DX OF THE CENTURY: APOLLO SIGNALS FROM THE MOON!

ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

JULY 1967 • 50¢

Consumer Report on POCKET TAPE RECORDERS

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- 160-Meter Ham Station
- Automatic Phone ... Set
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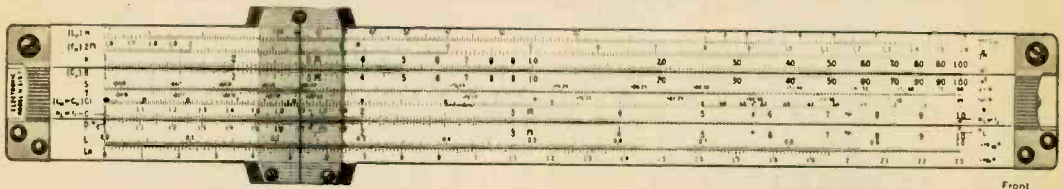
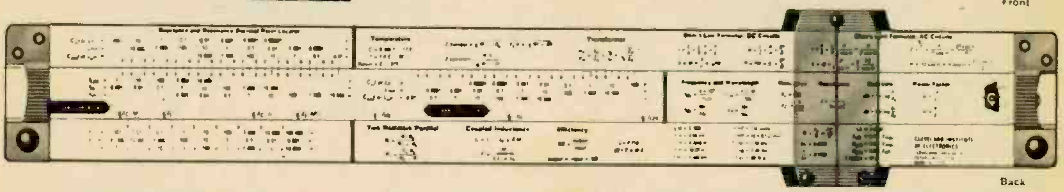
ELECTRONICS SLIDE RULE





SOME DAY EVERYONE in electronics may have a slide rule like this. Till then, the man who uses one will seem like a wizard as he solves reactance and resonance problems in 12 to 20 seconds —*without pencil and paper*.

This is a professional slide rule in every detail, a full 10" long, made exclusively for Cleveland Institute of Electronics, to our rigid specifications, by Pickett, Inc. It can be used for conventional computation as well as special electronics calculations. All-metal construction assures smooth operation regardless of climate.

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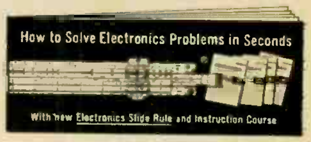

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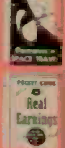

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2103

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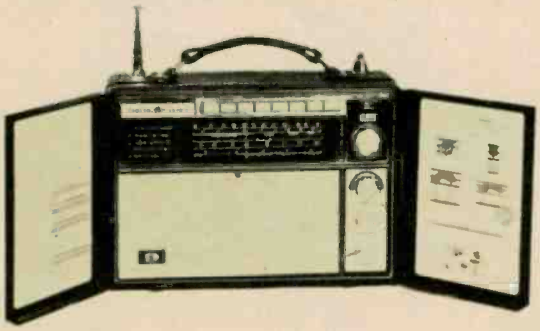
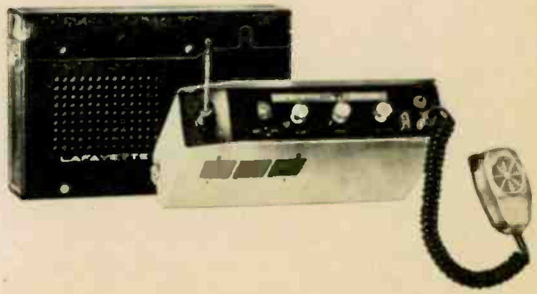
NEW STYLE . . . The AR-15 is a stereo FM (and AM) receiver kit that sets out to deliver all the latest features in one package. Immediately apparent is the face plate, which goes jet black when the power is turned off—tuning dial, meters and markings all vanish. Inside (FM section) there's an FET front-end, ICs in the IF strip, crystal filters instead of IF transformers (by-passing the need for alignment), SCA filter. A control setting cuts bass and treble controls out of the circuit altogether (for minimum phase shift) and a secret panel hides controls (in this case input level settings) you don't want anyone fooling with. Other features include audio output of 50 watts (sine wave, with 8-ohm load) per channel, full complement of controls. Kit, $329.95. Heath Co., Benton Harbor, Mich. 49022.

ELECTRONIC MARKETPLACE



Bands Aplenty . . . The World Monitor 10, featuring six short-wave bands, AM and FM broadcast bands, long-wave and marine bands, can be used as a portable or powered by house current. The separate FM tuner offers switchable AFC. Other features include tone control, 1.5-watt audio output, separate antennas for FM and short wave, voltage stabilizer circuitry. $150. General Electric Consumer Electronics Div., Bldg. 2, Electronics Park, Syracuse, N.Y. 13201.

3-Way Ham . . . The HA-144 2-meter transceiver is adaptable for mobile, portable or fixed base use. Its circuit (17 transistors, 7 diodes) features a tunable dual-conversion superhet receiver. A 10.7-mc mechanical filter and series-gate limiter suppress noise factors. Unit provides switching for five internal crystals or front-panel plug-in and takes standard 8-mc crystals or external VFO. Supplied with case, whip, mobile accessories, D cells. $189.95. Lafayette Radio Electronics Corp., 111 Jericho Tpke., Syosset, N.Y. 11791.



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MARKETPLACE

Convertible . . . With the power and polarity converter dubbed Power-Match by its manufacturer, 6-V electrical systems in cars, trucks and boats can be converted to 12 V or 18 V, 12 V to

24 V and positive-ground systems to negative ground. A major use is expected to be found in adapting 12-V, negative-ground CB gear (and similar equipment) for use in foreign cars. Handles 30 watts. $29.95. Pearce-Simpson, Inc., Box 800, Biscayne Annex, Miami, Fla. 33152.

Service . . . A highlight of the Model 235 VTVM kit is the 0.5-V range (claimed to be accurate down to 0.01 V), useful in servicing transistor equipment. Top readings are 1,500 VDC or rms

VAC and 4,200 VAC peak-to-peak, extendable to 30,000 VDC with optional probe. A zero-center provision is useful for FM and TV-sound detecor alignment. Seven overlapping resistance ranges give indications up to 1,000 megs. Kit $49.95; wired $64.95. Eico Electronic Instrument Co., Inc., 131-01 39th Ave., Flushing, N.Y. 11352.

Introducing EICO's New "Cortina Series"!

Today's electro-technology makes possible near-perfect stereo at moderate manufacturing cost: that's the design concept behind the new EICO "Cortina" all solid-state stereo components. All are 100% professional, conveniently compact (3⅛"H, 12"W, 8"D), in an esthetically striking "low silhouette." Yes, you can pay more for high quality stereo. But now there's no need to. The refinements will be marginal and probably inaudible. Each is $89.95 kit, $129.95 wired.

Model 3070 All-Silicon Solid-State 70-Watt Stereo Amplifier: Distortionless, natural sound with unrestricted bass and perfect transient response (no inter-stage or output transformers); complete input, filter and control facilities; failure-proof rugged all-silicon transistor circuitry.

Model 3200 Solid-State FM/MPX Automatic Stereo Tuner: Driftless, noiseless performance; 2.4μV for 30db quieting; RF, IF, MX are pre-wired and pre-tuned on printed circuit boards — you wire only non-critical power supply.

7 New Ways to make Electronics more Fun!

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You hear all the action-packed capitals of the world with the **NEW EICO 711 "Space Ranger" 4-Band Short Wave Communications Receiver** — plus ham operators, ship-to-shore, aircraft, Coast Guard, and the full AM band. 550KC to 30MC in four bands. Selective, sensitive superhet, modern printed circuit board construction. Easy, fast pinpoint tuning: illuminated slide-rule dials, logging scale; "S" meter, electrical bandspread tuning, variable BFO for CW and SSB reception, automatic noise limiter. 4" speaker. Headphone jack. **Kit $49.95. Wired $69.95.**

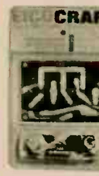
More "ham" for your dollar than ever — with the **one and only SSB/AM/CW 3-Band Transceiver Kit, new Model 753** "The best ham transceiver buy for 1966" — Radio TV Experimenter Magazine. 200 watts PEP on 80, 40 and 20 meters. Receiver offset tuning, built-in VOX, high level dynamic ALC, silicon solid-state VFO. Unequaled performance, features and appearance. Sensationally priced at $189.95 kit, **$299.95 wired.**

NEW EICO 888 Solid-State Engine Analyzer

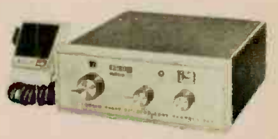
Now you can tune-up, trouble-shoot and test your own car or boat.

Keep your car or boat engine in tip-top shape with this completely portable, self-contained, self-powered universal engine analyzer. Completely tests your total ignition/electrical system. The first time you use it — just to tune for peak performance — it'll have paid for itself. (No tune-up charges, better gas consumption, longer wear) 7 instruments in one, the EICO 888 does all these for 6V and 12V systems; 4, 6 & 8 cylinder engines.

The EICO 888 comes complete with a comprehensive Tune-up and Trouble-shooting Manual including RPM and Dwell angle for over 40 models of American and Foreign cars. The Model 888 is an outstanding value at **$44.95 kit, $59.95 wired.**



New EICOCRAFT® easy-to-build solid-state electronic TruKits: great for beginners and sophisticates alike. As professional as the standard EICO line — only the complexity is reduced to make kit-building faster, easier, lower cost. Features: pre-drilled copper-plated etched printed circuit boards; finest parts; step-by-step instructions; no technical experience needed — just soldering iron and pliers. Choose from: Fire Alarm; Intercom; Burglar Alarm; Light Flasher; "Mystifier"; Siren; Code Oscillator; Metronome; Tremolo; Audio Power Amplifier; AC Power Supply. **From $2.50 per kit.**



New EICO "Nova-23" (Model 7923) all solid-state 23-channel 5 watt CB Transceiver featuring a host of CB advances — plus exclusive engineering innovations.

EXCLUSIVE Dual-crystal lattice filter for advanced razor-sharp selectivity of reception.

EXCLUSIVE Highly efficient up-converter frequency synthesizer provides advanced stability and freedom from trouble in all 23 crystal-controlled transmit-receive channels. All crystals supplied.

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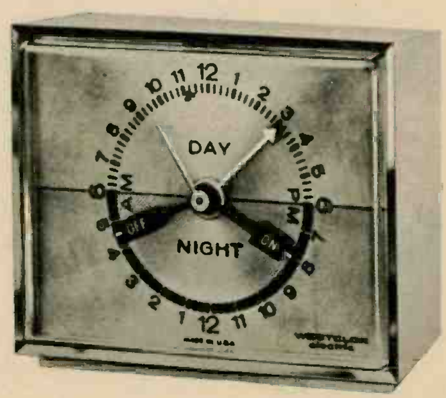
MARKETPLACE

No Holes . . . Nobody likes the idea of punching holes in the family car (particularly when you get to thinking about trading 'er in for something snazzier). But nobody likes dangling antenna cables, either. One way out is the Quick-Grip, a trunk-mount CB antenna designed to look like a conventional permanent antenna without requiring holes in the car body. A clamp slips over the edge of the trunk lid and locks into the underside with two sharp, self-tapping screws. The mounting clamp assembly also holds the antenna lead, feeding it to the interior under a chrome-plated housing. A rubber grommet protects the surface of the trunk lid and keeps water out of the assembly. The mount itself is available as Model M-161. It will accept any antenna requiring a ⅜-in. hole and adaptors are available for other hole sizes. (Model M-176—illustrated—is one of several of the company's CB antennas now available with the mount.) $7.50. Antenna Specialists Co., 12435 Euclid Ave., Cleveland, Ohio 44106.

Timely . . . Looking for an automatic timer-switch with some class? A new 24-hour model is dressed up with a gold dial and wood-tone or antique-white body. A sweep hand provides a visual check on operation. While the timer is



being marketed primarily as a device to discourage burglary by turning home lights on and off while you're away it is adaptable to any timed switching task requiring up to 15 amps. On and off functions continue at the times set without resetting between cycles. $10.95. Westclox Div., General Time Corp., La Salle, Ill. 61301.

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$479.95*
(295 sq. inch viewing area)

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All color TV sets require periodic convergence and color purity adjustments. Both Heathkit Color TV's have exclusive built-in servicing aids, so *you* can perform these adjustments anytime . . . *without* calling in a TV serviceman . . . *without* any special skills or knowledge. Just flip a switch on the built-in dot generator and a dot pattern appears on the screen. Simple-to-follow instructions and detailed color photos in the manual show you exactly what to look for, what to do and how to do it. Results? Beautifully clean and sharp color pictures day in and day out . . . and up to $200 savings in servicing calls throughout the life of your set.
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****Kit GR-180,** everything except cabinet, 102 lbs. **$379.95**
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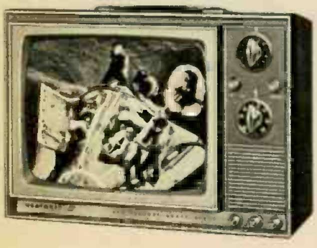
Early American cabinet available at $75.00

12" Transistor Portable TV — First Kit With Integrated Circuit



Kit GR-104
$119.95

Unusually sensitive performance. Plays anywhere . . . runs on household 117 v. AC, any 12 v. battery, or optional rechargeable battery pack ($39.95); receives all channels; new integrated sound circuit replaces 39 components; preassembled, prealigned tuners; high gain IF strip; Gated AGC for steady, jitter-free pictures; front-panel mounted speaker; assembles in only 10 hours. Rugged high impact plastic cabinet measures a compact 11½" H x 15¾" W x 9⅜" D. 27 lbs.

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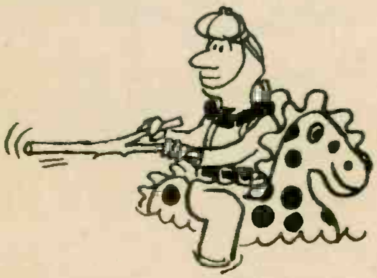
GOLD DIGGER



I am in need of a metal detector which can be used to detect metals underwater to depths of 75 ft., operating from the surface. I am attempting to locate various shipwrecks in the Great Lakes.

Kenneth E. Logan
Milwaukee, Wis.

Heavy-laden pirate galleons returning from the Near North Side, no doubt.

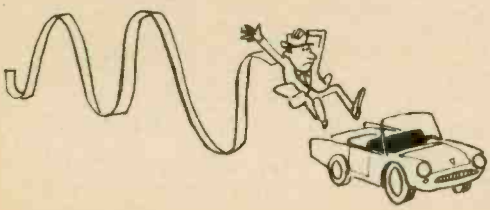
TILL IT HERTZ

The reason the term herts has replaced the basic unit of frequency is because of the abusiveness of most people, including Mr. Cartwright [Will Success Spoil Heinrich Hertz, March '67 EI] and not just cycles. Herts is synonymous with a cycle per second.

Mr. Cartwright's pun in the last sentence would therefore translate as: Perhaps we must take the long view of life as a complete cycle per second. And when he talks of a kilocycle I assume he means a vehicle with a thousand wheels.

K. J. Williams
Arlington, Texas

I think Herr Doktor Heinrich Hertz would be neither saddened nor pleased by your article. He would be annoyed by the efforts of the pseudo-scientific zealots who seek to honor him to the confusion and detriment of the science he served.



Donald E. Warner
Watsonville, Calif.

Hertz, as a unit of frequency, has been in use for at least 40 years on the European continent and elsewhere. I suggest you provide Mr. Cartwright with a horse so he can ride off to his Uncle Ben on the Ponderosa.

Philip W. Kor
Winnipeg, Manitoba

This is a subject that seems to get up people's danders (whatever they *are). Curiously, none of the letters we received mentioned either of two hard facts: (1) that the FCC recently accepted the unit Hertz as equivalent to and interchangeable with the term cycle per second, and (2) that the metric system, to which units of electronic measure are closely related, has been adopted by American scientists and soon may be adopted by our technology as well. Dr. Edward Teller is among those pushing hard in this direction. So the day may not be far off when you will go to the store for a litre of milk and a kilo of beans. (Kilo—that's short for kilogram. It* means *kilogram, just as cycle* means *cycle per second.)*

In the meantime, we'll continue to use the terms we think have the most meaning for the most readers.

ON SCHEDULE

Why not use GMT instead of EST in your 24-Hour Short Wave Schedule [March '67 EI]? The stations prefer reports in GMT.

Peter V. Siefel Jr.
APO San Francisco, Calif.

We stick with EST for the same reason we stick with cps—because it is easier to use. Novices find GMT confusing. If they live outside the EST zone they can convert more easily from EST than from GMT.

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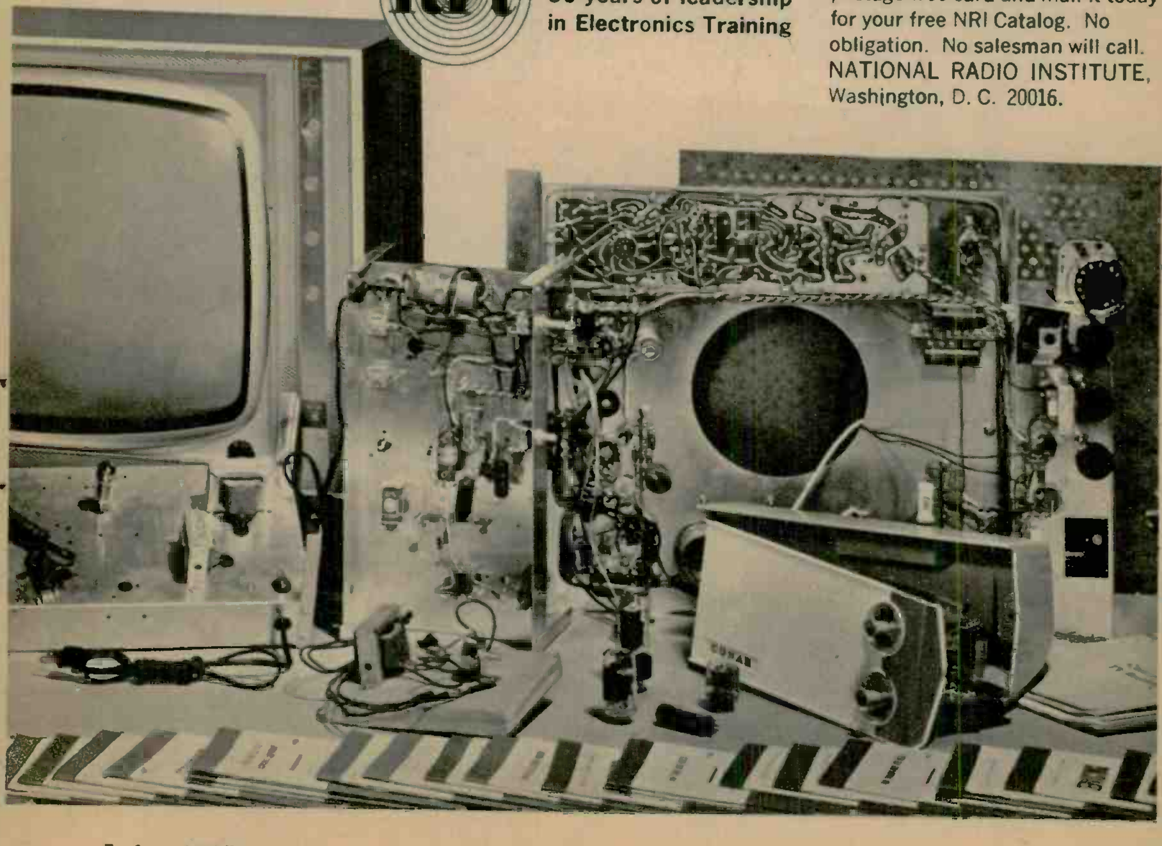


UNCLE TOM'S CORNER

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

By TOM KNEITEL, K2AES/KBG4303

★ *In the March '66 EI there was a story about how to monitor the communications of our manned space shots. I followed the instructions, I tried my hardest and finally heard a station. I sent a letter to NASA requesting a QSL. Instead of a QSL I got back a big official letter saying that I had violated the Communications Act, the United States Code and the International Telecommunications Convention. What does all of this mumbo-jumbo mean?*

Braford D. Evans
Redwood City, Calif.

