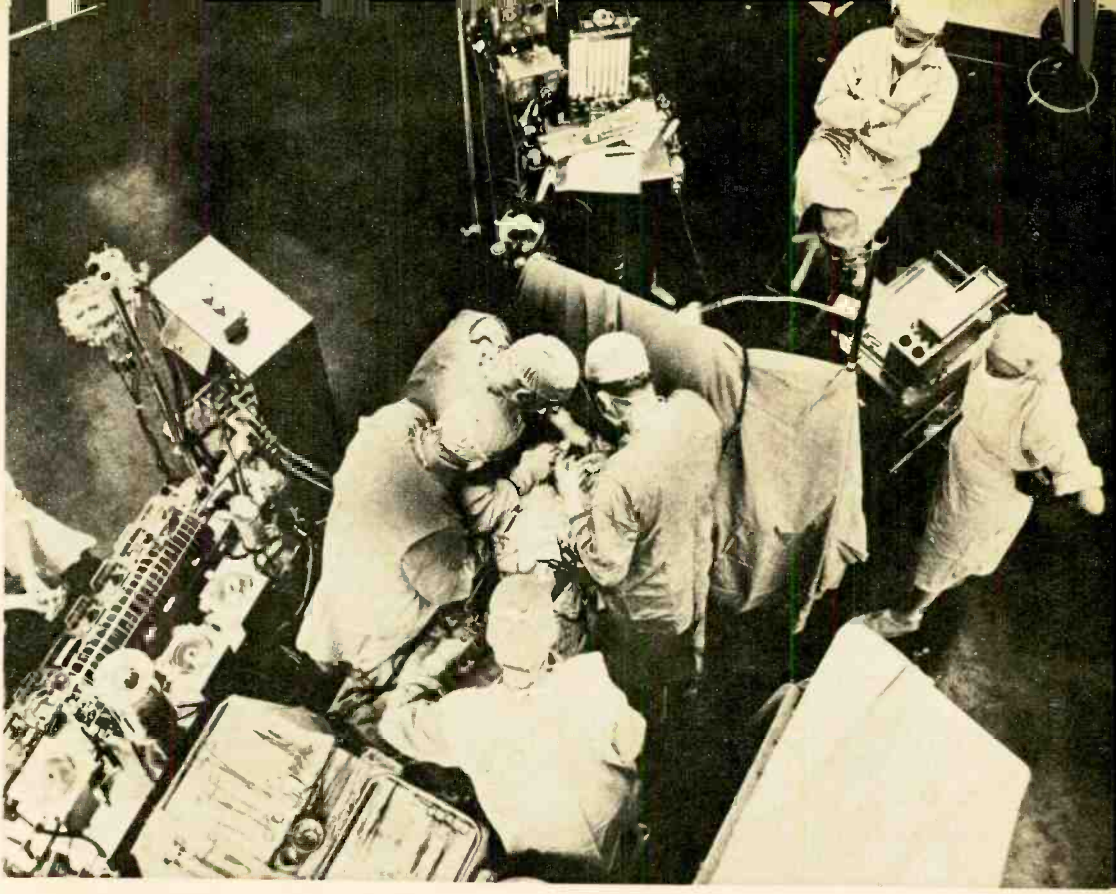
Set S1 to *mod.* Adjust R7 so M1's pointer is right over the *cal.* mark and then modulate. M2 will indicate the modulation percentage. Note that M2's indications are valid only when R7 is adjusted so M1's pointer is over the *cal.* mark.

Operation. Regardless of the SWR, the modulation meter always gives correct indications so long as M1 is calibrated. However, the power-output indications require a low SWR for accuracy. To check the *power* me-

[*Continued on page* 118]



Cut out these two meter scales and paste them over existing meter scales. Make sure the zeros line up.



A CAREER IN MEDICAL ELECTRONICS FOR YOU?

Now's the time to get in on the ground floor of a fast-growing branch of electronic technology, one so new it's still unsure of its own name.

By TOM W. HILL

WANTED — Pioneers to build and shape an industry that hardly exists! That's right, there *are* new frontiers to conquer—if you know where to look for them. And if you're planning to make a career for yourself in electronics there may be a new frontier for you in the emerging field of medical electronics technology.

Bionics, a term so new you probably won't find it in your dictionary, is the key word. It is used to denote the area where biology and electronics overlap. Or the areas—new applications of electronic technology to biomedical research and therapy are coming into being with dizzying rapidity. Published figures put sales of medical electronics equipment at between $200 and $300 million a year with a growth rate of 13 to 17 per cent —25 per cent above the overall growth rate for consumer electronics and 50 per cent above that for computers.

And that means opportunities for the man with a touch of idealism and a solid grounding in electronics. It also means confusion. Job classifications are vague and inconsistent; training programs are few, generally ill-defined and subject to change as the needs of the field itself grow and become better defined.

Opportunities, in fact, tend to stem from the confusion. In better-organized industries

MEDICAL ELECTRONICS

Technician at George Washington Medical School feeds recording of heart sounds to analog-to-digital converter for computer analysis at Heart Disease Control Program's Instrumentation Field Station (U.S. Public Health Service) in Washington, D.C. Pioneer service provides cardiac diagnoses in 15 sec. for teletype to doctors anywhere in the country.

there are more restraints on the growth of a really talented man because he will be expected to move step-by-step through the recognized pattern. In bionics, the man who is there first can easily have a whole department created under him.

Electronic instrumentation has been moving into the medical field so fast that most doctors still don't understand fully what's happening. It began in medical research, where electronics was used to measure factors that couldn't be measured in any other way or to do things faster or better than they had ever done before.

Then as medical electronic equipment became more sophisticated applications were found in places such as operating rooms and intensive-care units, where continuous measurement of heart rate, blood pressure, breathing and other factors could be made electronically. A number of hospitals now have coronary care units in which heart patients can be monitored electronically 24 hours per day.

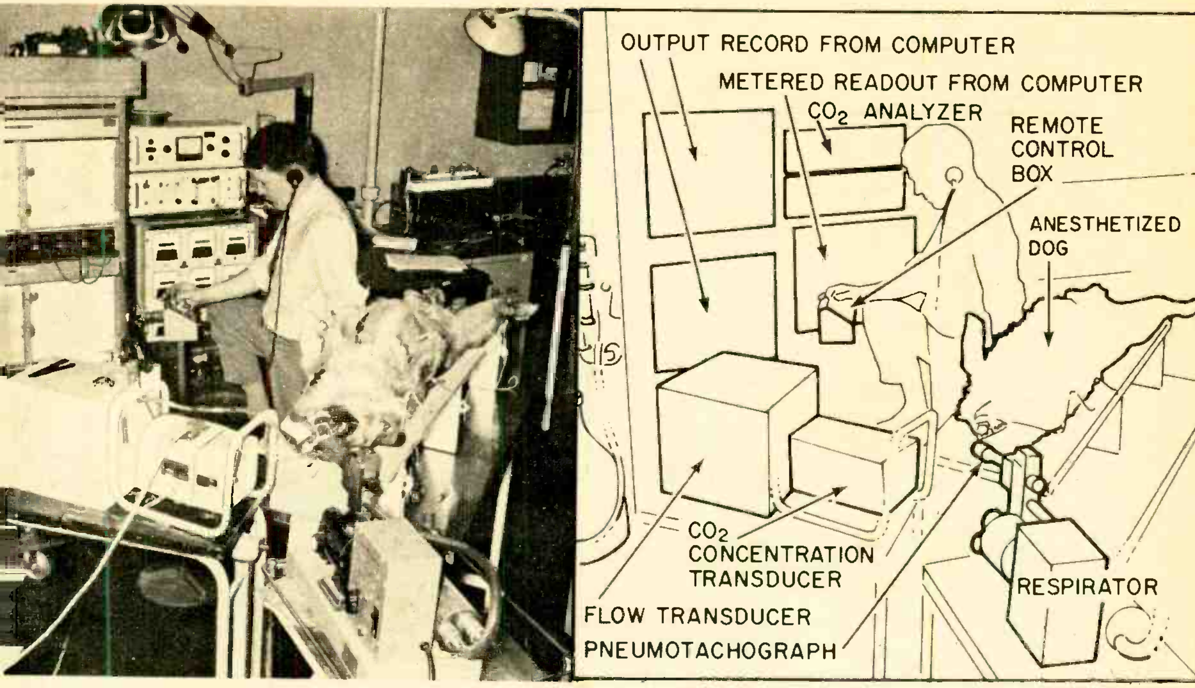
The next step seems to be electronic diagnosis. Relatively simple devices like the electrocardiogram (EKG) and the electroencephalogram (EEG) have been around for years, of course. But new electronic techniques, including the use of computers, have given medicine the means of automating physical and laboratory tests.

Most of the medical-electronics jobs opening up today are in either the manufacturing companies that produce the equipment or the larger hospitals (especially those engaged in research). Others are with private research organizations and drug manufacturers.

Job openings with manufacturers are apt to be in service work, since most of the medical-electronics equipment sold today is serviced by the manufacturer. Also, if the company is big enough and aggressive enough there can be interesting opportunities in its product-development program.

Hospital jobs offer more variety. Here, particularly, job patterns have yet to become standardized.

A new development in some of the research-oriented hospitals is the establishment of a special department responsible for (among other things) the servicing of all the electronic and electro-mechanical instruments and devices. The Scientific and Medical Instrumentation Department of the Downstate Medical Center, Brooklyn, N.Y., is one of the largest. In addition to servicing, the department does acceptance testing of



Drawing at right identifies equipment used by bio-medical engineer Michael Leeming in lung study at Memorial Sloan-Kettering Cancer Center. Information on air flow and carbon dioxide content are fed to computer in another building for analysis. Remote control box is for communications with computer room.

newly purchased instruments. It also designs and builds special instrumentation for research projects.

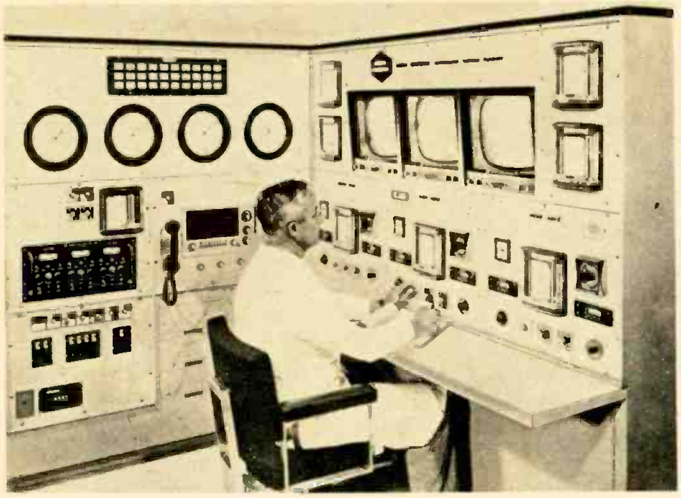
The department's working area looks much like that in any electronics service establishment. There are test benches, the usual range of electronic instruments, oscilloscopes, supplies of components, manufacturers' catalogs. The work runs all the way from simple soldering jobs to sophisticated breadboard work and complex circuit design.

Because most researchers have instrumentation problems, the modern research hospital offers plenty of scope for the talents of an ingenious electronics technician. Simple tasks you might expect to encounter would include assisting a bio-medical engineer in investigating the capabilities of the equipment he must use. If it does not do what the researcher wants you might be required to adapt it, changing the circuitry, adding new components or recalibrating it.

Sometimes a medical researcher will conceive a general idea for a series of experiments without having any notion what instrumentation he needs. In such cases a bio-medical engineer may have to design the instrumentation from scratch. You could find yourself working with him on this one project for weeks or even months at a time.

Very few hospitals, however, even if they are research-oriented, have a really elaborate service setup. For the design of research gear they often go to their Physics Department. Some hospitals also use electronics technicians in their anesthesiology departments where there is a great deal of instrumentation. Because electronics is beginning to invade operating rooms and patient-care areas, thousands of new jobs unrelated to research are expected to open up in the next few years.

New York University Medical Center has pioneered a system to provide, through one central unit, various technical skills needed in the operation and servicing of patient-care equipment. This unit grew out of the hospital's Inhalation Therapy Service but is now called the Instrumentation and Inhalation Services. Abe Kaiman, director of the unit, hires technical high school graduates with mechanical or electronic aptitudes to be



It may look like master control at a TV station but it actually controls high-pressure oxygen-atmosphere room used in special therapy and operating procedures at New York's Mt. Sinai Hospital. Somewhat similar-looking control rooms are used in some hospitals for centralized monitoring of specialized electronic diagnostic and therapeutic equipment in use throughout the building.

MEDICAL ELECTRONICS

trained on-the-job in the hospital.

In any hospital job it is essential, if you want to get anywhere, to learn something about the so-called life sciences (biology, physiology, anatomy) and about hospital procedure—the more the better. Michael Leeming, bio-medical engineer at the Memorial Sloan-Kettering Cancer Center cites this example:

Suppose you had been asked to design a piece of equipment to measure a patient's respiration during an operation (the volume of air breathed and similar factors are important to an anesthesiologist). You assemble your instrumentation. It includes a pneumotachograph that is put in the patient's mouth to measure air flow. You test it out in the lab and it works. Then you take it into the operating room, all ready to go.

First thing, the doctor puts an endotracheal tube down the patient's throat and expands the balloon attached to the tube. Now you see that the beating of the patient's heart acts on the endotracheal tube to produce a puff of air that shows up on your readings, although it has nothing to do with breathing. You have to move fast to damp out the false signal.

If you had known something about operating-room procedures this would not have happened. The endotracheal tube (which keeps the air passage open) is as common to the anesthesiologist as a soldering iron is on the service bench.

Aware that the medical field is generating "an insatiable demand over the next ten years for electronics technicians" (to quote Dr. John E. Jacobs, head of Northwestern University's Biomedical Engineering Center at Evanston, Ill.) a number of educators have been working on special courses for what they usually call bio-medical engineering technicians, a term intended to include electronics. Among them are the National Institutes of Health (which uses many technicians in its Bio-medical Engineering and Instrumentation Branch in Bethesda, Md.) and the Technical Education Research Center in Cambridge, Mass. In New York State, the Department of Education has been working on what it calls the Project on Community College Health Careers. So far it has produced a pilot training program at Monroe Community College in Rochester. More are going to be set up in other parts of the state during the next two years.

A few technical institutes also have developed courses. These include DeVry Institute of Technology (Chicago) and the New York Institute of Technology (New York City and Westbury, Long Island). Other technical schools (both resident and correspondence) offer courses in some phases of the subject.

Because the field is comparatively new, none of the hospitals that hire bio-medical electronics technicians expect to find men with medical or life-sciences training—nor with medical-electronics experience.

In general, the qualifications seem to boil down to high school graduation plus electronics background and experience. The

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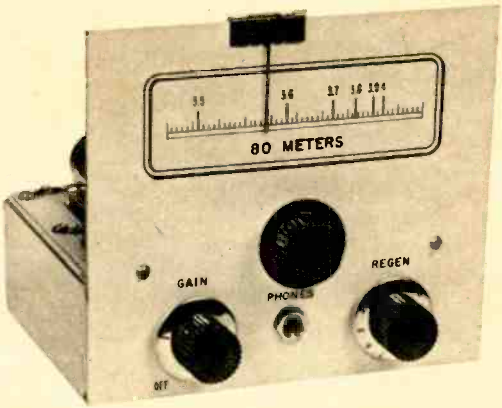


3 Transistors for 80 Meters

80 is busy, interesting, challenging. Our rig is the easy way to listen in.

By CHARLES GREEN, W6FFQ

EIGHTY meters is a busy band. Some hate it for this reason, others find all the phone and CW activity makes for exciting and interesting listening. There's so much going on you can spend hours digging out one obscure signal after the other.

Matter of fact, those who have been eavesdropping on 80 regularly will tell you it's especially great for learning or brushing up on code. The most enthusiastic supporters of 80 are Novices working for their General ticket or old-timers giving themselves refresher courses.

You get the opportunity to copy code-practice broadcasts and ham QSOs from slow to fast speeds—and always through plenty of QRM. And it's the QRM that separates the men from the boys.

You don't need a complicated receiver to tune the 80-meter band. All it takes is our three-transistor regen rig which is easy to build and has the entire 80-meter band (3.5-4 mc) spread over its dial. The receiver is built on a piece of perforated board which is mounted on a 5x7-in. chassis from which the top has been cut out.

An untuned grounded-base RF stage is used to isolate the antenna from the regen-detector circuit. A stage of audio provides plenty of power for headphones. Battery operation makes the receiver a natural for portable operation. Perforated board and flea clips make it easy to build.

Construction

All the components are mounted on the top of the perforated board and the chassis' front and rear panels. Begin by cutting out the chassis top, leaving a ½-in. rim all around so it looks like the bottom of the chassis. Position the slide-rule dial on the front of the chassis and mark

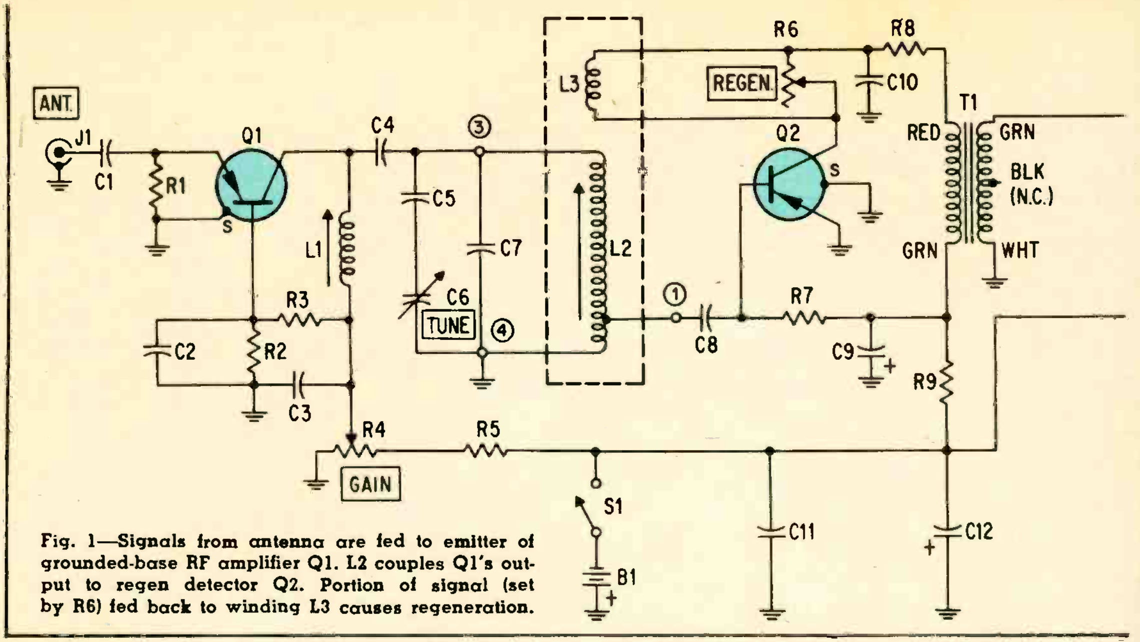


Fig. 1—Signals from antenna are fed to emitter of grounded-base RF amplifier Q1. L2 couples Q1's output to regen detector Q2. Portion of signal (set by R6) fed back to winding L3 causes regeneration.

3 Transistors for 80 Meters

off two 1½-in. sections on the front rim. Cut the two sections and bend them up to form mounting tabs to which you attach the dial.

Cut a 6¾- x 4¼-in. piece of perforated board to fit the top of the chassis (which you just cut out) and mount it with sheetmetal screws and ground lugs as shown in the pictorial. Use ½-in. metal spacers and washers to mount C6 so it is above the board. It is important that you make sure C6 is mounted so that when it is coupled to the dial pulley the dial turns easily. Mount a ground lug under one of C6's mounting screws on the underside of the board.

Carefully remove the shield can from the oscillator coil then wind three turns of No. 22 hookup wire on the top of the coil form as shown in Fig. 3. Fit the wires through the coil's index hole in the base. Replace the coil shield, install a grommet under the coil's base and snap the coil-mounting strap into the

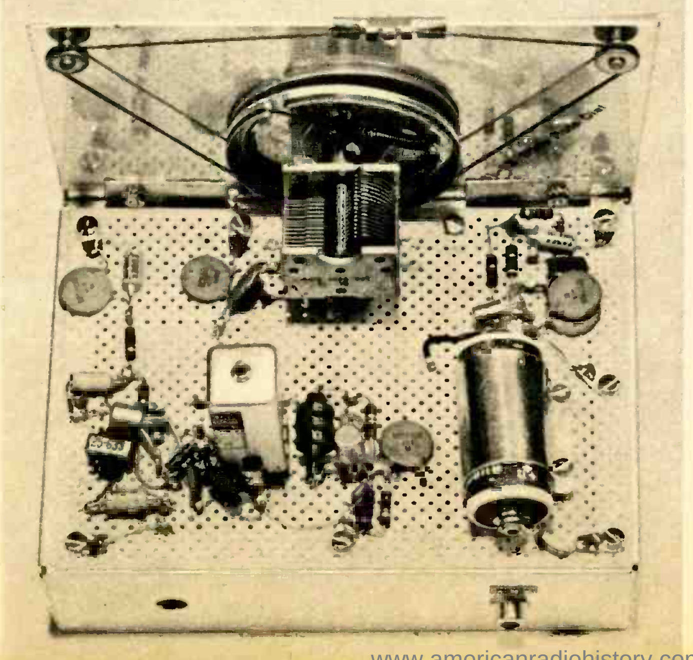


Fig. 2—Top view of receiver. First thing to do is cut out top of chassis, leaving a lip the same size as in bottom of chassis. Dial assembly is same width as chassis and is attached to chassis by bending up two 1½-in.-wide tabs cut out of lip at front. Mount the parts on the board after installing the board on the chassis.

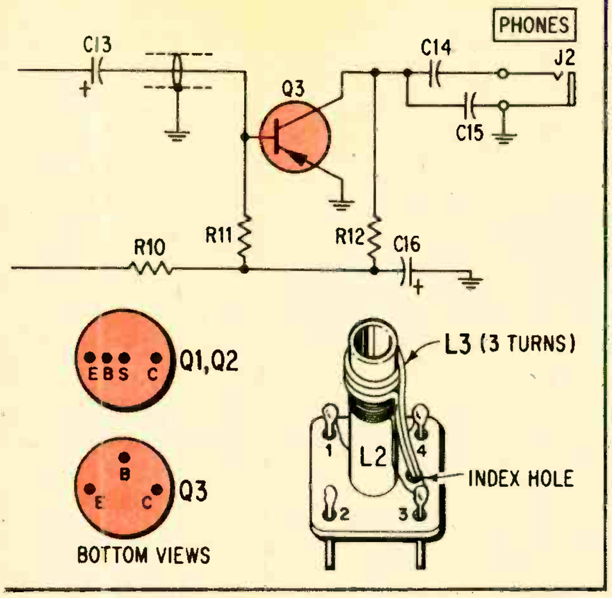


Fig. 3—Closeup of oscillator coil from which cover has been removed. Note how you wind the three-turn tickler coil (L3) above the existing winding. Leads go straight down and through hole in fiber base. Clip at bottom holds cover. Be sure to solder lead to clip, connect lead to ground.

shield can. Install four flea clips in the perforated board so they line up with the coil's lugs. Solder the coil lugs to the flea clips and solder a ground lead to the coil's mounting strap, as shown in Fig. 3.

Solder all components to the flea clips as shown in the pictorial. Even though parts placement is not as critical as it would be on higher-frequency bands, follow the layout shown.

Transformer T1 is mounted on the board by forcing its tabs through small cuts between holes in the board and bending the tabs on the other side of the board. Install spaghetti on all transistor leads and other component leads to prevent shorts.

Twist the leads going to R6 and run them *under* the board. Use shielded wire under the board from Q3's base lead to C13. Make a bracket for the battery out of sheet aluminum and mount it on top of the board.

The value of C15 depends upon the particular tone you prefer. The capacitance can range from .01 μf for harsh sound to .05 μf for a smooth tone. We used two .01-μf capacitors in parallel in our model. (The Parts List specifies a .02 μf capacitor.)

Test and Operation

Turn L2's tuning slug so it's about ¼ in. out of the top of the shield can and plug an antenna into J1. Plug high-impedance (2,000 ohms) headphones into J2 and set R4 to mid-rotation. If you have a signal generator, set

PARTS LIST

B1—12 V battery (Burgess PM8 or equiv.)
Capacitors: Ceramic disc, 25 V or higher unless otherwise indicated
C1,C11—.01 μf
C2,C3—.001 μf
C4—47 μμf
C5,C7—100 μμf
C6—10-365 μμf variable capacitor (Lafayette 32 C 1103 or equiv.)
C8—.002 μf
C9,C12,C13,C16—5 μf, 15 V electrolytic
C10—220 μμf
C14—.05 μf
C15—.02 μf (see text)
J1—Phono jack
J2—Phone jack
L1—2.4 mh RF choke (J. W. Miller 4666. Newark Electronics Corp., 500 N. Pulaski Rd., Chicago, Ill. 60624. Stock No. 59F304. 84¢ plus postage. $2.50 minimum order)
L2—Miniature oscillator coil (J. W. Miller B-121C. Allied 54-0044 $1.65 plus postage. Not listed in catalog.)
L3—3 turns No. 22 hookup wire wound on L2 (see text)
Q1,Q2—SK-3006 transistor (RCA)
Q3—SK-3004 transistor (RCA)
Resistors: ½ watt, 10% unless otherwise indicated
R1,R9,R10—1,000 ohms
R2—2,700 ohms
R3—10,000 ohms
R4—10,000 ohm, linear-taper potentiometer
R5,R12—4,700 ohms
R6—1,000 ohm linear-taper potentiometer
R7,R11—1.2 megohms
R8—270 ohms
S1—SPST switch (on R4)
T1—Transistor driver transformer; primary: 10,000 ohms. Secondary: 2,000 ohms, center tapped (Lafayette 99 C 6126 or equiv.)
Misc.—High-impedance headphones, 5 x 7 x 2-in. aluminum chassis, slide-rule dial (J. W. Miller SL-16. Allied 54-0090. $6 plus postage. Not listed in catalog), perforated board, flea clips.

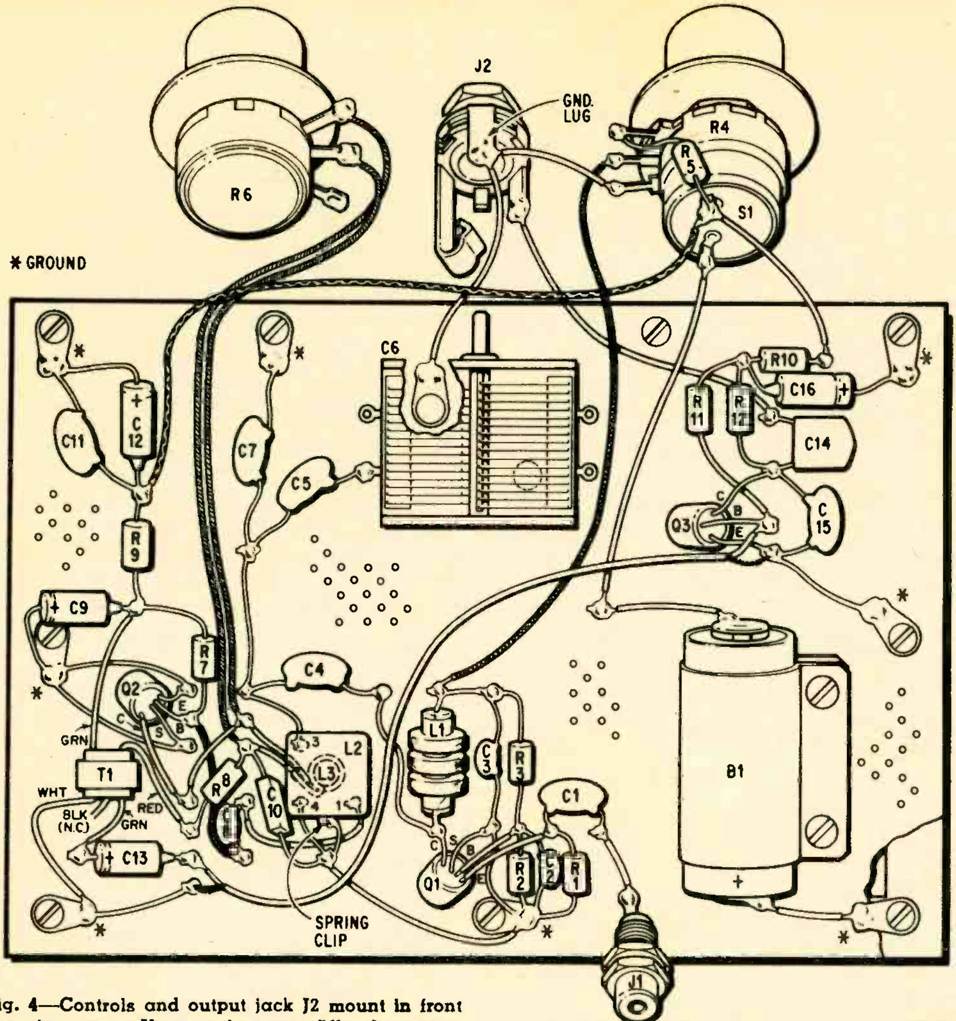


Fig. 4—Controls and output jack J2 mount in front chassis apron; J1 goes in rear. All other parts mount on board. Twist leads from R6 (under board) to R8.L3. Mount lugs marked (*) on chassis lip.

3 Transistors for 80 Meters

it up for a 3.5-mc (modulated) output and loosely couple its output to the antenna lead by twisting the generator lead around the antenna lead.

Set R6 to mid-rotation and tune C6 until you hear the 3.5-mc signal. If you do not hear the signal, reverse the connections of the leads of coil L3. Go ahead and calibrate the dial from 3.5 to 4 mc with generator.

If you don't have a signal generator, wait until evening when the band is active and mark the dial based on the frequencies of the signals you tune.

When operating the receiver you have to adjust R4 to prevent the detector from being overloaded. The setting of R6 varies with frequency so adjust it, if necessary, for best reception on each signal.

How It Works

Signals from the antenna at J1 are coupled through C1 to the emitter of Q1. Transistor Q1 is connected as a grounded-base RF amplifier. Bias for Q1 is supplied by R2 and R3 and stage's gain is controlled by R4. R4 prevents overloading the regen-detector circuit.

The amplified RF signals are fed through C4 to the regen-detector tuned circuit which consists of L2, C5, C6, and C7. The signals are tuned by C6 and coupled by C8 to the base of Q2. A three-turn tickler coil (L3) wound on L2 provides regenerative feedback which is controlled by *regen* control R6. Detected audio is coupled to the audio stage by T1 and C13. Audio from Q3 is fed through C14 to headphone jack J2.

ALMOST HERE... A COLLISION AVOIDANCE SYSTEM FOR PLANES

By LEN BUCKWALTER, KBA4480

RECENT newspaper headlines reveal the fact that air-traffic controllers (the men who electronically juggle the maelstrom of aircraft in our skies) believe the number of potentially disastrous events they encounter each week is three times greater than that officially reported through the Federal Aviation Agency. FAA reports of so-called incidents between Boston and Washington alone run to some half-dozen a week, though most are no more than cases of two planes coming closer to each other than the spacing prescribed by the FAA.

Even 25 years ago a book on the subject (Air Traffic Control) said, "It is considered extremely important . . . to provide, with least possibly delay, a collision-warning device that will give complete protection yet will be light and inexpensive and be simple to operate."

In 1956 the airlines committed themselves to an outlay of $10 million to develop a CAS (collision-avoidance system) but drew a technological blank. Their key word had been *practical* and no practical system could be found.