Like, mind your own business, Gramps.

Big Ears Dept. Amidst all of the yelling and investigations, the hidden microphones and the micro-miniature equipment, it seems a little humorous that one of the (potentially) richest areas of industrial espionage is totally undiscovered. Anyone with an inexpensive short-wave receiver and a few reference books could begin monitoring the international radiotelephone circuits. He could sit at home and listen in on transoceanic business conferences of some of the largest corporations in the world.

Illegal? Probably, but undetectable.

★ *Would you believe that I have an aunt who thinks you're cute?*

Ed Sawick, WB2WKN
Garden City, N.Y.

I believe it but most of the people who know me don't.

★ *Last summer a few hams in town complained to the phone company about static coming from their lines. They had us go around hitting hundreds of telephone poles with the dull side of an axe to find the faulty one and, surprisingly enough, whatever we did cured the static. Only trouble is that it has returned and nobody wants to go out konking telephone poles. Isn't there any permanent cure?*

Jeff Lawson
Brigham City, Utah

Yes, use the other side of the axe.

★ *What type of electronic equipment is pressed into use to permit us to announce with seeming accuracy that Red China is about to set off a nuclear bomb?*

Herb Lomax
Muskogee, Okla.

It's only called a bomb when *we* set it off. When *they* let one go it's called a device. Anyway, we predict the detonations with our Samos satellites (they pass over China four times a day), by our listening in on the Reds' military communications networks, by code analysis, by U-2 photo missions and by the most reliable and time-tested method of all—a large and well-organized pack of spies running around the rice paddies.

★ *Here's a gimmick that would be a handy extra for a TV set. Why not rig the set with a switch that would allow you to just listen to the sound with the picture tube turned off? This would permit you to wander about the house without taking hours off the life of the expensive picture tube.*

Hank Limoges
Stone Mountain, Ga.

Congratulations! You have just invented radio. [*Continued on page 22*]

UNCLE TOM'S CORNER

Continued from page 20

★ *While digging in an attic I came across an ancient Zenith short-wave receiver. The model number looks like 6V. I would like to try to get the set working again. The tubes all checked out but the power tube is missing. Can you give me any information on this set and the number of the power tube?*

Skip Bradford
Avoca, Iowa

Your mystery set sounds like a Zenith 6V27, a six-tube battery superhet from the Stone Age. It tuned to 23 mc, which was VHF when the set was new. The power tube was a type 19 and you still can pick these up for a buck if you do a little looking. If you can't find a 19, change the six-pin socket to an octal and use a 1J6 instead (assuming you can lay your hands on one of these oldies). Better check the capacitors and resistors, too. You've got a big job ahead but it's a real kick to get the steam up in one of these old veterans.

★ *What do you think of my newest invention? It's an electronic Uncle Tom doll. Just plug it in and it doesn't know what it's talking about.*

Marv Edelmar
Canton, Ohio

If you could get it to put up with letters like yours you might have something.

★ *Is it against the law to send reports to or receive QSL cards from radio stations behind the Iron Curtain?*

Billie Wonderlich
Detroit, Mich.

No, but you can expect that the station will make propaganda use of your report. Your name and city will be read countless times on mailbag programs and your own mailbox will overflow with fantastic assortments of hard-sell political literature. In addition, your report will be turned over to the station's technical staff for evaluation.

★ *What do you think, could 5 million people that have seen flying saucers be wrong or do you admit that UFOs just might be real?*

Dennis Runyans
Ashville, Ala.

Weather balloons, clouds, hallucinations, swamp gas, experimental aircraft, stars—possibly; vehicles carrying little green men from outer space—most unlikely.

★ *Each night I hear this weird music just above 13 mc. It sounds like some sort of bagpipe music and is repeated over and over every 6 seconds without an ID. Reminds me of something from a horror or science fiction movie. Whatzit?*

Lynn Bradley
Elkhart, Ind.

Offhand it sounds like a radio-control circuit or a flying saucer.

★ *Recently, while listening around 9030 kc, I heard a station identifying as Air Force One. Is this the Presidential plane? Can you identify any of the code names and stations they mentioned? Some were Tophand, Ivanhoe, Westy, Crown and Starbird.*

Pete Motlow
Paris, Tex.

President Johnson's plane, Air Force One (the actual USAF number of the plane is 26000), has been reported by many readers. Tophand and Ivanhoe are the Navy's secret radio stations at Washington and Norfolk. Westy is the code name for Gen. William C. Westmoreland. Crown is the White House. Starbird, which sounds like a typical code name, is the real name of an Army general.

Current Problem Dept. Ever buy a kid's toy that requires batteries? How come manufacturers of these contraptions don't state on the outside of the box the number and sizes of batteries needed. They force you to pull apart the box and the toy to see for yourself. When the kid gets the toy he wants to know why you didn't let him have first crack at it.

★ *I've always wondered about the little hole punched into each of the two prongs on all electric plugs. Why?*

Mel Atler
San Francisco, Calif.

Without a hole, how could the current flow?

★ *Okay, we all know that you're a droll fellow and that you can put down somebody who sends in a nutty question, but what does it all mean? Exactly what do you stand for?*

Ed Arleigh
Dayton, Ohio

The Star Spangled Banner.

BROADSIDES

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

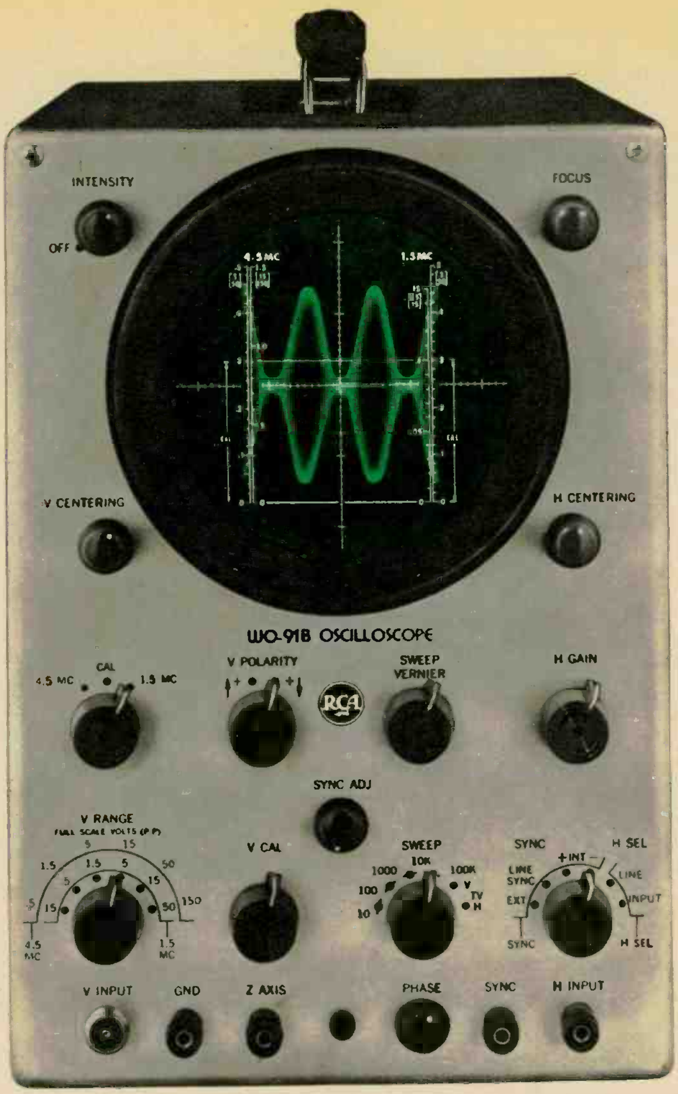
AMONG the **transceivers** and **accessories** shown in the Industrial Two-Way Radio brochure is a portable kit comprising two transceivers, battery charger, optional base-loaded antennas, nickel-cadmium batteries, charger and carrying case. For a free copy write Amphenol Distributor Div., 2875 S. 25th Ave., Broadview, Ill. 60153.

Specs In Brief is the title of a booklet providing information and characteristics on silicon VHF-UHF amplifier, switching, field-effect and power **transistors.** Free copy available from RCA Electronic Components & Devices, Harrison, N.J. 07029.

Hobbyists with an eye on a **career in electronics** will find a wealth of details on stay-at-home training programs in the catalogs of two technical schools. Copies are free from the National Radio Institute, 3939 Wisconsin Ave. N.W., Washington, D.C. 20016 and National Technical Schools, 4000 S. Figueroa St., Los Angeles, Calif. 90037.

With the rush of **integrated circuits** into the consumer-electronics market, experimenters will find articles in the Oct./Nov. '66 Bell Laboratories Record magazine on IC theory and applications informative. A copy is available for 25¢ from Editor, Bell Laboratories Record, Murray Hill, N.J. 07971.

A brochure describing **stereo amplifier** and **FM tuner kits** (a line dubbed Cortina by the manufacturer) is available free. Write Eico Electronic Instrument Co., 131-01 39th Ave., Flushing, N.Y. 11352



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DX OF THE CENTURY: APOLLO SIGNALS FROM THE MOON!

By HOWARD ELLINGTON

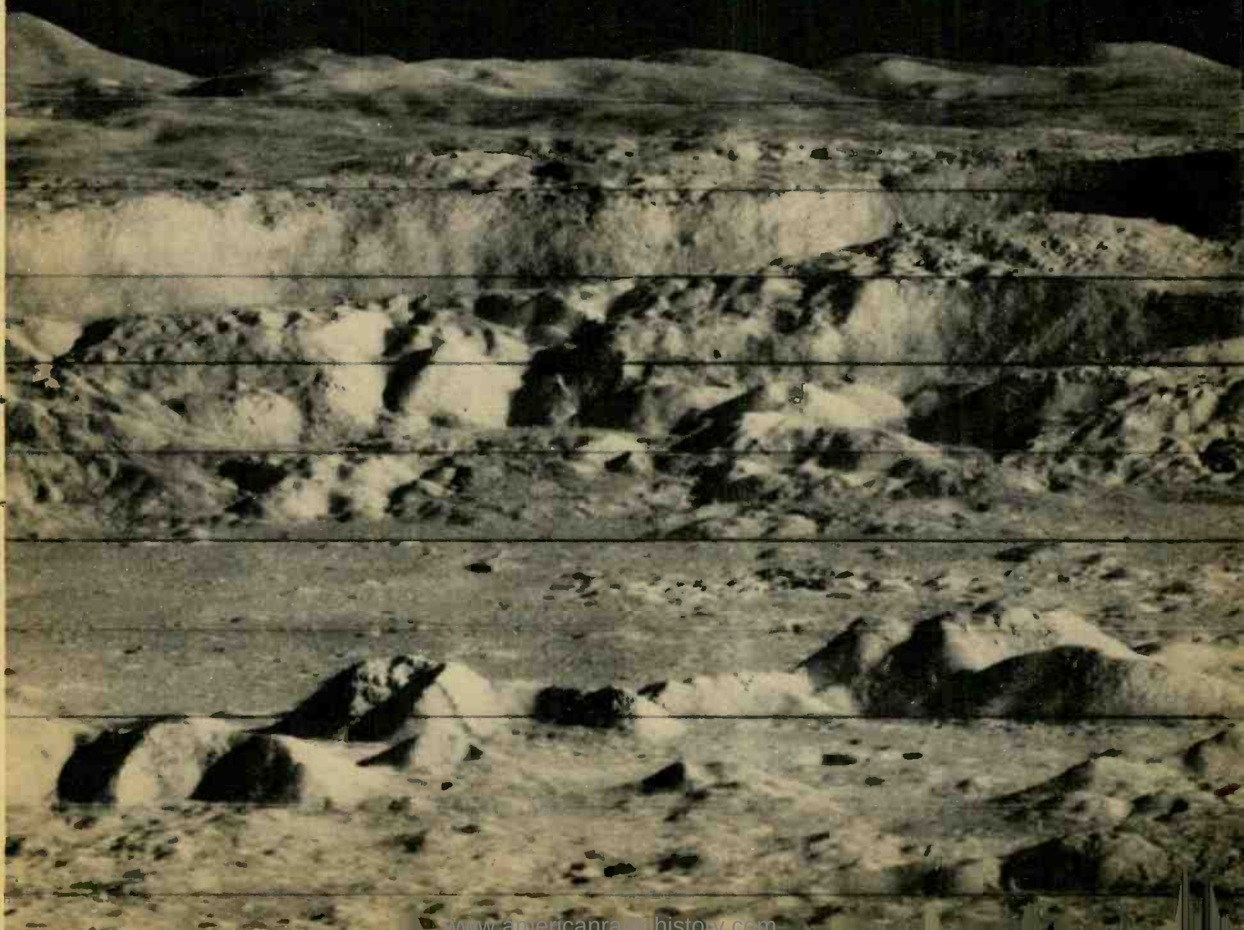
"ROGER, I am heading back to the LEM. That meteor shower does seem to be coming this way!"

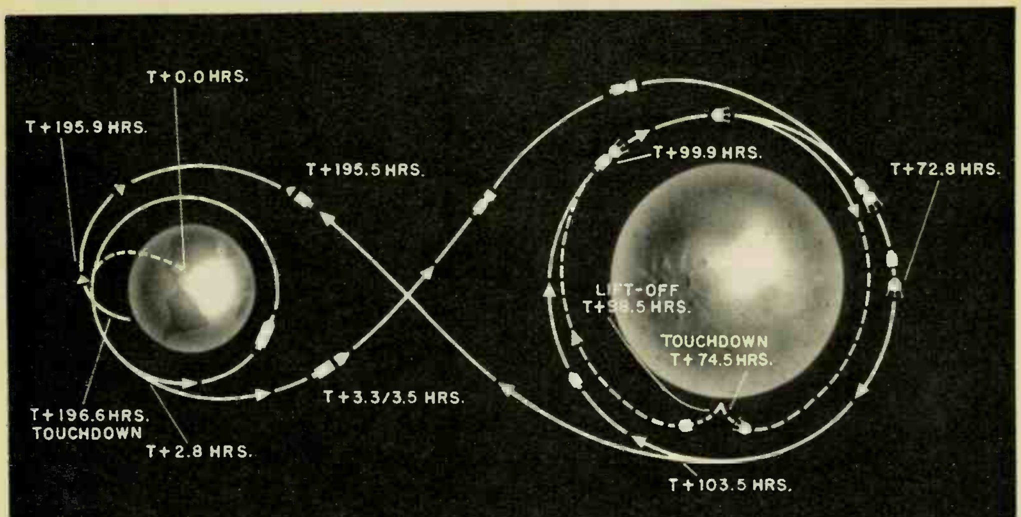
Buck Rogers in the next century? No—it could be a message from one of our own astronauts, transmitted directly from the moon and not many months in the future.

The landing of an American on the moon before 1970—and possibly as early as 1968—will mark more than just the beginning of man's exploration of other bodies in our galaxy. It also will be the dawn of a new era of radio communications, an age in which a well-equipped short-wave listener or ham may be able to pick up signals directly from points thousands of miles in outer space.

From the viewpoint of the radio hobbyist, at least two types of DX will be involved in the Apollo program. There also is a third possibility, though not anything that could be called DX. In this last instance, anyone could participate.

Dr. Wernher von Braun describes the incident thusly: "The first man stepping





Approximate timing sequence for typical mission. Vehicle starts at earth at T = 0, orbits earth, travels to moon (right), orbits moon, drops module on moon. Module leaves moon, joins service module, orbits moon, returns to earth, starts re-entry then touches down 196 hours after start.

out onto the moon will be televised by the other man, operating a camera inside the lunar module. We will hear the voices of the astronauts." Those TV and radio signals he describes will travel from the moon to the American space communications network, there to be seined out of a large mass of other telemetered data and then relayed to the world via radio and television stations. From that standpoint, almost anyone anywhere in the world could pick up Apollo signals from the moon, though reality would reduce the whole thing to tuning in the closest radio or TV station.

The other DX possibilities are the kind SWLs dream of. This is the reception of Apollo signals directly from the moon—leaving out the space network and the commercial radio and TV transmitters. At least two possibilities exist in this area.

The Apollo program has represented an awesome challenge to electronic research and development, requiring a communications and control network of a sophistication never before seen. Involved are not only communication with space vehicles and the tracking of them, but also the problem of obtaining these goals over a metered distance of 230,000 mi. The idea that even a skilled DXer could find a place in the Apollo program to exercise his hobby is startling—but the possibility definitely seems to exist.

Before discussing the communications side further, let's take a look at what is going to happen on the day that an American heads for the moon. At an early hour three astronauts will arrive at Complex 39 of the U.S. spaceport at Merritt Island, Fla., and will be carried by elevator to the Apollo Command Module about 320 ft. above the base of the Saturn V launch vehicle. After the countdown of the century, the vehicle will lift off and 2½ minutes later the first stage will separate. Some 6½ minutes after this, the second stage will drop off and a third will start burning, putting the craft into earth orbit.

After an orbit and a half, the third stage will fire again, pushing the space vehicle toward the moon. About halfway to the moon the astronauts will separate the Lunar Excursion Module (LEM) from the rest of the spacecraft, then turn their craft (made up of Command and Service Modules) around in flight and dock with the LEM, which now is in front of the Command Module's nose. After another flipflop, the whole thing would be pointed toward the moon and two astronauts will crawl through the hatch into the LEM.

On reaching moon orbit, the lunar bug will separate from the Command Module and will land on the moon's surface. One astronaut will leave the LEM to explore the moon on foot, changing positions with the man remaining aboard ship after about four hours. These field trips will take the astronauts up to a mile from the lunar bug and provide opportunity for taking photographs, gathering ground samples and for planting telemetry devices, which will continue to operate long after the crew returns to earth.

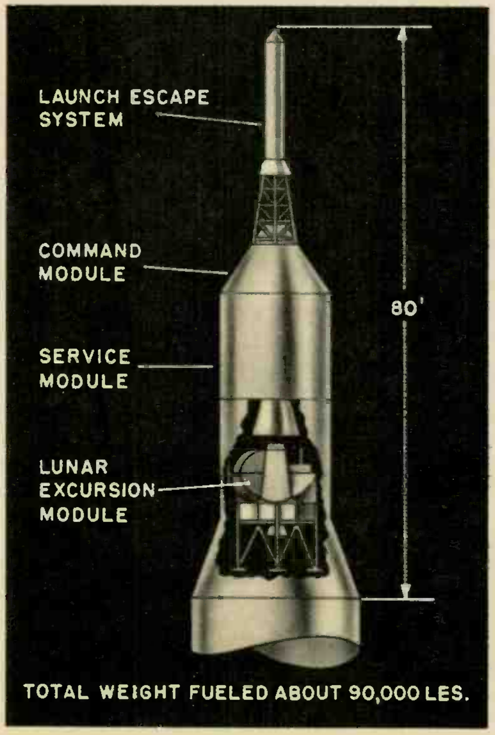
The two astronauts will blast off in one stage of the LEM and join the Command Module, and then they will leave lunar orbit, hit the earth's atmosphere and eventually descend by three parachutes to a Pacific target point, where recovery ships will be stationed.

During the entire flight, of course, the Apollo spacecraft and the astronauts will be in almost continuous communication with the earth. The main communications link will be within the S-band (1.55 to 5.2 kmc) on a channel from 2100 to 2300 mc. This broad channel will carry thousands of bits of information simultaneously, including two-way voice communications, television, telemetry data, range, range-rate and antenna-tracking information. The main pickups will be 85-ft. parabolic antennas located at communication facilities at Canberra, Australia, Goldstone, Calif., and Madrid. These stations will be aided by 30-ft. dishes at Cape Kennedy, Grand Bahama Island, Antigua, Canary Islands, Guaymas (Mexico), Ascension Island, Carnarvon (Western Australia), Guam and Hawaii—plus a task force of eight instrumentation aircraft and three ships, and two ships concerned primarily with re-entry. The whole network is called the United S-Band System of the Manned Space Flight Network.

Why was the 2100-mc band chosen? NASA feels that because of ionization and inversions that often trouble lower-frequency transmissions, microwaves would be the best bet. The 2100-mc band also offers a frequency that can cut through atmospheric reflection that sometimes sends signals back to earth or out into space.

Two separate S-band groupings have been arranged, one for transmitting (2090 to 2120 mc) and the other for receiving (2270 to 2300 mc). By keeping the bands close, the same antennas can be used for receiving and transmitting without great loss of efficiency.

Once the astronauts are on the moon, the



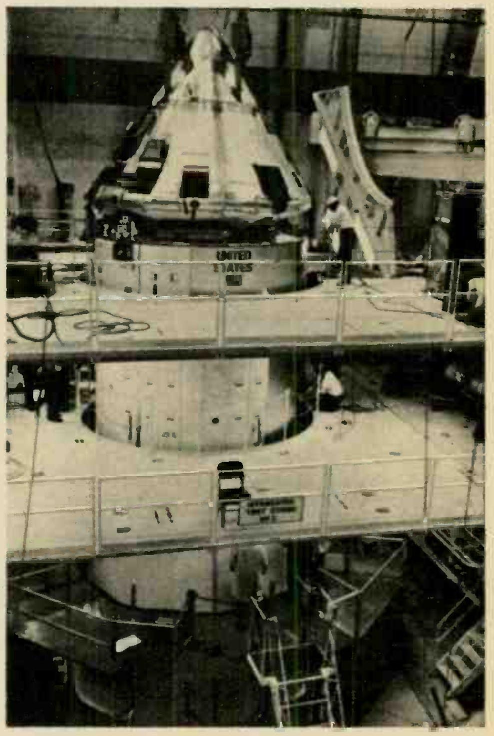
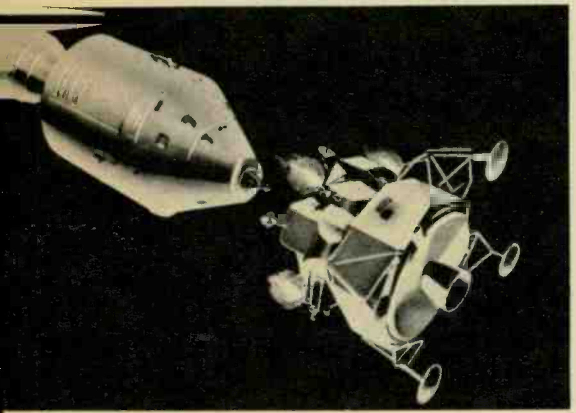


Photo at right shows Apollo spaceship for the first Saturn V super rocket flight undergoing test. At the left is a diagram of what's inside complete Apollo spacecraft. The Saturn rocket is 36 stories high.



Above is diagram showing lunar-excursion module (right) after it has been fired from Service Module (left). Module now starts descent to moon. Photograph, right, shows a man climbing aboard a full-scale model of the Lunar-Excursion Module.

man out walking around will communicate with the LEM via a short-range VHF system whose frequency has not yet been determined with finality. A repeater at the LEM will relay these communications via VHF to the Command Module which is orbiting the moon overhead. The Command Module will convert these signals to S-band frequencies for transmission to earth. The RF input power of the Command Module in its transmissions to earth is estimated at 20 watts. Transmissions from earth to the moon will run as high as 20 kw actual RF output.

As has been said, communicating with the Apollo moon capsule involves exceptionally complicated equipment with almost zero tolerances and for the hobbyist to even dream of duplicating what NASA has taken several billion dollars to bring about is more than a little far-fetched. However, there is a variance in goals. The Apollo people on earth and those on the moon must be capable of contacting each other at any time—meaning a system of 100 per cent reliability—and nearly every bit of data must be intelligible on the receiving end.

A hobbyist's demands are not quite so great. Just being able to pick up any of the signals from the moon, intelligible or not, would be an accomplishment of the first order.

EI now is working on equipment which may make it possible for a hobbyist to tune the S-band. It is possible that the project may not be as complicated as might first be supposed; we will keep readers informed.

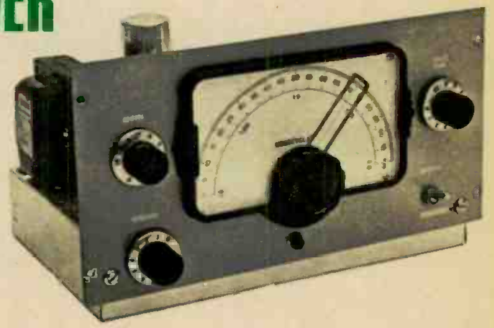
Even after picking up such a signal, a few problems remain. All of the data will be in multiplex form and sorting out the voice from the rest will be exceedingly difficult. A more practical approach would be the mere recording of the signal on magnetic tape. At this point the problem becomes one of verification. NASA currently has no plans to verify any such tapes, though by the time the first man reaches the moon the agency could have changed his mind. EI intends to try to bring this about.

The last remaining DX possibility is direct reception of the VHF signals used on the moon itself.

However, in the case of both VHF and S-band signals, the actual power will be a less-important factor than is the case with international short-wave broadcasting and amateur communications. The really attractive side of the propagation picture so far as the moon is concerned is almost identical with the moon's attractiveness to boys and girls parked on Lover's Lane—you can *see* the moon. In terms of radio, that means line-of-sight communications.

160-METER HAM STATION

This issue... THE RECEIVER



By JIM WHITE, W5LET

NOW some cigarette smokers would rather fight than switch. But it seems a few hams would rather switch than fight. And the slow but gradual switch is to higher operating frequencies because of crowding down on 80 and 40 meters. About the only places, hams claim, where there's peace and quiet, as well as a little open dial space, is up in the 6 and 2-meter reaches.

Not so! There's a fairly inactive band way down in the basement which a lot of operators have forgotten about, or in some cases have turned their backs on. It's the 160-meter (1.8 to 2.0 mc) band.

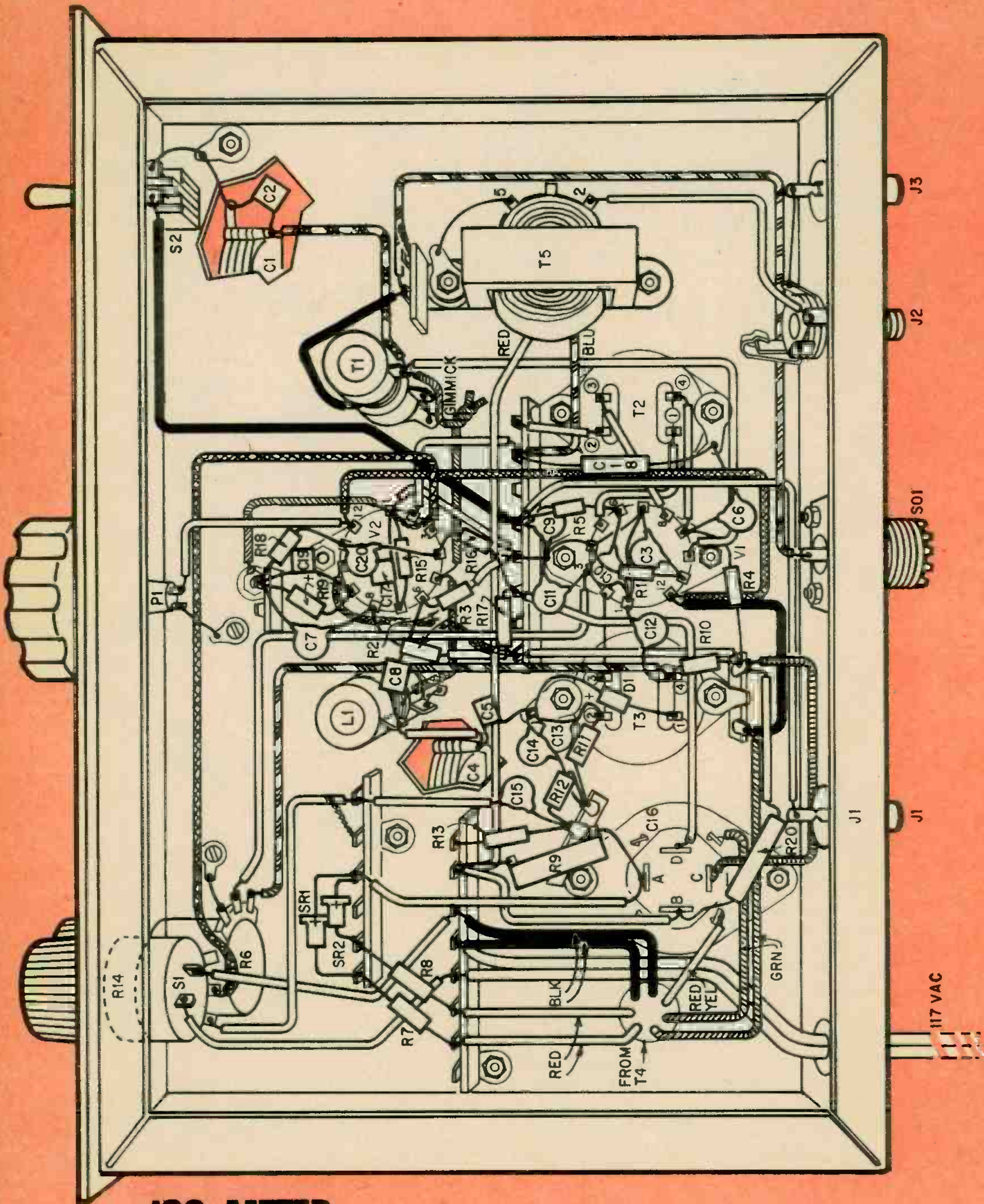
Ask any of the old timers and they will tell you that these 200 kc were some of the best frequencies that hamdom has ever possessed. Along the way though Loran stations moved in and the FCC issued some restrictions. The result was wholesale desertion. (We suggest you read over the restrictions in The Radio Amateur's Handbook.)

The 160-meter band can still provide a lot of challenge. Sure, there is interference from the Loran stations and the input power is limited, but a lot of good solid QSO's can be had with stations both far and near.

The Station

Very few receivers or transmitters manufactured these days include the 160-meter band so to get on the air you will have to build both. Here is a good station that will fill the bill. In this issue we present plans for the receiver. In our September, 1967 issue we will have plans for the 100-watt phone/CW transmitter.

Notice in the receiver's schematic that there are only two tubes. Don't be disappointed. They give a good account of themselves. The two tubes are multi-purpose compactrons. Twin pentode V1, a 6AR11, doubles as a mixer (V1A) and a 455-kc IF



160-METER HAM STATION

Fig. 1—Because receiver uses 12-pin compactron tubes, wiring on sockets is extremely crowded and requires careful placement. Tuning capacitor C4 is shown to left of center for clarity. You should mount it between V1 and P1.

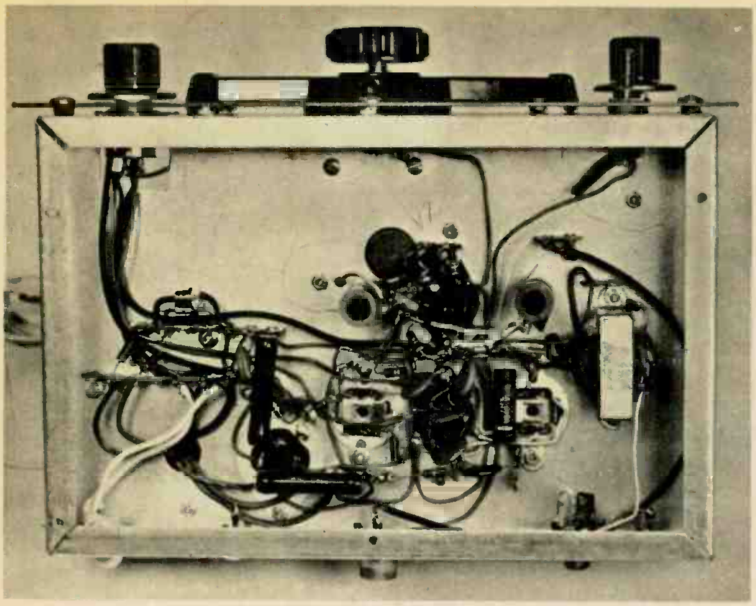


Fig. 2—To lay out your chassis, take dimensions from this photograph and multiply them by 3. It is permissible to spread out parts at left slightly but do not try to open up wiring in center around tube sockets and IF transformers. Note at top how thin spacers are used between chassis and the front panel.

amplifier (V1B). Double-triode pentode V2, a 6AF11, serves three functions. It's the local oscillator (V2B), audio preamp (V2A) and audio output (V2C). It furnishes plenty of power for a speaker or phones. A 1N60 diode serves as the second detector.

The only departure from standard design in the receiver is in the IF amplifier (V1B). This stage is made regenerative and by controlling the point of oscillation with R6, the gain and selectivity of the stage can be greatly increased.

The transmitter part of the station runs 100 watts input on AM phone or CW. There are only three tubes in the RF section. A 6AQ5, a crystal oscillator with an untuned plate, drives a pair of old reliable rugged 807s. There is only one circuit to tune—the plate circuit of the final. The audio section of the transmitter used two tubes, a 12AX7A

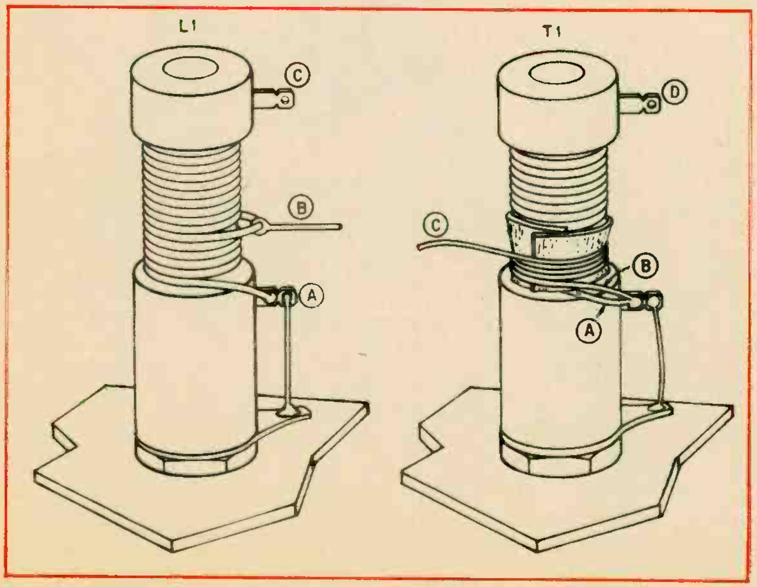
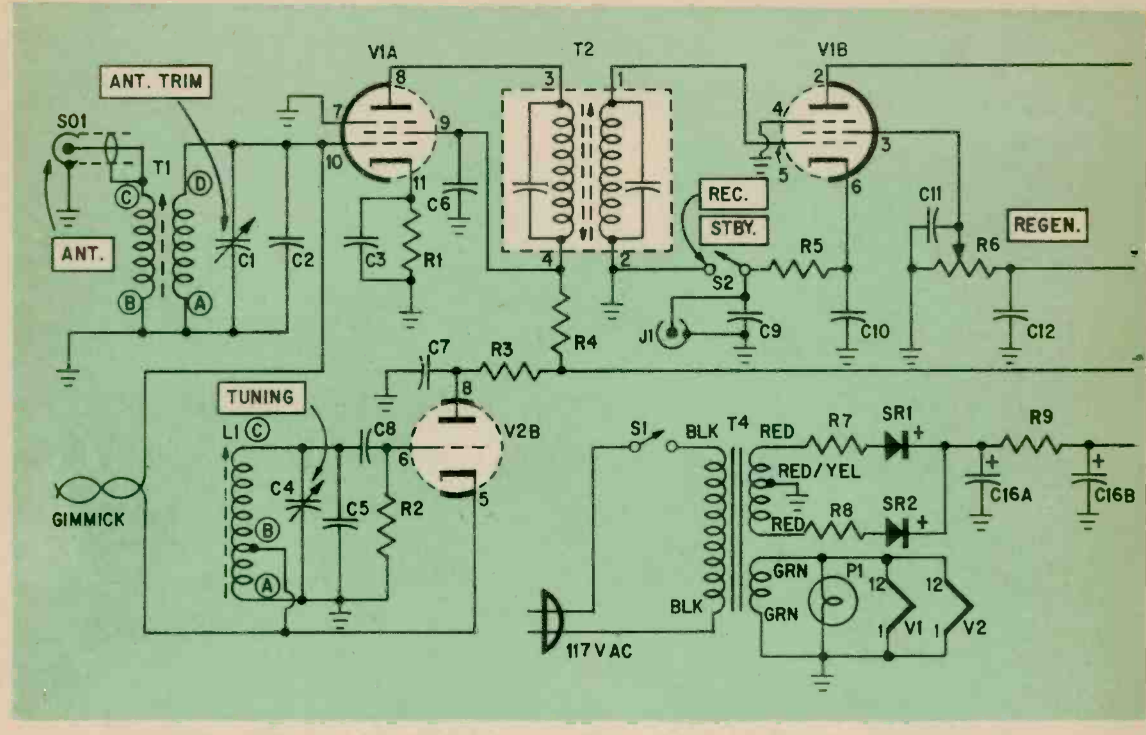


Fig. 3—Oscillator coil L1, at left, consists of 60 turns of No. 30 enameled wire tapped 10 turns from bottom. Tap is made by pulling out loop and continuing winding in same direction. Antenna transformer is at right. Wind secondary, consisting of 60 turns of No. 30 enameled wire, on form first. Put tape over winding and wind 6-turn secondary. See schematic to determine connections to the circled letters.



160-METER HAM STATION

speech amplifier and a 6BQ5 modulator.

Both the transmitter and receiver have power supplies which are similar in design. They are full-wave transformer types, using silicon-diode rectifiers. The filter circuits in both are the R/C design. By using large capacitors, hum is almost non-existent. Both the transmitter and receiver are housed in attractive Bud shadow-type cabinets. The backs provided with the cabinets should not be used to permit better ventilation.