The concept of a device that simply warns a crew of nearby aircraft was discarded at that time. Radar, for example, simply can't provide the necessary information to distinguish between a situation that is potentially dangerous and one that is not. It would, at best, sound constant false warnings. A study

A COLLISION AVOIDANCE SYSTEM FOR PLANES

by Collins Radio points out that, even if radar could operate at the hair-splitting 500-ft. range, normal air turbulence around aircraft would destroy its accuracy. And—with combined pilot-aircraft reaction time measured in seconds—a plane would travel much farther than 500 ft. between warning and the beginning of evasive action, even at subsonic speeds.

The imminence of supersonic aircraft increases manyfold the need for CAS. Fortunately, it appears that CAS will be a reality first. One system is, in fact, already operational. It prevents collision between military aircraft test-flown by the McDonnell Co. (which manufactured the Mercury and Gemini capsules and also makes fighter planes for Vietnam). Its critics feel it is far from practical for commercial and general aviation. But it points the way.

What must a collision-avoidance system do? Here's the broad outline generally agreed upon by FAA and the half-dozen or so avionics firms working on it:

Detect. The system first gathers information about nearby aircraft.

Evaluate. Then it decides whether threat of collision exists.

Determine remedy. If a collision threatens, the system must inform the pilot how to elude it (climb, descend, etc.) within sufficient time.

Even these sophisticated steps are not enough. Aircraft don't always fly straight and level. As they turn, climb or descend in routine, tight operation, temporary collision courses continuously spring up and disappear. The CAS must ignore these. Further, it must accommodate large numbers of aircraft, solve multi-plane conflict (more than two craft on a collision course) and handle fast jets and slow props at the same time.

The winning design is sure to work on a principle called, in the jargon of avionics, Time-Frequency Ranging. When it's picked apart you'll see why it's also the subject of lively controversy.

Our diagram shows how a TF system might work. It doesn't represent any particular system; organization of the pulses within the signal could be changed without affecting the basic principle. But any TF system will depend on an extremely accurate clock or time-measurement system (we'll come back to that later on).

The basic time period (known technically as the epoch) may last from 2 to 5 seconds. Each aircraft has its own time slot within the epoch which may be divided into as many as 1,000 time slots, each lasting a few milliseconds.

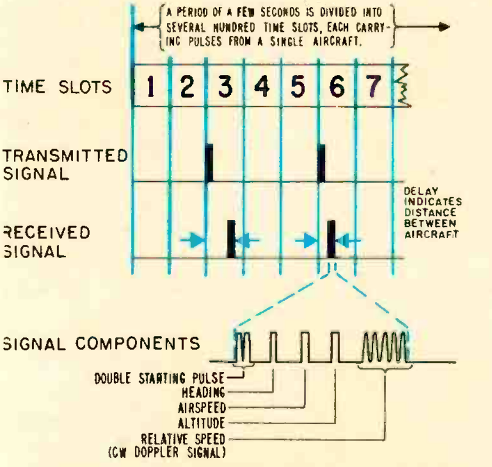
Let's say the epoch is 2 sec. long (so that all signals will be repeated every 2 sec.) and that our aircraft is receiving signals from two others—one using time slot No. 3 and the other time slot No. 6. Each will send out its signal precisely at the beginning of its time slot. Since the signals travel about a mile in 5 microseconds (μsec.) our receiver can measure the signal delays against the ultra-exact synchronous clock on which all time-frequency systems depend. If the signal in time slot No. 3 is received 40 μsec. after the beginning of the time slot, our computer will know that aircraft No. 3 is 8 mi. away. If the delay in time slot No. 6 is 20 μsec., aircraft No. 6 is only 4 mi. away and our computer will need more information to determine what (if any) evasive action must be taken.

The signal from No. 6 provides that information in coded form. Digitally-coded pulses showing heading, airspeed and altitude can be fed directly into our computer for evaluation. The double pulse with which the signal begins differentiates it from random noise for positive signal identification. The speed at which the aircraft on time slot No. 6 is approaching can be read from the Doppler shift in the frequency of the CW burst (1545 mc is used by McDonnell for this purpose). The faster the other aircraft is approaching, the higher will be the received frequency of this signal.

If, having digested all this information, our computer finds that we are on a collision course with No. 6 it will flash the necessary evasive action on readouts in the cockpit. In the imaginary situation pictured at the beginning of this article you will see that the word *descend* has appeared on the panel. The arrow pointing downward is also flashing to draw the attention of the pilot and co-pilot (who would have identical readouts). There would probably be 30 or 40 sec. left in which to complete the maneuver.

Now let's look at the problems of a TF system. First of all, the reference clock costs $10,000. To obtain the order of accuracy

HOW A TIME-FREQUENCY SYSTEM WORKS



This diagram (explained in detail in the text) illustrates the way in which data from more than one plane would be received simultaneously by a third.

necessary for a TF system all clocks must agree to within one part in ten million. While time-keeping is still the big technical hold-out, nip-and-tuck competition between such avionics outfits as Collins, National, TRG, Bendix and McDonnell is generating possible answers.

In the system used by McDonnell, precision crystal oscillators aboard the aircraft tick off the time slots. To remain accurate, these airborne clocks must be calibrated periodically against a primary standard on the ground. That's where the fault lies, say the dissidents. For a truly universal system, there'd have to be a vast network of ground stations. The clincher is that overseas flights would be out of range.

To answer this objection one system would place atomic clocks aboard each aircraft. By utilizing the accurate atomic resonance of cesium or rubidium, such clocks could get by with relatively few ground stations. Hopefully, the airborne atomic clock might be reduced in cost when punched out on a production line—possibly to $5,000 apiece.

One recent system would eliminate ground stations completely. Its principle is air-to-air synchronization: approaching aircraft automatically send out pulses to lock their clocks together. This system, however, is considered too limited to handle dense air traffic over much of the country. It is intended specifically as an immediate solution for heavy traffic over the North Atlantic where ground stations don't exist. It would provide long-range warning of other planes within 100 miles.

Although there's little hardware in the air, there's plenty of activity on the lab bench, even while standards conferences drag on and computers evaluate the capabilities and potential dangers of rival systems. And why not? One company estimates the coming market in CAS at $1 billion.

But what about general aviation, the fleet of light and business aircraft that often fly the same airspace as commercial airliners? Who'd expect the man who pays $4,000 for a private airplane to buy CAS for $25,000 more? A spokesman for an aircraft owners' group flatly says that a gold-plated CAS is not acceptable. Any system that doesn't take into consideration 97 per cent of aircraft, he continues, is doomed to failure.

That 97 per cent figure may come as a surprise to some. Airlines now operate about 2,000 planes. But the general aviation fleet numbers about 100,000. What's more, the smaller craft carry about as many people each year as do the airlines! Government thinking, says a leading aviation magazine, is that something's got to give—and it might be general aviation.

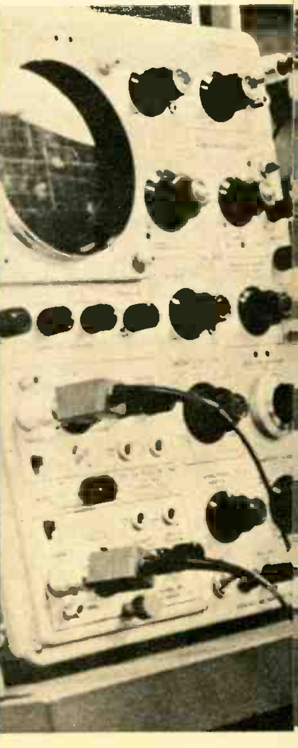
Some observers feel it could come as a ban on small planes from major airports during rush hours. Perhaps small aircraft might be restricted to a controlled airspace. Another possibility: Outfit commercial airliners with costly CAS but install a scaled-down, inexpensive pilot-warning indicator on light planes. This would at least be a partial solution. But it looks like the clash over collisions may never be settled unless someone comes up with a cheap black CAS box within the reach of everyone.

Worry over the possibility of midair collision has been with us, they say, since Orville turned to Wilbur and said, "let's make another." Of course anyone who went up in a flying machine in those days was, by definition, a daring young man. And our generation of daring young men seems to be on the brink of a solution to the Wright Brothers' problem.

Despite the furor over CAS, it's still statistically true that boarding a plane is safer than climbing into the family automobile. Soon—perhaps within months—it may be safer yet. ◆

In today's electronics boom, the demand for men with technical education is far greater than the supply of graduate engineers. Thousands of real engineering jobs are being filled by men without engineering degrees—provided they are thoroughly trained in basic electronic theory and modern application. The pay is good, the future is bright...and the training can now be acquired at home—on your own time.

How to become a "Non-Degree Engineer"



The electronics boom has created a new breed of professional man—the non-degree engineer. Depending on the branch of electronics he's in, he may "ride herd" over a flock of computers, run a powerful TV transmitter, supervise a service or maintenance department, or work side by side with distinguished scientists on a new discovery.

But you do need to know more than soldering connections, testing circuits and replacing components. You need to really know the fundamentals of electronics.

How can you pick up this necessary knowledge? Many of today's non-degree engineers learned their electronics at home. In fact, some authorities feel that a home study course is the *best* way. *Popular Electronics* said:

"By its very nature, home study develops your ability to analyze and extract information as well as to strengthen your sense of responsibility and initiative."

Cleveland Method Makes It Easy

If you decide to advance your career through home study, it's best to pick a school that *specializes* in the home study method. Electronics is complicated enough without trying to learn it from texts and lessons that were designed for the classroom instead of the home.

The Cleveland Institute concentrates on home study exclusively. Over the last 30 years it has developed techniques that make learning at home easy, even if you once had trouble studying. Your instructor gives the lessons and questions you send in his undivided personal attention—it's like being the only student in his "class." He not only grades your work, he analyzes it. And he mails back his corrections and comments the same day he gets your lessons, so you read his notations while everything is still fresh in your mind.

Students who have taken other courses often comment on how much more they learn from CIE. Says Mark E. Newland of Santa Maria, Calif.:

"Of 11 different correspondence courses I've taken, CIE's was the best prepared, most interesting, and easiest to understand. I passed my 1st Class FCC exam after completing my course, and have increased my earnings by $120 a month."

Always Up-to-Date

Because of rapid developments in electronics, CIE courses are constantly being revised. This year's courses include up-to-the-minute lessons in Microminiaturization, Laser Theory and Application, Suppressed Carrier Modulation, Single Sideband Techniques, Logical Troubleshooting, Boolean Algebra, Pulse Theory, Timebase Generators...and many more.

CIE Assures You an FCC License

The Cleveland method of training is so successful that better than *9 out of 10 CIE men who take the FCC exam pass it—and on their first try.* This is despite the fact that, among non-CIE men, 2 out of every 3 who take the exam fail! That's why CIE can promise in writing to refund your tuition in full if you complete one of its FCC courses and fail to pass the licensing exam.

This Book Can Help You

Thousands who are advancing their electronics careers started by reading our famous book, "How To Succeed in Electronics." It tells of many non-degree engineering jobs and other electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

If you would like to cash in on the electronics boom, let us send you this 40-page book free.

Just fill out and mail the attached card. Or, if the card is missing, write to:

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1776 E. 17th St., Dept. EI-72
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All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box on reply card for G.I. Bill information.

CB Corner
By Len Buckwalter, KBA4480

TIME CLOCK PUNCHES BACK

TERROR grips the CB populace when rumor hints there's an FCC monitor in town. Fingers freeze at the mike, outboard amplifiers are slyly slid under the bed. Then the band dies as CBers imagine FCC engineers stalking about with direction-finder, receiver and tattle-tale tape recorder.

But consider the case of a Detroit CBer who acted quite differently. It began when an FCC engineer monitored a man committing a slew of violations—from hobby talk and improper frequency to dropping his call-sign. When the Commission cited him for it, he denied the charge. He was in Kentucky, not Michigan, at the time of the crime—or so went his version of the story.

That would have been fine. But, while monitoring, the engineer heard the CBer say, "I got to get out of here and go make some Chevrolets." That transmission was recorded at 1:50 in the afternoon. Some detective work also revealed that the man had reported for work at the Chevrolet Division of General Motors at Livonia, Michigan, at 2:13. This meant only 23 minutes had elapsed between monitoring and the time he appeared on the job. It also placed one obstacle between his alibi and the truth: the state of Indiana.

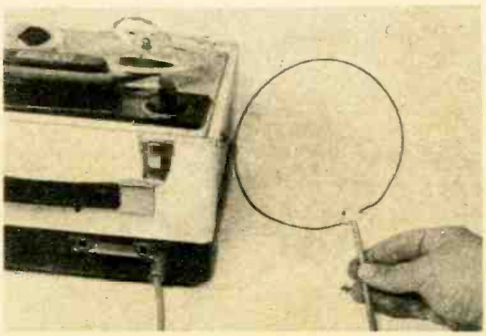
Creepy Crystals . . . Frequency tolerance for CB is a slim 0.005 per cent. But any good transceiver has no trouble toeing the mark. No matter which channel you're using, frequency must hover within some 1,300 cycles of the figure stamped on the transmit crystal. Some reasons why frequency goes astray: using crystals not designed for your rig, adding wires to the oscillator circuit (for an external crystal switch, for example) bad mistuning of the oscillator coil. Thus most troubles are rarely the fault of the original circuit.

There's no rule that requires regular checkout of CB transmitter frequency. Doing the job yourself isn't practical since it must be done with a frequency meter that costs upward of $200 and is about ten times more accurate than the rig's crystals. If you want to be certain your rig is operating within the letter of the law, the tolerance measurement can be made quickly by a CB repair specialist. About once every six months is the usual interval for frequency checks in other two-way radio services.

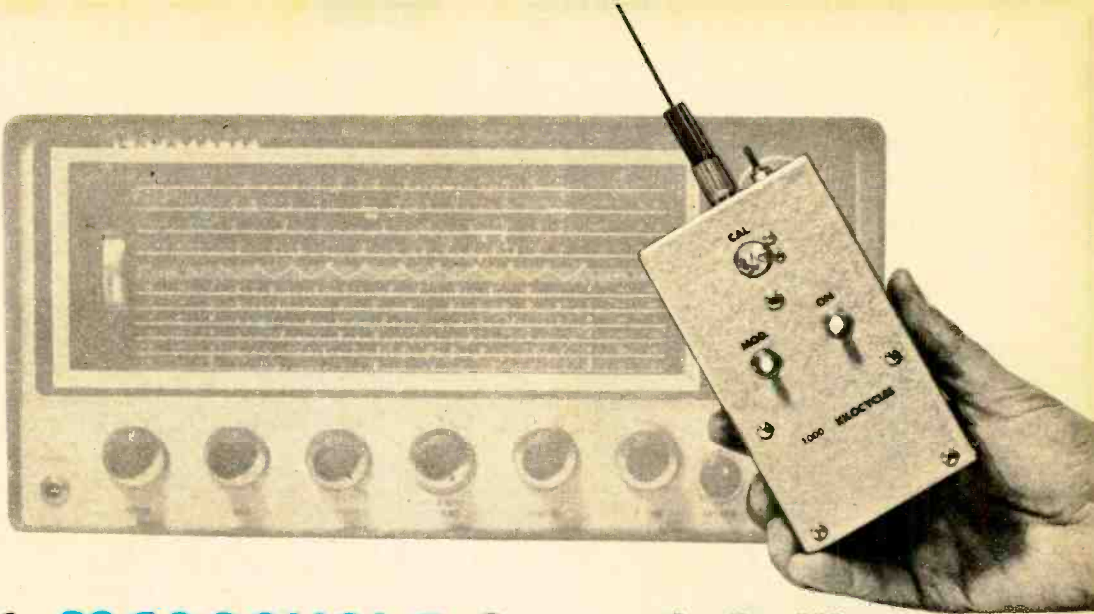
Self-Monitor . . . Many's the time you might want to judge the quality of your on-the-air signal, just as it's picked up by a distant receiver. That way you could spot trouble, determine correct speaking distance from the mike and make other checks. If you have a tape recorder you can make a simple adapter for about 50 cents and record your own signal.

The adaptor (shown in our photo) is made of several feet of shielded cable. One end plugs into the recorder's microphone jack. The other is stripped until about an inch of shield and center lead are exposed. Twist the leads of a 1N60 diode across the exposed ends. Then, using hook-up wire, fashion a loop about 5 in. in diameter and solder it in parallel with the diode. This assembly picks up stray RF energy and converts it to audio like a receiver.

To operate the adaptor, place the tape unit on record, talk on the CB mike and move the loop near the ventilation holes in the rig's cabinet. In our tests, we found best signal pickup was at slots on the rear of the cabinet. When you play back the recorded tape it'll sound like a strong CB station down the block, only it will be yours.



Adaptor made of shielded cable, one diode and a wire loop allows you to record your CB signal directly from stray RF at your rig's transmitter.



1 MEGACYCLE Crystal Calibrator

Eliminate calibration guesswork with widely-spaced markers.

By HERB FRIEDMAN, W2ZLF

PICTURE this dilemma. Your short-wave receiver's calibration is off on the 10-30-mc band. You set up your 100-kc calibrator—a device which produces marker pips every 100 kc (.1 mc). Upon tuning in its signal at, say 21 mc, you hear several pips right next to each other. Which of them is 21 mc? Are you certain you're not tuning to 19.9 or 21.1 mc? After all, there's nothing to distinguish one 100-kc pip from another when they're separated no more than the width of the dial pointer.

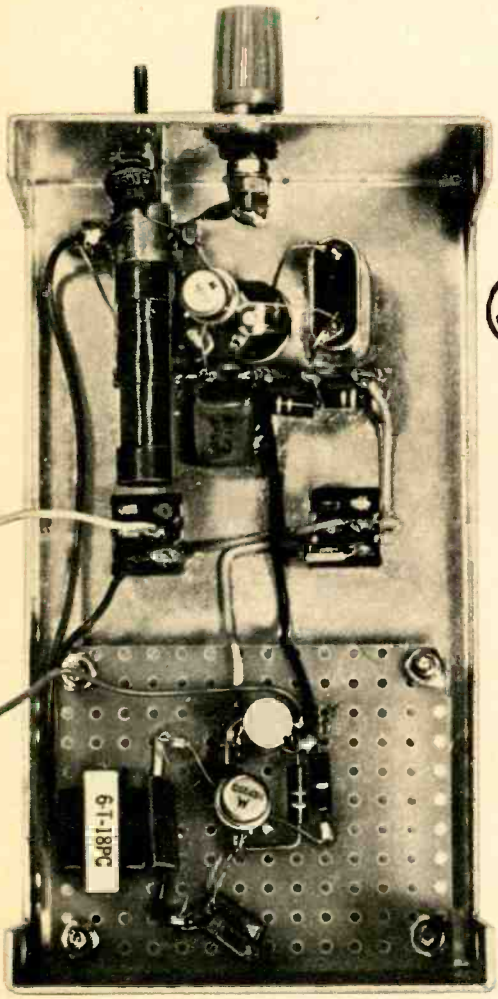
While some operators believe faithfully in the receiver's dial calibration, receivers do go out of alignment. When that happens, a calibrator is a must. And the experimenter who builds his own receivers and converters needs a calibrator to insure accurate calibration.

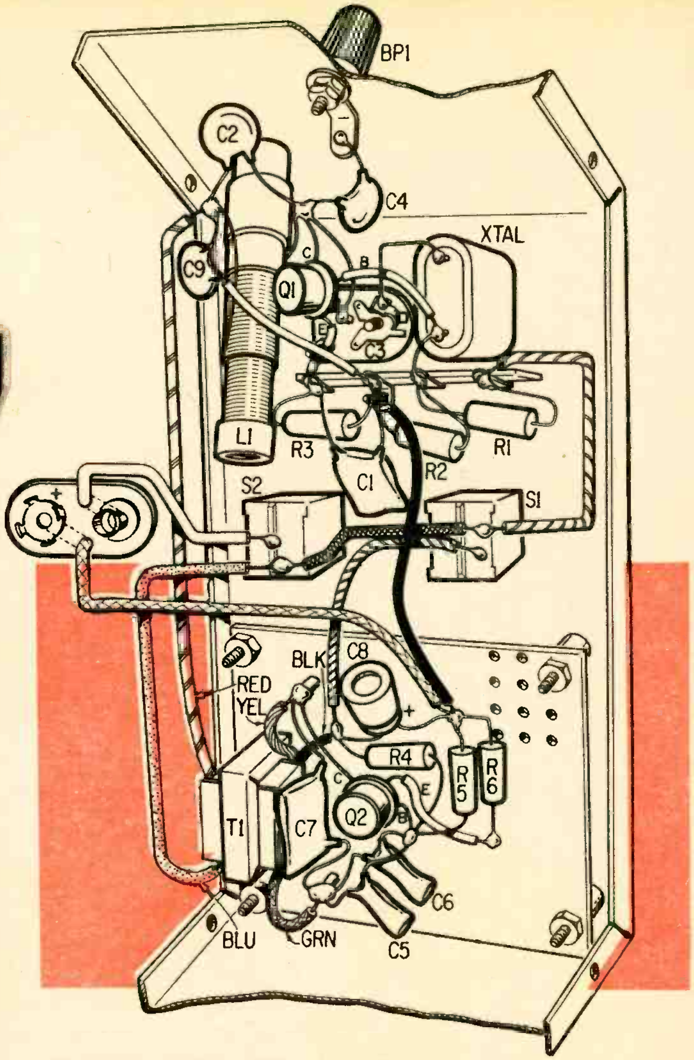
To *properly* calibrate a receiver, you need broad references—pips spaced 1 mc (1000 kc) to establish a coarse reference. Then you calibrate with 100-kc pips. Here's how. First, you use a 1-mc calibrator to find 21 mc. Then you'd use the 100-kc calibrator and tune up and down every 100 kc from 20 to 22 mc.

With a conventional calibrator, you use the receiver's BFO to actually hear the pips. However, if the receiver's antenna is connected it's often difficult to distinguish between a marker pip, received station or heterodyne whistle.

With EI's 1-mc modulated crystal calibrator, you get the convenience of 1-mc pips and two big extras. The first is modulation; a slightly distorted and easily recognized tone which stands out like a sore thumb. The

1 MEGACYCLE





First thing to do is drill a ½-in.-dia. hole on the center line of the cabinet, 1 in. from the top for trimmer capacitor C3. File the edge of the hole to remove burrs which would short C3. Build the RF oscillator circuit in top of cabinet, then test it with receiver. Then build the modulator circuit on board before installing board.

second feature is a *hefty* output signal which when radiated directly into the receiver can be heard up to 30 mc. Connect the calibrator to the receiver's antenna terminal and you'll hear the markers up 6 meters.

Construction

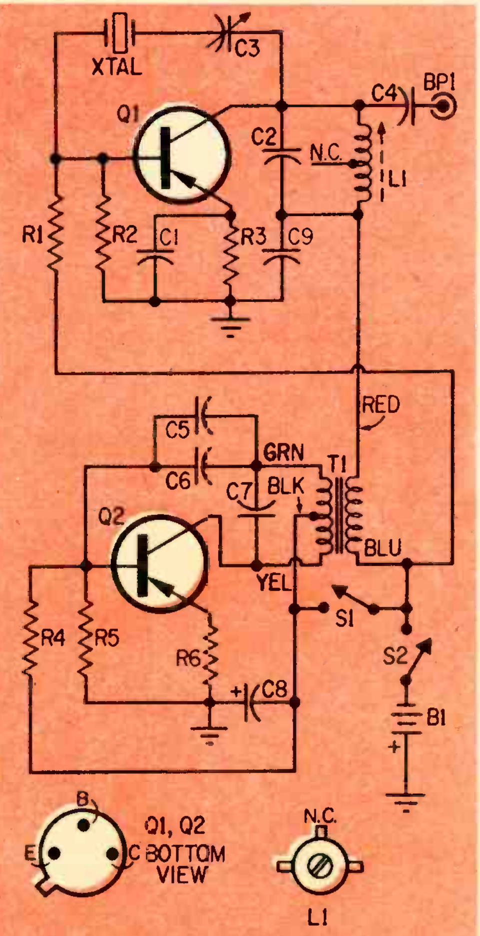
Our calibrator is built in the main section of a 5¼ x 3 x 2⅛-in. Minibox. The RF oscillator (Q1's circuit) is built right on the cabinet. The modulator, a 500-cps oscillator, is built as a subassembly. All components are critical and substitutions should not be made to assure proper operation.

Note trimmer capacitor C3 mounted on the front panel. This capacitor is required only if you must zero-beat the calibrator with WWV. If you don't need extreme accuracy and don't care whether the 2.5, 5, 10 and 15-mc markers are a few hundred cycles off, eliminate C3. Connect the crystal directly from Q1's base to collector.

Start construction by assembling the RF oscillator section so that it may be checked before the modulator is installed. Coil L1 mounts in a 5/16-in.-dia. hole. Though two

PARTS LIST

B1—9 V battery (Burgess 2U6 or equiv.)
BP1—Five-way binding post
Capacitors: 15 V or higher unless otherwise indicated
C1—.05 μf ceramic disc
C2—360 μμf silvered mica
C3—6-30 μμf trimmer capacitor (Centralab 827-C. Lafayette 33 C 2531)
C4—100 μμf ceramic
C5,C6—.005 μf, 75 V ceramic
C7—.2 μf, 75 V ceramic
C8—30 μf, 12 V electrolytic
C9—470 μμf, ceramic disc
L1—0.054-0.5 mh variable inductance (J. W. Miller 6196A. Allied 54 A 0053)
Q1—HEP-51 transistor (Motorola. Allied HEP-51. $1.29 plus postage)
Q2—HEP-250 transistor (Motorola. Allied HEP-250. 79¢ plus postage)
Resistors: ½ watt, 10%
R1—470,000 ohms
R2—150,000 ohms
R3—1,000 ohms
R4—330,000 ohms
R5—10,000 ohms
R6—10 ohms
S1,S2—Miniature SPST switch
T1—Transistor interstage transformer; primary: 10,000 ohms. Secondary: 3,000 ohms, center tapped. (Allied 54 D 2389. $3.33 plus postage. Not listed in catalog)
XTAL—1-mc (1000 kc) crystal. Texas Crystals, Inc., 1000 Crystal Dr., Ft. Myers, Fla. $8.50 for Type TC-6, 0.005% tolerance, series resonant. $6.00 for CT cut.
Misc.—5¼ x 3 x 2⅛-in. Minibox, perforated board, flea clips, terminal strips



One-megacycle oscillator is at top. Modulator oscillator is at bottom. If you don't plan to zero-beat RF oscillator against WWV, eliminate trimmer C3 and connect XTAL to Q1's collector.

mounting collars are supplied with L1 (a small one attached to the form and a larger add-on collar), only the small collar is used. L1 has a tap, but it is not used; connection is made to the two outside terminals.

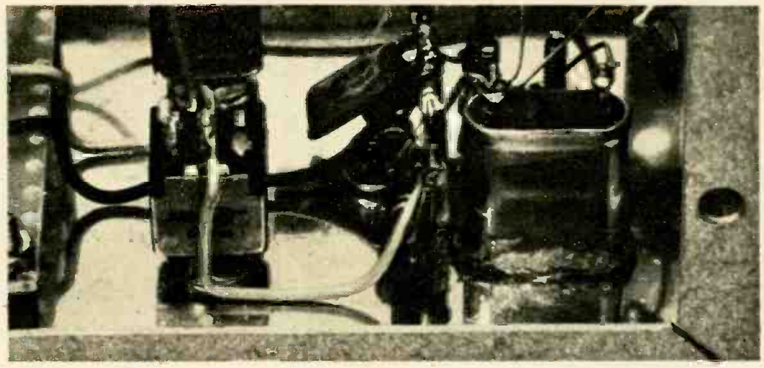
Capacitor C3 is mounted on the centerline of the front panel in a ½-in.-dia. hole. Make certain the hole has no burrs which will short the capacitor to ground.

Cement the crystal to the cabinet with epoxy and solder connections directly to its pins. A socket is not needed as its highly unlikely the crystal will go bad.

Note carefully Q1's base-bias connection. Bias resistor R1 connects directly to the battery through power switch S2. Do not connect R1, as is usually done, to the bottom of L1 as L1 is fed through modulation transformer T1. You must keep modulation off Q1's base.

When the RF oscillator is completed, check it out before adding the modulator. Temporarily connect R1 to the bottom of L1. Temporarily clip the positive terminal of a 9-V battery to the chassis. Connect the negative lead of a VOM set to indicate 10 ma, or higher, to the negative battery terminal. Connect the meter's positive lead to the junction of R1 and L1. The meter should indicate from 2 to 3 ma. If it indicates lower than 2 ma or substantially higher than 3 ma, there is a wiring error.

Place a receiver near the calibrator, connect a short length of wire to the receiver's antenna connector and place the free end of the wire near L1. Tune in a pip from 1 to 3 mc and adjust L1 for maximum S-meter indication. L1's slug should be within a ½ in. of full-in. Break the battery connection and



Because you'll probably never have to replace the crystal, cement it to the cabinet with epoxy or GE's silicone-rubber adhesive. Solder the leads directly to the crystal's pins taking care not to apply too much heat. Modulation switch S2 is at the left. It is a Lafayette subminiature DPDT toggle switch (99 C 6162) whose unused lugs were cut off.

1 MEGACYCLE

then re-establish it. If the oscillator fails to start (no signal), rotate L1's slug counterclockwise one turn at a time until the oscillator starts when the battery is connected.

We built our modulator on a 2 x 2½-in. piece of perforated board using Vector T28 terminals (or flea clips) as tie points. When building the modulator, install capacitor C5 but not C6. Install the assembly in the cabinet using ¼-in. standoff terminals or a stack of washers between the board and the cabinet at each mounting screw.

Checkout and Adjustment

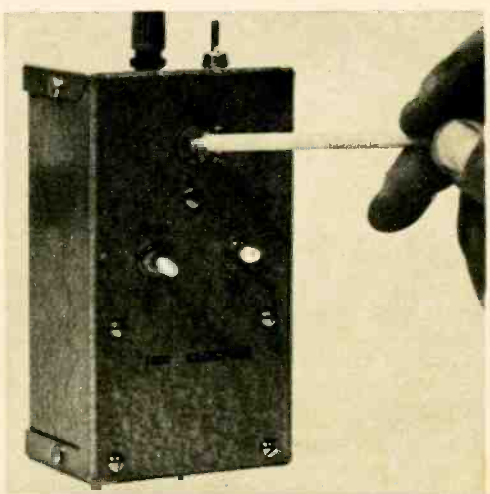
Temporarily connect B1's positive terminal to the cabinet and connect the negative lead of the VOM to B1's negative terminal. Connect the meter's positive terminal to the battery side of S2. Set S2 to *on* and note the meter indication. It should be between 1.5 and 3 ma. Then set modulation switch S1 to *on* The meter should rise to at least 8 ma. If it doesn't, the modulator is not working. (Check by tuning in a pip on the receiver.) Install C6 to activate the modulator. The received tone should be slightly raucous. If it sounds like motorboating, change R4 to 270,000 ohms.

Below 30 mc you will generally be able to pickup the calibrator's signal without a direct connection to the receiver. Attach about 12 in. of coat-hanger wire to a banana plug and insert the plug in BP1. With the calibrator near the receiver's antenna you will be able to hear an easily-recognized signal. If the receiver's sensitivity is low, or if you're trying to locate pips above 30 mc, connect BP1 to the receiver's antenna input.

Calibrating to WWV

Tune the receiver to any of the WWV frequencies and position the calibrator near the radio so just enough signal is received to produce a heterodyne beat but not mask the WWV signal. Since L1's adjustment has a slight effect on the RF frequency, adjust L1 within one turn so the calibrator's signal almost zero-beats with WWV. Then, using a fiber alignment tool, adjust C3 until the calibrator produces a zero-beat with WWV.

When modulation is applied, the calibrator loses its precise WWV calibration—this is normal. Use the modulation to locate the pip and then turn off the modulation and use the calibrator to beat against WWV.



Finished and ready for use. To zero-beat calibrator against WWV, adjust trimmer capacitor C3 with a fiber alignment tool. L1 is at the top, right.