Receiver Construction

Mount the cabinet front panel on the front of the chassis then attach the dial. After the dial is mounted make a small bracket for tuning capacitor C4 from a small piece of aluminum and fasten it to a short length of aluminum angle. Mount the angle on the chassis. When installing the bracket make certain C4's shaft lines up with the dial's shaft. Misalignment cannot be tolerated here. The two, the dial and capacitor, are coupled with a ¼-in. shaft coupling.

It will be necessary to drill three holes in the chassis and front panel for volume control R14, pilot lamp P1 and receive/standby switch S2. Allow about 1 in. clearance for the flange at the bottom of the cabinet.

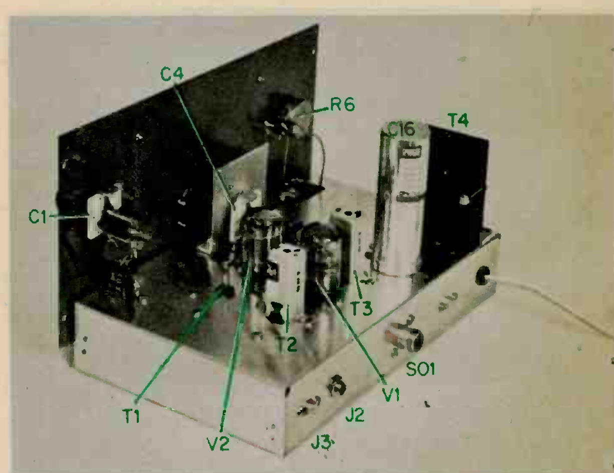


Fig. 4—Note the assembly on which tuning capacitor C4 is mounted. It is 2½-in. square piece of aluminum which is supported with angle brackets.

When mounting parts, orient V1's socket so that pin 10 faces the rear of the chassis. The socket for V2 should be mounted so that pin 4 also faces the back of the chassis. Look

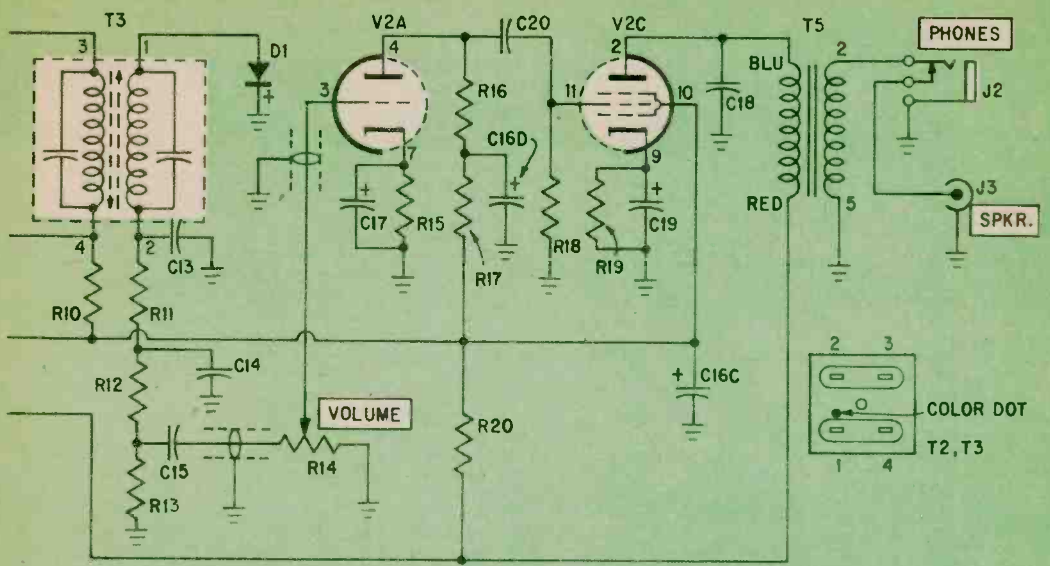


Fig. 5—Although receiver has only two tubes, it has five tube functions. Incoming signals are fed to mixer V1A where they are mixed with output of local oscillator V2B. Receiver is tuned by varying frequency of oscillator. The IF signal is fed to V1B whose gain can be changed by regeneration control R6.

at the pictorial of the receiver in Fig. 1. Note that antenna transformer T1 is underneath the chassis and is on the right side. Oscillator coil L1 is to the left. The IF transformers must be mounted where shown mounted so leads to them are short.

There are two coils to wind, T1 and L1. T1 is wound on a standard J. W. Miller slug-tuned form. Wind the secondary first as shown in Fig. 3. It consists of 60 closewound turns of No. 30 enameled wire evenly spread over the narrow-diameter portion of the form. After this winding is taken care of, place a small piece of plastic tape around it and then wind on 6 turns of No. 28 enameled wire. Be sure to wind the two coils in the same direction.

The oscillator coil, L1, consists of 60 turns of No. 30 enameled wire, closewound on the same type form as used for T1. This coil is tapped 10 turns from the ground end. To make the tap, form a loop at the tenth turn then continue winding in the same direction. The gimmick capacitor is made by twisting together short pieces of hookup wire connected to pin 5 on V2 and pin 10 on V1.

Note that R5 is connected to a terminal-strip lug from which leads are run to S2 and J1. When switch S2 is closed the receiver

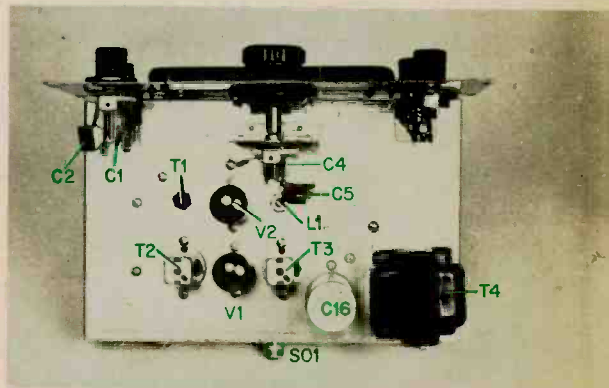


Fig. 6—Top view of receiver. Antenna trimmer capacitor C2 is mounted on front panel 2½ in. above chassis. Regen. control is at top, right.

operates normally. When S2 is in the *stby.* position a relay in the transmitter will mute the receiver when the transmitter is on the air. Headphone jack J2 is wired for low-impedance phones.

Alignment

With power applied to the receiver and S2 in the *rec.* position, feed a modulated 1775 kc signal to SO1. With *tuning* capacitor

PARTS LIST

Capacitors:
C1—5.3-100 $\mu\mu f$ miniature variable (Hammarlund HF-100)
C2—75 $\mu\mu f$, 500 V silvered mica
C3,C7,C9,C10,C11,C12,C15,C20—.01 μf, 1,000 V ceramic disc
C4—3.7-52 $\mu\mu f$ miniature variable (Hammarlund HF-50)
C5—150 $\mu\mu f$, 500 V silvered mica
C6—.0033 $\mu\mu f$, 1,000 V ceramic disc
C8—.001 μf, 500 V silvered mica
C13,C14—1,000 $\mu\mu f$, 1,000 V ceramic disc
C16A,B,C,D—10/80/10/10 μf, 450 V electrolytic (Lafayette 34 C 7305 or equiv.) C16B is 80 μf-section
C17,C19—25 μf, 10 V miniature electrolytic
C18—.02 μf 600 V tubular
D1—1N60 diode
J1,J3—Phone jack
J2—Closed-circuit phone jack
L1—Coil wound on J. W. Miller 43A000CB1 (Lafayette 34 C 8949) form (see text)
P1—6.3 V pilot lamp and socket
Resistors: ½ watt, 10% unless otherwise indicated
R1,R5—68 ohms R2,R11—47 ohms
R3—10,000 ohms, 1 watt R4,R10—1,000 ohms
R6—100,000 ohm, linear-taper pot
R7,R8—22 ohms
R9—1,750 ohm, 10-watt wirewound
R12,R16—100,000 ohms R13—56,000 ohms
R14—500,000 ohm audio-taper pot with SPST switch
R15—330 ohms R17—15,000 ohms
R18—470,000 ohms R19—100 ohms, 1 watt
R20—2,250 ohms, 10-watt wirewound
S1—SPST switch on R14
S2—SPST toggle or slide switch
SO1—SO-239 coax connector
SR1, SR2—Silicon rectifier; minimum ratings: 750 ma, 400 PIV
T1—Antenna transformer, wound on same type J. W. Miller coil form as L1 (see text)
T2—455-kc input IF transformer (J. W. Miller 14-C1, Allied 54 A 1954 or equiv.)
T3—455-kc output IF transformer (J. W. Miller 14-C2, Allied 54 A 1955 or equiv.)
T4—Power transformer; secondaries; 460 V center tapped @ 50 ma, 6.3 V @ 2.5 A (Allied 54 A 2502 or equiv.)
T5—Output transformer; primary: 10,000 ohms, secondary: 4 ohms. (Allied 54 A 1448 or equiv.)
V1—6AR11 tube
V2—6AF11 tube
Misc.—Dial (Lafayette 99 C 2567), 7½ x 13¼ x 9-in. cabinet (Bud SB-2141, Allied 42 A 72-54), 7 x 11 x 2-in. aluminum chassis, compactron tube socket (Lafayette 33 C 8701 or equiv.), knobs, terminal strips, ¼-in. dia. x ¾-in. long shaft coupling, RG174/U coax, ground lugs.

C4's plates fully closed, adjust the slug in L1 until you hear the signal. This should correspond to 200 on the dial. Now with *ant.-trim* capacitor C1 fully closed, adjust T1's slug for maximum volume. Adjust both slugs in T2 and T3 for maximum volume.

Next, check to see if the IF amplifier will oscillate with R6 advanced. Just before the point where oscillation begins, the gain should be considerably greater. In some cases the IF stage may not oscillate. If this happens a small amount of capacity may be necessary between pins 2 and 5 of V1. This can be provided by twisting two short pieces of hookup wire together. The number of turns is best determined by experimentation.

You are ready to start listening on 160.

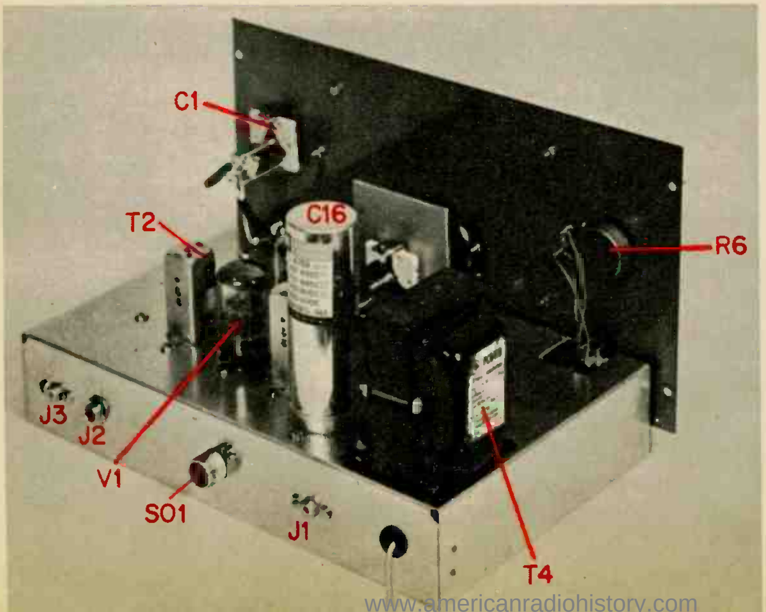


Fig. 7—Rear of receiver. Note how the front panel is mounted ¾-in. above bottom of chassis. This is necessary because of flange in front of cabinet. (See cabinet construction in top photo on first page of this article.) Cutout at upper right corner of chassis is over pot R14.

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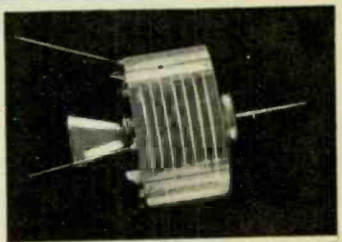

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WANNA GET IN TROUBLE

WITH THE FCC?

By ALEX KARLIN

WE like to think that most people can profit from grim experience, especially when the misery is the direct result of something that started out as fun. Fact is, however, that each year finds some 7,500 CB operators who have funned themselves into receiving a communication they hadn't counted on—a violation notice from the FCC.

From this 7,500 about 100 go on to bigger and better things, such as having their licenses revoked. Still another 50 are given that sad news that, because of rule violations, they must pay the piper by scratching up anywhere from $25 to $400, payable to the Treasurer of the United States. The saddest part of it all is that the old chestnut about how some people never learn seems to prevail among those CBers who run their CB ship aground on the FCC's rocks. With but few exceptions, the operators who get nicked this year are cited for the same tricks tried by the 7,500 misguided souls who got caught last year.

It's almost a pattern. Most of the CBers who find themselves on the business end of an FCC violation notice share a common reason: wanting to have some fun. What is fun? On CB it means (for one out of three recipients of violation notices) pushing the old mike button and yakking it up with a fellow raconteur.

Running a close second on the FCC score card are CBers who get so carried away with the fun of talking that they forget to identify their stations properly. Skip working is the next-most-popular trick attempted, that violation being pursued hotly by off-frequency operation. Overtime talking, sending false signals, calling CQ—all are high on the list of unsporting games.

But it's not just fun that causes 100 CBers each year to have their licenses yanked out from under them by the Commission—it's partly due to pure laziness. When the FCC sends you a violation notice, the agency sort of cherishes the thought that you will take a few minutes to write a note saying that you're awfully sorry for the trouble you've caused, that you've seen the error of your ways and have repented.

If you aren't prompt at answering your mail you eventually may receive a pleasant reminder suggesting that you make a little extra effort to dash off a few lines in reply to the earlier letter. If that fails to elicit a reply from you, the FCC may borrow a page from the finance company. No more fooling around. This time it's short and sour: unless you can come up immediately with a darn good reason for them to change their minds on the subject, they are going ahead with plans to revoke your license.

The 50 unfortunates who manage to get fined each year are those operators the FCC describes as wilfully and repeatedly violating the rules. This no doubt includes operators who earlier had received a violation notice, replied and apologized but never discontinued the violations.

Violations and violators crop up in the darndest places, and many of the case histories in the FCC's files still await a final chapter. While it's true that most violators are bland, garden-variety funsters, a few individualists go down in brilliant flames when fired upon by the FCC.

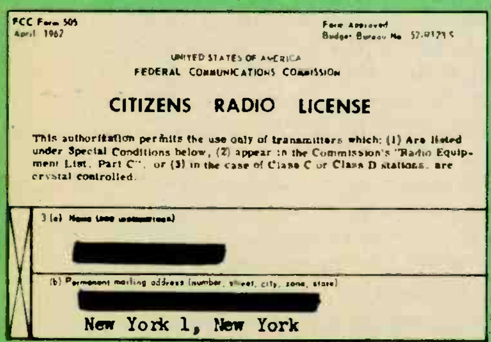
The story of one such encounter may be found in a bulging FCC file that bears the name of a family in Mattapan, Mass. No first name follows the last name because almost the whole family actually was involved.

One member, named Richard, it seems had been arrested in November 1964 for transmitting obscene, profane and indecent language over a CB station. He was released on $1,000 bail but his freedom indirectly caused his second arrest in July, 1965 when he was charged with operating an unlicensed radio transmitter. So it was just a crummy license the FCC wanted, eh? The family rallied to Richard's aid and four relatives (plus Richard himself) filed applications for a grand total of no less than 71 CB station licenses. The FCC said no and a Federal District Court judge said guilty on the charge of transmitting obscene language. Richard drew a year in jail. The charge of operating an unlicensed radio transmitter is still open as this is being written.

Speaking of bad language, we would like to have seen the FCC monitor's face when he tuned in station KHD9016 last year. He was greeted with a barrage of unprintable words, transmitted over a CB rig that, a month later, turned up pumping considerably more than the permissible power into the airwaves. Regardless of the fact that KHD9016 is a woman, she was told that she may lose her CB license.

Of the still-open cases at the FCC, one of the zaniest came to light when a Kansas City CBer complained to the FCC office that he was receiving CB interference from 4:30 P.M. to 7 A.M. daily. The FCC dragged out its direction-finding gear and tracked the mystery signal to a cemetery about two blocks from the complaining CBer. Right in the center of the graveyard stood a tree. Hanging from a branch by its extended whip antenna was a CB walkie-talkie. Someone had wired a miniature photocell into the circuit to turn it on each evening and off the following morning.

Nobody seems to know who left it there but the CBer who complained about it suspects that it must have been an unfriendly group of CBers, especially since right after the jamming started he found in his front yard a cardboard cylinder with a whip an-



FCC Form 505
April 1962

Form Approved
Budget Bureau No. 52-R173.5

UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION

CITIZENS RADIO LICENSE

This authorization permits the use only of transmitters which: (1) Are listed under Special Conditions below, (2) appear in the Commission's "Radio Equipment List, Part C", or (3) in the case of Class C or Class D stations, are crystal controlled.

3 (a) Name

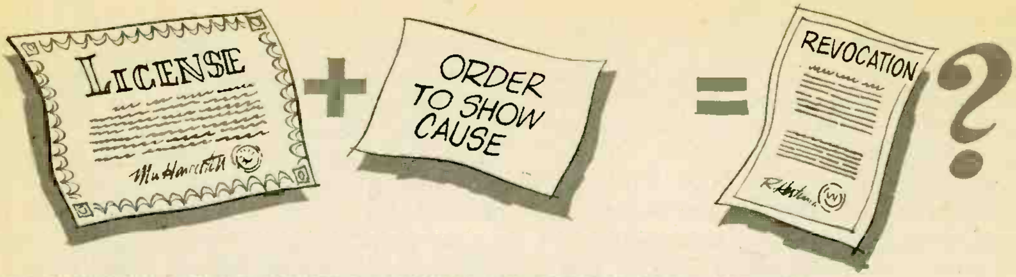
[redacted]

(b) Permanent mailing address (number, street, city, zone, state)

[redacted]

New York 1, New York

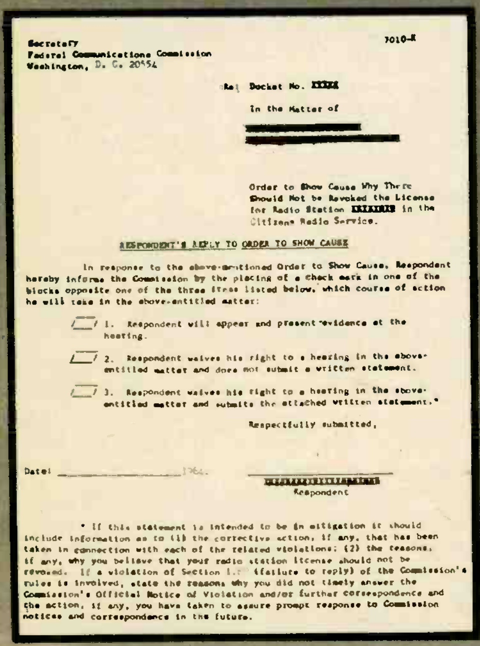
The FCC's Citizens Radio License fairly bristles with references to the conditions governing its use.



WANNA GET IN TROUBLE WITH THE FCC?

tenna attached to it. A note on the cylinder proclaimed, "This is not it, stupid."