Hi-Fi Today

By John Milder

* The shape of tape to come

OVER the next year, activity in the tape field promises to be phenomenal. It undoubtedly will be the busiest, most significant (and probably most confusing) period since the arrival of tape recorders for the home in the late '40s. I'm not about to make any predictions yet. But if you think you're a seer, here are some developments to sort out:

• Almost everybody is coming out with cassette recorders, including big names like Ampex, Sony and 3M (Wollensak)—all of whom, surprisingly, are marketing machines supplied by other manufacturers. The cassette, if you haven't heard by now, is a cartridge design introduced by Philips of Holland (Norelco in the U.S.). It consists of two mini-reels inside a plastic housing. It is better suited to recording than the endless-loop cartridges (which also can't be rewound). Cassettes presently share with other cartridge systems the shortcoming of less-than-stunning sound quality. That's subject to improvement, of course. But what are you supposed to think when one major manufacturer has said that cassettes are expected to supersede almost all reel-to-reel for home consumption over the next few years?

• The eight-track machines keep coming (Capitol claims response of 20-20,000 cps for their new one). They also keep heading for the repair shop.

• A completely new system has been demonstrated by Newell Associates. It uses flangeless, 2-in. Reelettes (illustrated below) and a drive system unlike any now on the consumer market. Claims for its fidelity and mechanical stability are very high. It is supposed to settle in at under $300 as a stereo recorder (and under $500 as a VTR).

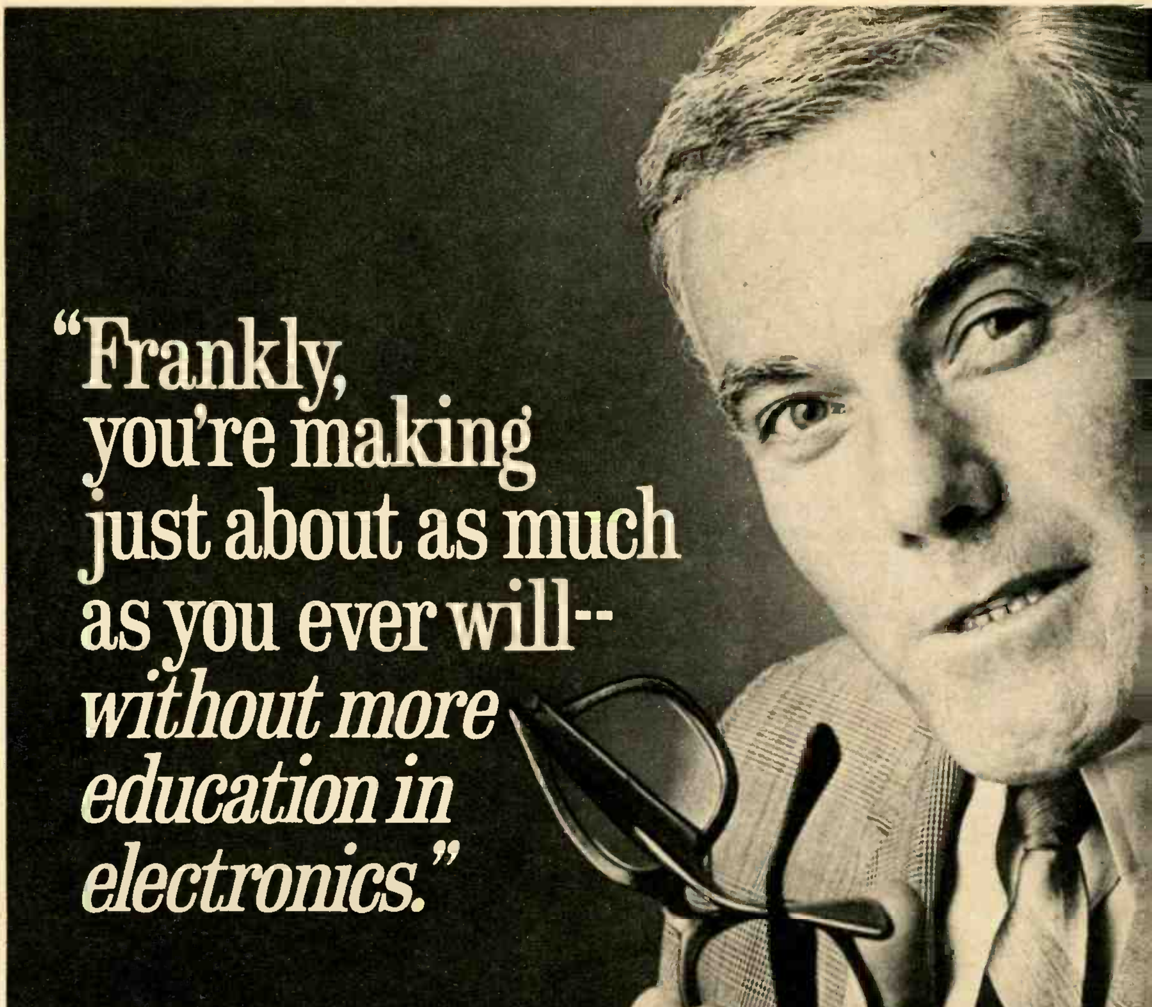
• Ampex, the biggest producer of prerecorder tapes, is now offering 4-track cartridges, 8-track cartridges, cassettes, and reel-to-reel releases at both 7½ and 3¾ ips.

• KLH has signalled its entry into tape with announcement of exclusive rights to the Dolby Audio Noise Reduction System (see September's Hi-Fi Today) in home tape recorders. KLH says the Dolby system will provide the frequency range and low-noise characteristics of 15-ips tape at 3¾ ips in its new reel-to-reel recorders.

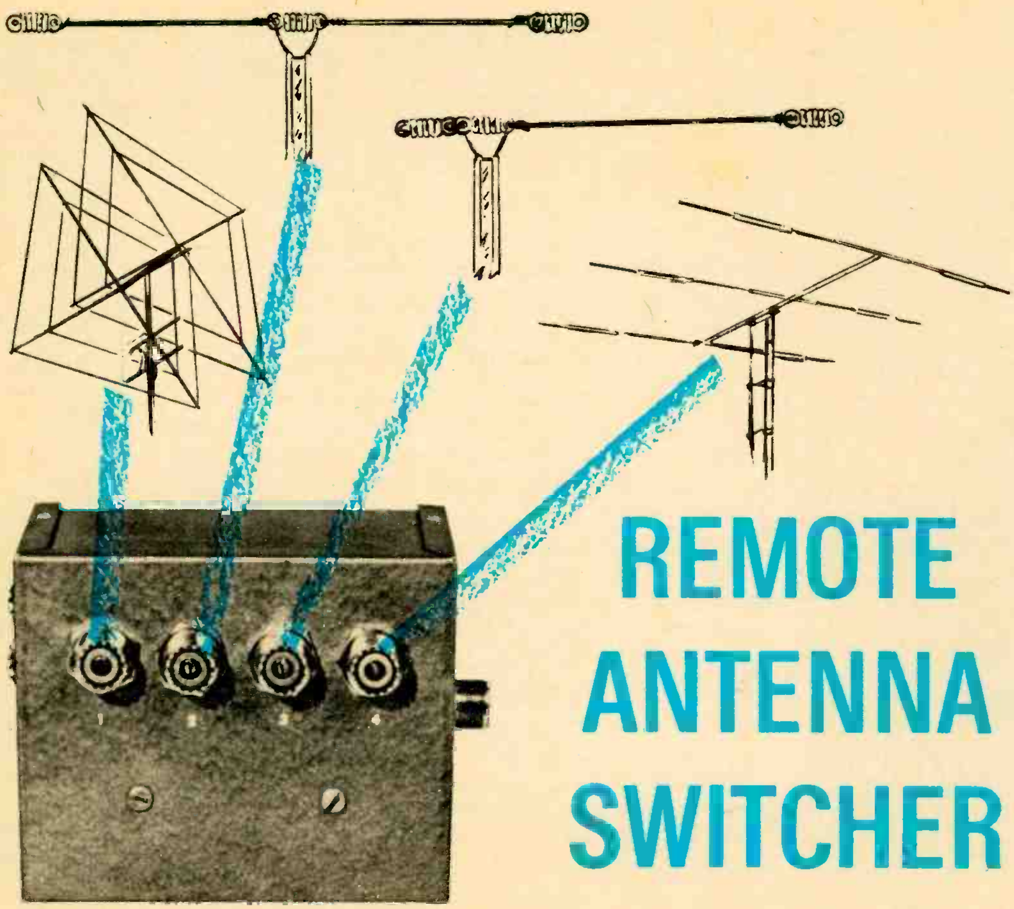
• Still another cartridge system, incompatible with the others, may be introduced next year. The company (which I can't identify at this point) says that, while its cartridge system is superior to those on the market, introduction will depend on what happens in the field over the next few months.

Now, if you care to predict which of the above items is going to prove most significant, drop me a note. Maybe we ought to run a contest. . .

Newell's Reelette contains equivalent of entire LP (8-track stereo, 3¾ ips). Reelette and takeup both act like pinch rollers, are driven by contact at outer edge with flywheel that acts like capstan. Tape is fed automatically from one to the other, passing heads as it moves around flywheel in the center. Flywheel is only driven element; tape path is nowhere unsupported, virtually eliminating tape tension so that even thinnest-base tape can be made to perform safely.


"Frankly,
you're making
just about as much
as you ever will--
*without more
education in
electronics."*


Founded 1927
CREI
Accredited Member



REMOTE ANTENNA SWITCHER

By JIM WHITE, W5LET

GREAT grandmother, not another skyhook! How many does that make on your roof now—three, four? You should give some thought to switching from one to another. Or maybe you are just going to run another (the fourth) coax line down into the house. That's the lazy, sloppy, expensive way. And it means plugging and unplugging leads at the back of your transmitter or receiver.

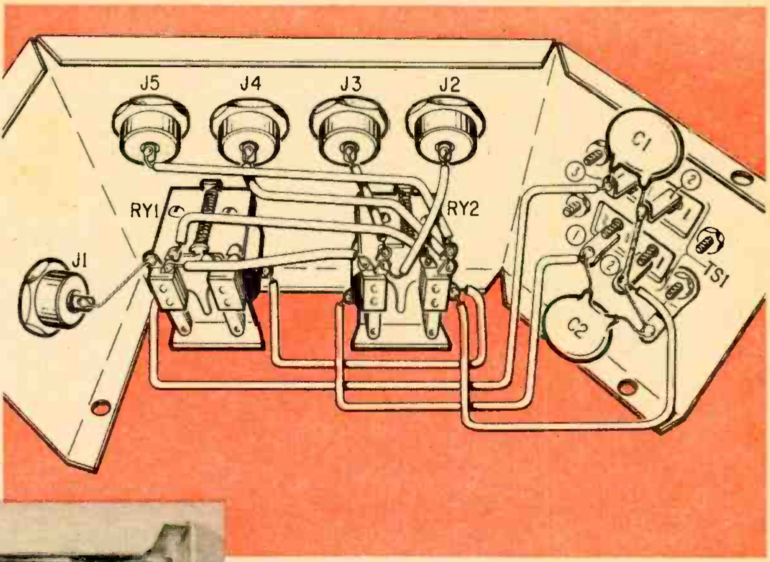
No need to put up with a second-rate method of changing antennas. With our switcher you can sit back and choose any one of four antennas at the turn of a switch. There are other advantages besides convenience. You can terminate all of your antennas at one spot, the roof or attic, and from there run only one coax line to your transmitter or receiver. This will save quite a few dollars and improve the appearance of your house. The switcher can be built in a few hours for less than $15.

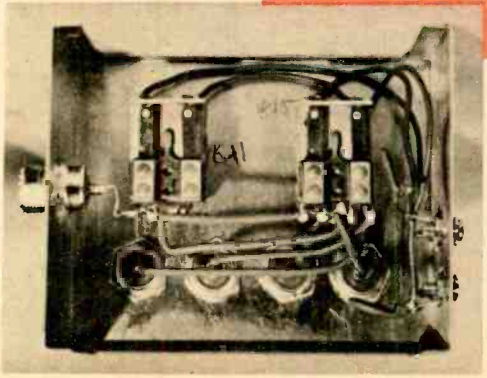
How It Works. The switcher consists of two 3 x 4 x 5-in. miniboxes. One is located at your operating position. In it there's a two-pole, four-position rotary switch, a 12.6-V, 2-A filament transformer, a pilot lamp to indicate that the switcher is on, and a power switch. There are also two .01-μf ceramic-disc capacitors to bypass stray RF to ground.

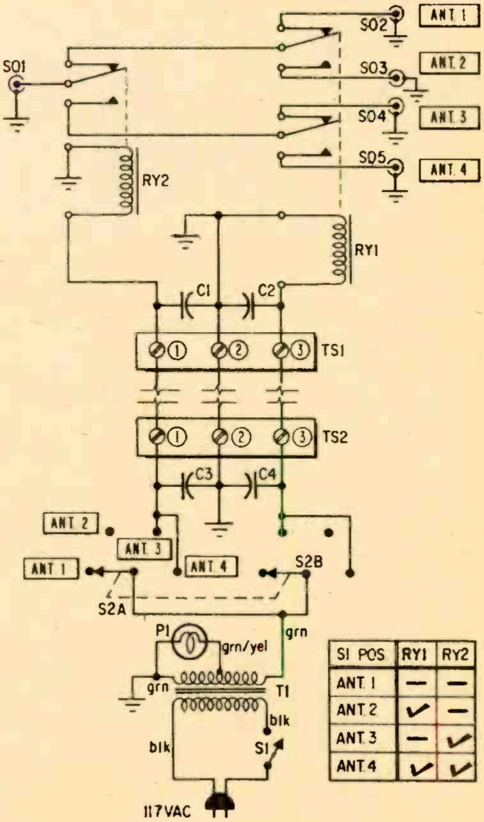
The other box is located at a place that is convenient to all of your antennas. In this box are two 12-V DPDT relays, five coax connectors and two more .01-μf disc capacitors.

The boxes are connected to each other with three-conductor cable. The rotary switch and relays are wired so that coax connector SO1 (remote box) is connected to any one of the four connectors (SO2-SO5) on the front of the box. By using a step-down transformer and running 12 V on the control cable, there is no danger of electrical shock, nor is there a fire hazard.

Inside of remote unit. Author's model used two, two-lug terminal strips (right), but you may use one, three-lug strip. Placement of parts is not critical, but be sure to use spaghetti on all wiring. Photo of inside of unit is shown below. Parts are installed in main section of 3 x 4 x 5-in. Minibox.







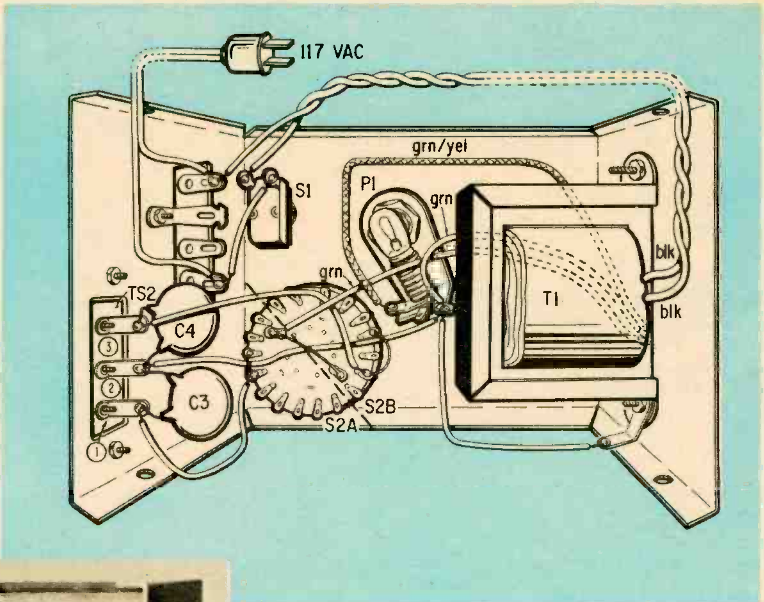
S1 POS	RY1	RY2
ANT 1	—	—
ANT 2	✓	—
ANT 3	—	✓
ANT 4	✓	✓

System's schematic. Remote unit includes TS1 and everything above. Components of control unit are from TS2 down. The table shows the sequence in which relays are energized as switch S2 is rotated.

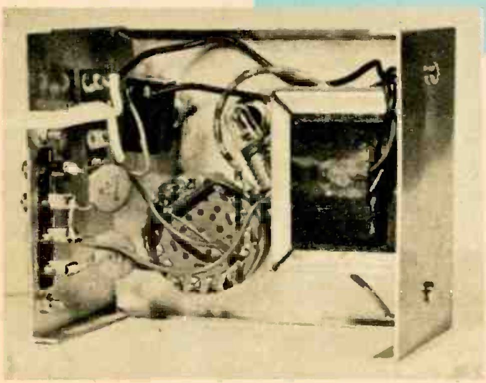
Construction. Begin with the control unit, which will be located at your operating position. Placement of the parts in the main section of the Minibox is not critical. When all are installed, proceed with the wiring. All of the wiring in this unit is No. 20 stranded hookup wire. Notice that the center tap of the transformer's secondary is connected to one side of pilot lamp P1.

In the remote unit the first thing to do is locate and punch (or drill) five ⅝-in-dia. holes in the main section of the Minibox for the SO-239 coax connectors. Four of these are equally spaced on the front of the box. The fifth is centered on one side. Be sure to mount the connectors high enough on the front of the box so there is room under them for the two relays. Mount a three-lug terminal strip on the side opposite the coax connector. This terminal strip is used to facilitate quick connection of the control cable. (The author's model has two, two-lug strips.)

REMOTE ANTENNA SWITCHER



Inside of control unit. Author used 9-position rotary switch, hence the unused lugs on switch S2. Note carefully in the pictorial the lugs on switch S2 which have jumpers connecting them. As in remote unit, parts are installed in main section of Minibox.



PARTS LIST

C1-C4—.01 μf, 1,000 V ceramic disc capacitor
P1—6.3-V pilot lamp and socket
RY1,RY2—DPDT relay, 12 VAC coil (Potter and Brumfield GPA, Allied 41 A 6539) and DPDT contacts (Potter and Brumfield GP11, Allied 41 A 6343)
S1—SPST toggle switch
S2A,S2B—2-pole 3-position rotary switch (Mallory 3223J. Allied 56 A 4353)
SO1-SO5—SO-239 chassis-type coax connector
T1—Filament transformer; secondary: 12.6 V @ 2 V (Allied 54 A 1420 or equiv.)
TS1,TS2—3-lug, screw-type terminal strip
Misc.—3 x 4 x 5-in. Miniboxes, line cord.

With the parts mounted you can proceed with the wiring, using No. 20 solid hookup wire. Insulated sleeving should be used on the wiring as an added precaution against shorts.

Operation. When you have completed the wiring of both units check them quickly by connecting the two together with short pieces of wire. With the control unit plugged into an AC outlet and power switch S1 in the *on* position you should be able to connect an ohmmeter to the input coax connector (SO1) and measure continuity to the connectors (SO2-SO5) on the front as switch (S2) on the control box is turned. Each of the switch positions on the control unit should connect SO1 to a different connector on the remote unit.

When the units have been checked and are operating correctly then can be installed. The remote unit should be mounted at a convenient spot near your antennas. One precaution, the metal box is not waterproof so it must be mounted in a protected place, such as your attic, to keep rain out. If you want, waterproof the box so water won't get in. As many as four antennas can be connected to the remote unit. If you prefer, a dummy load can be plugged in one connector.

From the remote unit it is necessary to run only one coax line to your receiver or transmitter. In addition to this, of course, it will be necessary to run a three-conductor waterproof control cable from the remote unit down to the control unit.

Good Reading

By Tim Cartwright

THE ELECTRONIC INVASION. By Robert M. Brown. John F. Rider, New York. 184 Pages. $3.95.

There are few topics more interesting and controversial these days than the subject of electronic eavesdropping. The invasion of privacy has reached the point where hardly a week goes by without some kind of court decision on wire-tapping and bugging. This book, then, is timely and pertinent—and thorough in its coverage of snooping techniques and the gadgets that make them possible. But before you start tinkering, I suggest that any would-be Maxwell Smart should think about his *own* privacy before yielding to the temptation to bug the kiddies' playroom. As for those interested in anti-bugging techniques (also listed at length) there's a thin line between self-protection and paranoia and there are plenty of legal and non-technical ways of dealing with the invasion of your own privacy.

ELECTRONICS ONE-SEVEN. Edited by Harry Mileaf. Hayden Book Co., New York. Seven paperback volumes. Complete set $20.95 (Vol. 1 $2.95, other volumes $3.45 each); cloth bound (as one volume) $14.96

Two issues ago, I had a lot to say in praise of Electricity One-Seven, as good an introduction to basic electrical theory as I'd ever run across. Now we have the companion treatment of *electronic* theory and it's every bit as good. For those who aren't familiar with it, the treatment used in this series is sequential—presenting a single basic idea per page in both text and illustration. The organization is excellent and both the text and two-color diagrams are pertinent and well done. The first volume of this new set deals with the way information is carried by electrical waveforms. The other six volumes deal with the actual hardware, circuit techniques and components. Again, the treatment is superb. It can be recommended (as very few books can) to someone who really wants to learn on his own.

At the U.N., Henry Cabot Lodge of U.S. drew world's attention to bugging practices. Famous event is recalled in The Electronic Invasion.

TROUBLESHOOTING AUDIO EQUIPMENT. By Mannie Horowitz. Howard W. Sams & Bobbs-Merrill, Indianapolis & New York. 160 pages. $3.25

There is still a real scarcity of troubleshooting material on transistor audio equipment, so this book definitely is welcome. Although its coverage of transistor circuitry is not quite as thorough as its treatment of tubes, the basic transistor configurations are presented accurately and the important practical considerations are all there. A good addition to the small service shop's reference materials.

RCA SILICON POWER CIRCUITS MANUAL. Radio Corp. of America, Harrison, N.J. 416 pages. $2.00

For anyone involved with modern electronic circuits at any level this reference is a must. There is probably more information here on today's circuits and their theories of operation than in any other single reference book. You've probably bought it already.

TEN-MINUTE TEST TECHNIQUES FOR ELECTRONIC SERVICING. By Elmer C. Carlson. TAB Books, Thurmont, Md. 176 pages. $6.95

This book attempts to strip away some of the mystery of troubleshooting simply by comparing all circuits to either an amplifier or a rectifier. I'm not convinced that this kind of over-simplification is all *that* marvelous or practical but the book does offer some useful and eminently practical servicing short cuts.

[*Continued on page* 123]

RADIO OPERATORS WANTED!

By ALAN R. SURPIN AHOY, mates! Looking for a job that doesn't infect you with 9-to-5itis, one that will give you a chance to sail the bounding main to all those places you've only dreamed of seeing? Then give a thought to becoming a radio officer in the Merchant Marine.

According to international maritime codes an ocean-going ship can't leave port unless a licensed radio officer is aboard and in recent months the scarcity of radio officers has caused sailing delays. It represents the first time in years that there have been radio-operator openings. One reason for the shortage is the reactivation of nearly 200 ships from the reserve fleet for service to Vietnam. As a result, many men have been called back from retirement and radio officers already employed on ships are being asked to forego vacations and leave time. The average radio officer on American-flag ships is around 50 and not far from retirement. If it were not for Vietnam many already would have retired but the influx of younger men hasn't been sufficient to alleviate the growing need.

The U.S. Merchant Marine offers top salaries and benefits. The trick is getting in. The radio officer on an American-flag ship must have at least an FCC Second Class

Radiotelegraph license. With it a man can work on a ship under a chief radio officer, who must have at least a First Class license and a minimum of six months of experience on an American ship.

Most ships of American registry, however, have only one radio officer. So how do you get the required six-month apprenticeship? And how do you get Coast Guard papers (also required in the Merchant Marine) which are issued only if you have a job or the promise of one?

To attract new men into the Merchant Marine the Radio Officers Union (which, along with the American Radio Assn., controls most jobs on U.S. ships) recently started a limited training program for men with FCC license (a radar endorsement is an advantage) but without sea experience. The trainee is assigned to a ship with an experienced radio officer for the first six months. After completing this time he will be assigned to one-man ships for the next 18 months. Then he will be entitled to full membership in the union. Monthly base pay is $300 for the first six months, an average of $600 over the next 18. With full union membership pay ranges from $900 to $1,000 a month.

Membership in the ROU costs $750 initiation (payment can be spread over a period of time) and $45 dues per quarter. With full membership a man and his family are covered by hospitilization and other insurance. He can retire after 20 years of service, regardless of age, at approximately a third of his annual base salary.

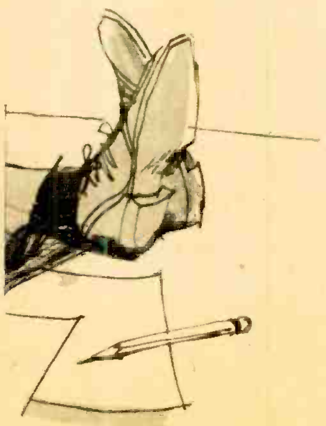
The Military Sea Transportation Service is the arm of the United State Navy responsible for shipping supplies to our military bases around the world. The majority of MSTS ships are civilian-manned with radio officers listed as top-priority jobs. Although most of its ships require only one radio officer, MSTS has a small fleet of troop transports needing more than one—so it can hire a man without previous experience and train him. Pay ranges from $9,400 to $10,000 per year.

Oil companies like Humble and Texaco presently are looking only for experienced men but these companies are well worth watching even if you have only the FCC ticket. Humble, in fact, is considering a training program. Salaries now average from $850 to $975 per month.

For the really adventurous, foreign-flag ships (many of them actually American-owned) offer some interesting possibilities. Radio officers are paid $400 to $600 per month. On a one-man ship an officer needs only the equivalent of a Second Class FCC ticket and no previous experience at sea is required aboard merchantmen. On passenger ships a minimum of two years is required for chief radio operators.

Since you'd have to contact the individual shipping companies about jobs, a good bet would be to get a copy of Lloyd's List of Shipowners. It costs $10—quite reasonable, considering the time it saves.

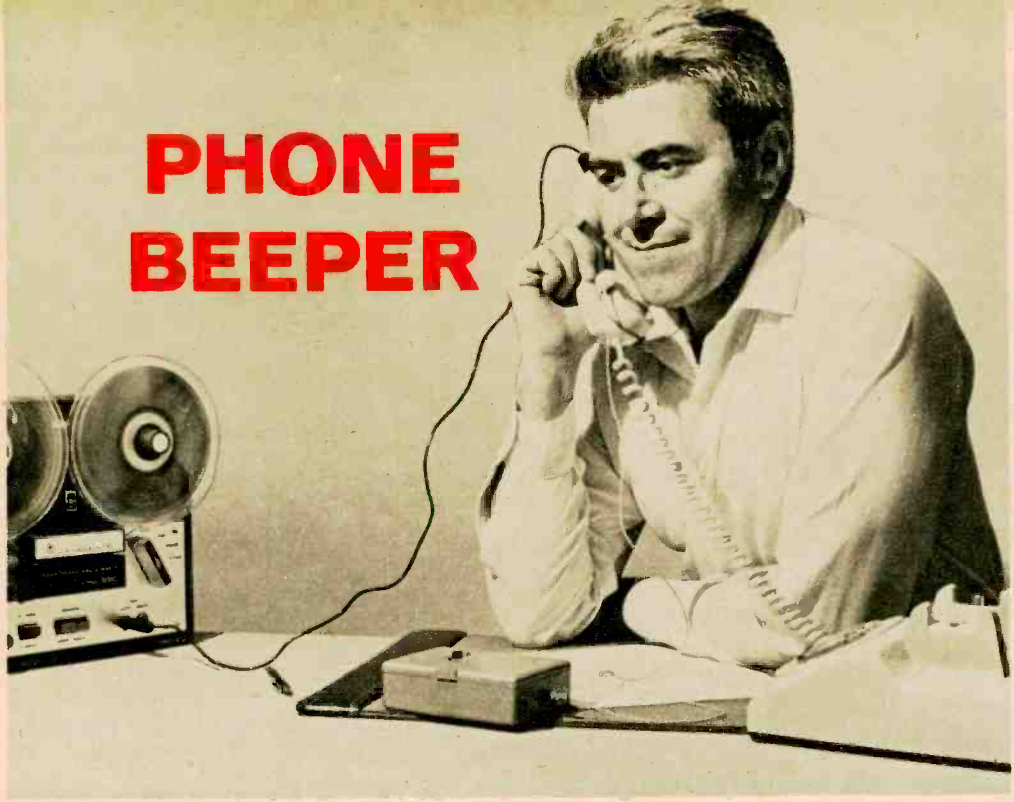
Ship-to-shore communications are handled by marine coastal stations operated by RCA Communications, ITT World Communications and Tropical Radio Telegraph. These companies run a total of 13 stations along the Atlantic, Pacific and Gulf coasts. Shore operators typically work a 37½-hour week and make between $6,000 and $9,000 a year, with no danger of seasickness. You must have at least a Second Class FCC Radiotelegraph license.



WHERE TO WRITE IF YOU'RE LOOKING FOR A JOB AS A MARINE RADIO OFFICER

AMERICAN RADIO ASSN., 270 Madison Ave., New York, N. Y. 10016
RADIO OFFICERS UNION, 225 W. 34th St., New York, N.Y. 10018.
MILITARY SEA TRANSPORTATION SERVICE, Commandant, Atlantic Area, 58th St. & 1st Ave., Brooklyn, N.Y. 11220, OR Commandant, Pacific Area, Naval Supply Center, Oakland, Calif. 94625
HUMBLE OIL & REFINING CO., Marine Dept., Box 1512, Houston, Tex. 77001.
TEXACO OIL CO., Marine Dept., Box 1028, Port Arthur, Tex. 77640
LLOYD'S REGISTRY OF SHIPPING, 17 Battery Pl., New York, N.Y. 10004
RCA COMMUNICATIONS, INC., Radiomarine Dept., 69 Broad St., New York, N.Y. 10004
ITT WORLD COMMUNICATIONS, Employment Sect., 67 Broad St., New York, N.Y. 10004
TROPICAL RADIO TELEGRAPH CO., Box 130, Higham, Mass. 02043, OR Box Drawer E, Pearl River, La. 70452

PHONE BEEPER



By NORMAN H. CROWHURST

HOLD on, there. Are you about to record a telephone conversation? It's not as simple as just setting up a tape recorder and attaching one of those inductive pickup coils to the phone base or handset. You may be required to put a beep tone on the line.

You've heard this tone many times—especially when you are listening to news broadcasts. The reporter may be phoning in his story, which is being taped for later broadcast. And every 15 seconds a beep comes through loud and clear. It is a warning to the other person on the line that the conversation is being recorded.

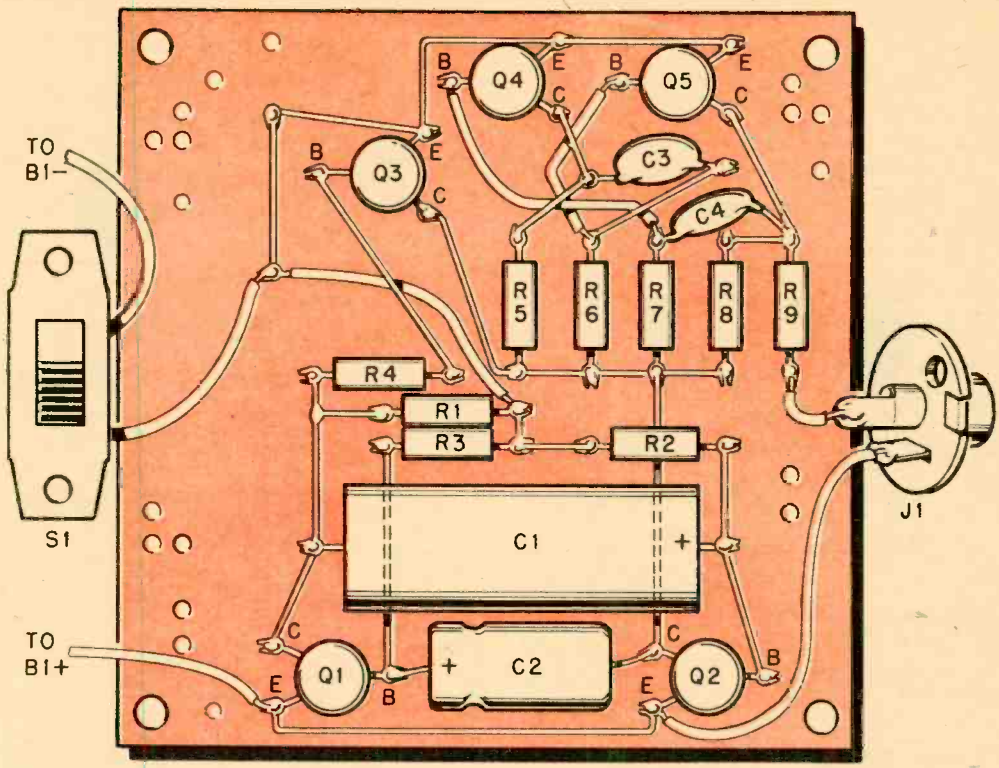
All of this comes about because of a communications law regarding the use of tape recorders and telephones. What it boils down to is that you must give the person you are calling a sporting chance by letting him know he's being recorded. There are some exceptions such as bugging your own phone under certain circumstances but, not being guardhouse lawyers, we'll leave that to the courts and say if you're beeping while bugging you can't be doing *everything* wrong.

Easiest and cheapest way to stay on the right side of the law when you record conversations is to build our five-transistor beeper. It has no moving parts and does not have to be connected electrically to your phone line. Its output is fed to an earphone, which blasts the tone directly (acoustically) into the mouthpiece on the handset. It's a one-evening project which will set you back about $10.

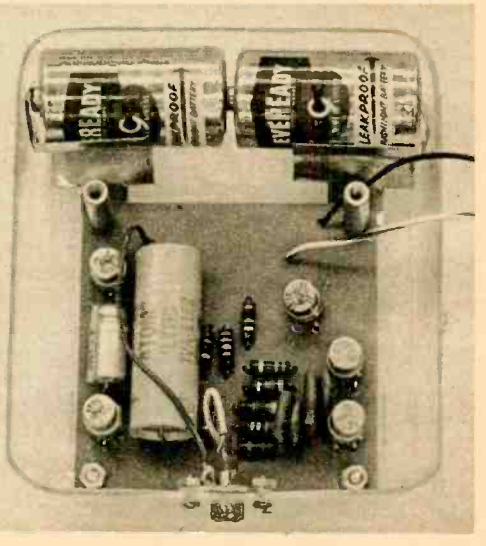
How It Works. Now you can't get away with just whistling into the phone every few seconds. There are strict rules about the tone. First, the beep, as specified by the FCC, must be a 1,400-cps (± 10 per cent) tone lasting 0.2 second (± 20 per cent) and repeated every 15 seconds (± 3 seconds).

Our beeper consists of two multivibrators, or oscillators. The first, made up of transistors Q1 and Q2, turns the tone on and off. It could be called the timer. The other multivibrator, consisting of Q4 and Q5, generates the tone. The tone is produced only when Q2 conducts, which is for 0.2 second every 15 seconds. Q1 conducts for the remainder of the 15-second period, during which time Q2 is cut off.

The frequency of the tone is determined by the values of resistors R6 and R7 and capacitors C3 and C4, which are associated with Q4 and Q5. The values we used are 0.125 μf and 4,700 ohms for the capacitors



Complete circuit can be built on a 3-in.-square piece of perforated board. Standard flea clips are shown for all tie points on this model. Author used a custom-made printed-circuit board (below) for his model and made his own battery clips.



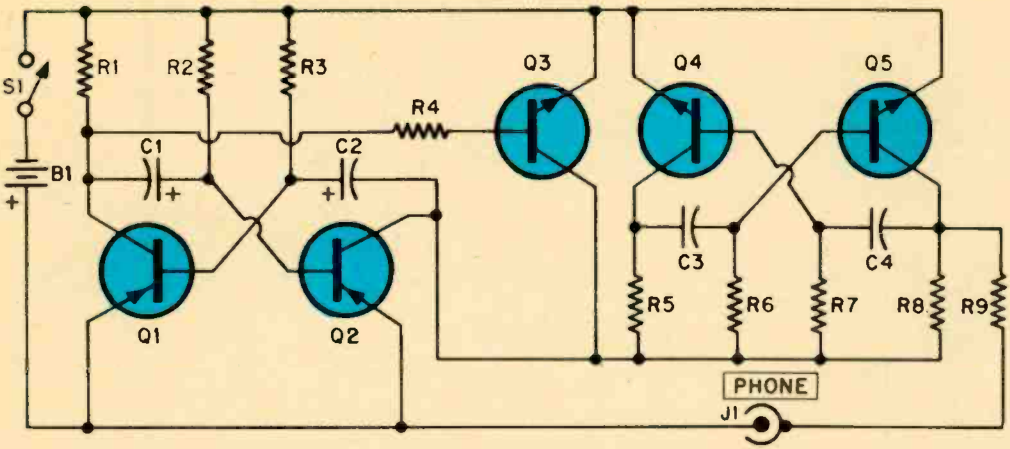
and resistors, respectively. The tone is required to be within plus or minus 10 per cent of 1,400 cps so it is well to use 5 or 10 per cent tolerance parts and to check frequency, if you have an audio oscillator and an oscilloscope.

We paralleled a 0.025 μf capacitor and 0.1 μf capacitor (total of .125 μf) and got a frequency of just about 1,400 cps. In the pictorial, we show just one capacitor for C3 and C4. In the photograph of the author's model you can see two capacitors for C4 and C5.

But if you use 0.1 μf capacitors that are close to true value you may come close to 1,400 cps without paralleling.

Timing is controlled by the value of parts associated with Q1 and Q2. The interval between beeps is set by the 500 μf capacitor (C1) and the 33,000-ohm resistor (R2). With a 500-μf capacitor, a 33,000-ohm resistor produces an interval of about 13.5 seconds (which is within tolerance). A 39,000-ohm resistor (the next value we tried) made the interval about 19 seconds, which is too long. The beep duration is controlled by the 50-μf capacitor (C2) and 6,800-ohm resistor (R3).

Transistor Q3 is needed in the circuit to prevent the tone from dying slowly; the tone must stop abruptly at the end of the 0.2-second interval. Without Q3 the tone would die slowly because current in the tone multivibrator (Q4, Q5) is not stopped when



Timing multivibrator (Q1, Q2) turns the tone multivibrator (Q4, Q5) on and off. Q3 cuts the tone off sharply.

PHONE BEEPER

Q2 is cut off suddenly. Adding Q3 (whose base is controlled via R4 by the collector of Q1) shorts the voltage across the tone multivibrator at the same moment Q2 is cut off.

Construction. The beeper shown in the photograph was built by the author on his own custom-made printed-circuit board. Realizing it might be difficult to duplicate this board, we show a pictorial of the circuit built on a 3-in.-square piece of perforated board on which we used flea clips for all of the circuit's tie points.

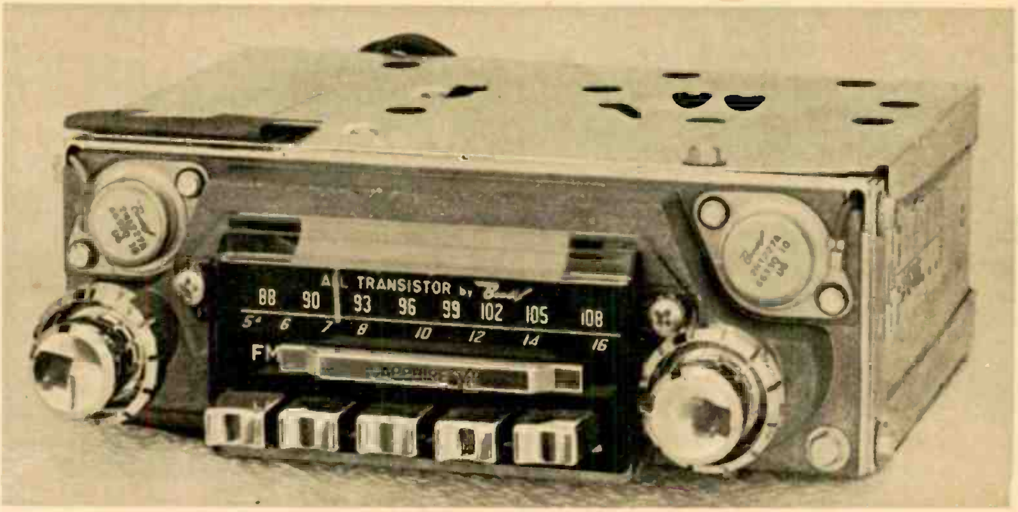
The layout is not particularly critical. However, be sure to use spaghetti on all bare leads where they cross. Also, be careful when installing the transistors that you do not apply heat to them too long. Matter of fact it's better to make other connections to the flea clips to which the transistors are soldered before soldering the transistor leads. Be sure to get the polarity correct when installing C1 and C2 and make sure you identify the transistor leads correctly.

Next, drill holes in the plastic box for the four screws which will hold the circuit board, output jack and the power switch. Install the board with ¼-in. spacers to keep the back of the board from touching the box. So far as the batteries go, they may be installed in a holder or you can solder the leads to them directly. We used two C cells in our model, which were slightly less than the width of the box. We could have held them in place with some home-brew clips made from an old discarded tin can.

PARTS LIST

B1—1½-V battery (2 reqd.)
C1—500 µf, 6 V electrolytic capacitor
C2—50 µf, 6 V electrolytic capacitor
C3,C4—.125 µf, ceramic disc capacitor (made up of .1 µf and .025 µf capacitors in parallel. See text)
J1—Phono jack
Q1,Q2—2N396 transistor (RCA)
Q3,Q4,Q5—2N388 transistor (RCA)
R1,R5,R8—330 ohm, ½ watt, 10% resistor
R2—33,000 ohm, ½ watt, 10% resistor
R3—6,800 ohm, ½ watt, 10% resistor
R4—10,000 ohm, ½ watt, 10% resistor
R6,R7—4,700 ohm, ½ watt, 10% resistor
R9—220 ohm, ½ watt, 10% resistor
S1—SPST slide or toggle switch
Misc.—125-ohm earphone (Telex EMV-2. Newark Electronics Corp., 500 N. Pulaski Rd., Chicago, Ill. 60624. $4.55 plus postage. Stock No. 27F380), flea clips, perforated board, 4¾ x 4¼ x 1½-in. plastic sandwich box.

Operation. Best way to get that beep tone into the mouthpiece is to make a holder for the earphone with a piece of heavy wire. This will be strictly cut and try. The object is simply to clip the earphone at the edge of the mouthpiece so the sound goes right in. Properly placed, the phone will inject a good beep which the person at the other end of the line will not miss. Just in case he wonders what the tone is for, tell him your conversation is being recorded. But don't be surprised if he hangs up. Some people get terribly shy when they know they're being taped.



HOW MUCH BETTER CAN CAR RADIOS GET?

Among AM radios it's hard to beat the ones for the road. Here's why.

By DAVID WALKER

CAR RADIOS have improved more in the past four years than they have in the last forty. Your next warranty card should prove the point —it will probably read in years, not months. Or listen while driving through the steel superstructure of a bridge. Transistor sets are no longer plagued by excessive fading the way they once were.

Or talk to a dealer about optional accessories. You may discover that the car radio as such is on the way to extinction. It's being supplanted by the entertainment package, replete with AM and FM radio, stereo FM and stereo tape player. (Some designs on the drawing boards even incorporate two-way emergency communications.) It will just about fit in the space occupied by the regular radio of a decade ago. And even if you're not interested in loading your next car with electronic extras, there's still good news. The AM car radio today—improvements included—costs less than equivalent sets of the 1950s.

When you think about it, the receiver in an automobile has to drive circles around a home AM radio. Signal strength swings wildly from mighty millivolts to fast-fading microvolts. An RF stage, rare in a table radio, is a car-radio necessity to assure good sensitivity and selectivity. Then there's audio output power. Wattage must be beefed up so the speaker sounds off when you're doing 70, windows open, maybe top down.

Selectivity has got to be good. In town, where stations are separated by a yawning 20 kc on the dial, there is no problem. But as you move out

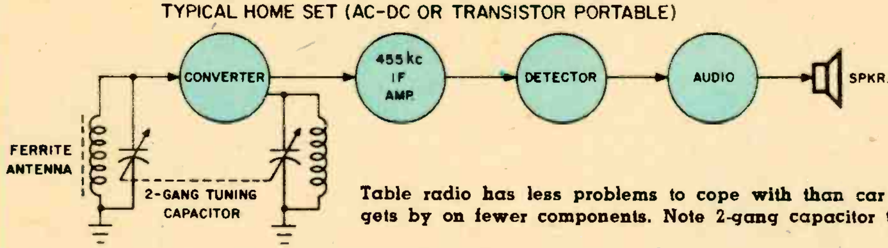
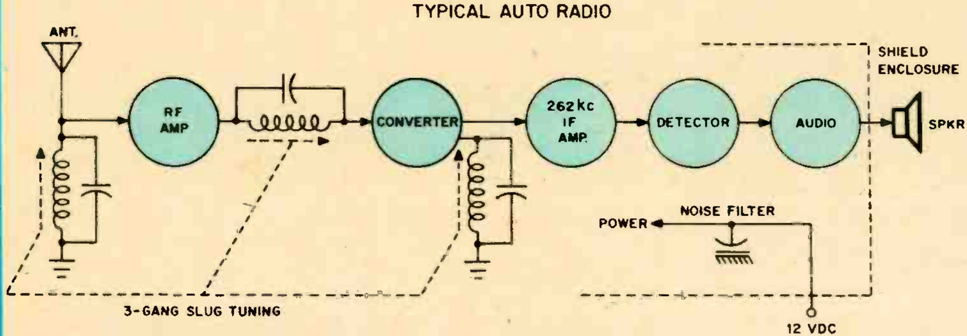


Table radio has less problems to cope with than car radio, gets by on fewer components. Note 2-gang capacitor tuning.



Auto radio begins by adding RF amplification stage and using 3-gang slug tuning. Lower IF frequency in car radio contributes to greater selectivity needed between cities where close stations crowd dial.

CAR RADIOS

between towns distant stations fill in the gaps, cutting clearance to a slim 10 kc. So a car set has more tuned circuits and a better IF strip for narrow bandwidth.

Other items add complexity. There's a well-shielded metal enclosure, noise suppression, lead filtering, probably pushbutton tuning. Instead of a simple variable tuning capacitor, a special assembly moves slugs through coils as you tune. It's electrically superior and costly. So the typical car radio has plenty of additional hardware and circuitry to justify cost significantly higher than for a table receiver.

Prices of car radios surely would have climbed with everything else if the industry hadn't started to zing about 1954. That year triggered a three-step breakthrough that saw engineers tear out the power supply (site of many troubles), eliminate tubes (another recalcitrant component) and embark on an ambitious test program to expose weak points in receiver design.

It all began before the transistor (at six years) was old enough to be taken seriously. Another new-fangled device—one the industry was willing to ride on—was the space-charge tube. Conventional tubes in auto sets (6BA6, 6BE6, 6AQ5, etc.) demanded as such 250 VDC for their plate circuits. But the new tubes could perform the same tasks on 12 V. Since filaments *and* plates of a space-charge tube could operate directly from the car battery, all components in the power supply were tossed out. And villains they were: the mechanical vibrator whose points pitted and stalled, the gaseous OZ4 rectifier containing sputtery mercury vapor, the electrolytic filter capacitor with oozing innards, the ponderous power transformer.

Meanwhile, the burgeoning semiconductor took aim and plinked way. First to topple were tubes in the audio section. Ads called those radios transistorized or transistor-powered. In the trade they were known by a more accurate term: hybrid. But today the transistor has buried the tube. It has the required specs for critical RF and IF as well as audio circuits. A semiconductor that cost $7 in the early '50s now goes for about 30¢. Just as important, circuit designers have learned how to live with peevish peculiarities of the transistor—a tendency toward thermal runaway, quick signal overload and cross modulation.

The first all-transistor sets which bowed in 1957 had their share of problems. Not the least was fading—an inability to hold station volume reasonably constant with fluctuating signals. This would point to deficiencies in the AVC (automatic volume control) circuit or to what was perhaps the real culprit—the early transistor. Those semiconductors simply couldn't deliver enough signal to prevent a drop-out of audio under difficult reception conditions. Today's transistors can deliver receiver sensitivity as good as that of older tube sets.

The national service manager of one large manufacturer, discussing fading, says that AVC is now as good as it ever was. What's really changed, he explains, is the number of stations. He reasons that some of them are simply getting lost in the crowd of today's broadcast band. The motorist who can receive them at all shouldn't complain about poor results when he does. The service manager also commented on occasional complaints of poor sound quality. Here he believes the real problem to be speaker placement (which is critical to customer enjoyment) rather than circuitry. Many auto models now come off the line with factory cutouts for a rear-deck speaker that is easy to mount and can really upgrade audio quality.

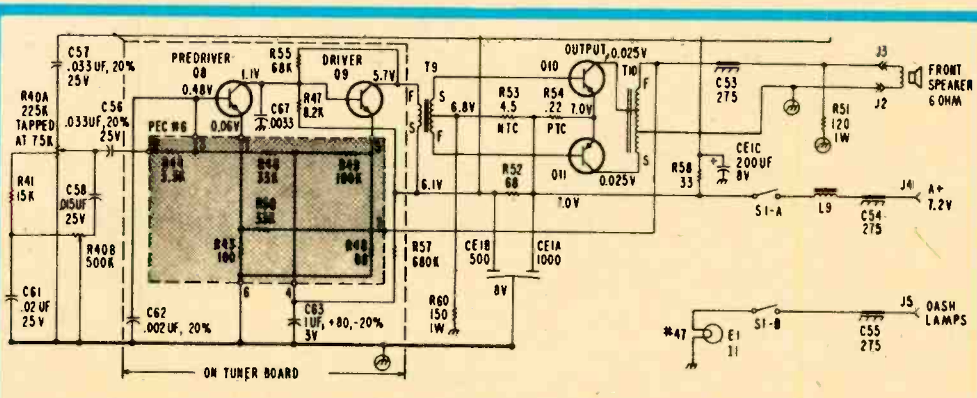
As anyone who's sweated over the repair of an intermittent radio knows, a circuit's only as good as its weakest component. All those glamorous semiconductors won't do a thing for leaky capacitors or overheated resistors that drift far from Ohm. Which introduces the final phase of the three-step breakthrough mentioned earlier—testing.

Time was when car radios coming into auto plants from outside suppliers were treated as strictly automotive products from there on in. But Ford's Radio Section in Dearborn, Mich. questioned whether a car's regular proving ground tests, designed for mechanical components, were valid for the radio. A car under test may accumulate 40,000 miles over rough roads, but the radio is barely affected. So Ford set out to design a ten-hour radio test that would simulate 1,500 hours of operation under all environmental conditions encountered in the U.S.

The new approach was to ride the radio to ruin under a torturous set of lab conditions. Transistors disintegrated from thermal runaway, printed-circuit boards cracked under strain, capacitor leads parted, insulation sizzled. Radios were punished by extremes of temperature, humidity, voltage and impact separately and in combination.

Data on warranty returns from the field already pegged the major troubles, of course. But the new test did yield a few surprises. In one case, a radio seemingly failed after a trip through a chamber that dosed the circuit with high heat and humidity. But 24 hours later, after complete dry-out, the circuit recovered completely. Could this failure be reason enough to kick back the radio for redesigning? Or were test conditions too rough to be realistic?

Investigation revealed that moisture had collected on mica plates of trimmer capaci-



Audio stage of modern car radio, isolated from rest of circuit, illustrates quality built into today's product. Note push-pull output stage. This is actual schematic as it appears in manual.

CAR RADIOS

tors, causing drift and loss of gain. The real fault, however, was traced to solder flux forced up through printed-circuit-board holes in production. Flux on the capacitor plates, innocent enough in a dry circuit, could retain moisture and kill performance. The problem was solved by hand-soldering capacitor leads.

The standardization of radio quality that results from full-scale testing means that you generally cannot go to a car dealer and demand the best radio money can buy. Options are usually limited to pushbuttons, FM and maybe a convenience like a signal-seeking tuner. Chances are (as we've seen) that any version of the factory-installed radio will prove to be a fine performer. But was the radio, in fact, installed at the factory?

It is not an uncommon practice for the dealer to slip in a cheapie radio—one that puts an extra piece of sugar in his pocket. Or he may offer to sell you a car with a free radio. A notorious flaw in such sets (and a major headache of car-radio design) is tuner tracking. The relationships between tuned stages must be maintained precisely from point to point along the dial or the radio will have dead spots or poor sensitivity on some frequencies. Also, the local oscillator might die or components wither under temperature and humidity.

This doesn't mean you can't get a good radio for do-it-yourself installation. Reputable manufacturers sell sets with circuits almost identical to those for auto-makers.

In fact, basic circuits don't usually vary with the car's price bracket. Don't look now but in a certain 1967 service manual there's just one radio schematic covering both Toronado and Chevrolet. Would you believe it's the same for a Lincoln? It is. Remember, though, we said basic. There are differences outside the circuit's viscera that account for a price difference.

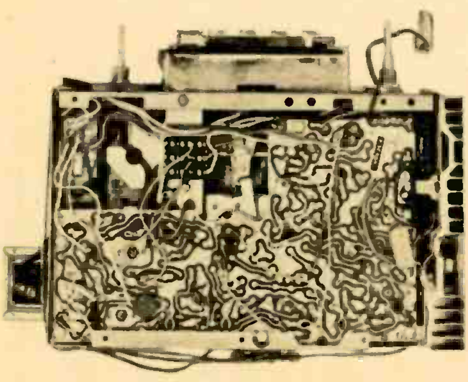
Put the same radio in a de luxe car and the exterior goes exotic. Electrically, the audio output may be a sweeter-sounding push-pull stage instead of an economy single-ended version with more distortion and less wattage, driving a smaller speaker. And more attention is often paid to ignition noise problems, usually worse in an expensive, powerful automobile.

Recently there has been new interest focussed on antennas. Although the auto antenna evolved from chicken wire imbedded in the fabric roof of early cars to today's telescoping whip, it has experienced little electronic refinement. Now under study is the inductive antenna, in contrast to the present capacity type.

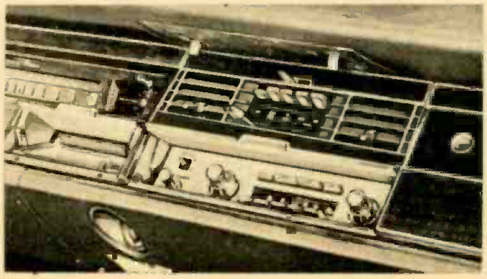
The inductive antenna is essentially the same as the ferrite rod or loopstick. It is considerably less susceptible to certain types of interference but it's too directional. Another fault is small size, which vastly reduces the antenna's signal-capturing ability. (The experimental ferrite is about 7 in. long vs. 57 in. for a regular whip.) This one'll take some thought, but the noise-killing benefit is there.

The second major effort to improve signals assails the problem of stereo FM reception on the road—which can be badly deteriorated by reflected signals (multipath). A partial solution is offered by the FM stations that transmit signals not only from a conventional (horizontally-polarized) antenna but from a

[*Continued on page* 118]



Printed-circuit construction of AM-FM radio puts circuit in space once large enough for AM alone.



Automatic station searching is among features of de luxe model. Others may include tape player.

The Listener

By C. M. Stanbury II

Chasing the Channel-Hoppers

POSSIBLY the No. 1 headache for shortwave listeners is that never-ending series of frequency changes made by international broadcasters. Aside from seasonal variations (which are unavoidable), many broadcasters hop constantly from channel to channel within the same band. No sooner does a listener find an interesting program than the transmitter switches to another frequency and he must go hunting again. Or, when a DXer tunes for a particularly rare catch he has read about, its actual frequency may be as much as 50 kc wide of the mark.

Then there are the Latin American stations that drift primarily because of unstable equipment. An operation that seems to fall into both categories is 4VB, La Voix de la Révolution Duvalieriste at Port-au-Prince, Haiti. It engages in limited international broadcasting as the mouthpiece of Haitian dictator Duvalier and may be found on any frequency between 5900 and 6000 kc. The station, which first came on the scene as R. Commerce, also makes an occasional appearance around 9480. If (or perhaps when) the Duvalier regime runs into trouble this will be the station to *try* to find.

There really isn't anything you can do about channel-hopping—except be prepared for it.

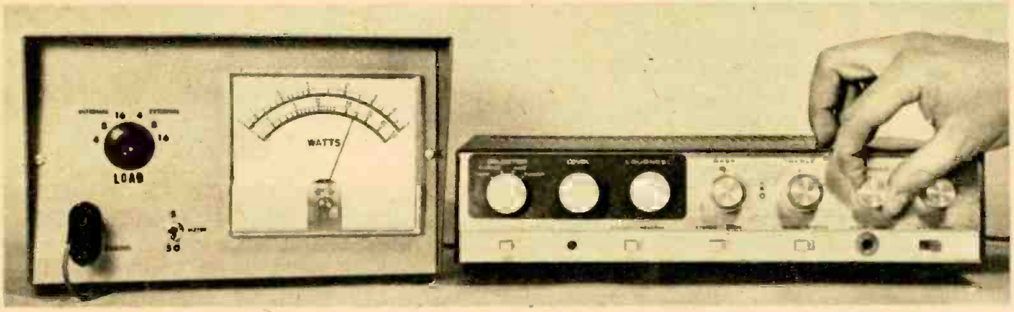
Forest-fire DX . . . Last winter, reporting on the utility QSL crisis, we noted that some of the larger utility organizations (such as Cable & Wireless) no longer would verify reception reports. We then suggested DXers concentrate on smaller stations, like the one operated by the Ontario Department of Lands and Forests at White River. No sooner had that issue hit the stands than an East Meadow, N.Y., DXer picked up the station, sent a reception report and promptly received his QSL. Meanwhile, the station's Chief Radio Operator, Lawrence M. Wilson, wrote directly to me advising that reception reports are, indeed, welcome.

This station is, needless to say, busiest at the height of the forest-fire season—just about the time you are reading this. It is equipped to operate on eight different shortwave frequencies (3376, 4460, 4520, 4590, 4880, 5170, 5499 and 9172 kc). To communicate with fire towers and mobile units they use VHF. Since F2 skip is nearing its peak, you also may be able to bag some of these. Frequencies of the VHF channels (1 through 5) are 46.70, 46.74, 46.78, 46.82 and 46.86 mc.

So here you have a utility station that definitely is a friend to DXers. But don't spoil things for your fellow listener. When you report be sure your identification is correct. Always name at least one station with which it was in contact (to prove reception), include return postage (either a Canadian 5¢ stamp or an International Reply Coupon) and be patient while waiting for the reply.

[*Continued on page* 125]

A champion at not-so-fine art of channel-hopping is 4VB, La Voix de la Revolution Duvalieriste, Port-au-Prince, Haiti between 5.9-6.0 mc.



Direct-Reading Audio Wattmeter

By JOHN SMITH RICHARDS

TO many audiophiles, measuring the output power of a stereo amplifier means load resistors dangling from the back panel, a voltmeter to measure the voltage across the resistors and then several maneuvers with a slide rule to calculate power.

That calculation time can be cut to zero with our direct-reading audio wattmeter, which is calibrated for internal or external 4-, 8- and 16-ohm loads. Simply connect the wattmeter to your amplifier, set the range and load switches, feed a test signal into the amplifier and read the output power directly on a large meter. No calculations, no slide rule, no wasted effort or time.

The wattmeter is calibrated to read up to 5 watts on one scale and up to 50 watts on the other. A single load switch selects either 4-, 8- or 16-ohm internal load resistors or sets up the meter for 4-, 8- or 16-ohm external loads. The frequency response of the meter is flat from 20 to above 20,000 cps. Accuracy is 5 per cent or better, depending on which scale and load are used. To simplify calibration, a meter face is printed on the third page of this article which you can cut out and cement over your meter's scale.

Construction. The wattmeter's accuracy is extremely dependent on component values; therefore, part substitutions should not be made.

Our model is built on the U-section of a 6 x 10 x 7 in. cowl-type Minibox. A less expensive and somewhat smaller cabinet can be substituted if desired.

As you can see in the photographs, there's lots of extra space in the cabinet (the oversize cabinet is needed only to accommodate the meter). Spread things out, don't jam the components into one corner and try to keep the input leads away from the diodes.

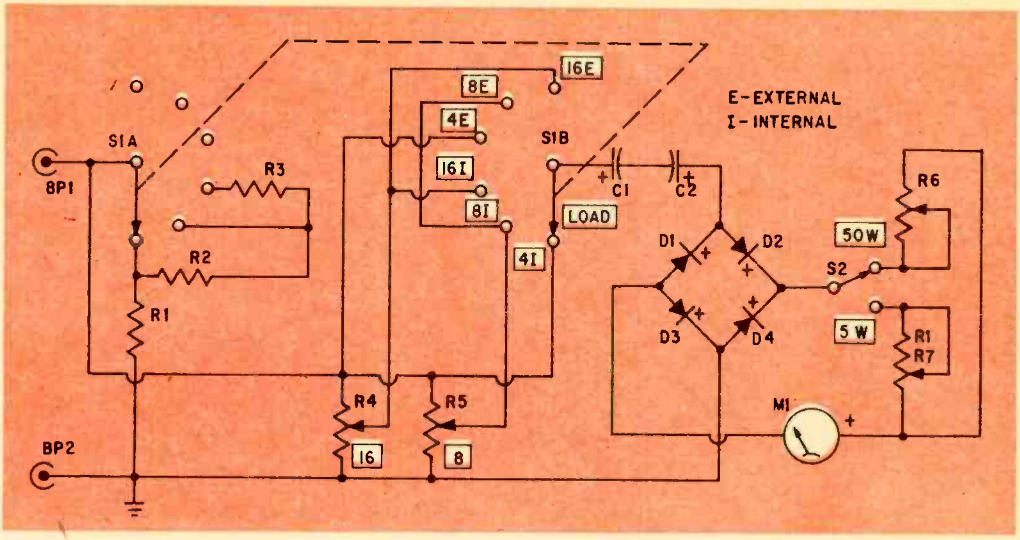
The 5-watt (R7) and the 50-watt (R6) calibration potentiometers, and the 8 (R5) and 16 (R4) ohm calibration potentiometers are mounted on an L-bracket which is approximately 3 x 3 in. It is made from scrap aluminum or an old Minibox.

Load resistors, R1, R2 and R3 are rated at 50 watts and have a tolerance of 1 per cent. Mount them securely on the rear of the cabinet, far away from all other components as they will run hot when a full 50 watts is applied to them.

Carefully note the connections to S1 before wiring to it. S1 has two sections with six lugs on each section (pole). On section *A* only three lugs are used for the 4, 8 and 16-ohm load resistors. The six lugs on the *B* section are wired to automatically select the connections for either internal or external loads.

Note that capacitors C1 and C2 are connected back-to-back — *negative* leads together. Be sure they are not connected in series—plus-to-minus.

Cut all cabinet holes and mount and connect all the components except the meter, which is installed after all other wiring is completed. The template for the meter holes is printed on the bottom of the meter's box.



Wattmeter schematic. Switch S1 selects amplifier load. In 4I, 8I or 16I positions (internal), power resistors R1,R2 and R3 are connected to amplifier. Use 4E, 8E or 16E positions (external) when speaker is amplifier load. Signal from amplifier is rectified by D1-D4 and fed via either R6 or R7 to meter.