And some of those who feel the wrath of the FCC don't easily forget, either. One CBer in New Mexico no doubt is the prime example. Upon having his license revoked several years ago, this gent embarked on a one-man anti-FCC campaign that included the founding of a national club, personal tours around the country to spread the word among CBers and an intensive letter-writing campaign to the Commission, to publications, to clubs. When last heard from, the chap was readying for publication a huge book (more than 600 pages) as an expose of FCC dealings with CBers.



Secretary
Federal Communications Commission
Washington, D. C. 20554

7010-K

Re: Docket No. [redacted]

In the Matter of

[redacted]

Order to Show Cause Why There Should Not be Revoked the License for Radio Station [redacted] in the Citizens Radio Service.

RESPONDENT'S REPLY TO ORDER TO SHOW CAUSE

In response to the above-mentioned Order to Show Cause, Respondent hereby informs the Commission by the placing of a check mark in one of the blocks opposite one of the three items listed below, which course of action he will take in the above-entitled matter:

/__/ 1. Respondent will appear and present evidence at the hearing.

/__/ 2. Respondent waives his right to a hearing in the above-entitled matter and does not submit a written statement.

/__/ 3. Respondent waives his right to a hearing in the above-entitled matter and submits the attached written statement.*

Respectfully submitted,

Date: ______________ 1964.

____
[redacted]
Respondent

* If this statement is intended to be in mitigation it should include information as to (1) the corrective action, if any, that has been taken in connection with each of the related violations; (2) the reasons, if any, why you believe that your radio station license should not be revoked. If a violation of Section 1.__ (failure to reply) of the Commission's rules is involved, state the reasons why you did not timely answer the Commission's Official Notice of Violation and/or further correspondence and the action, if any, you have taken to assure prompt response to Commission notices and correspondence in the future.

If you get one of these don't delay sending it back. Next may be Order of Revocation.

One other point that deserves to be mentioned: certain areas of the country are particularly dangerous territory for CBers who stray from the straight and narrow. Never heard of such a thing? Well, the FCC doesn't own up to it but cold statistics demonstrate the point.

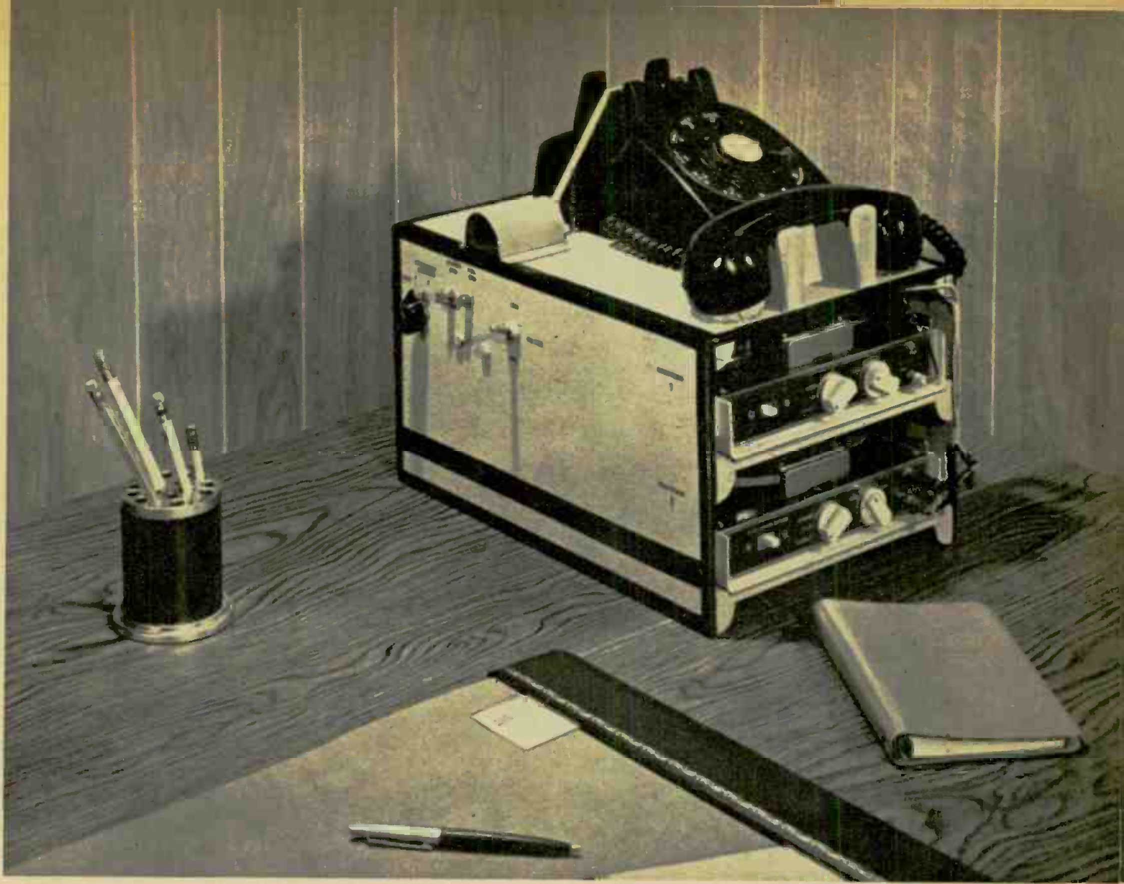
We took a year's worth of FCC police actions and mulled them over to find the states that had the highest and lowest percentages of CBers in trouble. On this basis, the Terrible Ten areas, showing the largest number of crackdowns, turned out to be Maine, Wyoming, Hawaii, Colorado, New Hampshire, Georgia, Kentucky, Montana, the District of Columbia and Puerto Rico, in that order.

On the other end, if you guessed Indiana to have the best CB record in the union you can give yourself a star. In the 12-month period we checked, nary a CB license was revoked nor was any operator fined. Other clean states include Virginia, Minnesota, Connecticut, Kansas, Mississippi, W. Virginia, Nebraska, New Mexico and Utah.

So, frankly, anybody who goes in for ragchewing (CB's most-often-reported violation) in Maine (with the largest number of FCC actions) would do well to consider other outlets for his energies. In Indiana, where operators seem to live by the FCC's book, CB has never had things so good.

Most of us who wander around somewhere in the limbo between the extremes can only keep our fingers crossed and hope that we never will bring upon ourselves that long white envelope with the window—the one marked *Postage and Fees Paid by the Federal Communications Commission, Official Business.*

How can we be so sure about what the envelope says? You get one guess.



Automatic Telephone Answering Set

You'll never miss a phone call with our electronic secretary on the job.

By **FRED BLECHMAN, K6UGT** "HELLO, this is the Blechman residence. No one is home right now. This is a recording. If you'd like to leave a 40-second message, please start it at the sound of the tone. B-e-e-p."

This is what you hear if you call when we are out. Forty seconds after the first tone you hear another tone, then a click as the phone is hung up. When we arrive home we are able to listen to your message as well as about 15 others.

Designed to be built for about $50, the Automatic Telephone Answering Set (TAS) will do the same job as commercial message recorders that might set you back a few hundred dollars.

The TAS has been designed around two inexpensive battery tape recorders. One recorder answers the telephone with a pre-recorded message. The other recorder tapes the caller's message for 40 seconds.

The timing of all operations is controlled by a 1-rpm motor which drives four poker-chip cams which in turn operate microswitches. Each microswitch controls a separate function. The phone is coupled inductively to the TAS for ring-sensing and message recording. Direct connections to the telephone line are not necessary. The answering message is acoustically fed to the handset's mouthpiece.

How it Works. Take a look at Fig. 4, a schematic of the TAS. When the telephone rings, a pickup coil (L1) near the telephone base, picks up the bell's magnetic field and feeds a signal to the two-transistor ring amplifier. A relay (RY1) at the output of the ring amplifier then starts the 1-rpm timing

Fig. 1—The ring amplifier is built on a small piece of perforated board which is mounted on the inside of the chassis' rear panel. Use spacers between the board and the chassis to prevent parts from touching the chassis.

Automatic Telephone Answering Set

motor. During the third ring, cam 1, which controls solenoid L2, turns and trips microswitch S1 which energizes L2. L2 lifts a spring-loaded lever which latches (S6) the timing motor and lets the telephone-cradle pushbutton rise. This "answers" the phone.

One second later *recorder 1* is energized by cam 2 which closed microswitch S2. This plays the pre-recorded answering message into the answering speaker (SPKR 1) which is located underneath the telephone handset mouthpiece. *Recorder 1* stops after about 14 seconds and the tone is started by another microswitch, S4. The tone sounds through SPKR 1 for a fraction of a second.

Next, *recorder 2* records the caller's message via handset-earpiece coil L3. Thirty-seven seconds after *recorder 2* starts, the tone

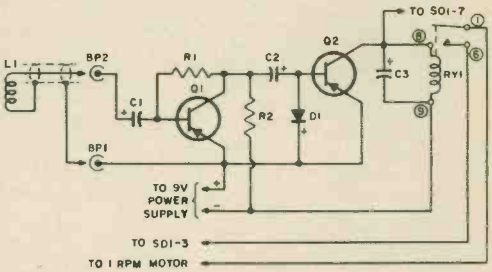


Fig. 2—Ring-amplifier schematic. Ring signal at phone is picked up by L1, fed via shielded wire to Q1, amplified and fed to Q2 which closes RY1.

sounds again, *recorder 2* stops and 2 seconds later L2 is released. This causes the spring-loaded arm to press down the telephone cradle pushbutton. When L2 is released, RY1 is unlatched and the motor stops turning.

If you cannot obtain the tape recorders shown in our model, use any battery-operated

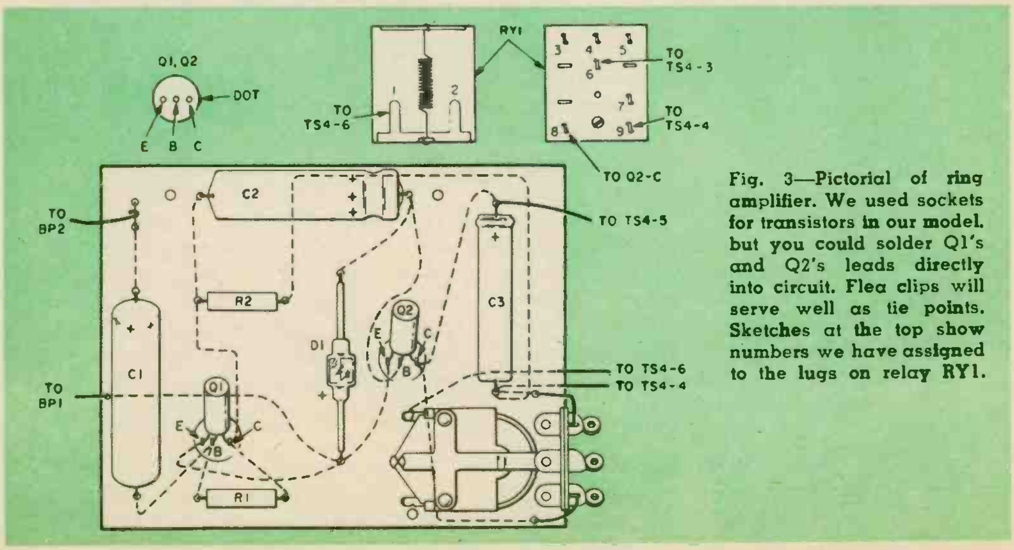


Fig. 3—Pictorial of ring amplifier. We used sockets for transistors in our model, but you could solder Q1's and Q2's leads directly into circuit. Flea clips will serve well as tie points. Sketches at the top show numbers we have assigned to the lugs on relay RY1.

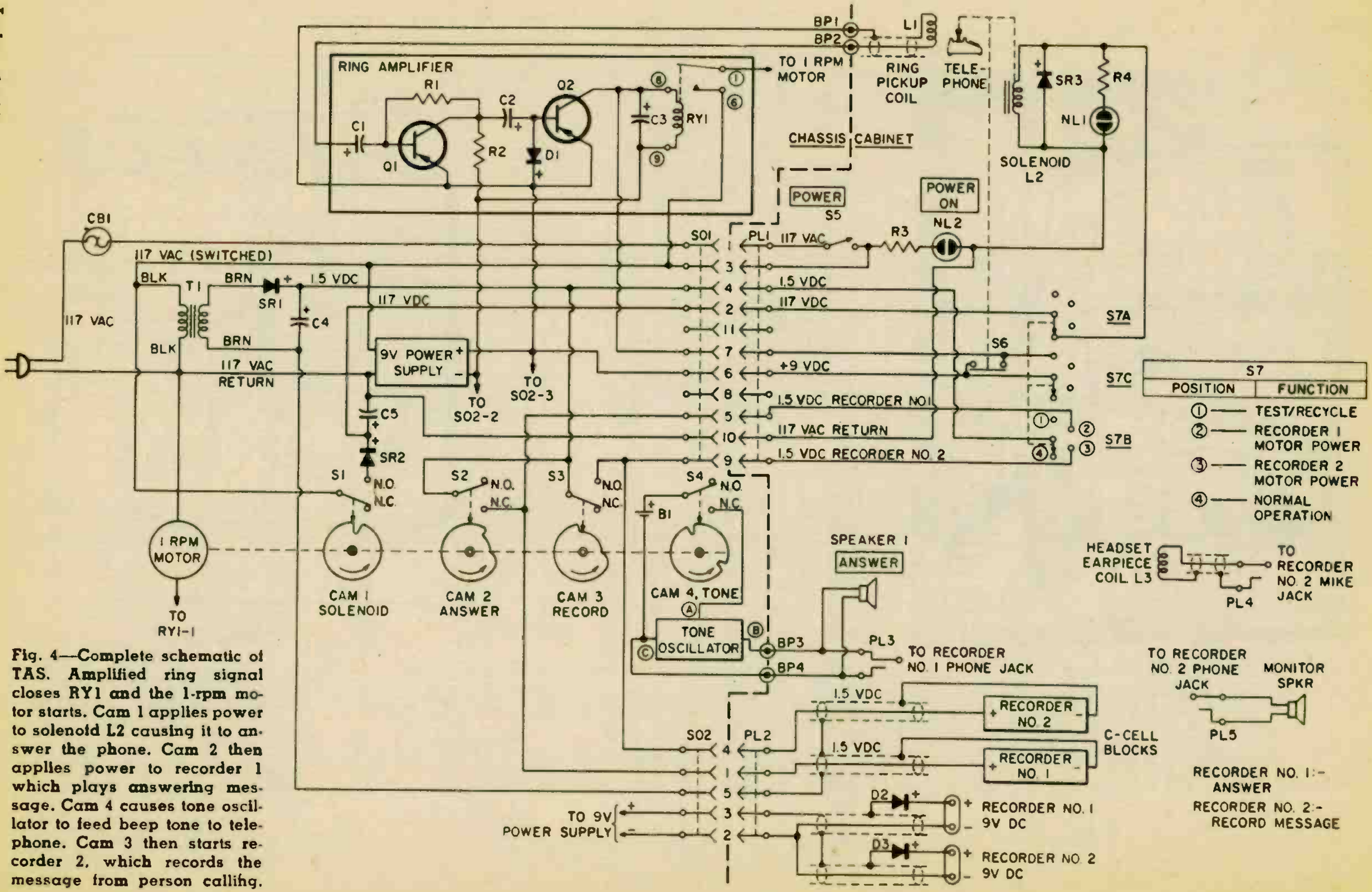


Fig. 4—Complete schematic of TAS. Amplified ring signal closes RY1 and the 1-rpm motor starts. Cam 1 applies power to solenoid L2 causing it to answer the phone. Cam 2 then applies power to recorder 1 which plays answering message. Cam 4 causes tone oscillator to feed beep tone to telephone. Cam 3 then starts recorder 2, which records the message from person calling.

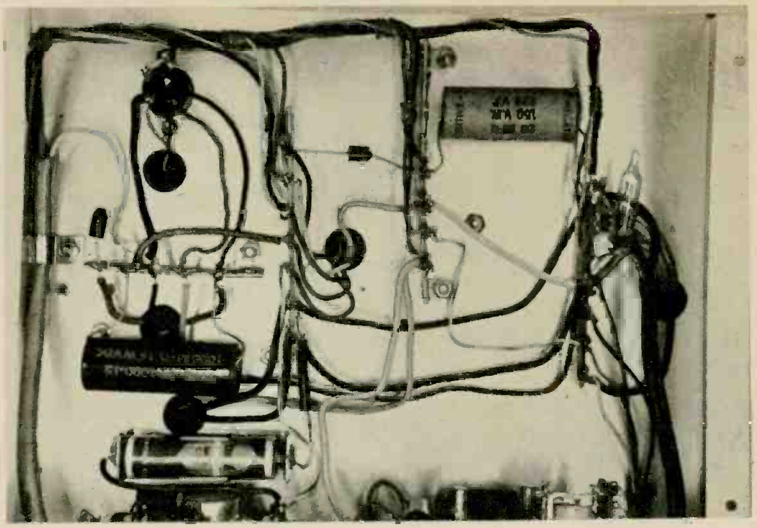


Fig. 5—Underside of control chassis. Liberal use of terminal strips simplifies wiring and keeps everything neat. Partially visible at bottom are tone generator (left) and the ring amplifier (right) boards.

Automatic Telephone Answering Set

transistor tape recorders. But be sure their motors operate on 1.5 V and their amplifiers operate on 9 V. These requirements are very important as the TAS is designed to supply these voltages only.

The schematic of the ring amplifier is shown separately in Fig. 2. The 1.5 V for the recorder's motors is obtained from a 2.5-V transformer (T1), rectified (SR1), filtered (C4) and is controlled by S2 and S3 (cams 2 and 3).

The power to operate L2 is obtained by rectifying (SR2) and filtering (C5) 117 VAC and is controlled by S1 (cam 1). Diode SR3 suppresses arcing across S7A's contacts when L2 is deenergized. Function switch S7A,B,C is a 3-pole 4-position rotary switch, used for making the master answering tape and to allow rewind and playback of each recorder

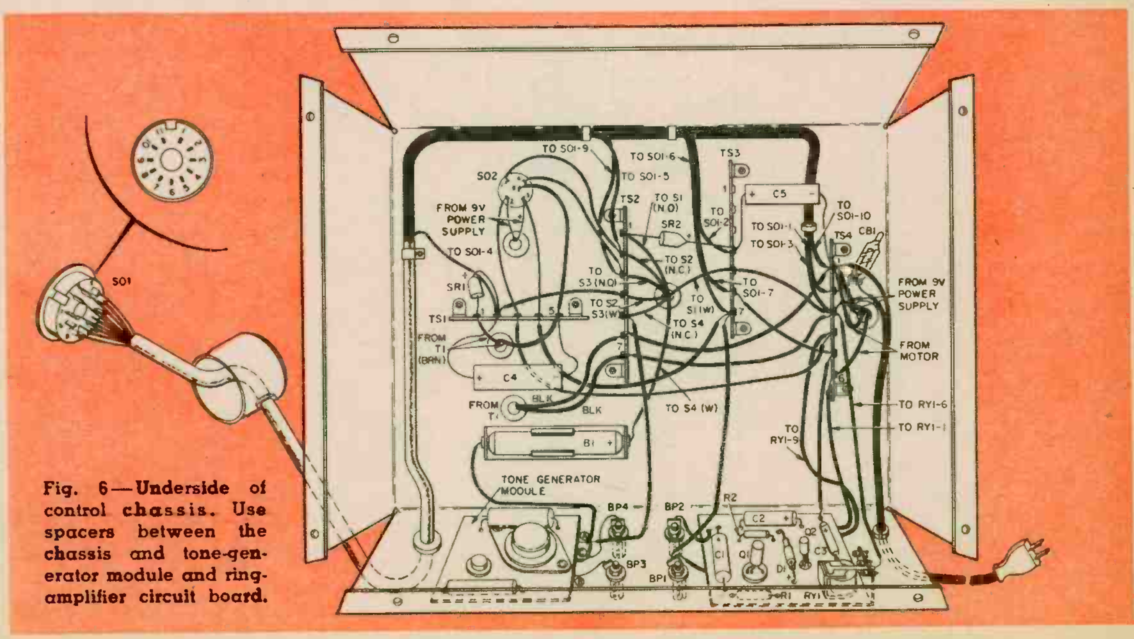


Fig. 6—Underside of control chassis. Use spacers between the chassis and tone-generator module and ring-amplifier circuit board.

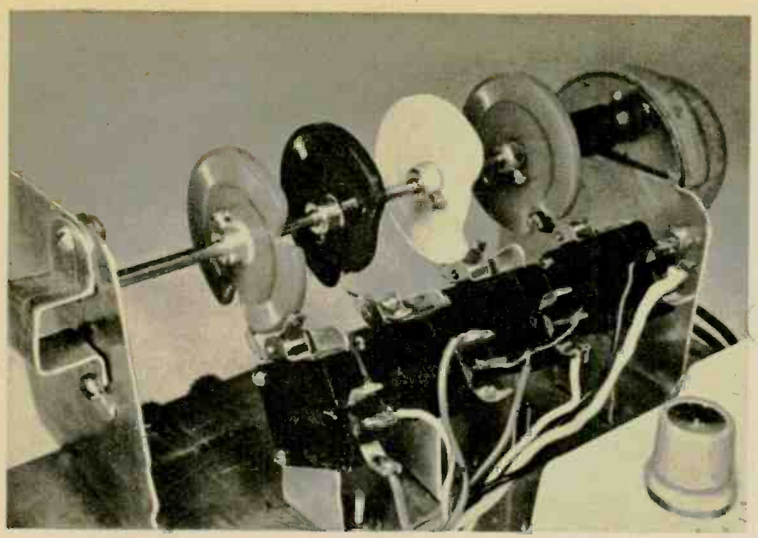


Fig. 7—Timing assembly. U-shaped bracket which supports drive motor (upper right) and cam shaft is home brew. Dimensions are not critical. Note the hubs which are glued on all the poker chips.

independently of the timer and the solenoid. Pilot light NL2 comes on when power is applied to the TAS. A green light (NL1) comes on when solenoid power is applied.

Since components are located in the cabinet and on the chassis, a multi-conductor cable is used to connect the two. The cable is equipped with an 11-pin connector (SO1) to provide easy separation. Similarly, the shielded cables that provide power to the recorders are connected to a single plug (PL2) that plugs in SO2 on the chassis. Diodes D2 and D3 are necessary to DC-isolate the recorders from each other. If you don't use them you'll find strange interactions.

Construction. The ring-amplifier (Figs. 1,2,3) can be built on a small piece of perforated board. Be sure to observe proper diode and capacitor polarity. The value of resistor R2 may have to be changed to provide about 0.7-ma drain from the 9-V supply with *no* ring signal. A ring signal should

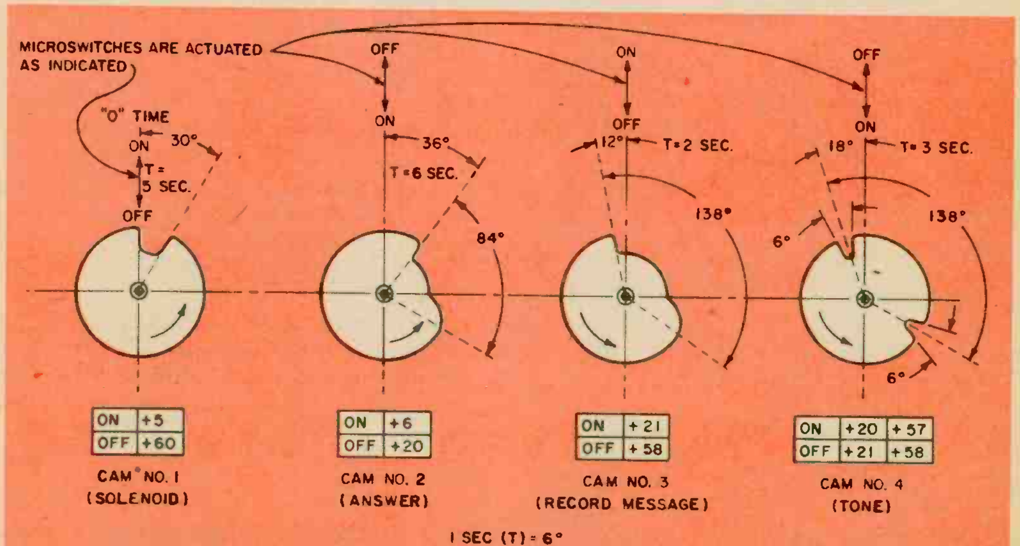


Fig. 8—Cam dimensions. Make all cuts with a jewelers saw then use sketches to line up cams on shaft. Numbers in boxes below cams show time after motor starts that the cams should actuate their associated circuit. Cam 1, for example, should turn L2 on after 5 seconds and off after 60 seconds.

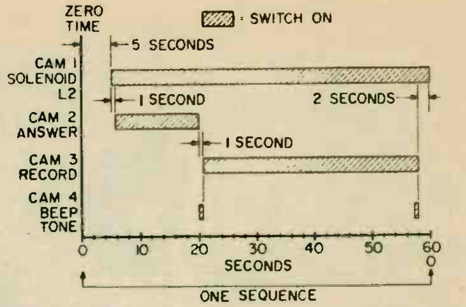


Fig. 9—Cam-timing sequence. Duration of time a switch is on may change. Do not change the time intervals between operations of the switches.

Automatic Telephone Answering Set

cause the current to rise to about 2 ma. Capacitor C3 is necessary to prevent relay chatter.

A *flat* telephone pickup coil *must* be used. Place it alongside the phone base, as shown in Fig. 13. During preliminary tests later, have someone call you several times to find the best coil location for fast relay closure. Be sure to use shielded wire from L1 to the amplifier to prevent random noise from triggering the amplifier and relay.

The frame for the timing motor and cams is made by bending a piece of aluminum into a *U* shape, as shown in Figs. 11 and 12. The dimensions are up to you. On one end mount the motor. Add about a 6-in. length of 1/8-in. dia. brass rod or tubing to the motor shaft using a standard 1/4-in. shaft coupling, modified as shown at the top of Fig. 10. All you do is push a piece of 1/4-in. O.D. polystyrene tubing (1/8-in. I.D.) into the coupling then drill two holes for the setscrews. The screws will cut their own threads in the polystyrene tubing. The other end of the brass tubing fits through a small hole in the far end of the U frame.

The cams are made from poker chips. Drill a 1/8-in. dia. hole in the center of each poker chip and cement a model airplane wheel hub to each side to the chip, as shown in Fig. 10. These aluminum hubs, sold in hobby shops, have a 1/8-in. center hole and a setscrew.

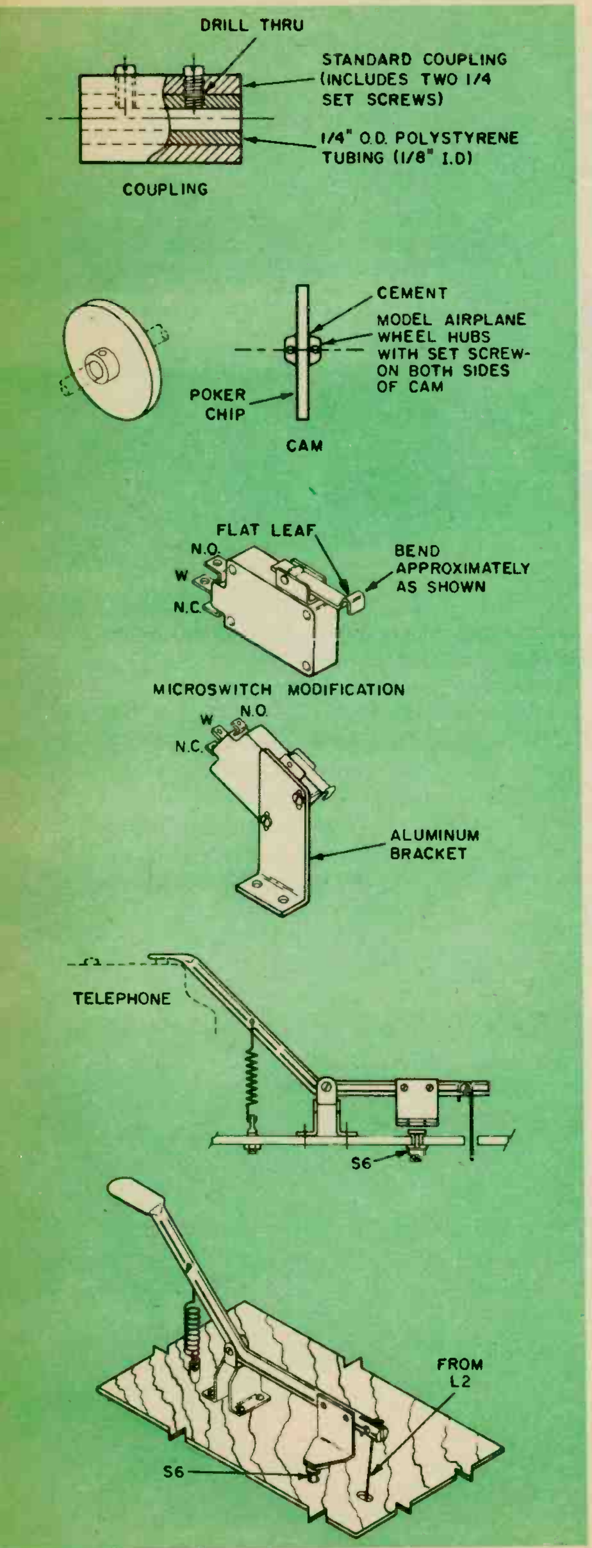


Fig. 10—Miscellaneous construction details. Coupling at top connects motor and cam shaft. Diagrams below show cam construction, microswitch modification and construction of answering arm.

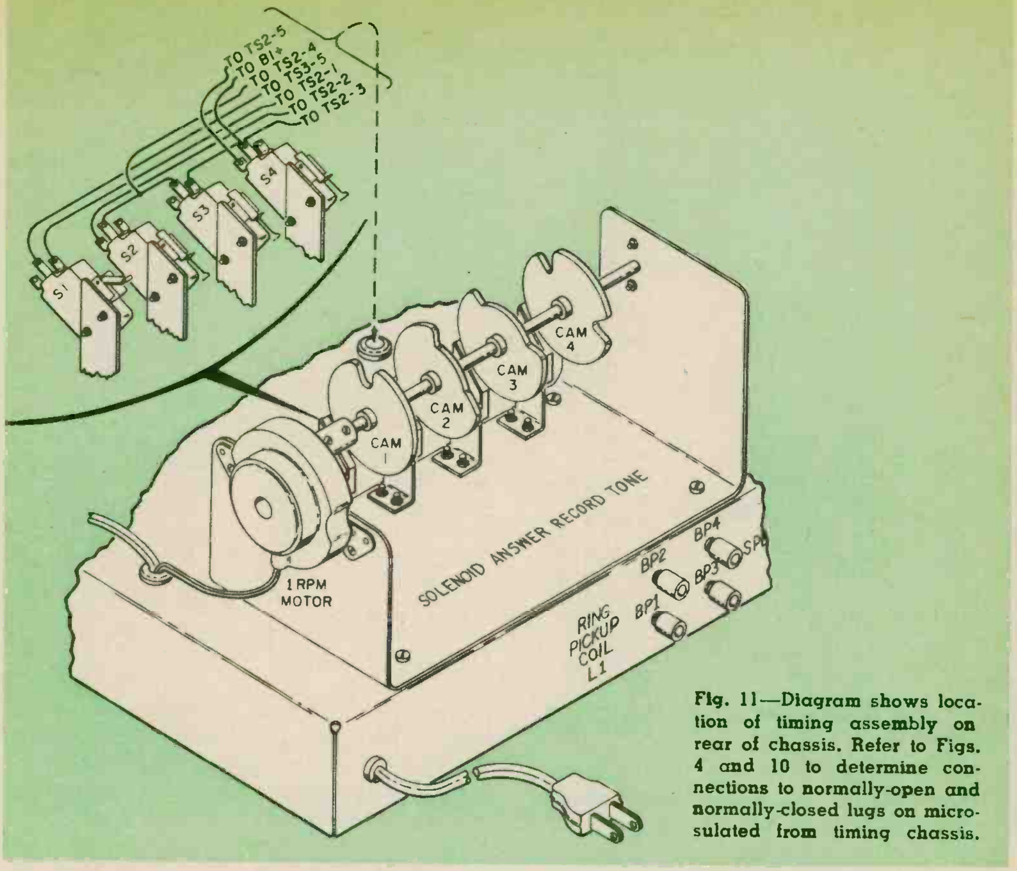


Fig. 11—Diagram shows location of timing assembly on rear of chassis. Refer to Figs. 4 and 10 to determine connections to normally-open and normally-closed lugs on microsulated from timing chassis.

The setscrew hubs allow individual cam rotation for final sequence adjustments during testing.

Figure 8, shows the cam configurations and Fig. 9 shows the timing sequence in our model. If you prefer to have a longer answering message and shorter recording period, change the angular cutouts accordingly, remembering that one second equals 6 degrees of rotation. Once set and tightened, the cams need not be touched again.

The four microswitches are mounted on sheet-metal brackets (Fig. 10) and adjusted later on. The flat-leaf actuator of each micro-

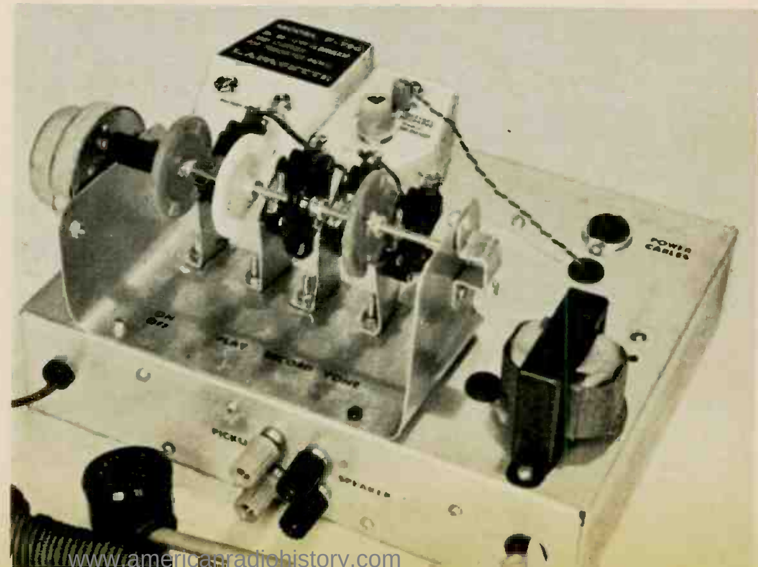


Fig. 12—Control chassis. Transformer T1, used to provide power to tape recorders' motors is at right. 9-V power supply is at upper left of the chassis.

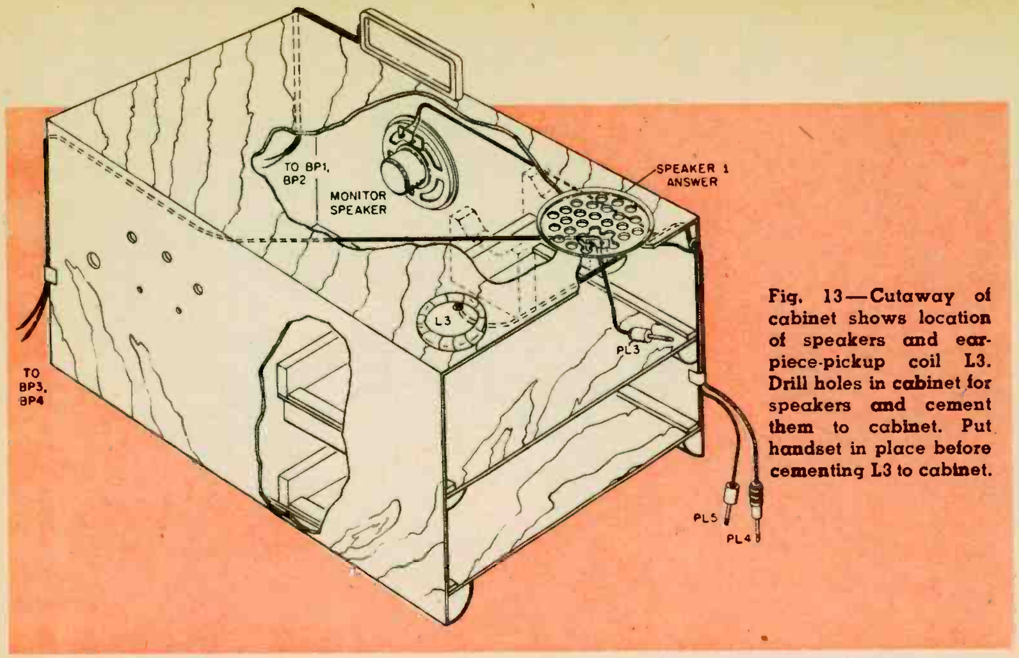


Fig. 13—Cutaway of cabinet shows location of speakers and ear-piece-pickup coil L3. Drill holes in cabinet for speakers and cement them to cabinet. Put handset in place before cementing L3 to cabinet.

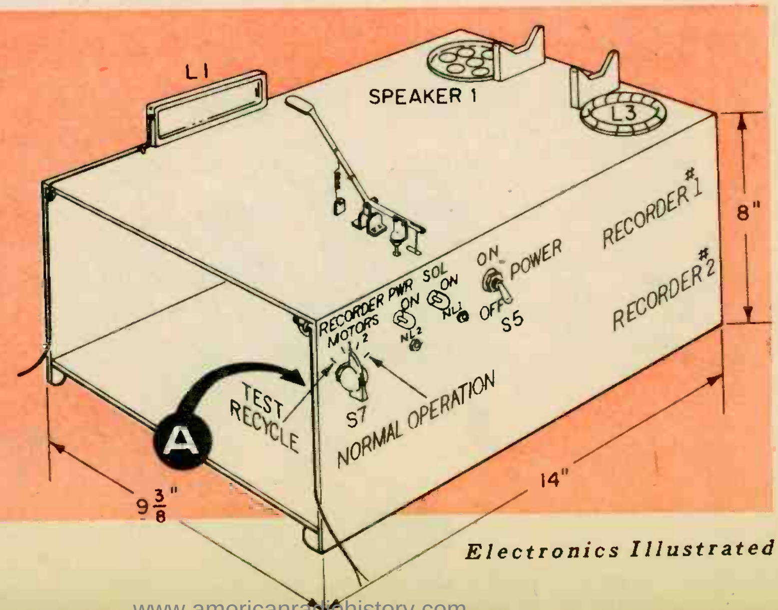
Automatic Telephone Answering Set

switch should be bent as shown in Fig. 10 for better action. The timing blocks in Fig. 9 show the times the cams should actuate their associated microswitches.