PARTS LIST

BP1,BP2—Dual five-way binding posts (H. H. Smith 224 BB or equiv. Allied 47 A 1328)
C1,C2—100 µf, 50 V electrolytic capacitor
D1,D2,D3,D4—1N100 diode (Sylvania)
M1—0-1 ma DC milliammeter, 4½-in. square. (Allied 52 A 7214)
R1,R2—4 ohm, 50 watt, 1% wirewound resistor (Dale type RH-50. Allied 45 D 6369 C. $3.23 plus postage. Specify resistance when ordering. Not listed in catalog. 25 watt is Dale Type RH-50. Allied 45 D 6360 C. $1.82 plus postage. Specify resistance when ordering. Not listed in catalog.)
R3—8 ohm, 50 watt, 1 % wirewound resistor (Dale Type RH-50. Allied 45 D 6370 C. $2.23 plus postage. Specify resistance when ordering. Not listed in catalog. 25 watt is Dale Type RH-25. Allied 45 D 6360 C. $1.82 plus postage. Specify resistance when ordering. Not listed in catalog.)
R4—1,500 ohm, linear-taper potentiometer
R5—1,000 ohm, linear-taper potentiometer
R6—25,000 ohm, linear-taper potentiometer
R7—5,000 ohm, linear-taper potentiometer
S1A,S1B—2-pole, 6-position rotary switch (Mallory 3226J, Allied 56 A 4354)
S2—SPDT toggle or slide switch
Misc.—6 x 10 x 7-in. cowl-type Minibox

Temporarily mount the meter in the cabinet. Then, insert a wide-blade screwdriver in either of the slots at the top or bottom of the meter face. Very gently twist the screwdriver until the face comes away from the meter; use hand pressure to separate the face from the meter.

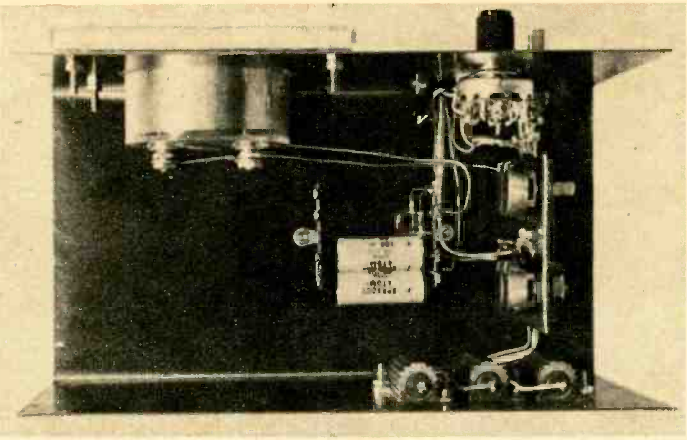
Remove the meter from the cabinet and carefully remove the two screws which hold the meter scale. *Slide* the scale upward from under the pointer, being careful not to bend the pointer. Cut out our meter scale and cement it over the original meter face; making certain the 0 and 5 marks correspond to (are directly over) the original 0 and 1 marks. Install the complete scale assembly on the meter—again taking care not to bend the pointer. Snap the face into position and install the meter in the cabinet then make the connections to it.

Calibration. First step is to set S2 to the 5-watt position and S1 to the *4E* (4-ohm, external load) position.

Connect a sine-wave voltage source to BP1 and BP2 and also connect an AC voltmeter of good accuracy to BP1 and BP2. The signal source can be a 60-1,000 cps signal from an audio generator, the AF output from an RF signal generator or AC from a power line if dropped through a resistor or a Variac (variable AC auto-transformer). Anything will do as long as the voltage is a pure sine wave.

Adjust the output level of the signal source until the voltage across BP1 and BP2 is exactly 4.47 (rms) volts—the voltage corre-

Wattmeter



Looking down into wattmeter. Cabinet is quite large because of 4½-in. meter. All this space makes for easy construction. It will be a lot simpler to wire load-selector switch S1 (upper right) before installing it in cabinet. Capacitors C1 and C2 are located at the bottom.

sponding to 5 watts in 4 ohms. Adjust R7 until the meter needle indicates 5 watts. Without changing the input voltage set S2 to the 50-watt range and adjust R6 so the pointer indicates 5 watts. The 5 and 50 watt meter-multiplier potentiometers, R6 and R7, are now calibrated. Take care that during the following adjustments the settings of R6 and R7 are not disturbed.

Set S1 to the *8E* position and adjust the signal source output until the voltage across BP1 and BP2 is 6.33 (rms) volts. Set S2 to the 5-watt position and adjust R5 until the pointer indicates 5 watts. Finally, set S1 to the 16E position, adjust the signal source for 8.95 V across BP1 and BP2 and adjust R4 so the meter indicates 5 watts. The calibration is now completed.

Using The Wattmeter. Keep in mind that the wattmeter is accurate only if the input signal is a low-distortion sine wave.

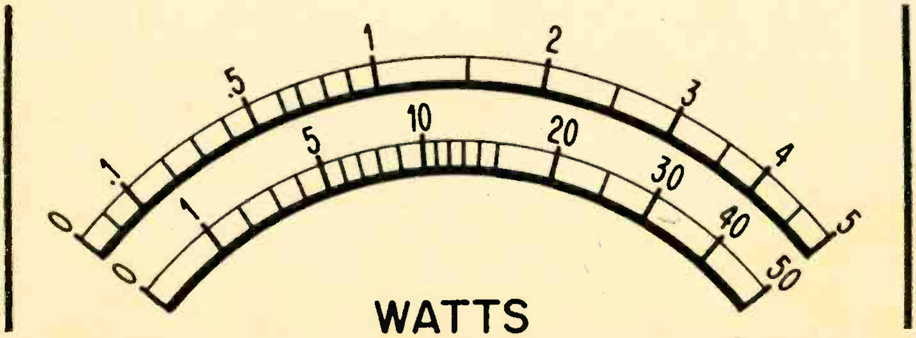
If the wattmeter is to provide the load resistance for the amplifier set S1 to the appropriate *internal* load position *(4I, 8I, 16I)*. S1 will simultaneously select the load-correction potentiometer (R4 or R5). If the amplifier already has a load connected, or if you prefer to use an external load resistor, set S1 to the appropriate *external* load position *(4E, 8E, 61E)*. Again, S1 automatically selects the appropriate load-correction potentiometer.

If you are in doubt as to the amplifier's output power, start the test with S2 in the 50-watt position. While the 50-watt range is calibrated below the 5 watt level, maximum accuracy will be obtained if the 5-watt range is used for power levels below 5 watts.

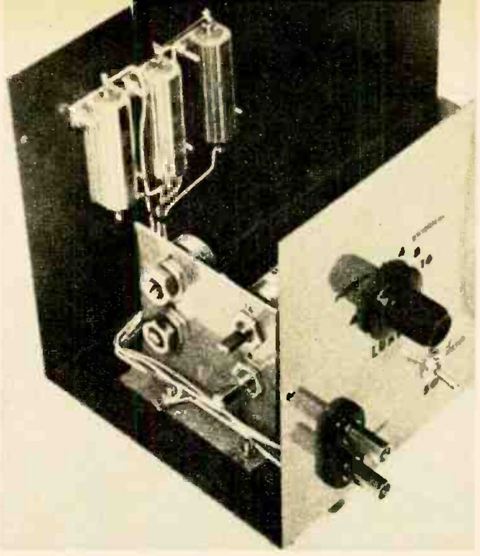
As a general rule, for continuous power output tests the power applied to the wattmeter should be no more than half the power rating of the load resistors.

Note that the 4-ohm load consists of only resistor R1, which is rated 50 watts. This means the 4-ohm load should have no more

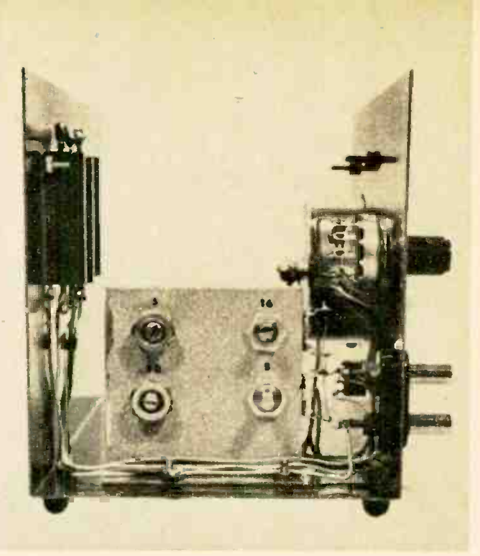
[*Continued on page* 118]



Cut out this scale and paste it over meter scale. Zero and 5 must line up with 0 and 1 on meter scale.

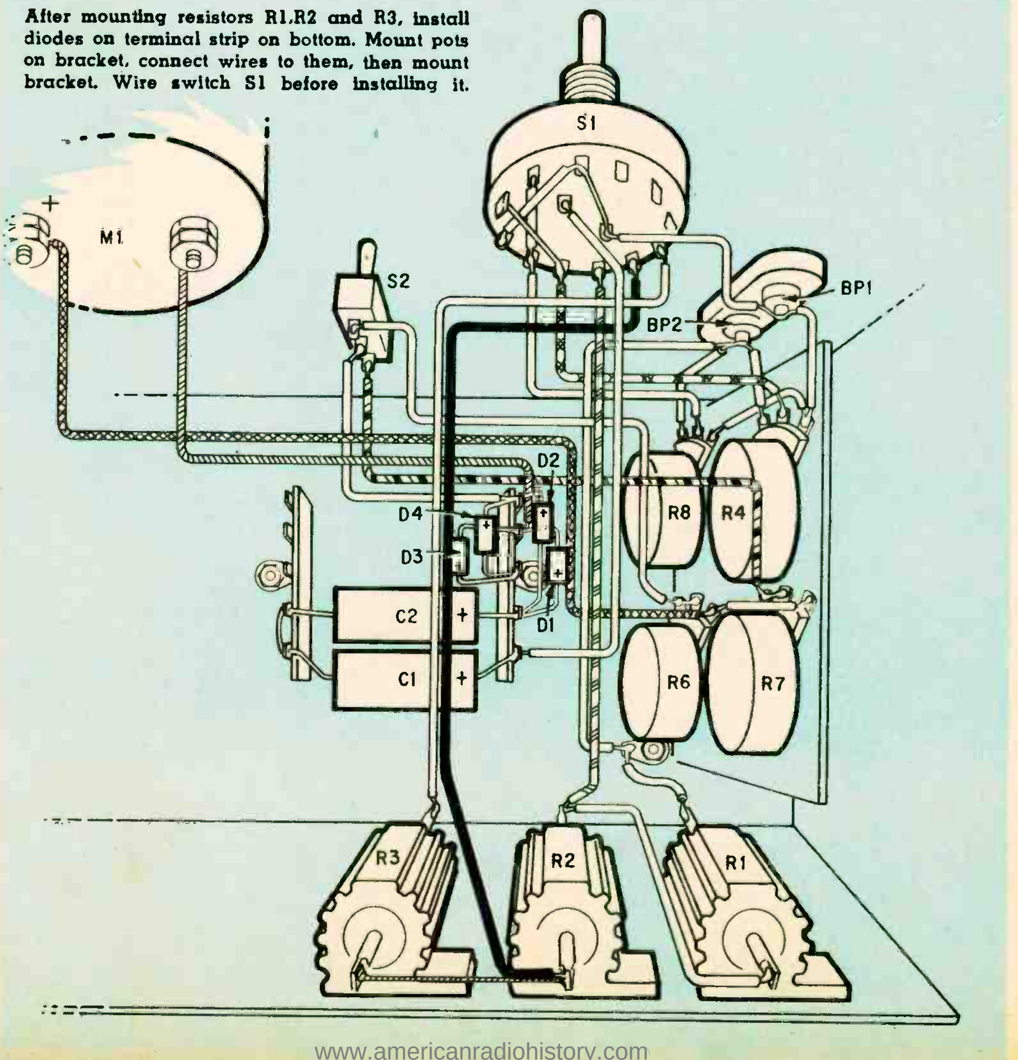


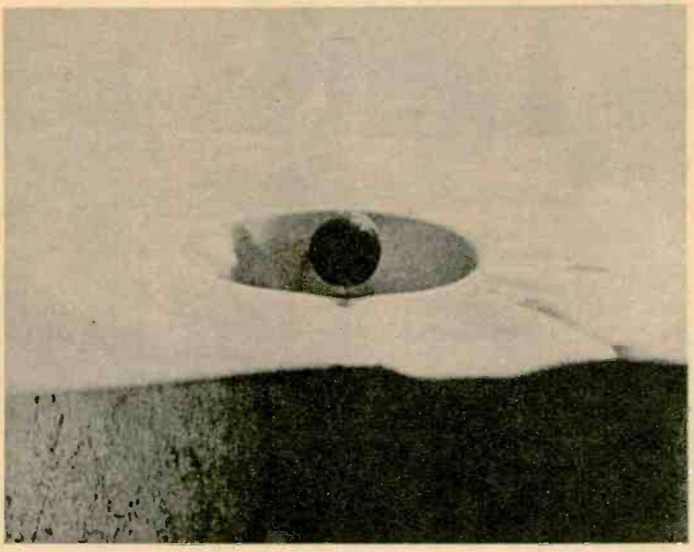
Power resistors must be tightly attached to back panel because panel serves as their heat sink. The brackets on which the potentiometers are mounted can be made from a piece of scrap aluminum.



For long-term stability we suggest you use locking potentiometers, although standard potentiometers can be used if meter will not be banged around. Note how wires are routed close to chassis.

After mounting resistors R1,R2 and R3, install diodes on terminal strip on bottom. Mount pots on bracket, connect wires to them, then mount bracket. Wire switch S1 before installing it.

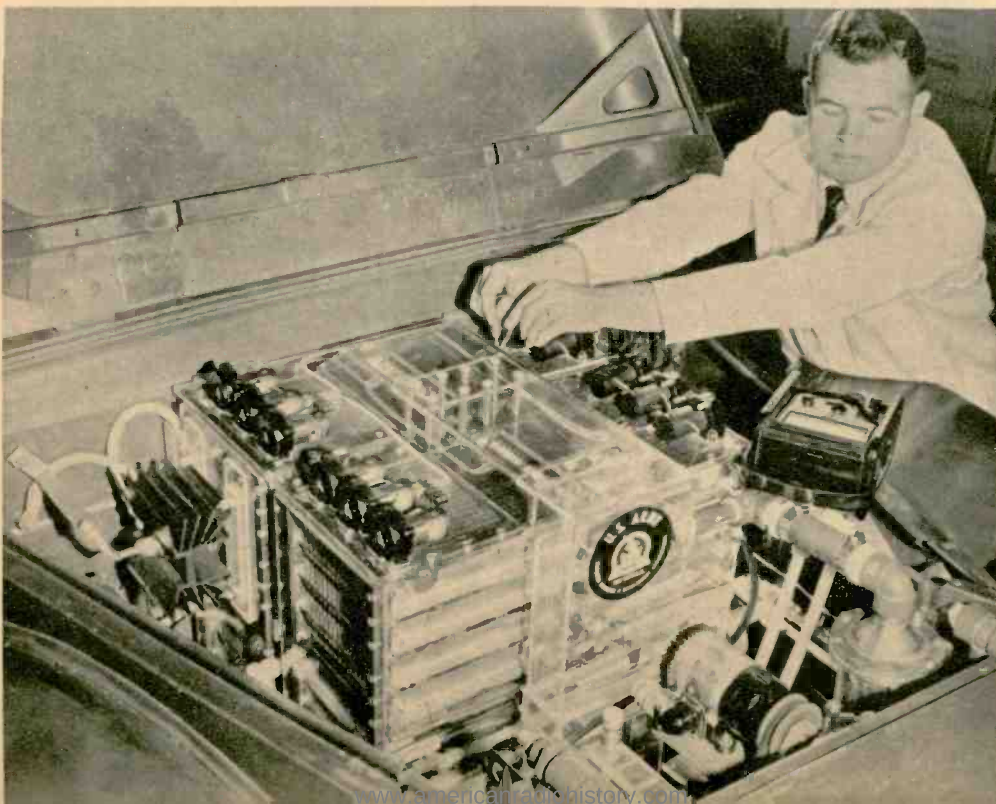


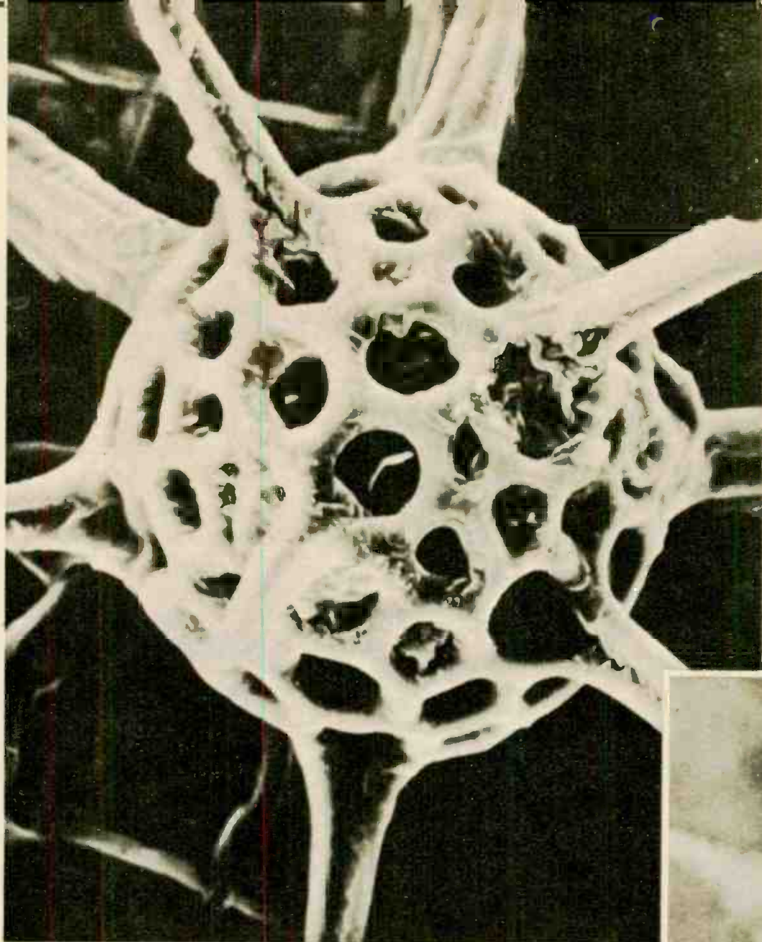


WHICH WAY IS UP? . . . Leapin' lizzards, Sandy! Is that a real flyin' saucer? No, it's a ball of polystyrene foam just over ¼ in. in diameter that, with apparent disregard for gravity, floats above the target-striped base of its transparent, evacuated container—kept there by the field of low-density radioisotopes on its surface. The principle, used by Nuclear Guidance, Inc. for inertial sensors to keep spacecraft on course, is said to bypass problems inherent in conventional electro-mechanical sensors.

Electronics in the News

Under the Hood . . . A total of 20 kw are developed by the four fuel-cell modules that power this M-37 Army truck, being tested at Ft. Belvoir, Va. Hydrazine (NH_2NH_2) is oxidized in the cells to produce the potential to drive a 3,900-rpm DC motor—rated at 27 hp for a top speed of 47 mph on level roads. It replaces a 94-hp internal-combustion engine. Monsanto, who developed the cells, says that doubling the number of cells (for 53 hp) should provide performance comparable to gasoline. Similar cells are designed for silent auxiliary power used in combat-zone communications.





A Good Look . . . The weird shape at left is a marine micro-organism, as seen by a scanning electron microscope which gives startling depth of field by comparison with standard microscope techniques (optical equivalent is below). Specimen is vacuum coated with metallic film to make the surface conductive. As microscope's beam scans it, the specimen releases secondary electrons, adding to beam at a collector plate. Collector current is amplified and modulates CRT viewer, synced to the original probe beam. Since entire collector voltage is used at any instant, scattering of probe beam by specimen has no effect on resolution. Microscope was developed by Washington University and Monsanto.

Hero . . . HL9TK, Airman Second Class John Ferrara (left), wanted to spend some off-duty time last May at the ham rig in his quarters at Osan Air Base in Korea. His first QSO was a May Day sent out by Thomas Kurth of Milwaukee, whose 87-ft. biological research vessel, Donte Deo, had struck a reef off the Paracel Islands and was sinking fast. Water shorted out the ship's generator before Ferrara was able to get her precise location. But an hour later he re-established contact. In a seven-hour effort that eventually included the Osan MARS unit, HL9KH, HL9KO, KA8AB and KA8LM in Japan, KR6AF in Okinawa and KG6IJ in Iwo Jima, Kurth and his crew were rescued. The Donte Deo had long since settled to the bottom although she was not entirely submerged.

Notes from EI's DX Club

ANY ham looking to work international waters should stand by on 14337 kc until after the 1200 EST Coast Guard net is concluded. Among those currently active in the north Atlantic are WA1HDP and K1TNF. Jim Sheffield, WA5NLF (Texas), has come up with an even rarer catch fished from the high seas—ZBTAR/mm aboard the HMS Rooke.

Bill Sparks (California) reminds us that now is the time to watch for the Rhodesia Broadcasting Corp. transmitter at Gwelo on 3396 kc around 2000 PST (2300 EST).

Edward Shaw (Virginia) reports consistent reception of the R. Tashkent (Uzbek S.S.R.) English program, 0700 EST on 9600 kc. Because of earthquake damage, the station is said to be operating from a trailer with a temporary antenna. Question is, does R. Tashkent use its own facilities on 9600 kc or does it use those of some other Soviet station?

A new frequency for Vatican Radio, coming in well on the West Coast, is 21510 kc. This one is used for English to Asia at 0645 PST (0945 EST).

Jordan's Hashemite Broadcasting Service is being received in California on 11810 kc with Arabic from 2230 PST (0130 EST).

A Brazilian broadcaster recently returned to 19 meters is R. Sociedad de Bahia at Salvador on 15121 kc. Bob LaRose (New York) reports reception around 0600 EST.

The recently reported R. Republik Indonesia relay on approximately 5065 kc turns out to be a new frequency for their Medan transmitter. They have a local ID (in Indonesian) at 0730 PST.

Joshua Heller (New York) shows us what probably is the only professionally printed QSL card ever issued by a radio beacon—RAB, 1613 kc, Rabinal, Guatemala. Reports for this one (which should specify the exact number of seconds it takes to send the letters RAB and should include return postage) go to: Communications Dept., Pan American World Airways, Miami International Airport, Miami, Fla.

R. Cairo has a new frequency for its 1645-1815 (EST) English transmission to Europe —12005 kc. It is heard in eastern North America even better than the transmission (intended for NA) on 9475 at 2030-2200 EST.

A new frequency for Conakry, capital of the Guinea Republic, is 4900 kc—a switch from 4910, probably to avoid R. Ghana (4915 kc) QRM. Conakry sign-on is at 0100 EST.

According to one of R. Sweden's West German reporters, the Voice of Germany (Deutsche Welle) will build its Latin American relay in El Salvador and the station will consist of three SW transmitters (two weighing in at 250 kw, one at 150 kw) and a 100-kw BCB outlet.

A new Australian Broadcasting Corp. home-service relay is being heard on 11765 kc at 0400 EST (0100 PST), perhaps from Melbourne. Meanwhile, R. Australia is building a powerful new station at Darwin.

Propagation: The continued rapid increase in sunspot activity will result in good-to-excellent DX during the daylight hours and generally good DX at night.

For the first time in nearly seven years, the amateur 10-meter band is expected to open almost daily between the U.S. and Europe. For hams in the East, best 10-meter openings will occur during the late morning hours, local time. CB DX will be more prevalent than it has been in years during daylight hours and some transatlantic TV DX is possible between 10 a.m. and 1 p.m., local time.

At night, 9, 11, and 15 mc will offer good DX of short-wave transmission when the entire path is in darkness.

AN L-L-L-L-L-L-L-L-LP

Ever heard of a disc that will play all day long . . . and all night, too?

By H. B. MORRIS

NOT too long ago a Manhattan patent attorney spotted an item in the Wall Street Journal. The Russians, reported the article, claimed they'd invented a phonograph record that could play for two hours, about double the time of our regular LP. It didn't take long for the attorney to get on the phone for a little one-upmanship. His client, you see, already had a record playing 24 hours.

"Mathematically impossible!" said a Russian technical representative in New York. He echoed the sentiments of many an engineer who considers it unbelievable that a record could be cut at such a slow speed as 2 rpm.

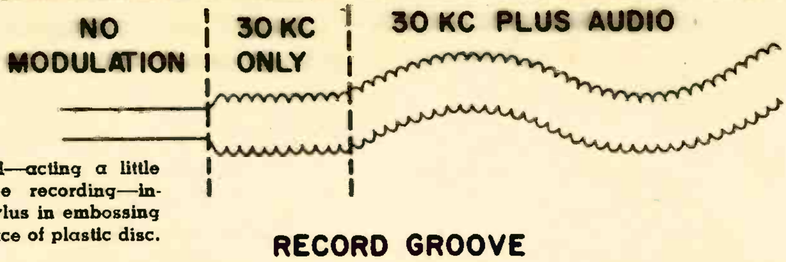
But the attorney produced a 1962 U.S. patent issued to his client. Hidden in its formidable title was the secret: "Stylus Recording With Superimposed High-Frequency Excitation." After studying the contents of this patent the Russian capitulated. "This," he admitted good-naturedly, "we cannot do!"

Inventor Robert Wagner is no kin to any name-sake. He is a celebrity in his own right. High-steppers of a generation ago may recall him as Buddy Wagner, jazz musician and bandleader. Even in those days his interest in tinkering with disc recording was so consuming and led to so much hookey-playing that Walter Winchell once called him On-Again Off-Again Buddy Wagner.

Wagner's problem in working with slow-speed recording was that as you slow the recording medium, frequency response drops off and noise and distortion climb. Wagner's approach adopted the technique by which Edison originally had made his tin-foil recordings—embossing.

Almost all disc-recording equipment today (outside of some dictation machines) cuts the groove, using a chisel action to gouge out a thread of the plastic material from which the disc is made. This thread in itself can cause problems which the embossing process side-steps. Wagner also did not have to worry about the fact that a cutting stylus is pyramidal in shape, rather than conical like a playback stylus. This causes what is known as tracing distortion: the difference in shape produces a difference in the path described by the two styli. Since tracing distortion is increased at slower disc speeds, it would have worked against Wagner had he used a cutting stylus. But an embossing stylus can be the same shape as the playback stylus—theoretically eliminating this type of distortion.

Embossed records, however, suffer from two faults. One is spring-back: the attempt of



30-kc energizing signal—acting a little like AC bias in tape recording—increases efficiency of stylus in embossing record groove into surface of plastic disc.

AN L-L-L-L-L-L-L-L-LP

the groove material to return to its original, unrecorded shape. The other is the weight necessary to make the ballpoint stylus tip create a large enough groove without tearing the plastic of the disc.

Wagner already had one clue in his search for ways to make his disc practical. A 9-kc tone produced good groove modulation but low tones didn't. Somehow, high frequencies recorded with greater efficiency. If he kept a 9-kc tone going continuously he could record lower tones with ease. But who wants to hear a 9-kc whistle with his music?

The big break came about 1958 with the introduction of ceramic cartridges made of barium titanate. They were cheap, rugged and (unlike the rochelle-salt crystals with which Wagner had been working) could resonate at ultrasonic frequencies. In Wagner's final design the barium titanate element, connected to a 0.3-mil spherical stylus, is cut so that it will resonate at 30 kc. Wagner selected that frequency because, being twice the frequency of the highest audible tones (for practical purposes), it would not be audible itself nor would it yield audible intermodulation products when combined with audible tones.

It's the 30-kc signal that makes Wagner's system work where others failed. Its energy helps the embossing stylus to produce wide, deep grooves with only about 2 grams of stylus pressure. In addition, the rapidly-vibrating stylus creates frictional heat that causes the surface of the vinyl disc to flow and set, overcoming spring-back.

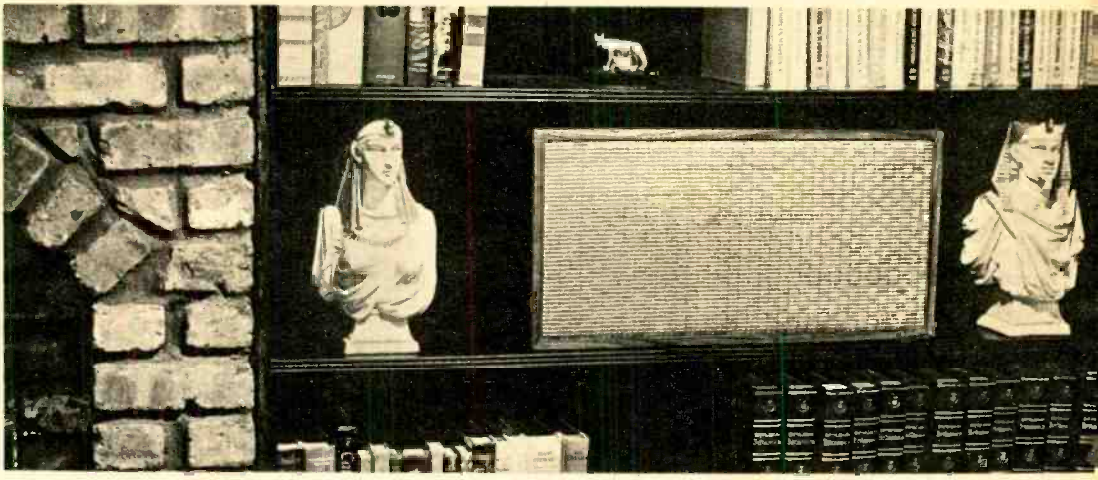
Wagner's record, known as MicroDisc, now is being used by more than 100 broadcast stations for logging complete program schedules of each broadcast day. The consumer and industry may be introduced to the MicroDisc in such applications as talking books, courtroom and airport logging and educational productions.

Wagner predicts that a home-type machine will cost about $150, with recording costs

[*Continued on page* 118]

Record/player unit for the broadcast industry turns a 9-in. disc at 2 rpm. It is designed to make recording of an entire day's broadcasts.

Home applications envisioned by inventor Robert Wagner include recorder/player the size of pack of cigarettes to accept 2-in. discs like these.



EI-8x Speaker System

By HARRY KOLBE

WITHOUT a doubt the bookshelf-style speaker has established itself solidly in the world of high fidelity. Of course there are still a few huge speaker systems around despite the fact that their popularity generally has declined. Although the bookshelf concept has firmed up, the number of such speakers on the market increases constantly. In conversations they're familiarly referred to by merely their model numbers. (Audiophiles often tend to speak in a model-number shorthand.)