Note that for proper sequencing, cam 2 must activate *after* cam 1. Cam 3 activates 1 second *after* cam 2 deactivates. Cam 3 must deactivate 2 seconds *before* cam 1 deactivates. Some latitude in timing and spacing can be tolerated, but the *sequence* must be as shown. The position of the beep tone in the sequence is not critical, so long as it occurs near the beginning and end of the recording period.

Chassis Assembly. Remove the 9-V power supply's bottom cover. Then drill three holes in it and install mounting screws and nuts; the latter will act as studs. Now replace the bottom cover. The extended studs are used with nuts to mount the power supply to the chassis. Mount the transformer on the top of the chassis using grommets in its leads' holes. Mount a 5-pin socket (SO2) for the recorder power cables on the top of the chassis. Mount the timing assembly on the

Fig. 14—Other side of cabinet shows location of mode switch S7, indicator lamps and power switch S5. Note location of ring pickup coil L1. Detail of corner of cabinet marked with the letter A is in Fig. 16.



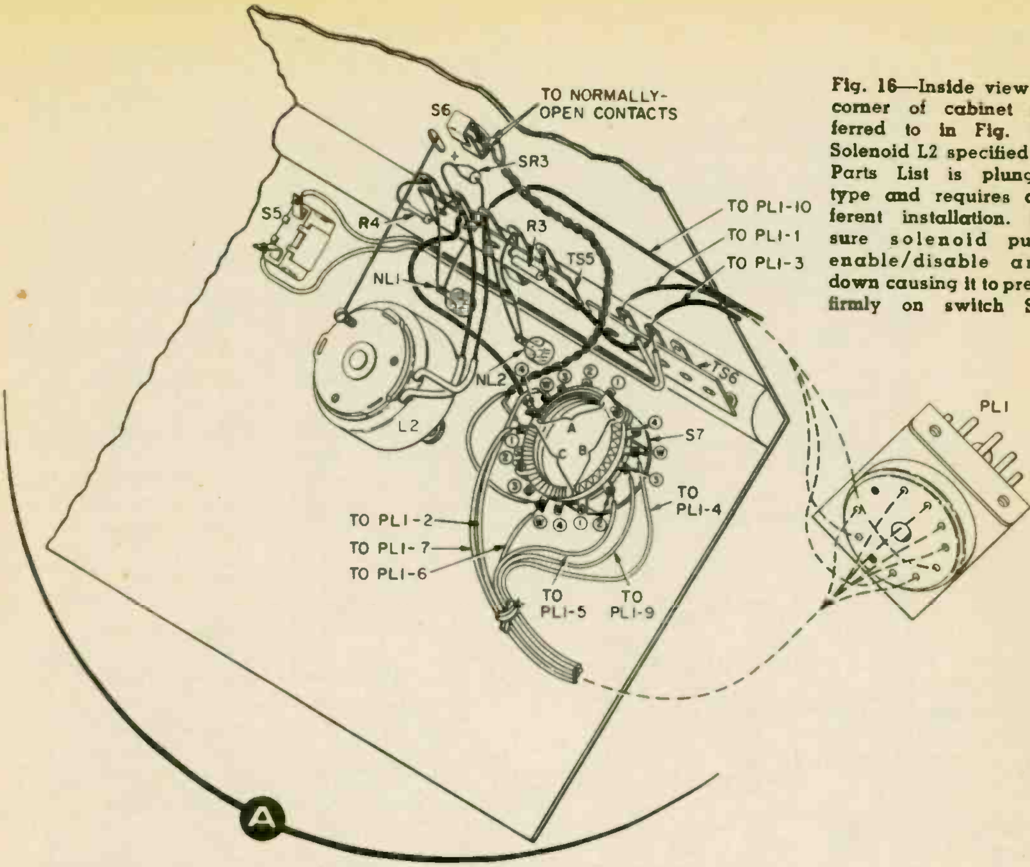


Fig. 16—Inside view of corner of cabinet referred to in Fig. 14. Solenoid L2 specified in Parts List is plunger type and requires different installation. Be sure solenoid pulls enable/disable arm down causing it to press firmly on switch S6.

top of the chassis.

On the back of the chassis (inside) mount the ring amplifier, tone generator and insulated binding posts BP1-BP4. Make no *connections* to the chassis. Since a flat toroidal pickup coil (L3, left, Fig. 13) is not available commercially, you must make your own by random-winding 1,600 turns of No. 34 enameled wire on a 1¼-in. dia. form. Remove the coil, tightly bind it with masking tape and solder a shielded lead to the ends. The resistance of the coil should be about 150 ohms.

Cabinet Assembly. Our cabinet was built from ¼-in. plywood and held together with strips of molding in the corners. Details are

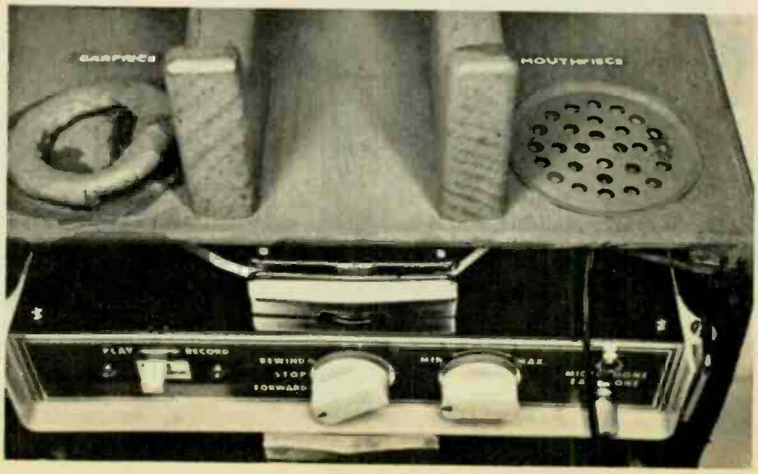


Fig. 15—Top view of front of TAS. Note location of blocks on which handset is placed. Also note the locations of the speaker at the mouthpiece position and the home-brew coil at the earpiece position (left).

PARTS LIST

B1—1.5 V penlite cell
BP1-BP4—5-way, insulated binding posts
C1—50 μf, 15 V electrolytic capacitor
C2—100 μf, 15 V electrolytic capacitor
C3—20 μf, 15 V electrolytic capacitor
C4—1,000 μf, 15 V electrolytic capacitor
C5—20 μf, 150 V electrolytic capacitor
CAMS 1-4—Cams made from poker chips (see text)
CB1—1 A circuit breaker (Sylvania MB-315 Mite-T-Breaker. Allied 56 A 4075)
D1-D3—General-purpose germanium diode (Lafayette 19 C 4901 or equiv.)
L1—Telephone pickup coil (Lafayette 99 C 1034 or equiv.)
L2—Solenoid: 115 VAC, ⅛-1½-in. stroke, continuous duty, 65-oz. lift. (Guardian No. 14. Allied 41 A 5895 or equiv.)
L3—Induction pickup coil wound with No. 34 enameled wire (see text)
MOTOR—1 rpm motor, 117 VAC (Olson MO-113)
NL1,NL2—NE-2 neon lamp
PL1—11-pin chassis connector (Amphenol 86-CP11.)
PL2—5-pin plug (Amphenol 71-5S)
PL3,PL4,PL5—Subminiature phone plug (Lafayette 99 C 6210 or equiv.)
POWER SUPPLY—9 V power supply (Lafayette 99 C 9021)
Q1,Q2—2N217 transistor
RECORDERS 1, 2—Battery-operated transistor tape recorder (see text)
R1—47,000 ohm, ½ watt, 10% resistor
R2—33,000 ohm, ½ watt, 10% resistor
R3,R4—100,000 ohm, ½ watt, 10% resistor
RY1—SPDT relay, 5,000-ohm coil (Lafayette 99 C 6091 or equiv.)
S1-S4—SPDT microswitch, leaf actuator (ACRO 2CMD1-2AXX-A24. Allied 56 A 5030)
S5—SPST toggle switch
S6—Normally-open miniature pushbutton switch (Lafayette 99 C 6159 or equiv.)
S7A,B,C—3-pole, 4-position non-shorting rotary switch (Mallory 3234J)
SO1—11-pin cable socket (Amphenol 78-PF11)
SO2—5-pin miniature socket (Amphenol 78-S5S)
SPKR 1, 2—8-ohm, 2-in, speaker (Olson S-636 or equiv.)
SR1-SR3—Silicon rectifier, 750 ma, 400 PIV (Lafayette 19 C 5001 or equiv.)
T1—Filament transformer: 2.5 V @ 1.5 A (Allied 54 A 3712)
TONE OSCILLATOR—Miniature code oscillator module (Lafayette 19 C 1513)
Misc.—¼-in. dia. x ¼-in. long shaft coupling (Allied 47 A 1108 or equiv.), 7 x 9 x 2-in. aluminum chassis, 9-conductor cable (Belden 8449 or equiv.), penlite-cell holder, wheel collars.

Automatic Telephone Answering Set

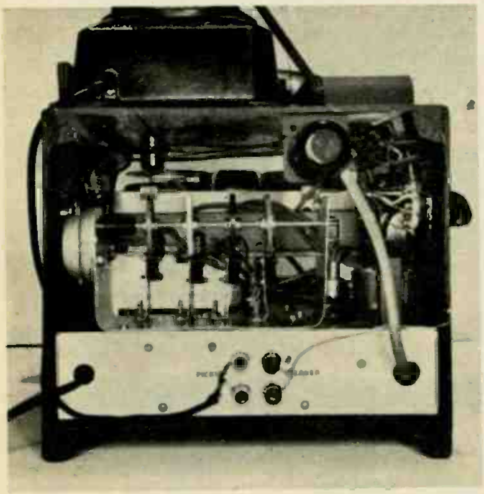


Fig. 17—Completed model with control chassis in place and connected via 11-pin socket at upper right corner to the cabinet-mounted components.

shown in Figs. 13 and 14. The telephone handset holder is made from two wooden blocks. Drill small holes for the two miniature speakers (Fig. 13) and cement them to the inside of cabinet. Note in Fig. 10 that the latching pushbutton switch (S6) must be mounted so that it is pressed when the solenoid pulls down the back of the enable/disable arm.

The arm by the way, is made from ¼-in. aluminum tubing. One end is flattened so it will press down the phone's pushbutton to hang up the phone. The arm is pivoted on a small screw held in a home brew sheet-metal bracket.

A short length of piano wire couples the solenoid to L2. When L2 is energized it pulls the back of the arm down, and pulls the flattened end upward to "answer" the phone. At the same time, the back of the arm presses S6, which latches RY1 to keep the timing motor running.

Make sure S6 is pressed firmly. If the tim-
[Continued on page 113]

HI-FI TODAY

By John Milder

ICs are in—well, part way

Music to feel betrayed by

WELL, here it is. The integrated circuit has made the audio scene. Scott, Fisher, Harman-Kardon and Heathkit all have announced tuners and receivers with ICs in the IF strip and it won't be long before we see other manufacturers and other circuits featuring ICs.

The IC has been heralded, with some justification, as the next step beyond the transistor in hi-fi equipment. It unquestionably promises greater reliability in many products and measurably better performance in some areas, particularly in the sensitivity and limiting characteristics of tuners. To argue against the advantages of the IC would be, to most engineers involved in solid-statery, like spurning motherhood and the American flag.

But one implication of the IC is getting some dismayed second looks. Several manufacturers already have pointed out that the IC, at this stage of the game, is a bit dictatorial by nature. That is, the hi-fi manufacturer must accept the configurations favored by the big manufacturers, who may go part way toward fulfilling specific needs but can't go far without raising the price of the IC by a significant margin.

Avery Fisher of Fisher Radio Corp. holds in his right hand IC used in company's FM IF strip and in his left hand the many parts it replaces.

The big manufacturing virtue of the IC is its potential for production in vast homogeneous quantites. Wrinkles cost money. And, since the hi-fi manufacturer can't participate at as early a design stage with ICs as with conventional circuit components, he may have to settle for what he uses rather than select it.

Fortunately, some basic notions of good design are so widely accepted these days that the danger of getting something inferior for your money is not great. But the consumer has never liked being homogenized, particularly in buying something for his special interest. So let's hope that enough hi-fi manufacturers take enough time in getting on the IC bandwagon to make sure that they can get what they—and you—really want.

A while back I talked about the limitations (to my way of thinking) in the eight-track cartridge system for home use. Those limitations look as dire to me as ever and I've seen a further omen I don't like at all. In looking at the new release list of a major tape producer recently I noted not only that the 8-track release was dominated by the kind of short-selection pop stuff that's ideal for listening on the road but that the classical list for conventional reel-to-reel tapes had gotten awfully skinny. This, by the way, was two months after the same manufacturer had apologized for the skinnyness of that classical release and promised bigger and better things to come.

It's beginning to look as if Gresham's Law is at work. That pop stuff on 8-track (however good it may be on its own terms) seems to be driving out the kind of prestige material that got hi-fi types interested in tape to start with. If that next classical release is as skinny as I expect, I'm going to write a few angry letters. We'll see.

How to get into

One of the hottest money-making fields in electronics today–servicing two-way radios!

HE'S FLYING HIGH. Before he got his CIE training and FCC License, Ed Dulaney's only professional skill was as a commercial pilot engaged in crop dusting. Today he has his own two-way radio company, with seven full-time employees. "I am much better off financially, and really enjoy my work," he says. Read here how you can break into this profitable field.

More than 5 million two-way transmitters have skyrocketed the demand for service men and field, system, and R&D engineers. Topnotch licensed experts can earn $12,000 a year or more. You can be your own boss, build your own company. And you don't need a college education to break in.

HOW WOULD YOU LIKE to start collecting your share of the big money being made in electronics today? To start earning $5 to $7 an hour... $200 to $300 a week... $10,000 to $15,000 a year?

Your best bet today, especially if you don't have a college education, is probably in the field of two-way radio.

Two-way radio is booming. Today there are more than *five million* two-way transmitters for police cars, fire department vehicles, taxis, trucks, boats, planes, etc. and Citizen's Band uses—and the number is still growing at the rate of 80,000 new transmitters per month.

This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Many of them are earning $5,000 to $10,000 a year *more* than the average radio-TV repair man.

Why You'll Earn Top Pay

One reason is that the United States Government doesn't permit anyone to service two-way radio systems unless he is *licensed* by the Federal Communications Commission. And there simply aren't enough licensed electronics experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A home radio or television set may need repair only once every year or two, and there's no real emergency when it does. But a two-way radio user must keep those transmitters operating at all times, and *must* have their frequency modulation and plate power input checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available licensed experts can "write their own ticket" when it comes to earnings. Some work by the hour and usually charge at least $5.00 per hour, $7.50 on evenings and Sundays, plus travel expenses. A more common arrangement is to be paid a monthly retainer fee by each customer. Although rates vary widely, this fixed charge might be $20 a month for the base station and $7.50 for each mobile station. A survey showed that one man can easily maintain at least 100 stations, averaging 15 base stations and 85 mobiles. This would add up to at least $12,000 a year.

Be Your Own Boss

There are other advantages too. You can become your own boss—work entirely by yourself or gradually build your own fully staffed service company. Instead of being chained to a workbench, machine, or desk all day, you'll move around, see lots of action, rub shoulders with important police and fire officials and business executives who depend on two-way radio for their daily operations. You may even be tapped for a big job working for one of the two-way radio manufacturers in field service, factory quality control, or laboratory research and development.

How To Get Started

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC Exam and get your Commercial FCC License.
2. Then get a job in a two-way radio service shop and "learn the ropes" of the business.
3. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move *out* and start signing up and servicing your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you $5,000. Or you may even be invited to move *up* into a high-prestige salaried job with one of the major manufacturers either in the plant or out in the field.

THIS COULD BE YOUR "TICKET" TO A GOOD LIVING. You must have a Commercial FCC License to service two-way radios. Two out of three men who take the FCC exam flunk it ... but nine out of ten CIE graduates pass it the first time they try!

The first step—mastering the fundamentals of Electronics in your spare time and getting your FCC License—can be easier than you think.

Cleveland Institute of Electronics has been successfully teaching electronics by mail for over thirty years. Right at home, in your spare time, you learn electronics step by step. Our AUTO-PROGRAMMED™ lessons and coaching by expert instructors make everything clear and easy, even for men who thought they were "poor learners." You'll learn not only the fundamentals that apply to all electronics design and servicing, but also the specific procedures for installing, troubleshooting, and maintaining two-way mobile equipment.

Get Your FCC License ... or Your Money Back!

By the time you've finished your CIE course, you'll be able to pass the FCC License Exam with ease. Better than nine out of ten CIE-trained men pass the FCC Exam the first time they try, even though two out of three non-CIE men fail. This startling record of achievement makes possible the famous CIE warranty: you'll pass the FCC Exam upon completion of your course or your tuition will be refunded in full.

Ed Dulaney is an outstanding example of the success possible through CIE training. Before he studied with CIE, Dulaney was a crop duster. Today he owns the Dulaney Communications Service, with seven people working for him repairing and manufacturing two-way equipment. Says Dulaney: "I found the CIE training thorough and the lessons easy to understand. No question about it—the CIE course was the best investment I ever made."

Find out more about how to get ahead in all fields of electronics, including two-way radio. Mail the bound-in postpaid reply card for two FREE books, "How To Get A Commercial FCC License" and "How To Succeed In Electronics." If card has been removed, just send us your name and address on a postcard.

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THE TRANSISTOR RADIO SCANDAL

From the Orient come radios that consume transistors like coolies eat rice.

By H. M. GREGORY

THE ads grab you. A 16-transistor radio for $5.99? Fourteen transistors for $4.97? Ten transistors for $3.99? Now these look like real bargains. What with that number of transistors you'd expect to pick up Africa on a clear day—or maybe the moon at night. Or perhaps there will be super selectivity, extraordinary sensitivity, magnificent tone, superb AFC action and other big features.

What's it all about—this upping of transistor count and lowering of cost of pocket transistor radios? Gimmicks—come ons—misrepresentations—even bait. Don't let it fool you. Curious thing about the radios with all those transistors is that they sell for less than most six- or eight-transistor radios!

Anxious to see if these widely advertised radios with so many transistors for so little money really would give something for next to nothing, EI went out and purchased a batch of them to find out what was going on inside those plastic cases.

As we were unpacking the boxes we recalled the days back in the late 1930s and early 1940s when there were ads for radios that had high *tube* counts. The All-American five had come into existence by that time and had become the standard table radio. But some radios had awesome tube counts, anyway. The numbers were impressive in newspaper ads and catalogues.

Back in those days, tube filaments were connected in series, of course, as they still are. Since the heater voltages of the tubes did not add up to the line voltage, some device had to be employed to take care of the extra voltage. In some radios it was a resistance line cord. (Remember how hot it got?) In others there was a ballast tube whose purpose was to drop the voltage.