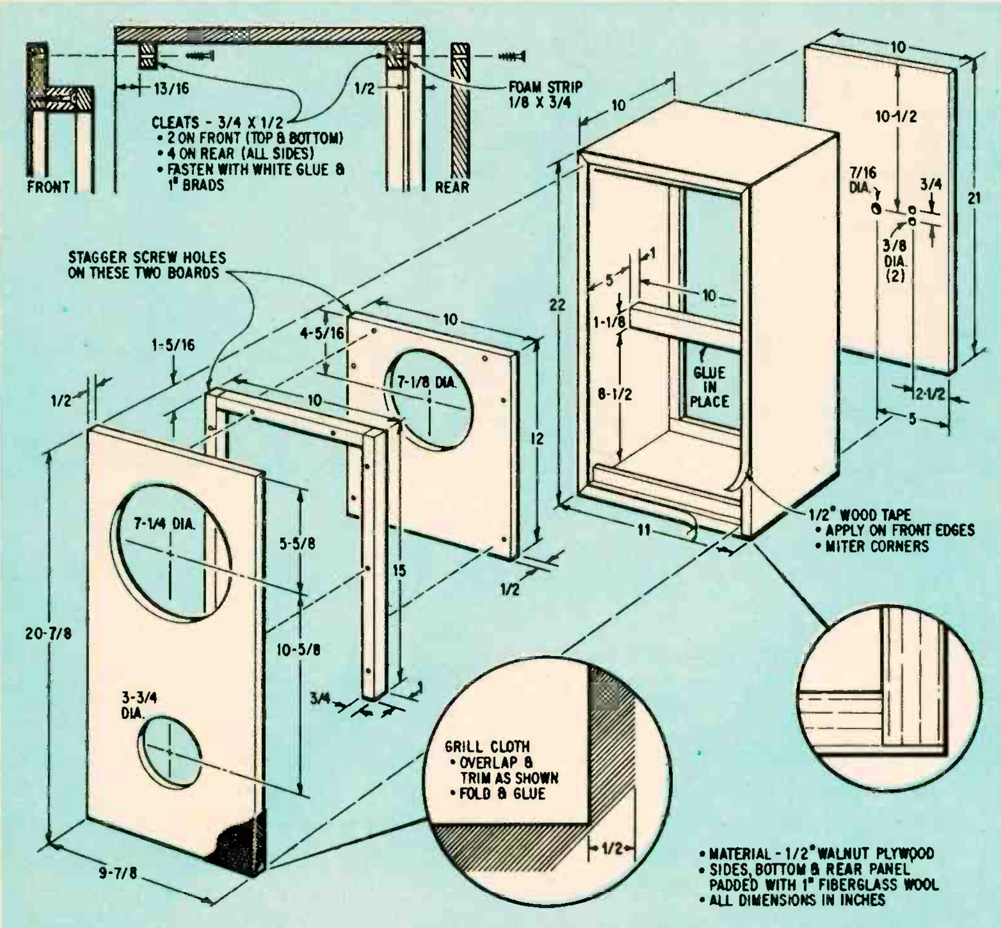
There are the Model Six, the AR-4, the XP-33, the 9000/MHX, the Model DLS-529, the AS-10, the Model 9 and the S-13, etc. etc. Only by being very close to the world of hi-fi can you keep up with who makes what.

And now, there's another speaker and number. Take special note of it and remember it. It's the EI-8x speaker system. As far as commercially-made speakers go, some of the numbers have meaning. But the designation EI-8x definitely means something. The letters EI you know about, but the 8x requires a few words. The number 8 is the diameter of the 8-in. woofer. The x, well, that comes from the name *X-Air*, which Olson Electronics calls it.

What kind of a system is the EI-8x? In its size class (10 x 11 x 22 in.) it beats many commercially-made speakers—especially when you consider its less than $30 price tag. Its sound leaves little to be desired. Bass is strong, clean and undistorted. The mid-range has no peaks and the high end is smooth right out to about 16 kc.

The EI-8x system is basically the old familiar R-J type enclosure—an enclosure in which the woofer is front loaded. The enclosure consists of a separate speaker board which is mounted 1 in. behind the cabinet's front board.

To visualize this, take a look at the cabinet-construction diagram which

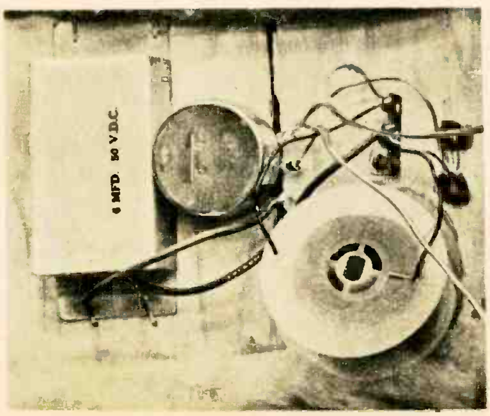


Cabinet construction. Front panel, spacers and speaker panel could be assembled as a separate unit then installed in cabinet. Front panel is held to cleats with wood screws installed from the rear.

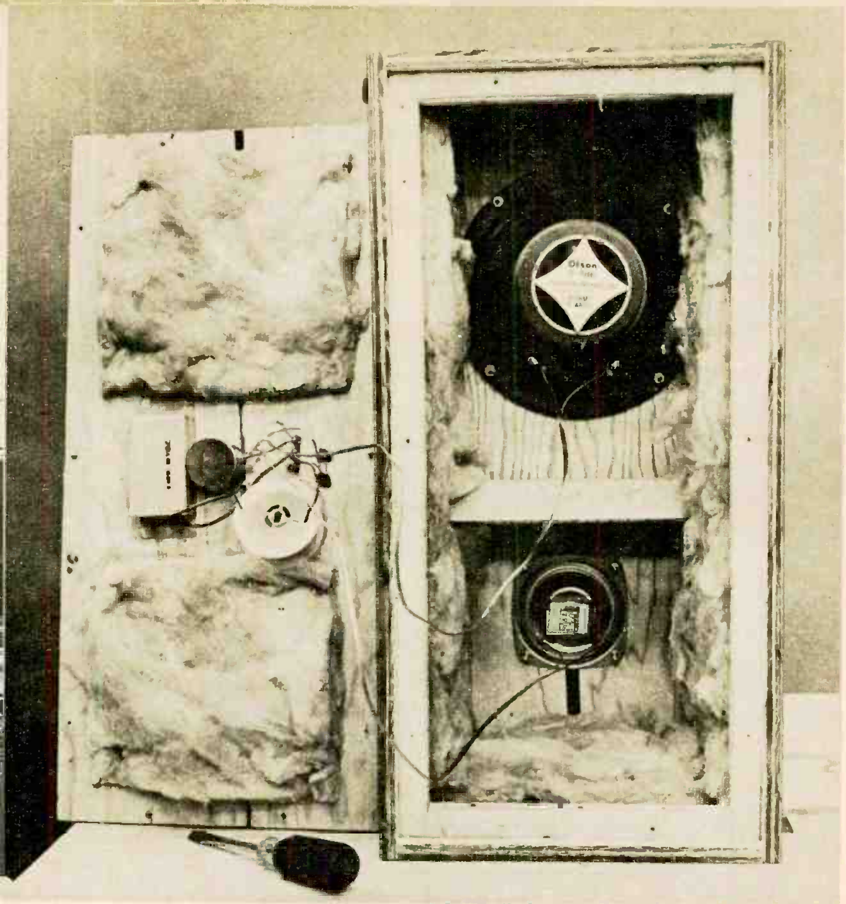
EI-8x

is shown above. The cabinet's front board is at the extreme left. Only the tweeter is mounted on it in the smaller hole. Note that nothing is mounted in the large hole at the top. Behind this board are 1-in. spacers on the back of which is attached the 10 x 12-in. speaker board. On this board is mounted the woofer. Mounting the woofer on a panel behind the front panel in this fashion, forms a chamber, the bottom of which is open. This chamber front-loads the woofer.

The effect of the front-loaded woofer shows up when listening to music that has a well-defined bass line—a string quartet, for instance. We compared the EI-8x with



Crossover. We used 6 μf metallized-paper capacitor (left) but you can use two 10-μf electrolytic capacitors connected in series, back-to-back.



Ready to be closed up. Fiberglass wool can be held to cabinet with staples, tacks or glue. Be sure that crossover capacitor is firmly held to back so it won't rattle. Choke should be held to cabinet with brass screw as an iron screw will change choke's inductance. Before closing box, make sure the speakers are connected in phase.

PARTS LIST

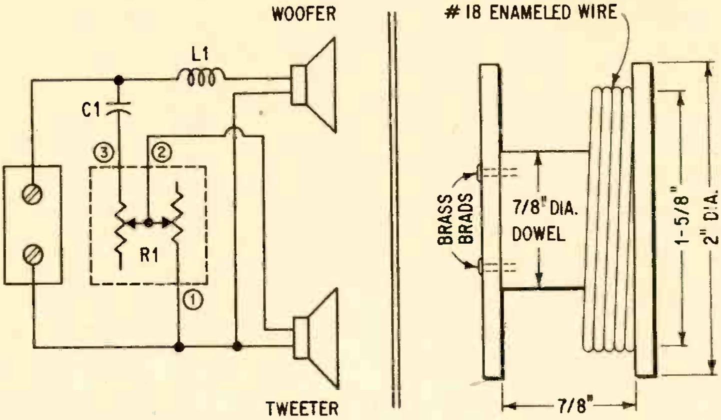
C1—6 µf, 50 V or higher, metallized-paper capacitor, or two 10-µf, 50-V electrolytic capacitors in series, back-to-back. (See text)
L1—Choke wound of No. 18 enameled wire on ⅞-in. I.D. x 1⅝-in. O.D. x ⅞-in. thick form.
R1—8-ohm L-pad (Lafayette 99 C 6134 or equiv.)
TWEETER—4-in. full-range (Lafayette 99 C 0172)
WOOFER—8-in. speaker (Olson electronics 8-in. X-Air, Stock No. S-786; $13.98 plus postage.)
Misc.—two-lug terminal strip, ½-in. walnut plywood, grille cloth, hardware, fiberglass wool, wood tape, foam strip, ⅞-in. dia. dowel.

a system of using a single, high-quality, full-range 10-in. speaker in a ported enclosure. Cost of the two systems was about the same. (In terms of overall sound, our comparison speaker had generally been able to out-perform smaller, high-compliance systems.)

Better high-end response in the EI-8x was to be expected as a matter of course (you can expect just so much out of a 10-in. full-range speaker). But wouldn't the larger cone of the comparison system give it an advantage at the bottom? An A-B test proved that it did not. Frequency doubling (the tendency of a speaker to produce a tone an octave higher than the signal fed into it as the tone descends toward the speaker's resonant frequency) was considerably more noticeable from the comparison speaker. Frequency doubling is, of course, hard to hear as such unless it is extreme. The cello in our string quartet, for example, produces the octave above the note it is playing as part of its natural pattern of overtones. Doubling simply reinforces the overtones. Our comparison speaker made the overtone of some of the lower notes more prominent than the fundamental, while the EI-8x did not. The EI-8x gave the cello a cleaner, clearer sound.

Construction. Everything in the EI-8x speaker system is related. You can't substitute speakers and you should not try to build a larger or smaller cabinet. Start with the sides, top and bottom which are made from ½-in. walnut plywood. All joints are rabbeted, as shown in our diagram. This construction is among the easiest there is in

Crossover schematic, left, L1's dimensions, right. L-pad R1 is used to establish balance between speakers. Circled numbers on R1 are numbers stamped on lugs. C1 can be replaced by two back-to-back, series-connected electrolytic capacitors.



EI-8x

woodworking. It eliminates edge grain and is far simpler to make and assemble than a mitered joint.

A table saw is best for rabbeting. Adjust the blade height so it leaves at least two layers of veneer, as indicated. The depth of the cut should be a trifle less than the thickness of the plywood. The length of the cut from the edge of the wood should be a little over the thickness of the plywood.

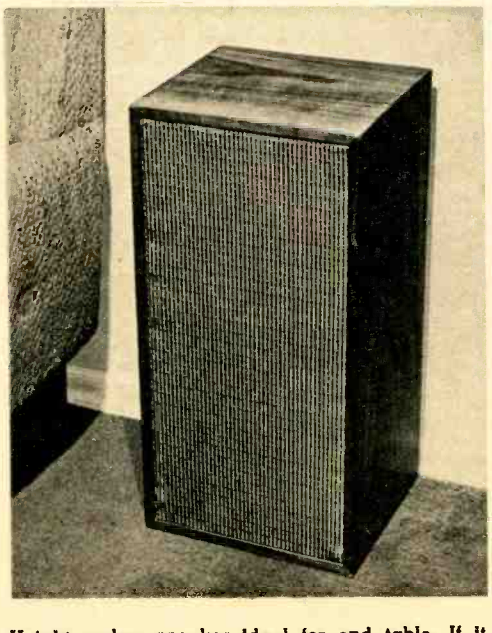
Prepare the cleats next, cutting them to sizes shown. The rear of the cabinet gets four cleats—one on each side, top and bottom. They are set in 9/16 in. from the rear edge and are held with brads and white glue. At the front use cleats only at the top and bottom. Another set of cleats, used as spacers between the front panel and speaker panel must be attached to the sides of the cabinet.

Note that the rear speaker panel as well as the cleats to which it is attached are set 1 5/16 in. below the front panel. A ⅛ in. x ¾ in. piece of foam-rubber strip is used to line the rear cleats so there will be a tight seal with the rear panel.

The front panel is cut ⅛ in. smaller in length and width than the cabinet opening to allow for grille-cloth overlap. A few staples will hold the cloth while the glue sets. Use a little Mortite between the front panel, the top and bottom cleats and the panel-spacer cleats to get a good air-tight seal.

Sand the entire cabinet and smooth all sharp edges. Apply paste filler if you used an open grained wood such as walnut, oak or mahogany, then finish off with several coats of brushing lacquer either satin or gloss.

The crossover network is mounted on the cabinet's rear panel. In our model we used a 6 μf, metallized-paper capacitor for C1. As this type capacitor is expensive, we suggest you connect two 10 μf, 50 V electrolytic capacitors in series, back-to-back. (The capacitance will be close enough.) That is, connect the negative terminals together. Make the coil form shown out of wood and wind the No. 18 enameled wire on it in even layers until you reach the diameter shown. One pound of wire will be enough. Good listening.



Height makes speaker ideal for end table. If it is to be used on the floor, instead of on a bookshelf, make sure that the woofer is at the bottom.

EI Kit Report

MENTION *electronic keyer* to a group of hams and you probably will start a controversy. Some believe the perfect code it produces takes the friendly swing out of the sender's fist. Others like it because it eliminates the drudgery of pounding a regular key or semi-automatic bug. Most would agree, though, that machine-like code from an electronic keyer is the easiest kind to copy when the band is crowded.

Latest addition to the handful of keyers now on the market is the Eico 717, which unerringly produces code according to the book: a *dah* is always three times longer than a *dit* and intervals between characters are always one *dit*. These proportions hold at a lazy 3 wpm or 75 wpm.

Cost of the 717 kit is $49.95 ($69.95, assembled). This does not include a key—the side-swiping paddle that is operated manually. This is an extra item which costs about $15 at distributors. If you already have a semi-automatic bug you can modify it by following Eico's instructions.

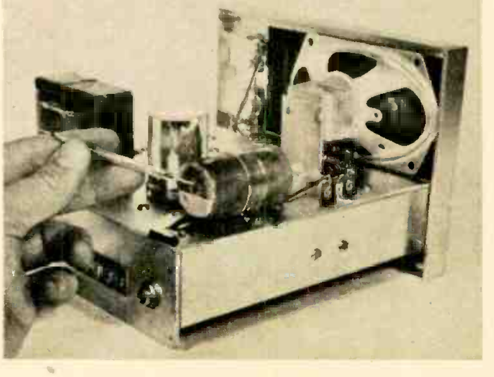
The 717's design is staunchly conservative, from its battleship-like construction to its circuitry. The keyer uses six vacuum tubes and is assembled on a standard metal chassis with conventional wiring.

We clocked construction at 14 hours. Nothing more disturbing was discovered than a few missing lockwashers and a 7.5-megohm resistor listed as yellow-green-green (the first color should have been violet). A welcome feature is the addition of large numbers on the pictorials which correspond to each step in the construction manual.

The 717 sports two important features. First is a superb speed range of 3 to 75 wpm (four ranges plus a vernier adjustment).

The other feature becomes apparent when the keyer is hooked to a transmitter. The circuit has a relay which does the keying. Solid-state advocates would argue that a keying transistor is electronic, has no contact bounce and won't wear out. But the 717's relay is not an ordinary type. It contains a sealed, fast-acting reed that could prove more versatile in application than a transistor. A transistor keyer might be restricted to transmitters which utilize grid-block keying (a negative bias is shorted to ground). The reed relay, on the other hand, can handle the current in almost any CW transmitter. In other respects the 717 offers the usual features of an electronic keyer: a built-in monitor with volume and tone controls and provision to switch on the carrier continuously.

Our first trial on the air with the keyer proved its worth. After a couple of CQs on 20 meters, a W4 some 1,200 miles away returned the call. In clipped CW style he reported; *Keyer vy gud.*



Transmitter is keyed by glass-sealed reed relay, shown here being inserted into large electromagnet coil which supplies required driving force.

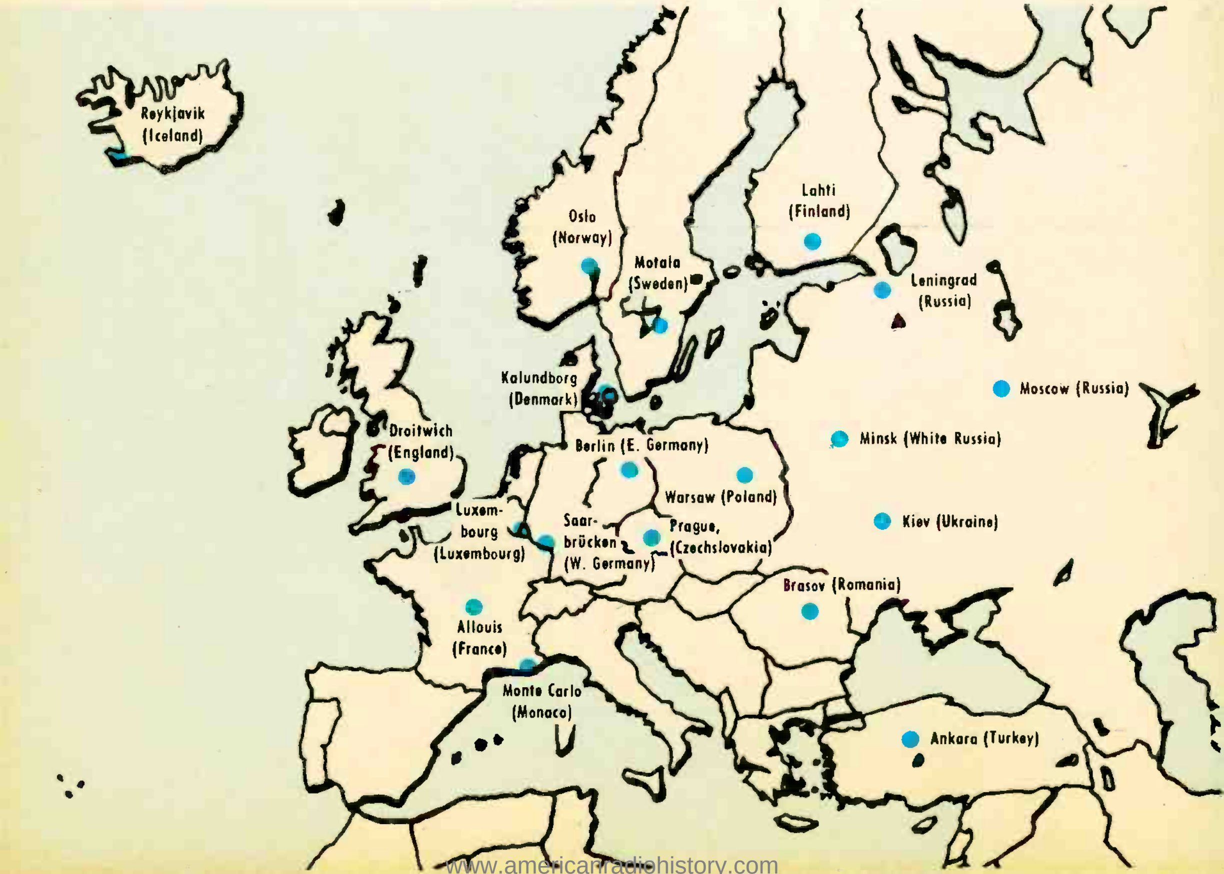
THE FORGOTTEN WORLD OF

IN the early days of radio it was long wave rather than short wave that was used for distant communications. Today, despite vast improvements in equipment that have made short wave far more effective over long distances, there still are European and Asian international broadcasters operating in the band from 150 to 300 kc. And, with a little effort, some of them can be heard in North America.

At night, frequencies from 300 kc down tend to penetrate the lower edge of the ionosphere only slightly and are, therefore, reflected efficiently. And ground-wave losses are extremely low. As the frequency drops these properties improve. Below 150 kc, however, voice modulation becomes impractical. Another practical problem with LW is the long wavelength itself—about a mile in the band we are talking about. This means mammoth antennas.

For North American DXers, 200 kc is a critical dividing line. Above it, LW is used on this continent for radio beacons and aeronautical radio ranges (although the latter gradually are being replaced by VHF and UHF facilities). Some of these stations have weather broadcasts superimposed on the navigational (CW) signals. The result is a band almost as crowded as the BCB. Still, high-powered overseas broadcasters do occasionally sneak through—primarily because music can be spotted so easily.

Frequencies between 150 and 200 kc are used only to a limited extent in North America—ironically for two European-style radionavigation systems. One of these is called DECCA. Its stations create a minimum of interference because they transmit nothing but unmodulated carrier. There are also a handful of Consolan stations transmitting strings of dots and dashes (the ratio of dots to dashes determines your bearing relative to the station) with CW IDs every minute.



LONG-WAVE BROADCASTING

By ALEX BOWER & WALTER R. LEVINS

But at worst you will never have to fight your way through more than one North American transmitter at a time below 200 kc.

Two of the oldest European LW stations are right on the 200-kc dividing line. Most frequently heard on this side of the Atlantic is at Droitwich, England, operated by the BBC. It signs on at 2300 EST. Providing QRM for Droitwich is R. Moscow.

The best bets for DX higher in the band are the 1400-kw R. Monte Carlo, R. Luxembourg, Czechoslovakia's CS-1 and, closer to home, TFW in Reykjavik, Iceland. All should peak around 1800 EST. Also try CS-1 about 2230, R. Monte Carlo at 0500.

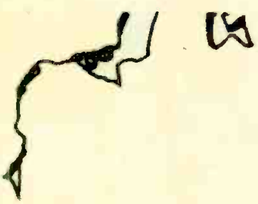
West-Coasters, meanwhile, should watch for R. Ulan Bator any time after midnight PST. Also worth watching are the Siberian stations at Vladivostok and Novosibirsk.

The most widely-heard LW broadcaster of them all is operated by the O.R.T.F. on 164

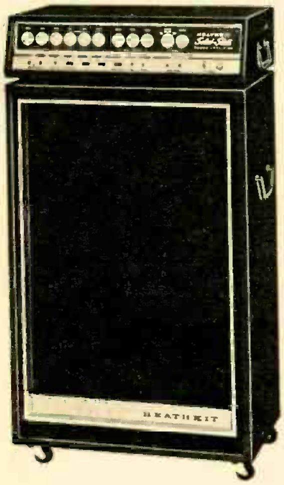
[*Continued on page* 122]

EI'S GUIDE TO LONG-WAVE BROADCASTING

FREQUENCY (kc)	POWER (kw)	BROADCASTER
151	50	Moscow I, U.S.S.R.
155	150	Brasov, Rumania
164	500	Allouis, France
173	500	Moscow II, U.S.S.R.
182	1000	R. Europa I (Saarbrücken), W. Germany
182	240	R. Ankara, Turkey
185	1000	Deutschlandsender (Berlin) E. Germany
191	600	Motala, Sweden
200	100	Moscow III, U.S.S.R.
200	400	Droitwich, Great Britain
209	150	Kiev I, U.S.S.R.
209	100	Reykjavik, Iceland
209	150	Ulan Bator, Outer Mongolia
218	200	Oslo, Norway
218	50	Krasnoyarsk, U.S.S.R.
218	1400	R. Monte Carlo, Monaco
227	500	Warsaw I, Poland
227	150	Ulan Bator, Outer Mongolia
233	500	Luxembourg I, Luxembourg
236	100	Leningrad I, U.S.S.R.
245	150	Kalundborg I, Denmark
245	100	Vladivostok, U.S.S.R.
254	200	Lahti, Finland
272	200	CS I (Prague), Czechoslovakia
272	100	Novosibirsk, U.S.S.R.
281	100	Minsk, U.S.S.R.



Look What's NEW In The



NEW! Deluxe Solid-State Combo Amplifier & Speaker System!

Kit TA-17 Amplifier
$175.00
40 lbs.

Kit TA-17-1 Speaker System
$120.00
100 lbs.

Special Combo Offer!
Kit TAS-17-2 Amplifier & 2 Speaker Systems
Save $20.00
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240 lbs.

All the "big sound" features every combo wants . . . tremolo, built-in "fuzz", brightness, reverb, plus a shattering 120 watts of EIA music power. Has 3 independent input channels each with 2 input jacks. Handles lead or bass guitars, combo organ, singer's mike, even a record changer. Speaker system features two special 12" woofers, special horndriver and matching black vinyl-covered wood cabinet.

NEW! Low Cost Single-Channel Solid-State Guitar Amplifier

Kit TA-27
$89.95

Boasts 20 watts EIA music power, 40 watts peak power; variable tremolo & reverb; two inputs that handle lead guitars; singer's mike; special heavy-duty 12" speaker; line bypass reversing switch that reduces hum; transformer-operated power supply; and handsome leather-textured, black vinyl covered wood cabinet with extruded aluminum front panel and chrome knobs. 35 lbs.

NOW Available Fully Assembled . . . Heathkit "Starmaker" Dual-Channel Guitar Amplifier

Assembled TAW-16
$199.95
(Kit TA-16 $134.95)

Features all solid-state circuit; 25 watts EIA, 60 watts peak power; two channels, one for accompaniment, accordion or mike, the other for variable tremolo & reverb; two inputs each channel; two 12" heavy-duty speakers; line bypass reversing switch for hum reduction; leather-textured black vinyl covered wood cabinet with extruded aluminum front panel & chrome knobs. For extra savings, build the kit version in just 15 hours. 52 lbs.

NEW LOW PRICE On Heathkit "180" Deluxe Color TV

Now Save $30 on this superb set. Features 180 sq. in. rectangular viewing area, plus exclusive built-in servicing facilities so you can converge and maintain the best color pictures at all times. Also has 24,000 volt picture power, automatic degaussing, rare earth phosphors for livelier colors, 3-stage IF, plus many more advanced features. Choice of installation . . . in a wall, your custom cabinet or an old black & white set cabinet, Heath assembled contemporary (Illust. $49.95) or Early American ($75.00) floor cabinets, or new Heath table model ($24.95) cabinet. Build in 25 hours. 102 lbs.

Kit GR-180
Was $379.95
Now Only
$349.95
(less cab.)

'68 HEATHKIT® Catalog!

NOW Available Fully Assembled . . . World's Most Advanced Stereo Receiver

Assembled ARW-15
$499.95 (less cab.)
Kit AR-15, $329.95

Boasts advanced features like integrated circuits and crystal filters in the IF amplifier; ultra-sensitive FET FM tuner; 150 watts dynamic music power; AM, FM and FM stereo; positive circuit protection; all-silicon transistors; "black magic" panel lighting; stereo only switch; adjustable phase control and many more. 34 lbs. Optional wrap-around walnut cabinet $19.95

NEW! Professional 10-Band Shortwave Listener's Receiver

Kit SB-310
$249.00 (less speaker)

Covers 6 shortwave bands (49, 41, 31, 25, 19, & 16 meters) . . . 80, 40 & 20 meter ham bands . . . 11 meter CB. Has 5 kHz crystal filter for AM, SSB and CW; Selectivity that slices stations down to last kHz . . . no more guessing station identities; 11-tube circuit; crystal-controlled front-end; prebuilt & aligned linear oscillator; metal cabinet. Other crystal filters available. 20 lbs.

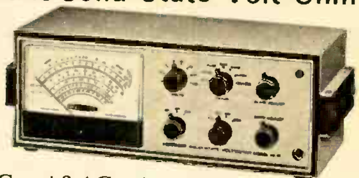
NEW! Amateur Novice CW Transceiver

Kit HW-16
$99.50

Novices! New Hams! Get on-the-air at lowest cost. Provides CW operation on the first 250 kHz of the 80, 40 & 15 meter bands. 75 watt CW input, up to 90 watts for general class operation. True "break-in" CW operation. Crystal control transmit with VFO receiver tuning. Built-in sidestone. Grid-block keying. Metal cabinet and simple assembly. 25 lbs.

NEW! Deluxe Solid-State Volt-Ohm Meter

Kit IM-16
$44.95



Features 8 DC and 8 AC voltage ranges from 0.5 v to 1500 v full scale; 7 ohmmeter ranges; 11 megohm input resistance on DC ranges; 1 megohm on AC ranges; internal battery or 120/240 v. 50/60 AC power for portable or "in-shop" operation; 6" 100 uA meter; single test probe for all measurements; new Heathkit "unitized" cabinet construction.

NEW! Heathkit Jr.® Solid-State Portable Phonograph

Kit JK-17
$19.95

Perfect for the youngster in your family. Plays all 4 speeds, all record sizes. Crystal cartridge with sapphire stylus for all types of records; 4" speaker; built-in 45 rpm adaptor; preassembled turntable and hardboard cabinet. Build in 1 to 2 hours. 117 VAC, 60 Hz operation. 11 lbs.

NEW! Heathkit Soldering Iron

Kit GH-17
$14.95

Ideal for kit-building or other electronic soldering jobs. Safe 6 volt, 25 watt GE midget iron with non-corroding tip. 3 heat ranges. Excellent heat recovery time. Quick warm-up . . . iron ready in 2 minutes. Protective metal cage. Build in an hour. 5 lbs.

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EI Kit Report

State-of-the-Art CB Transceiver

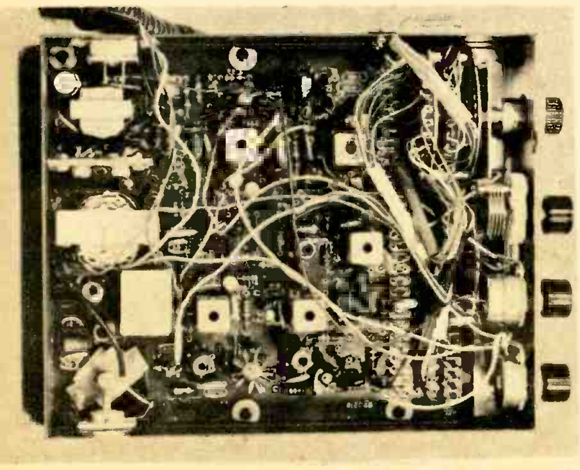
Knight-Kit Safari III

THE Knight-Kit Safari III 5-watt transceiver represents the state of the CB art for the time being in size and operating flexibility.

Consider its size—2⅛ x 6⅞ x 8½ in. Compared to transceivers of but a few years back, it is minuscule.

Look at it as a rig for all occasions. A neat $84.50 buys the basic transceiver (12-V operation only), which has sockets and dial marked for 23-channel coverage (only one pair of crystals included). Put it on a $19.95 AC power supply and battery charger base (shown above) and it becomes a base station. Install it in a special mounting bracket and it becomes a hardly-noticeable under-the-dash rig. Attach it to a $19.95 battery pack (standard or rechargeable D cells) and you can stroll around with 5 watts over your shoulder. A portable antenna and canvas carrying bag are extras.

Extreme compactness and the ability to operate in almost any situation describe the best-designed 5-watters around today and the Knight-Kit entry is up there with the best.



Underside of transceiver. Tedious jobs were wiring channel-selector switch (top, right) and installing crystal pin holders (left of controls).

Unlike many small solid-state transceivers, the Safari III does not have a cabinet-mounted speaker. Instead, in the receive mode the microphone serves as speaker. Though we found this inconvenient for base operation, it was a decided advantage in mobile and portable operation, where ambient noise levels can be high. Other features include a control for tuning off-frequency signals as well as volume and squelch controls and an S-meter.

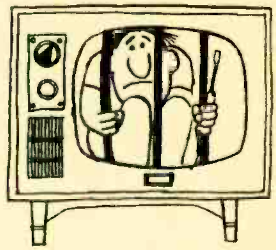
Building It. The only tedious construction was the wires from the crystal sockets to the channel-selector switch. Except for the oscillator coil, all tuned circuits are pre-aligned at the factory. The oscillator coil must be adjusted for peak reception. And you could set it incorrectly. The coil has two peaks. Use the peak that permits the tuning control to operate. If the coil is tuned to the other peak the tuning control has no effect. (Our alignment instructions didn't mention an extra peak.) We built the kit in 20 hours.

Performance. The receiver, which the builder assembles, worked straight off. Unfortunately, the factory-wired transmitter section had to be returned to Knight for repairs.

The receiver's sensitivity checked out at 1.8 μv for a 10db S+N/N (signal-plus-noise to noise) ratio with adjacent-channel rejection of 35db (pretty good, we thought, for a transceiver under $100). Image rejection was 30db (good) and AGC action was good.

The three-stage transmitter portion of the rig, as we said, is supplied factory wired and aligned (to conform to FCC regulations). With an operating voltage of 13.8 V (the voltage of a charging automobile battery), the RF output power was nearly 3.9 watts. The modulation reached 85 per cent—essentially 100 per cent—with a normal mike (speech) input level and was limited to a maximum of 100 per cent with no overmodulation regardless of the mike input level.

BEWARE OF YOUR OWN TV REPAIR TRAPS



Go ahead. Do it yourself. But read this first.

By ART MARGOLIS

AT the front of my TV repair shop is a tube tester and a display of replacement parts. Together, they lead to many a successful do-it-yourself repair. But others end up on our service bench in sad disarray. For, hidden in the complex route from diagnosis to repair, booby traps await the unwary home handyman.

While all kinds of bizarre electronic tragedies happen to the fearless, little can hurt the careful. A few professional tips can help you bypass the ambushes with techniques that are mostly common sense. Let me tell you about some case histories that exemplify what I mean.

Two for the Tester

One evening two people were taking turns at the tube tester when a gentleman brought in a 19-in. portable TV. As he lifted the TV onto the service counter he glanced at the brunette at the tester. She was about to press the button.

"That's a bad one," he snapped and pointed to the lit neon that indicated a shorted tube.

She looked up, startled, then smiled. Taking the tube out of the tester, she handed it to me. It was a 6BQ7. Meanwhile, the tall young fellow opened his paper bag and began testing tubes. As I was writing up the bill for the brunette's new 6BQ7 she started to put it in her handbag.

"Hold on, honey," said the man with the portable. He took the tube from her hand and shouldered the young fellow away from the tester. "Always test a new tube. Some of them are bad." Her 6BQ7 wasn't, though. She smiled, paid me and left.

I started to take the back off the man's portable but he was watching the younger fellow at the tester. Presently the young man was at the counter asking for a 6EA8 and a 6CE5. I gave him a 6U8 and a 6BC5 as replacements and the young man proceeded to put all the tubes back in the bag.

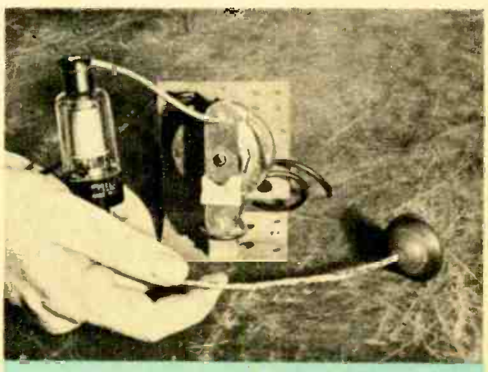
"Don't put those bad ones in your bag," snapped the older man. He grabbed the two bad tubes and tossed them into the trash can. "They'll get back in your set if you don't heave them. Also, you'd better make a note that the 6EA8 goes in the 6U8 socket and the 6BC5 in the 6CE5 socket. You'll get them mixed up otherwise."

In spite of the way it was said, this obviously was good advice. The young fellow made a face but did as he was told.

The Hotter Heater

"I know, the 1B3 is bad again," moaned the gentleman, turning his attention to the portable. "I changed five of them in the last few months." There was high voltage at the cap of the 1B3 rectifier but none going into the picture tube.

"Looks like you've been booby trapped," I said, breaking the news as tactfully as I could. "Your set takes a 3A3 high-voltage rectifier, not a 1B3. Even though the two tubes look exactly alike your 3-V heater



1B3 and 3A3 high-voltage tubes look exactly alike, often are mistaken for each other.

BEWARE OF YOUR OWN TV REPAIR TRAPS

voltage will keep on opening up the 1¼-V heater of a 1B3."

The Inexact Replacement

Harry Townsend owns a hi-fi store and is an expert in his own right.

"Strange thing," he said, trying to cover his embarrassment at having to go to anyone else for electronic service help. "The picture on this set won't hold still. It rolls sporadically."

"He adjusted the vertical height and linearity until the picture had shrunk about 2 in. from the top and bottom of the tube. "Now it will hold," said Harry, adding sheepishly that he had worked on it the day before. "When I turned it on there was no picture—just a white line across the screen. I found the vertical output transformer had an open winding so I put in a new transformer and it's been rolling ever since."

"How had the vertical hold been before it went off?"

"Perfect!"

"First thing I always do when I cure a trouble and discover a new one is double check any part I replaced."

"Way ahead of you," he sighed.

"Once I determine the part is good I check its value to be sure it's the right part."

"Did that too, Art. In fact, I didn't even use a universal replacement. I called the distributor for the exact factory part."

Fortunately, he had the old output transformer with him. It was marked 104102-4. The number on the one inside the set was 104102. Not *quite* the same. I looked up the universal replacement number and tacked one into the circuit. Now the picture filled the screen. I tried the vertical hold. It was locking solid.

"The replacement transformer didn't quite match the impedance of the yoke," I said. "It's like a mismatch in the output of an audio circuit—you get lowered output. If you try to compensate by turning up the controls, the way you did with the linearity and height, you get distortion—in this case a loss of vertical hold."

I could see he was burning. I reached for a record changer I had been having trouble with. "Harry, I'm stuck on this bomb. The reject doesn't always work. I wonder . . ."

Color Un-Coded

"That yoke you sold me—it's not the trouble," said a pathetic voice on the phone one day. I could hear his wife cluck-clucking in the background and I knew it must be Mat Harrison. They had been in earlier in the day and she was dead set against his trying to fix the TV.

His trouble was a classic case. "The picture comes on but it is shrunk in on all four sides,"

Reversing the leads of the deflection yoke results in reversed deflection of electron beam. Universal replacement yokes can't match color coding of all yokes they replace. You must peel off cover to match lead wires.

he had said. "And the picture is shaped like a keystone."

I explained that he probably had a bad deflection yoke. The yoke has four sections. The two vertical sections spread the picture out from top to bottom. The two horizontal sections spread the picture from side to side. Whenever one of the windings shorts, it's respective picture area shrinks. This causes the keystone-shaped picture. So I sold him a universal replacement yoke.

"The picture is not shrunk any more," he moaned. "It's worse. It's upside down and backward."

"Your yoke is okay," I told him. "You just have it wired wrong."

"Impossible," he said emphatically, "I matched the colors wire for wire."

"Sorry about that, chief, but the colors don't match. A universal replacement is made for a hundred different TVs. You'll have to peel the cover off the old yoke, make a sketch of which wires are coming from which connections and match the new yoke to the old." He had been trying so hard to touch all bases in replacing the yoke that he had not stopped to consider what might go wrong.

Gently Does It

A similar case showed up one Sunday morning. The girl from my answering service sounded rattled when she told me that someone's TV set had exploded.

It turned out to be a finicky accountant who loves to save money by doing everything himself. He's great at following instructions to the letter. He had been in the shop on Saturday to get a 24-in. picture tube. My advice that, for replacement purposes, a rebuilt tube was the best buy fell on deaf ears. But when I offered tips on installation of the tube he made notes of everything.

As I took the replacement out of the box for him I pointed to the plastic cap on the CRT neck. "On your old tube you'll find a little metal strap that connects two pins. Be sure to take it off the old tube and put it on this one. Without it your picture will be blurred."

Next I pointed to the yellow band on the CRT neck with the lettering DO NOT USE ION TRAP. "This new tube has a straight electron gun instead of a bent one like your old tube. You won't need the ion trap. It's the ring with the small magnet around the neck of the old tube. Leave it off. The main tube is aluminized so the ions won't burn up the screen."

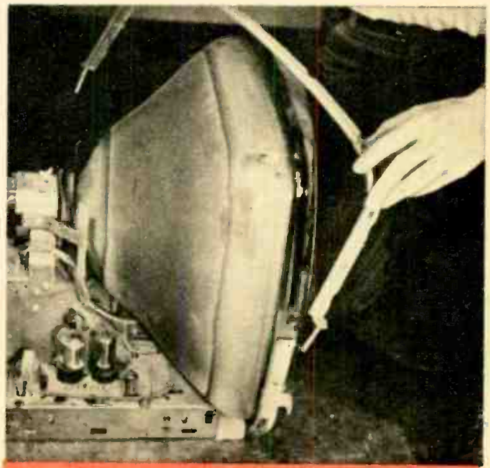
The last advice I had given him was, "As you take the old tube out make a note of every move you make. Then retrace your exact steps as you install the new tube."

"Don't you worry about that," he snorted.

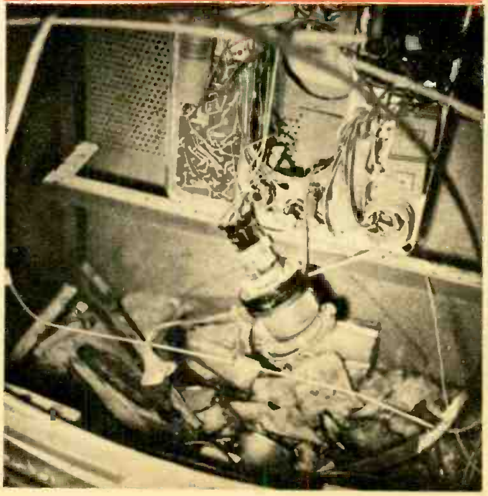
As I walked into his living room I found glass all over the floor. The trail of glass led to the TV which looked sad with its face blown out.

"I made sure I got that strap back on exactly like it came off," said the accountant,

[*Continued on page* 116]



CRT circumference varies from tube to tube. Metal strap should be tightened only until it is snug around replacement, regardless of position on old tube. Tighten it too far and you will be in for some serious trouble.



Swap Shop

Individual readers (not commercial concerns) may swap electronic gear by sending one listing, name and address to Swap Shop, ELECTRONICS ILLUSTRATED, 67 West 44th Street, New York, N.Y. 10036. Space is limited; only most interesting offers are published.

AMATEUR RADIO

KNIGHT T-150A. Will swap for SSB transceiver, rotor or best offer. Roland Kulish, WA5LTV, 5075 Heisig St., Beaumont, Tex. 77705.

EICO 753A VFO with AC power supply. Swap for SB-34 or best offer. Bruce Bennett, 938 Kintyre Way, Sunnyvale, Calif. 94087.

TAPECODE course, 4 to 18 wpm. Make swap offer. Ned Sebring, WA8OWL, Box 325, Owosso, Mich. 48867.

KNIGHT T-60 transmitter. Will swap for tape recorder. Robert Friedman, 425 Dayton Towers Dr., Apt. 6Q, Dayton, Ohio 45410.

ARC-5/BC-696 transmitter. Will swap for antenna rotator, low-pass filter or best offer. Joe Steppy, 2031 Reach Rd., Williamsport, Pa. 17701.

GENERAL ELECTRIC transmitter, AM/CW, 1.5-22 mc. Will swap for Lafayette HA-520 receiver or best offer. Ronnie Dean Carter, Box 67, Olivia, N.C. 28368.

JOHNSON Viking I AM/CW transmitter. Will swap for electric guitar or best offer. Mark Freedman, WB2MRJ, 67-10C 190th La., Fresh Meadows, N.Y. 11365.

GONSETT G-66, G-77 mobile rig. Will swap for CB transceiver. O. C. Powell, 214 Chandler Rd., Goldsboro, N.C. 27530.

NOVICE TRANSMITTER. Will trade for 2-meter gear or best offer. Bob Dakin, WA1GIR, 5 Charles St., Rutland, Vt. 05701.

AUDIO & HI-FI

AUDIO AMPLIFIER, homebrew. Will swap for intercom. Kevin King, 6324 Southgrove Dr., Mentor, Ohio 44060.

LAFAYETTE RK-142 tape recorder. Will swap for tube tester adaptable for TV picture tubes. Sam Greb, Box 976, Frederick, Okla. 73542.

GRANCO FM tuner. Will swap for walkie-talkie or best offer. Richard Landis, 36 Wartman Rd., Graterford, Pa. 19426.

STARLITE tape recorder. Will swap for Lafayette HA-63A receiver or similar. Ray Maletto, 22 Wall St., Red Bank, N.J. 07701.

WEBCOR 2150 stereo tape deck. Trade for HB555 or similar. Dr. L. J. Wiley, 1726 W. 40th, Erie, Pa.

MAGNECORD PT6-J recorder. Swap for Hallicrafters, Hammarlund communications receiver or best offer. John H. Schmeler, 3667 W. Allenville Rd., Rt. 1, Oshkosh, Wis. 54901.

LAFAYETTE amplifier/speaker with power supply. Make swap offer. Richard Southard, 1896 Rockville Dr., Baldwin, N.Y. 11510.

MAGNAVOX Combo AM/FM/phono. Will swap for CB transceiver, 1-watt walkie-talkies or best offer. Steven Rothstein, 1005 E. 103 St., Brooklyn, N.Y. 11236.

LAFAYETTE RK-155 tape recorder. Will swap for CB transceiver. Dale K. Moseman, RFD1, Oakland, Neb. 68045.

PHILCO AM/FM receiver. Swap for pre-1930 radio gear. Donn Miller, 2391 Werren Rd., Walnut Creek, Calif. 94529.

VISTA 520 tape recorder. Want VHF receiver or auto radar detector. Tom Sanor, 1300 Monter Ave., Louisville, Ohio 44641.

TAPE RECORDER. Will swap for audio amp or AM/FM tuner. Ron Hawthorne, 27854 Lincoln Rd., Bay Village, Ohio 44140.

BIRCH stereo record player. Trade for general coverage or amateur-band receiver. Larry Puffen, 142 W. Church St., Nanticoke, Pa. 18634.

HI-FI AMPLIFIER, 32-watt. Swap for best offer. Jimmie Jones, 125 Poplar St., Abilene, Tex. 79602.

ZENITH AM/FM and AM/SW. Will swap for Lafayette HA-230 or similar ham gear. Ricky Miller, RR#1 Box 267, Tripoli, Ia. 50676.

SONY 300 tape recorder. Trade for Uher recorder, communications gear, hi-fi equipment. Arthur R. Tilford, 1072 Ash Ave., Provo, Utah 84601.

EICO HF-86 28-watt stereo amplifier. Want oscilloscope. James B. Lagerkvist, 316 Jeffery, Royal Oak, Mich. 48073.

AMPLIFIERS. Want tape deck, recorder or PA gear. Mark Nesbitt, 7 DeSalaberry St., Hull, Que., Canada.

ELECTRO tape recorder. Will trade for Knight Star Roamer short-wave receiver or best offer. Jason Fabre, 702 Tumenello St., New Road, La. 70760.

ANTIQUE ELECTRONICS

PRE-1926 radios. Will swap for CB transceiver. Ernest Wagner, 1345 Varner La., Conemaugh, Pa. 15909.

MARCONI CRYSTALS. Will swap for 7- to 7.3-mc crystal or best offer. Larry Dahl, Box 487, Beaverlodge, Alberta, Canada.

ATWATER KENT receiver. Will swap for VTVM or oscilloscope. Clarence Womack, Box 694, Luling, La. 70070.

QST MAGAZINES, 1921-65. Will swap for 2-meter gear. Joe Zolik, WB2SAF, 153 Lincoln Ave., East Paterson, N.J. 07407.

ASSORTED PARTS, TUBES, 1929-32 vintage. Swap for Heath 10-20 auto analyzer or similar. Eric B. Olsen, Rt. 1 Box 4, Kingsville, Ohio 44048.

ATWATER KENT Model 40. Will swap for RME Model 69 receiver, 1938 vintage. Ray Fisher, Box 234, Charleroi, Pa. 15022.

PARTS FOR cylinder, disc phonos. Will swap for stereo amplifier. Chiron Morgan, 720 5th Ave., Lewiston, Ida. 83501.

ATWATER-KENT 55 receiver. Want test gear. Philip Vogel, Divine Savior Seminary, Lanham, Md. 20801.

COLIN B. KENNEDY receiver, vintage 1914. Swap for ham gear. Alfred Boatman, Box 83, Cookeville, Tenn. 38501.

PHILCO 250 SW/BCB/LW receiver. Swap for SW receiver with 11-meter band or 1-watt walkie-talkie. John Reilly, Jr., 514 4th Ave., Haddon Hts., N.J. 08035.

WESTERN Air Patrol receiver. Want CB transceiver or Lionel trains built before 1960. Roy E. Bales, 7823 Peppertree Rd., Dublin, Calif. 94566.

ATWATER-KENT receivers. Make swap offer. Frank Pagano, 1835 W. 7th St., Brooklyn, N.Y. 11223.

ATWATER-KENT 40 receiver. Want short-wave receiver or best offer. Warren Tuiskula, 386 Stafford St., Cherry Valley, Mass. 01611.

CROSLEY 51 receiver. Want Hammarlund HQ-180AC and assembled Heath DX-60A. Steven Bryant, Star Rt., Central Bridge, N.Y. 12035.

ATWATER-KENT 60C receiver. Will swap for ham gear or test equipment. Kent Price, WB6SMA, 2913 Dale Ave., Ceres, Calif. 95307.

EDISON phonograph with cylinders. Want HO equipment or best offer. Tom A. Blade, Box 238, Olean, N.Y. 14760.

OLD TUBES. Want blueprints for Benson Gyrocopter. Bob Stratta, 96 Maple Leaf Way, Atherton, Calif. 94025.

CITIZENS BAND

REALISTIC TRC-X20 transceiver. Will swap for ham gear. Scott Stewart, WN5QNC, 102 S. Grace St., Crockett, Tex. 75835.

OLSON transceiver. Will swap for SW receiver or best offer. John Kendall, 3019 Sunnyside, New Castle, Ind. 47362.

ROSS 11-transistor walkie-talkie. Swap for communications receiver. Frederick Struebing, 763½ Nash Rd., North Tonawanda, N.Y. 14120.

HEATH GW-10 transceiver. Swap for Lafayette Comstat 9. Pat Griffith, KLK5459, 824 Blue Lake Ave., Rockford, Ill. 61102.

WALKIE-TALKIE, 100 mw. Will swap for 01-type X-ray emitting tube. Mike Henderson, 21 Powhatton Dr., Milford, Ohio 45150.

REALISTIC TRC-6 transceiver. Swap for SW receiver or best offer. Mitch Joelson, KOD7145, 32-63 77 St., Jackson Heights, N.Y. 11370.

HEATH GW-52 walkie-talkies. Swap for Heath MW-34 or similar. Mark Baugh, WA7EKQ, Box 191, Roy, Utah 84067.

SHORT-WAVE LISTENING

HALLICRAFTERS S-38D receiver. Will swap for Knight R-55A. Richard Enix, Lake City, Tenn. 37769.

HEATH GR-81 receiver. Will swap for walkie-talkie or tape recorder. Monte Bernstein, 5 Hawthorne La., Great Neck, N.Y. 11023.

KNIGHT Ocean-Hopper. Will swap for Lafayette HA-700 or similar. Craig Thompson, 6269 S. Orange, Fresno, Calif. 93725.

KNIGHT Star Roamer. Will swap for 35-mm or Polaroid camera. Larry Hendricks, 285 College St. S.W., Valley City, N.D. 58072.

SURPLUS HRO receiver 190 kc to 30 mc. Will swap for best offer. Gary Henman, WA9IYF, Box 22, Milan, Ind. 47031.

RECEIVER, BC-603, 20 to 29.1 mc, minus power supply. Will swap for BC-348. R. K. Jump, Box 276, Cameron, Wis. 54822.

HALLICRAFTERS SX-99 receiver. Want CB transceiver. Clarence R. McGowan, 2108 E. Houston St., San Antonio, Tex. 78202.

HALLICRAFTERS S-200 receiver. Will swap for best offer. Stephen Portwood, 3217 S. Stults, Oklahoma City, Okla. 73119.

KNIGHT Span Master. Swap for CB transceiver or Knight KG-220. Gary W. Jones, RD#3, Quaker City, Ohio 43773.

HALLICRAFTERS S-120 receiver. Will swap for VHF receiver or Demco modulator. Dave Crookham, 14312 Thompson Blvd., Cleveland, Ohio 44142.

OTHER EQUIPMENT

SETCHELL CARLSON TV units. Swap for CB base station. John Girard, 223 Marlow Dr., Oakland, Calif. 94605.

MISCELLANEOUS electronic components. Swap for Knight Star Roamer or best offer. Eddie Turner, Rt. 2 Box 279, Pamplico, S.C. 29583.

RCA VTVM model WV77E. Want SW receiver or ham gear. William Maddock Sr., 2941 W. Dunlap Ave., Phoenix, Ariz. 85021.

SURPLUS FS tone generator (455 kc) will swap for tuner for R237B V/R receiver or best offer. Ted Barnes, 7116 Oakberry Way, Citrus Hts., Calif. 95610.

IGNITION SYSTEM, 12-V negative ground. Make swap offer. Earl Melton Jr., Box 173, Moultrie, Ga. 31768.

ELECTRIC GUITAR and amplifier. Will swap for hi-fi gear or oscilloscope. Daniel F. Bryars, 4818 Court V., Birmingham, Ala. 35208.

KNIGHT plate modulator model T-150. Make swap offer. Tom Brown, WA6UOZ, 40445 High St., Beaumont, Calif. 92223.

VERTICAL ANTENNA (14AVQ) and roof mount (14 RMS). Swap for best offer. Brent Nichols, WN6UIS, 4303 Elm, Long Beach, Calif. 90807.

TRANSFORMER, 10,000-V. Will trade for SW receiver. D. Thompson, 26 Valerie Dr., Greenville, S.C. 29607.

LAFAYETTE VOM model 99R. Swap for standard AM/FM radio or micro relay. Glenn Anderson, 1100 New Jersey Ave., Pine Beach, N.J. 08741.

TRIPLETT tube tester model TR-14. Trade for ham transmitter. Garry White, 38 Sills Ave., Prospect, Conn. 06712.

EMC in-circuit capacitor tester and comparator bridge model 801. Make swap offer. Charles Lamb, 4916 Spring St., Verona, N.Y. 13478.

EICO signal generator. Swap for Hallicrafters S-120 SW receiver or similar. W. A. McCarter Jr., Rt. 1 Box 706, Elberta Trailer Park, Warner Robins, Ga. 31093.

HICKOK tube tester model 532 with current chart. Swap for CB, ham gear or best offer. N. Harkness, Box 182, Winnetka, Ill. 60093.

PHILCO 21-in. TV. Want EI's VHF Broadspanner (Jan. '65) or best offer. Dennis Jones, 817 Normandy View, Gastonia, N.C. 28052.

SIMPSON conductance tube tester model 1000. Will swap for Antenna Specialist CB line amplifier model M-82. R. Smucker, RD3 Box 42, Huntington, Pa. 16652.

DUMONT 19-in. TV. Want ham gear or test equipment. Joe Carver, 301 Adams, Mena, Ark. 71953.

CAPITOL Radio Engineering course. Swap for R/C transmitters & receivers. Frank Witmer, 3122 N. Harding, Chicago, Ill. 60618.

EICO 5-in. oscilloscope. Need VTVM, VOM or CRT tester-rejuvenator. O. Nichols, 811 W. Race, Searcy, Ark. 72143.

ASSORTED TUBES. Will swap for dot-and-bar generator. Everett Nussman, 128 Lincoln, East Alton, Ill. 62024.

KNIGHT 100-in-1 assembled Lab Kit. Swap for guitar amplifier. Bobby Wardrep, 3029 Dodd St., Knoxville, Tenn. 37920.

RADIO CONTROL transmitter, 27 mc. Want ham transmitter, test gear or best offer. David Bear, WN3FVQ, RD#5, Greenville, Pa. 16125.

URANIUM SCOUT Geiger counter. Will trade for X-ray tube. Raymond P. Grayson, 165 S. Main St., Keyser, W. Va. 26726.

IASCO tube checker. Want 100- or 200-mw walkie-talkies. Juris Burkevics, 1021 Alameda Ave., Fircrest, Wash. 98466.

OSCILLOSCOPE, 5-in. homebrew. Trade for CB transceiver or VHF receiver. R. Metro, 10 Dawn Cres., Central Islip, N.Y. 11722.

EICO 232 VTVM. Will swap for VOM or best offer. Michael Herman, 16 Beechwood Dr., Lawrence, N.Y. 11559.

TRANSFORMER, 10,000-V Secondary. Will swap for direct-readout 24-hour clock. Ronnie Foltz, 3235 Old Vineyard Rd., Winston-Salem, N.C. 27103.

EICO 324 signal generator. Will trade for any 2-meter gear. Robert Bollard, 436 W. Spencer St., Philadelphia, Pa. 19120.

ASSORTED TUBES. Swap for SW receiver. John Montayne, 814 Amsterdam, New York, N.Y. 10025.

ELECTRONIC KIT. Make swap offer. C. Marble, Box 3175, Scottsdale, Ariz. 85257.

LAFAYETTE VOM. Want Channelized Ham Transmitter as in EI project (July/66). Glenn Anderson, 1100 New Jersey Ave., Pine Beach, N.J. 08741.

TV CHASSIS. Swap for walkie-talkie, tape recorder or signal generator. Glen Milner, 6306 220th Pl. S.W., Mountain Lake Ter., Wash. 98043.

HALLICRAFTERS SP-44 panoramic adaptor. Want RCA 155C scope and 5CP1. C. E. Knapp, 6547 Virginia Hills Ave., Alexandria, Va. 22310.

ELECTROSTATIC GENERATOR. Make swap offer. Lyle Kruckenberg, RR #2, Hagan, N.D. 58545.

SURPLUS 40-meter gear. Will swap for best offer. H. L. Coonts, 7006 Corbin, Reseda, Calif. 91335.

ASSORTED COMPONENTS. Will swap for TV booster or amplifier. Barry Francis, 49 Sunset Hill Rd., Simsbury, Conn. 06070.

KENT guitar amplifier. Want Lafayette HA-225 communications receiver. James D'Amato, 2565 Marion Ave., New York, N.Y. 10458.

EICO model 145 signal tracer. Swap for VTVM or VOM. Paul Lo Galbo, 1202 Hammond Ave., Utica, N.Y. 13501.

ASSORTED DIODES. Want Honda motorbike. John Annal, Jr., 23 Walnut St., Medford, Mass. 02155.

ASSORTED tubes and components. Want SW receiver. John Dudley, 29 Beekman Rd., Summit, N.J. 07901.

GENERAL RADIO resistance, capacitance and inductance bridge model 650A. Will swap for 4-track stereo tape recorder. R. Wurtzinger, 830 N. Waller Ave., Chicago, Ill. 60651.

RADIO-CONTROL plane and accessories. Need ham band receiver or novice gear. Gary McLorkle, Rt. 1, Box 75, Gatesville, Tex. 76528.

TRANSISTOR inverter, 6/12-VDC mobile, 100-watt. Need VFO and portable tape recorder. Kai Swiak, 139 Engert Ave., Brooklyn, N.Y. 11222.

HICKOK tube tester model 533. Will swap for oscilloscope. Brent Aldenfer, 135 South Oak Dr., Harleysville, Pa. 19438.

COYNE job-training set. Will trade for FM receiver, 152-174 mc. Charles Beaumont, 415 Central Ave., Brooklyn, N.Y. 11221.

OSCILLOSCOPE. Trade for SW, CB transmitter or transceiver. Richard Metro, 10 Dawn Crescent, Central Islip, N.Y. 11722.

TV CHASSIS with tubes. Want CB or Ham gear. James L. Skelton, 415 E. Leafland Ave., Decatur, Ill. 62521.

CAR RADIO. Will swap for SW receiver. Raymond Sanders. 409 6th St., Jasper, Ala. 35501.

TELEPHONE equipment. Will swap for CB walkie-talkie. Mike Johnson, 315 Crissey Ave., Geneva, Ill. 60134.

ASSORTED TUBES. Make swap offer. John Crooks, 391 N. Wellwood Ave., Lindenhurst, N.Y. 11757.

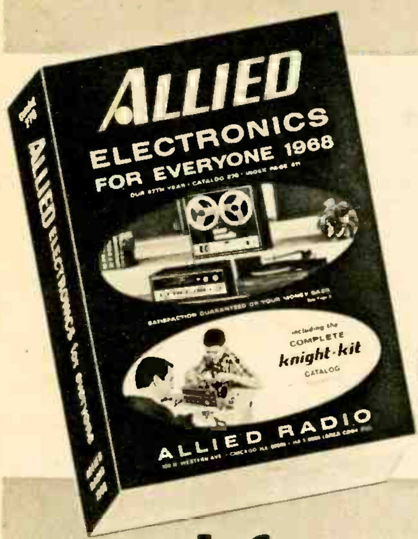
MOTOROLA car radio. Will swap for transistor tape recorder. F. E. Krick, Jr., 11350 Hermosa, Chicago, Ill. 60643.

OSCILLOSCOPE, dual trace, two plug-in units. Will trade for Hammond organ. E. B. Long, 3168 E. Maplewood Ave., Littleton, Colo. 80120.

MAGAZINES, back issues QST & CQ. Will swap for Clegg 22er or best offer. Joe Zolik, 153 Lincoln Ave., E. Paterson, N.J. 07407.

SURPLUS TUBES. Will trade for ham gear. Dana Custer, 17638 Clymer St., Granada Hills, Calif. 91344.

MALLORY model TV-101 UHF converter with service manual. Make swap offer. Thomas R. Sundstrom, Box 185, Levittown, Pa. 19059.



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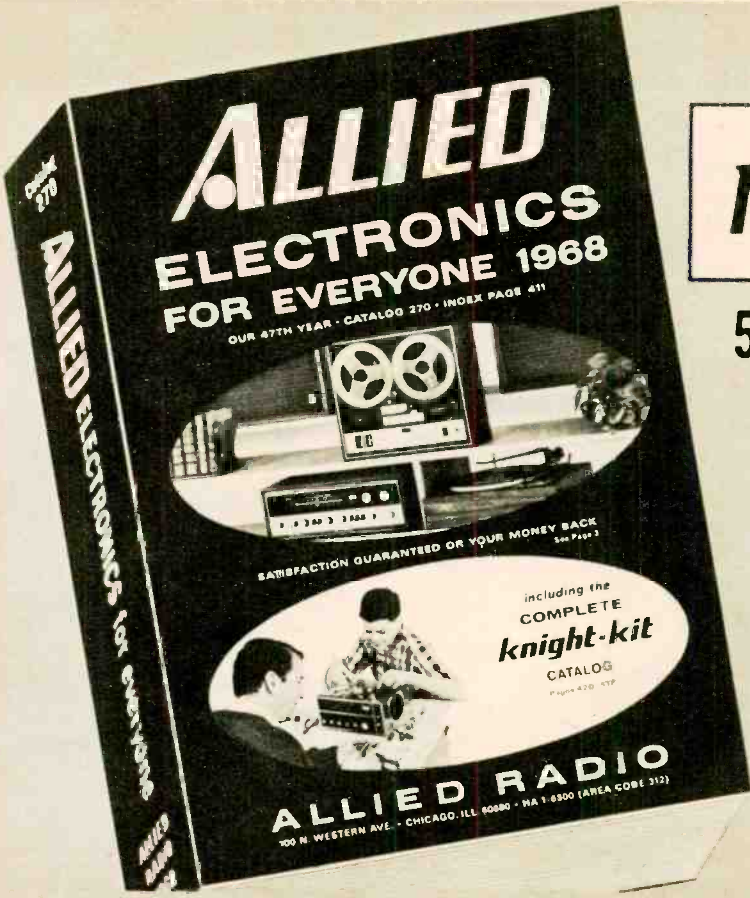

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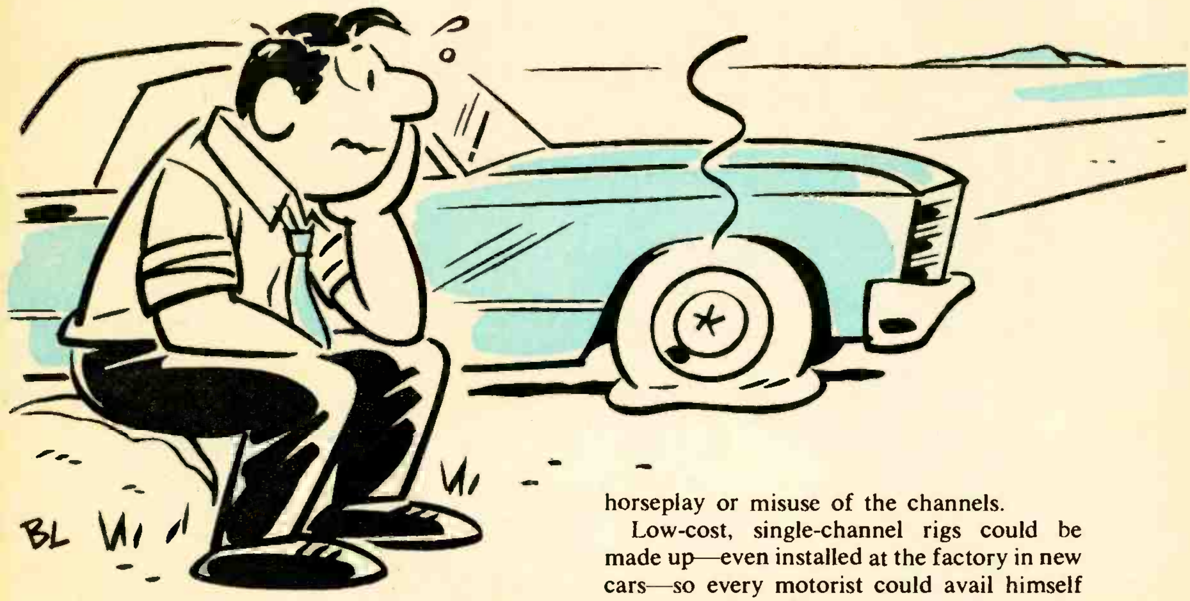


FLAT TIRE, you say? And the last garage was 23 miles back? Would you believe that, as you sit there wondering whether you should trust that beat-up spare, multi-million-dollar corporations and government agencies are battling over the best method of helping you?

A few years ago there wasn't any problem. If you dumped the DeSoto into a ditch a passing CBer would stop, give his wife the ol' 10-33 and within a few minutes you would have at your disposal either a tow truck or ten hairy, 300-lb. CBers.

Then someone at the Automobile Manufacturers Association (AMA) got a better idea. Why not establish a service something like CB using the two Business Band channels located between CB channels 22 and 23? Base stations could be in police stations, service stations and hospitals.

If the base stations would transmit on one of the channels and receive on the other (and mobile units do likewise but on opposite channels) interference could be cut to a minimum. Mobile units couldn't yak it up between themselves because they could receive only the base station frequency. Since monitoring was to be done by police there would be little horseplay or misuse of the channels.

Low-cost, single-channel rigs could be made up—even installed at the factory in new cars—so every motorist could avail himself of the service. CBers could participate by using the proper crystals.

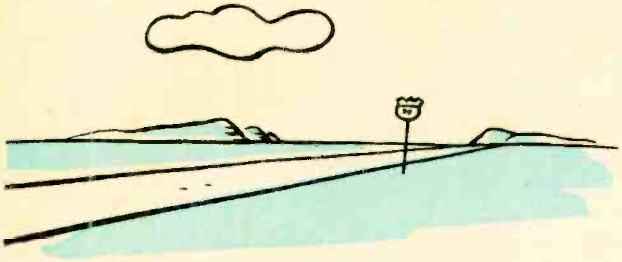
Since the AMA petition, filed with the FCC in February, 1965, was backed by the big auto manufacturers, it seemed assured of quick approval. Several experimental units were established on channel 9 to test the idea, now dubbed HELP (Highway Emergency Locating Plan).

HELP was quickly endorsed by REACT, many CB clubs, all CB publications, even major CB equipment manufacturers. The Industrial Communications Newsletter, however, claimed (in June) that "internal rumblings have been detected. . . ." They were right.

In July the American Association of State Highway Officials (AASHO) urged the FCC to delay approval of HELP pending further study. W. D. Dillion, speaking on behalf of AASHO, commented that the AMA should not have filed its brief "without the prior knowledge and support of those who have the sole responsibility for our . . . roads and streets—namely the state, county and local highway and police officials of this nation."

By October the International Association of Chiefs of Police (IACP) had asked the FCC to withhold rulemaking on HELP "until

By ALAN LEVESQUE



such time as it has a meaningful data base upon which a sound proposal can be made." The IACP claimed that "the concept appears to call for the assignment of certain communications responsibilities to police agencies. . . . These responsibilities must be defined and the resources available to meet them must be assessed before any such plan could realistically be implemented."

During the first year after the filing of the AMA brief all interested parties, it seemed, had taken a stand on HELP—with the exception of the seven commissioners of the FCC. They agreed that (in principle at least) HELP appeared "to have considerable merit in providing a communications link between disabled motorists and sources of aid." Of the trials on channel 9, however, they commented: "The number of participating vehicles is but a handful compared with the 85 million vehicles on the road today, all of which would be potential participants under the more extensive program. With but ten per cent of the cars produced annually (approximately nine million in 1965) equipped to participate, there would be a two-fold increase in one year alone in the total number of units in the Citizens category and perhaps a ten-fold increase in the number directly involved in the HELP program. Thus, before we become further committed to this course, we think it wise to allow more time for consideration of the matter . . ."

The FCC agreed to conduct an inquiry into "how radio might be effectively and efficiently used in the promotion of highway safety." Their inquiry brought numerous comments.

The American Automobile Association (AAA) said that the channel 9 experiments had "convinced the AAA that the HELP program . . . is feasible and that a major contribution to highway safety can be made."

AT&T, understandably, commented that it would prefer to see greater use of mobile telephones in cars.

The Associated Public-Safety Communications Officers, as expected, backed the earlier views of the IACP in urging caution and delay.

The Automotive Safety Foundation supported the general concept of the establishment of a new radio service for the motoring public.

Chrysler Corp. said: "The essential value of a radio service with provisions for summoning aid is clearly in the public interest on a national scale. The AMA's proposed HELP program presents a beginning towards this end."

General Motors agreed that HELP might be established, but only as an interim program until the implementation of a system of their own—called DAIR (Driving Aid Information and Routing).

Motorola supported the idea that the FCC should encourage developmental work and set up coordinating committees in the field.

RCA claimed that they thought HELP well-intentioned but totally unsuited to the 27-mc band due to skip interference. It suggested a service that would use 3-watt units operating in the 150, 450 and 900-mc bands with coded tones instead of voice.

Coming out strongly against HELP was Carrier Communications Corp. which said that the service would be "inefficient in operation, undisciplined and subject to severe interference leading to the same chaotic situation that now exists in the Citizen Band."

An unexpected dig at HELP came from the Michigan Citizens Band Council. The group said it had established channel 17 as an emergency channel (even though the rest of the country uses channel 9) and that it couldn't find "any beneficial use of the HELP idea in the prevention of accidents or improvement of highway safety if the project is put into effect as it is presently outlined."

These comments gave the FCC considerable food for thought. They are, in fact, digesting it still, with no hint how long it may be before we find out how they enjoyed the menu.

Oh, I almost forgot about your flat tire. Maybe you can flag down a truck and get a lift into town.

THE LATEST ON DXING APOLLO

IN our article DX OF THE CENTURY: APOLLO SIGNALS FROM THE MOON (July '67 EI) we announced that we were developing a receiver which could be used to pick up signals directly from the Apollo LM (Lunar Module; formerly LEM, Lunar Excursion Module) and its mother ship in orbit around the moon. Because it would not be feasible for us to design a receiver to decode the signal and recover the voice communications we asked NASA whether QSL cards would be sent to persons submitting a tape of the multiplexed signal.

Since then, we have evaluated a surplus military receiver (AN/APR-4Y) which tunes up to 8000 mc. However, we found the receiver's sensitivity and noise figures made it unsuitable for receiving a 20-watt signal from the moon.

The engineer designing our receiver concluded that a converter (with a crystal mixer), not a complete receiver, would be the best approach. The converter would be used with a communications receiver. Instead of a large parabolic dish, the antenna will be a horn with the converter mounted inside it. Research and development is progressing in this area.

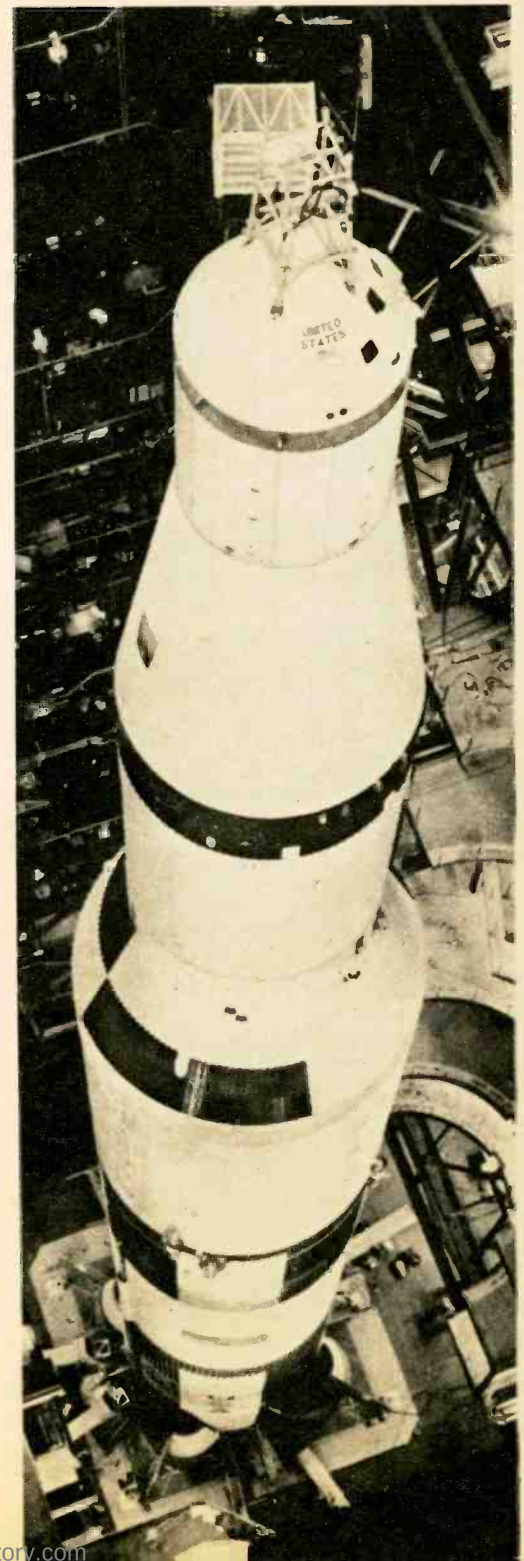
Getting NASA to issue QSL cards is another matter. We contacted Stuart Ayres of the Public Information Office at NASA and asked whether QSL cards would be sent by NASA to persons who submitted a tape recording of the sounds they received. We said the person would include a stamped, self-addressed QSL card with the tape. This would require NASA simply to listen to the tape then sign the card and return it.

The response was negative. Mr. Ayres says, "NASA is not set up to do this and there simply are no personnel available to listen to tapes." Everyone is hired for a specific job at NASA, he adds, and cannot devote extra time listening to tapes and returning QSL cards. "To get someone released from his regular duties for even a short time," he continues, "would require an act of Congress."

With regard to other manned space flights in the past, it was possible to get an unofficial QSL from a NASA employee. The procedure was to send a stamped, self-addressed QSL card to a ground station that the capsule was in contact with at the time of reception and report both ends of the contact. With luck, a person at the ground station might sign and return the card.

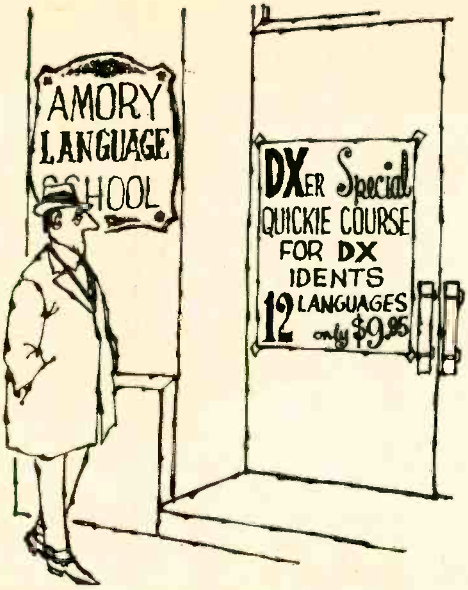
We asked Mr. Ayres whether it would still be possible to obtain a QSL card this way and were told: "It is a very personal matter which depends on the personnel at the ground station."

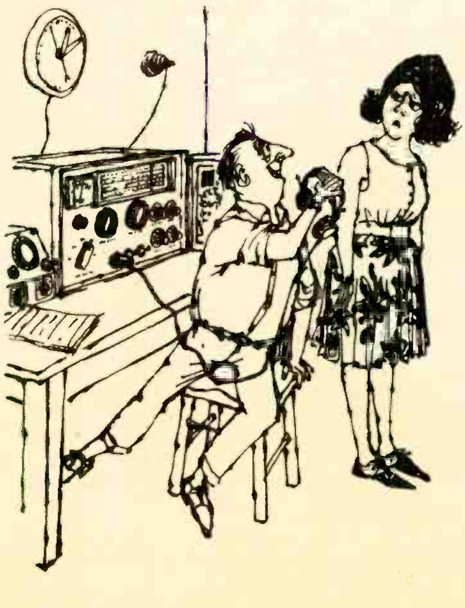
More on Apollo next issue.



Over and Out

rodrigues

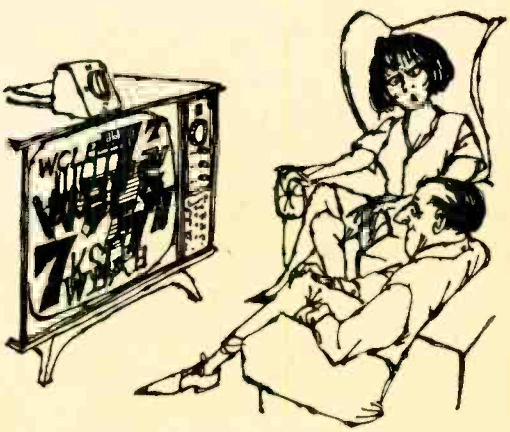




"What's such a big deal about a satellite? The washing machine makes funny noises, too."

"I haven't been able to log that one since the dentist put in my new bridge."

"What do you mean, am I going to work today? WWV has broadcast a W-9 propagation notice!"



"And what do I do while you're DXing with your triple-stacked antennas?"

Beware of Your TV Repair Traps

Continued from page 105

"even though the last turn or two was tough going. But I know the nut ended up in the same location on the bolt. I could tell by the rust marks."

There was no sense in telling him that no two picture tubes are exactly the same size and that each needs a fit that is snug but never tight—he probably won't be changing any more tubes.

Turn of the Screw

Mr. Myer is a nice old gent who makes his living by manufacturing kitchen gadgets. The last time I had a service call from him he told me, "I must 'fess up, Art. The set was good 'till I got ahold of it."

I turned on his TV. Light and background noise came on. There was some semblance of audio and video but they showed up on the wrong channels with very severe interference.

"What did you do?"

"He removed the channel selector and fine tuning knob and pointed into the hole they had been covering. "I tried to adjust those little screws for best sound and picture. But something went wrong."

The oscillator slug adjustments in most TVs are readily available. They move sound and picture settings to the center of the fine tuning range so you can switch from channel to channel without bothering with the fine tuner.

Some sets have all the channels hooked together while others (like Mr. Myer's) have individual adjustments for each channel. When they are hooked together you have to adjust only two screws—one for channels in the high band (7 through 13) and another for the low band (2 through 6). You must know which type you are working on before making the adjustment.

In any case the adjustments should be made with a non-metallic alignment tool. If you use a screw driver with a metal blade it acts as though it, too, was a slug as long as it is in the coil. You have to pull it out of the coil to check every adjustment you make.

If they are tuned too far the slugs can fall out—there are no stops in some tuners. When that happens you lose your range altogether. That's what had happened to Mr. Myer's TV.

I began removing his front-end's oscillator strips one by one, gingerly holding the coil and removing the slug. Then I reinserted the slug into the front of each strip and adjusted them.

And while I was at it I decided to clean all the contacts on each strip. Very often the accumulation of dirt on the contacts can cause intermittent reception, or none at all, when you switch channels. Also, I got up into the front-end to clean the fingers which touch the contacts. They, too, get dirty and are a frequent cause of a missing picture when you switch to another channel. Best thing to clean the contact with is an aerosol spray cleaner.

Mr. Myer had been watching me closely, muttering, "There must be an easier way."

A few weeks later he sent me a small package. It contained a gadget that looked like a long, thin screw driver with an adjustment to rotate the center of the blade. Inserted in the slot of a screw it can be made to grip the sides of the slot so that you can reach into a tuner coil and retrieve the slug. Mr. Myer had found that easier way.

Medical Electronics

Continued from page 44

amount of experience required depends on the job opening and the individual employer. Dr. Sergei Feitelberg of New York's Mt. Sinai Hospital considers amateur radio to be a good background. Seymour Ben-Zvi of the Downstate Medical Center in Brooklyn, who has been advertising for electronics technicians over a period of several months, prefers men who are technical-school graduates with some commercial electronics experience.

Abe Kaiman of New York University Medical Center has somewhat different requirements. He looks for people who are fresh with no particular experience, because those he hires receive in-hospital training.

One way to find where jobs are likely to be is to visit your public library and look through the Research Grants Index, published annually by the federal Public Health Service.

Don't overlook the large drug companies, most of which spend a great deal on research. Some even have gone into the electronics business themselves. For example, Corbin-Farnsworth, Inc., Branson Instruments, Research Specialties and Nuclear-Chicago are all owned by pharmaceuticals houses.

Most of the big electronics manufacturers now make medical instrumentation of one type or another. These include: General Electric, IBM, Westinghouse, RCA, Honeywell, Hewlett-Packard, Beckman Instruments and many more. A guide to the field is published each year in the third week of November as a special issue of Science magazine.

We have saved mention of wages for the end of this article because we didn't want to discourage you. That, in fact, is the only disadvantage pointed out to us by those already in the field. New Careers in Health Sciences (available from the Superintendent of Documents, Washington, D.C.) says the pay for bio-medical engineering technicians runs between $4,000 and $8,000 per year. On the other hand, some experts contend that there is no significant difference between hospital and industrial rates.

The basic fact is that the medical electronics field is new enough still to be in a state of flux. Getting into medical electronics now means getting in on the ground floor. ■

Car Radios

Continued from page 78

vertical antenna as well. This should produce stronger signals at the car receiver, whose vertical whip normally suffers from cross-polarization with the FM station antenna.

An electronic approach is to reduce the FM circuit's local oscillator level in an effort to make the radio less responsive to multipath signals (which are weaker than the direct signal). This technique requires enough IF stages to compensate for lowered sensitivity in the front end. Another electronic measure is to boost the 19-kc pilot signal from the stereo station in order to reduce loss of stereo during strong multipath conditions.

But car radios *are* better than ever today. Warranty repair records over the last three years prove it. Car buyers confirm it—85 out of 100 want radio. So, while manufacturers may find things to add, it looks like the basic radio will wear its present laurels in good health for a while—until that not too distant day when ICs start moving into autos.

An L-L-L-L-L-L-L-L-LP

Continued from page 88

less than that of tape. (Discs, however, cannot be erased and reused.) Also under study is a disc recorder the size of a cigarette pack in the under-$50 class.

But don't expect instant hi-fi. For radio-station use, response is stated as 100 to 3,000 cps. Doubling the turntable speed to 4 rpm boosts response to 6,000 cps—comparable to an AM table radio. Wagner now is at work on a model that he says will be the first home disc recorder for stereo. For 2-channel operation, the machine would contain a dual-element cartridge and operate at 8 rpm, yielding a six-hour playing time with frequency response of about 30 to 12,000 cps.

Wagner's slow-motion discs recently produced some perplexed reactions when shown at an inventors' exhibition. One gentleman studied the sluggishly moving record and asked, "Who'd want to record only slow music?" (Figure that one out.) A woman declared she couldn't listen for 24 hours. But the weirdest comment came from an electronics engineer. After seeing the disc play he accused Wagner of hiding a tape recorder under the table.

In-Line Mod/Power Meter

Continued from page 40

ter, note the transceiver's output power into a dummy load and then remove the load and connect the antenna. If M1 indicates the same power output with the antenna connected you've got nothing to worry about. If the reading changes—either up or down—you'd better check the antenna system with an SWR meter.

While M2 is calibrated for 100 per cent modulation, keep in mind that many transceivers—particularly those of good design—will not indicate in excess of 85 or 90 per cent modulation because the transceiver has built-in protection against overmodulation. Do not feel your rig lacks punch if M2's pointer doesn't go over 85 per cent because there is no effective difference at the receiving end between 85 per cent and 100 per cent modulation.

Also note that M2 should not hit 85 per cent or 100 per cent modulation continuously. Unless you are using a speech clipper or heavy compression, only occasional speech peaks will rise to 85 per cent. Most of the time the pointer will flicker between 40 and 60 per cent. Trying to keep the modulation at 85 per cent continuously will cause the speech peaks—which the meter cannot follow because of inherent damping—to exceed 100 per cent.

Audio Wattmeter

Continued from page 82

than 25 watts applied to it continuously. If you apply more than 25 watts it should not be for more than a few minutes at a time. The 8-ohm load consists of two series connected 50 watt resistors (R1 and R2) for a total rating of 100 watts, so 50 watts, continuous, can be applied. The 16-ohm load can withstand 50 watts, continuously, without overheating.

If desired, the power ratings of the load resistors can be changed to accommodate different power levels. For example, if you will not test at higher than 25 watts with a 4-ohm load resistor R1 can be rated at 25 watts. Also, if 8-ohm testing will not exceed 50 watts R1 and R2 can be rated 25 watts each.

The Forgotten World

Continued from page 97

kc at Allouis, France. Another interesting station below 200 kc is Europe No. 1, a million-watter at Saarbruecken—the only privately-owned broadcast station in Germany. It obtained its license while the Saar was still an independent state, just before it voted (in 1956) to rejoin the Federal Republic.

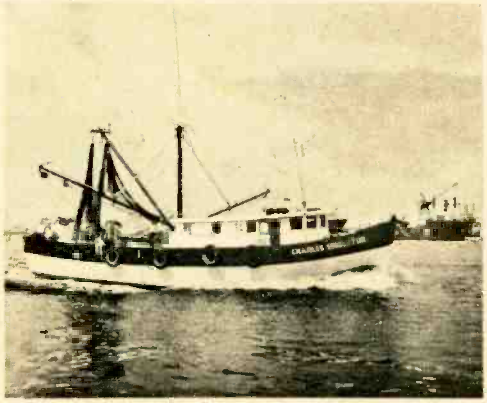
Post-war Germany has, in fact, been quite active in LW broadcasting. For a time R.I.A.S. (like the Voice of America an arm of the U.S. Information Agency) maintained a million-watter in Munich. It was heavily jammed by the Russians and, as part of a deal that was supposed to end all jamming of the VOA, it was eventually shut down. The Communists still maintain a German million-watter, called Deutschlandsender, in East Berlin.

One rather odd program note before we leave the subject of broadcasters: On a few of these stations (Europe No. 1, R. Monte Carlo and, sometimes, R. Luxembourg) you will occasionally hear an old-fashioned American Hell-fire evangelist—via tape.

What are the prospects for the future of LW broadcasting? Not very promising. With the exception of uses like the DECCA system, there's nothing it can do that some other band can't do better. It's too high for ideal submarine propagation, too low for everything else. Most of the current receivers capable of tuning LW go down only to 200 kc, the lower limit of the beacon band. Ironically, one of the least-expensive, the Knight-Kit Ocean Hopper, tunes down to 165 kc. (But the best bet for LW still is, of course, the surplus variety.)

"I warned you about live commercials!"

CB ON THE HIGH SEAS



MANY landlubbers have CB to thank for being alive today. But when CB took to the high seas and saved nine shrimp fishermen from the deep six, it had one of its finest hours.

When the trawlers Charles, Penny and Mark E. Singleton were enroute from Tampa Bay, Fla. to Nicaraguan fishing waters one January day, strong winds and heavy seas sent the Charles aground in Cuban waters.

Using CB, her captain alerted the Penny and Mark E., who stood by ready to pick up the crew of the Charles. Then using regular marine radio, the Penny called the Coast Guard at Miami. Since the trawlers were in Cuban waters, the Coast Guard was unable to assist directly. However, it radioed Cuban Air-Sea Rescue who aided the Charles.

After freeing the Charles, the three trawlers were escorted to a nearby Cuban Port. The Coast Guard notified the U.S. State Department who arranged, through the Swiss Embassy in Havana, for the men's release.

Why use CB when all boats were equipped with marine radiotelephone equipment? For one thing, much less QRM than on the marine band. At sea, CB interference is not the problem it is on land. Another thing, a CB rig draws much less current than a marine radiotelephone—a vital consideration on small boats with little power to spare.

—*Alex Bower*

Good Reading

Continued from page 69

COMPUTER DICTIONARY. By Charles J. Sippl. Howard W. Sams & Bobbs-Merrill, New York & Indianapolis. 336 pages. $4.95

An entirely different brand of dictionary, this one is devoted to the esoteric language of computers. What gives it an added fillip of interest is that the computer's vocabulary contains a lot of words we already know, but with entirely different meanings. Anyone with need to be hip to computer talk should investigate this volume.

RADAR, Principles and Practices. By F. Jonathan Mivec. TechPress, Brownsburg, Ind. 260 pages. $4.95

This hardly is an introductory book for anyone vaguely interested in radar. But is a fact-packed reference that lots of people will find of value. Every aspect of radar theory is covered in detail, with excellent and plentiful illustrations.

And make note of . . .

ELECTRIC GUITAR AMPLIFIER HANDBOOK. By Jack Darr. Sams. 144 pages. $2.95

How to make money servicing electric guitars.

STANDARD MATHEMATICAL TABLES (14th Edition). Chemical Rubber Co. 632 pages. $5.50

Ready reference material for anyone using math.

FUNDAMENTALS OF VACUUM-TUBE AMPLIFIERS. Tech-Press, Brownsburg, Ind. 305 pages. $3.95

MOST-OFTEN-NEEDED 1967 TELEVISION SERVICING INFORMATION. Compiled by M. N. Beitman. Supreme Publications, Highland Park, Ill. 192 pages. $4.00

APPLIED MATHEMATICS FOR ELECTRONICS. By Lovincy J. Adams and Russell Journigan. Holt, Rinehart & Winston, New York. 702 pages. $10.95

The Listener

Continued from page 79

At Sea . . . When Cable & Wireless ceased verifying reception reports, many found it difficult to add Bermuda (which counts as part of North America, incidentally) to their collections. Fact is, if you know where to look logging Bermuda really isn't so hard.

If you live east of the Mississippi at least one of the BCB stations probably is within DX range. ZBM-1 operates all night on 1235 kc, between two North American graveyard channels. If your receiver is reasonably selective, this is an excellent prospect. ZFB-1 operates all night on 960 kc, relaying the Voice of America at times. Your best bet would be Monday at 0300 EST.

Meanwhile, on short wave, Kindley AFB (maintained by the USAF) can be heard readily by sitting on any of the north Atlantic or eastern Caribbean aero frequencies (2868, 5566.5, 8871 kc, etc.). If you address your report to Technician in Charge, Kindley Aeradio, and include a stamped, self-prepared QSL card which he merely has to sign and drop in the mail, you'll probably have it made.

Oh, yes—utility frequencies, unlike their SWBC counterparts, are *not* subject to variation.

"You know, Bill, my rig's been showing some of the same symptoms. I think there's something going around."

ELECTRONICS ILLUSTRATED Classified Ads

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BACK-ISSUES, ELECTRONIC, Scientfiic Magazines. Semco, Box 130, Roxboro, Quebec, Canada.

CONVERT ANY television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco A-19, Box 10563, Houston, Texas 77018.

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

INTEGRATED CIRCUIT experimenters kit. Two IC's, 2 transistors, several circuits. Kit $12.50: wired $17.00. Adams, Box 399, Hazelwood Missouri, 63042.

BUSINESS STAMP Printer. To four lines. Self-inking case. Send $1.00. Ames, 100-E South Main, Eureka, Kansas. 67045

GOVERNMENT SURPLUS. How and Where to Buy in Your Area. Send $1.00. E.I. Surplus Information, Headquarters Bldg., Washington 6, D. C.

EXPERIMENTERS! HAMMOND Reverberation Mechanism—$4. Cal's, Box 234, Dearborn, Mich., 48124.

INVESTIGATORS, FREE Brochure, latest subminiature electronic surveillance equipment. Ace Electronics, 11500-X NW 7th Ave., Miami, Florida. 33168.

TREASURE HUNTERS! Prospectors! Relco's new instruments detect buried gold, silver, coins. Kits, assembled models. Transistorized. Weighs 3 pounds. $19.95 up. Free catalog. Relco-A19, Box 10839, Houston, Texas 77018.

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We know a man doesn't come by $539.80 just like that. And parts with it only after carefully deliberating his alternatives.

So we've put together a new illustrated booklet that explains just what you'll be getting into should you decide to spend $269.90 for our completely hand wired Director 23 mobile radio telephone; just what you'll be getting into should you decide to spend $269.90 for our matching hand wired Guardian 23 (or 23-B) base station radio telephone. And just what you could be getting into should you decide that $539.80 is too much to spend for two two-way radios.

Total cost for the booklet? Nothing. But you've got to mail the coupon to let us know you want one, and that'll set you back a nickel.

But just in case you're thinking you'll save the nickel because you already know all about our 23's, you might just as well know that we've redesigned them to include some rather exotic new features. (The all solid state Director 23, for instance, now boasts a final transistor that won't blow—even if you key up and forget to connect the antenna. Plus a tone control. Plus a front-mounted speaker.)

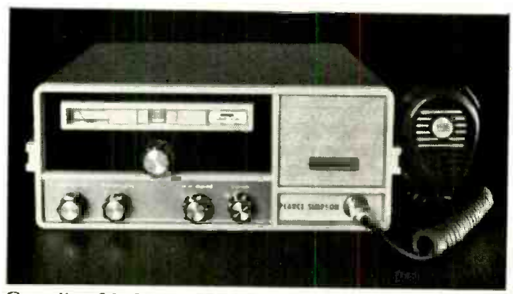
Plus features like HetroSync® Circuitry. (Which has all but completely wiped out spurious signals.) And our remarkable Superhet Receiver. (Which is so good that sloppy signals from adjacent channels have virtually become a thing of the past.)

And electronic switching, dual function S-meter, and your choice of two base stations. (The Guardian 23 comes with a conventional palm microphone. The Guardian 23-B, which comes without a microphone, comes with a built-in solid state pre-amplifier which permits the operator to remain from 1 to 1½ feet from a desk microphone and still broadcast at 100% modulation. Costs are identical.)

In short, we think it's well worth the price of a stamp to know exactly what you're getting into before you decide to get into it. So we'd like to send you one of our brand new illustrated booklets that tells you all about all of our new CB radios, and some things about some CB radios that aren't ours.

If you'll just tell us where to send it.

Director 23 (23-channel mobile unit), $269.90



Guardian 23, 23-B (23-channel base stations), $269.90

Before you spend $539.80 for one of Pearce-Simpson's new base stations and matching mobile units, spend 5¢ and find out why you should.

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- Rectification
- Resistance
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- Filter Circuits

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