Then some bright guy decided to use a different ballast tube to make it necessary to use more of them—three or four perhaps. And, of course, ballast tubes, which were nothing more than resistors, were always included in the radio's tube count. Using so many did keep the set warm in winter. But most of all, they simply upped the tube count to a more impressive figure. As far as im-

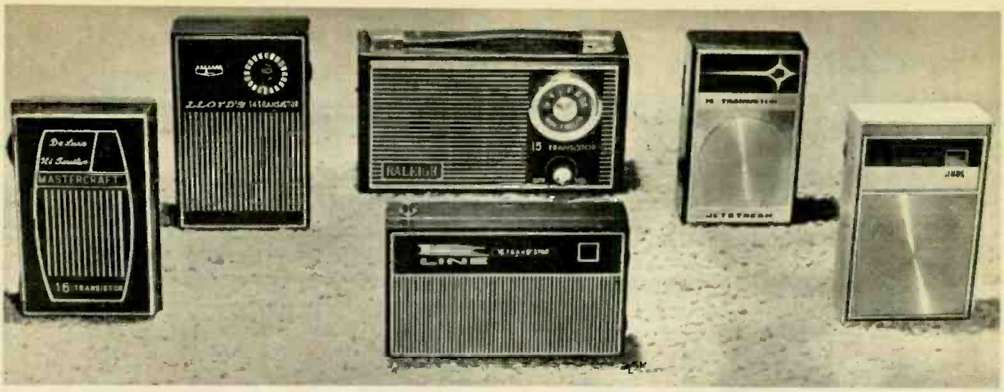


Fig. 1—Representative of a growing trend toward a high transistor count in portable radios are six purchased at discount stores in the New York area. Most of them were about the same size as six- or eight-transistor radios. In these the count went as high as 16. All had dummies or over-designed circuits.

proving performance, they did nothing. As time passed, so did ballast tubes. Eventually the tube count dropped back down and the All-American five became just that again.

Would you believe they're starting in all over again with transistor radios? As we unpacked the last one we got the feeling that this was where we came in. But we decided to see what the new show would be like. We had a feeling the old circuit-expanding engineers were still around. And we quickly found out they still haven't forgotten how to lay a thick smoke screen.

Now a good pocket transistor radio doesn't need more than eight transistors—separate ones for the oscillator and mixer, two more in the IF stages, perhaps one as the second detector (though a diode is all that's necessary) one in an audio preamp stage and, finally, two in a push-pull output stage. But how could as many as 16 transistors be put to use in such a set? Could some of them be superfluous? We investigated—and were amazed.

Oddly enough, all the advertised receivers with a high transistor count sold at low prices, relatively speaking. Radios with American brand names (even though in several cases imported) and with only six to eight transistors generally were priced slightly higher. Granted, the lowest-price radios were loss leaders—which means that the advertiser is selling them at cost, or below, just to get you in the store. But when you see a price of $5.99 for a 16-transistor, it bears a second look.

Our six receivers were purchased at discount houses in the New York City area. All came neatly packaged, included battery and the inevitable earphone. Perhaps most surprising was that they all played—and well.

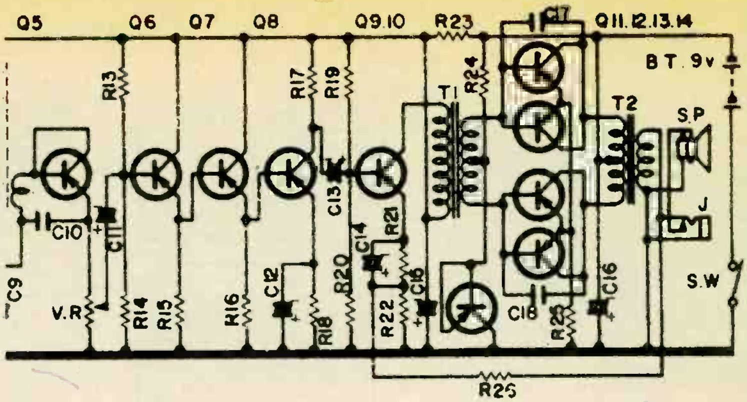
We made no effort to analyze the receivers electrically at great length other than to make a check of current drain. Idle current on all sets ran 5 to 8 ma, and most drew over 35 ma at loud volume. This is about what the drain would be for 6- to 8-transistor radio. This was our first clue that some transistors weren't doing anything. All but one radio sounded fairly good. It had distortion when the volume was raised, but this could have been a bad speaker.

Our bag of tricks included two 16-transistor radios, one 15 and three 14's. Four of them were made in Hong Kong, one in Japan and the sixth in Taiwan. Cases were mostly plastic; a couple had a metal front. One case was made of heavy cardboard with a plastic front. Despite this, it had the best tone of the lot.

Now, how about all those transistors? It turned out that half of those put in by some manufacturers were dummies—just soldered to the board and doing nothing. Some manufacturers did put them all to work in some fashion—though in most cases the receivers would work just as well with about half the transistors taken out. In every case, the transistor count lived up to advertised claims. In some sets, half of the transistors were utilized as diodes (the base-emitter or base-collector junction)—some had all three leads in use (at least the leads went through holes in the circuit board and were soldered underneath). Others had one lead clipped off.

Where the transistors were out-and-out dummies a schematic was not included. A

THE TRANSISTOR RADIO SCANDAL



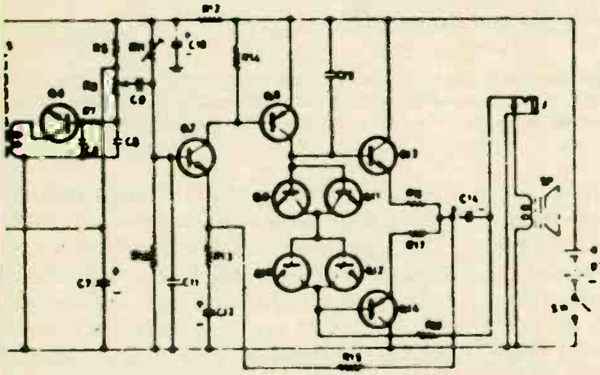


Fig. 2—The schematic at the top is of the audio stages of a 14-transistor radio. Q5, connected as a diode, is the detector. Q6, Q7 and Q8 are direct-coupled pre-amp stages; Q9 is the driver. Q10 is used as a varistor. A well-designed output stage could get by with one transistor instead of those four connected in push-pull parallel. In the output stage at left, four transistors in series-parallel are used as diodes. But a resistor would have done the job.

complete schematic was included with three sets. Where the transistors were used as diodes or were dummies, they were unmarked. Transistors working as such in the same receivers had markings on them. Most of the sets had a few extra transistors used as diodes in the AF stages.

The first receiver we dissected had the audio circuitry shown at the left in Fig 2. Now this is quite a circuit—a transformerless complementary-symmetry output stage. The odd thing here is those four transistors used as diodes and connected in series-parallel. They may have a useful purpose—perhaps as temperature compensators, but as it turned out, the set worked just as well with a resistor in their place.

The circuit shown is of the Master-Craft 16; the four diode-connected transistors are unmarked. The Jade-14 radio had almost the same audio circuitry. These two receivers had plastic-case transistors throughout which were the small button type. Some of the working transistors in the Master-Craft, in fact, had an *F* preceding the type number which looked exactly like the Fairchild-Semiconductor trademark *F*.

Though the audio circuitry of the Master-Craft could, by a big stretch of the imagination, be considered sane, three more transistors used as diodes were in the circuit. The emitter lead of the mixer transistor was connected via those three parallel connected-transistors (used as diodes) to the case (ground) of one of the shielded RF coils. It looked like transistors were being used as diodes which were used as resistors.

In almost all receivers the second detector was a transistor connected as a diode. In the Jetstream-14 there were two such detector transistor diodes in series. Only the Raleigh-15 used a real diode as second detector.

The Lloyd-14 (Fig. 2, top) had an instruction booklet which included a complete list of parts. At least in this receiver all transistors were put to work. Only two of the 14 functioned as diodes. One was a second detector and there was another from the center tap of the driver transformer secondary to ground. But the Audio section had other surprises. Following the detector we found three direct-coupled transistors, feeding, via a capacitor, the driver transistor. And the output stage has four transistors in push-pull parallel. Is all this necessary? This was one of the neater receivers, inside and out, and it

Fig. 3—At left, pencil points to three leads from a transistor which have been soldered together. Center photo shows solder being melted away. At the right it becomes plain. Two leads through one hole were connected to the third lead. The radio worked just as well with this and other transistors removed.

worked quite well besides.

We've probably given enough details of the six receivers to convey the overall picture. Briefly, some manufacturers try to put all the excess transistors to legitimate but questionable use. Others apparently install extra transistors so the count will be high and simply short together their leads. Even where the supposed transistors are possibly useful as diodes, it doesn't seem that they should be advertised as transistors—which they are not—when you consider how they're used.

The sets purchased worked, as we said, and it is obvious that the high transistor count is unnecessary. You would do well to stick to moderate numbers of transistors—say six to eight. All sets came with the usual 90-day guarantee.

We'd much prefer to buy a name-brand set with a modest transistor count (and the high probability that every transistor was doing its job in a well-designed circuit) than a high-transistor-count set which sells for less.

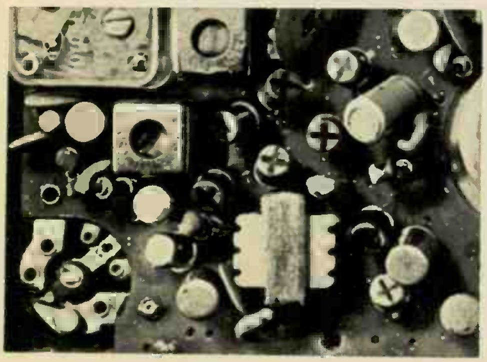


Fig. 4—Notice those eight transistors marked with X. We found they were all dummies. Their leads were all soldered together on foil side of board.

What does the **Federal Trade Commission** have to say about all this? EI wrote to the Washington headquarters, asking whether the FTC had issued any comments, directives or rulings in the matter. We received a reply typed on the bottom of our letter: "We do not find any cases involving transistor radios. Enclosed are several publications you may find of interest." The publications simply described the good doings of the FTC.

We then wrote to the National Better Business Bureau in New York to find out what it had done about apparently misleading advertising.

The reply was a letter called, "An appeal to importers of transistor radios to accept the challenge of self-regulation and to cooperate voluntarily in insuring honesty." The letter was titled "The Transistor Count."

It goes on and on describing what we have just talked about and concludes by stating, "If warning publicity becomes necessary because of failure of importers to exercise effective self-discipline, then a government crack-down also can be anticipated." It ends with the statement, "A prompt expression of your cooperation in this matter will, therefore, be appreciated." No sample expressions were appended.

Wanna bet you someday will see radios on the market with 25 transistors in them? But maybe some will be good spares which you can wire in the circuit when one of the working transistors goes bad. *Caveat emptor!*

Notes from EI's DX CLUB

A HOT amateur DX prospect these days is ZD7IP on St. Helena Island. Kenneth Shedeker, WA9OQE (Illinois) and John Brennan, K8HAB (Michigan) both have worked him on 20 meters around 1630 EST.

A new frequency for the R. Nacional Espana relay in the Canary Islands is 15380 kc. DXer Bob LaRose reports reception around 1500 EST with QRM from the Deutsche Welle African relay at Kigali, Rwanda.

DXer Robert Cate (New Hampshire) notes that YSS, R. Nacional de El Salvador, sometimes has excellent signals on 6010 kc shortly after 1900 EST. Moving down 10 kc, another good Latin American prospect is YVNL, R. Miranda at Los Toques, Venezuela around 2200—now that you-know-who has flown the coup.

All India Radio's General Overseas Service is now being received on 15375 kc 0830-1000 EST. Reception should be possible all summer.

Keith Beebe, WA4QOO, down in Florida reports another nice DX QSO—FR7ZD, Reunion Island, on 20 meters. Speaking of Reunion, now is the time to watch for O.R.T.F.'s 20-meter SWBC outlet on 2446 kc at 2130 EST (1830 PST) sign-on.

Don L. Fortner (South Carolina) got his EIDXC 10-Countries Award the hard way. One of his entries was XHY-TV, Channel 6, at Merida, Yucatan, Mexico. Now is the time for that kind of television DX!

East and West Pakistan, of course, count as separate countries for DX purposes. Most transmissions come from Karachi in the West. One that appears to emanate from Dacca in rare East Pakistan, however, has been logged on 11850 kc with English news at 1000 EST (0700 PST).

VL8BD, 3304 kc, R. Daru, Papua appears to have boosted its power to 10 kw. Bill Sparks (California) reports reception at 0100 PST (0400 EST). They should also make it through to the East Coast around that time.

A good catch, because its schedule is erratic, would be HIAD, R. San Juan in the Dominican Republic. Watch for it around sunset on 3375 kc.

Most of us have heard R. Liberty's West German transmitters. But how many have heard their station on Taiwan? One frequency for the latter is 17720 kc with sign-on at 1800 EST. All transmissions are in Russian and heavily jammed.

A rare one in North America is the BBC's West African relay at Monrovia, Liberia. But it has been heard in the Midwest on 9555 kc at 0100 EST. Programs at that time are mostly in English.

Trans World Radio's Monaco station has a Sunday-only English transmission on 9585 kc at 0030-230 PST. West Coasters especially should watch for this one.

Propagation: Regular short-skip openings in the amateur 10-meter band and Citizens Band will occur during the daylight hours due to a seasonal increase in sporadic-E activity. This phenomenon also will result in fair-to-good FM and TV DX during the hours from 10 a.m. to 2 p.m. local time.

During daylight hours short-wave reception conditions will be good in the 13- and 16-meter bands and good-to-fair in the 15-meter band. At night DX will be possible in all bands from 49 to 16 meters at various hours with 19-meter DX probable around the clock on most nights. Best reception during these hours will be on 25 and 31 meters.

Broadcast band DX will continue at a seasonally low level due to high noise.

the ABCs of COLOR TV

By JOHN T. FRYE, W9EGV

PART 4: TRANSMITTING COLOR

PART III in this series showed how any color or black-and-white scene can be constructed by properly-timed intensity variations of the red, green, and blue beams sweeping the face of a color picture tube. Now we must reverse the process. We must secure an instantaneous, continuing analysis of every tiny area of a televised scene in terms of the proportions of the three primary colors required to produce the hue, saturation, and brightness of the immediate area being scanned. Then this information must be translated into a continuous flow of electrical signals capable of being transmitted and reproduced in color on a color receiver or in shades of gray on a B&W receiver. The assignment is a tough one, so let's get at it.

Fig. IV-1 is a skeleton view of a color camera. The lens system focuses light from the scene before it on the screens of three separate, identically-scanned TV camera tubes, labelled *red, green* and *blue*. Red light falls only on the red tube, blue light on the blue tube, green light on the green tube. This trick is done with mirrors: *dichroic mirrors* which are transparent to all colors except the one they reflect. That color is bounced off just as it would be by an ordinary plane mirror.

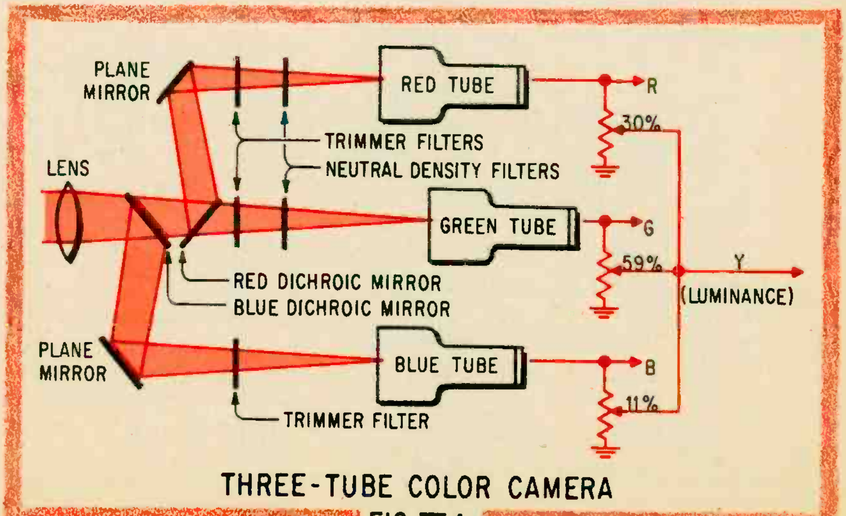


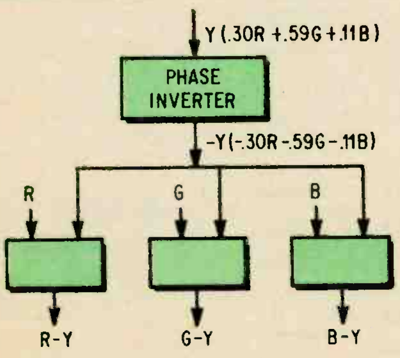
FIG. IV-1

One dichroic mirror reflects blue light via a plane mirror to the blue tube but passes red and green light. The next dichroic mirror passes the green light to the green tube but reflects red light via a plane mirror to the red tube. *Trimmer* and *neutral density* filters placed in the paths of the various beams keep the total spectral response of the camera output equal to that of the human eye under all lighting conditions (much as you use filters to balance sunlight or artificial light for a color film).

With the camera aimed at a white area, all three camera tubes are adjusted for equal 1-V outputs. Voltage dividers in a matrix arrangement combine 30 per cent of the red output, 59 per cent of the green output and 11 per cent of the blue output. Remember how this 30:59:11 ratio of relative brightness of the primary colors always was perceived by the eye as white or shades of gray? That means the matrix output always corresponds to the total brightness the eye would see in the area being scanned at the moment. This is precisely the same as the output of the B&W camera discussed in Part I. So this matrix output signal—variously called the *brightness, luminance,* or *Y* signal—amplitude-modulates the transmitter carrier and operates a monochrome receiver just as if it came from a B&W camera.

While this signal satisfies one demand of compatibility it can't, alone, produce a color picture. If we connected the full output of each camera tube to the respective gun of a tri-color picture tube, any scene viewed by the camera would be reproduced in full color because the beam current of each kinescope gun—and so the light output of its phosphor—would be controlled by the amount of light *of that color* present in the corresponding area being scanned. But how can we broadcast these three signals—and produce a satisfactory B&W signal as well?

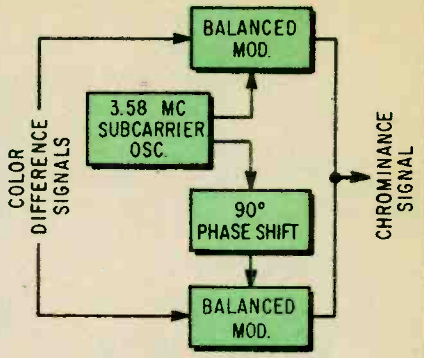
The solution lies in first converting the camera output signals into *color difference signals.* Fig. IV-2 shows how this is done. A phase inverter applied to the Y signal changes the sign of each of its three components from positive to negative. This inverted Y signal can then be added algebraically to each color output signal, yielding R-Y, G-Y, and B-Y signals. But we need not use all three. If I told you that one-half the sum of three numbers is six and two of the numbers are three and four, you could find the third number, couldn't you? By similar (though more involved) mathematical legerdemain the G-Y signal can be reconstituted if we transmit only the R-Y and B-Y signals. But how can we insert even these two color-information (*chrominance*) signals in that already well-occupied 6-mc TV channel?



GENERATION OF COLOR-DIFFERENCE SIGNALS
FIG IV-2

The answer lies in the fact the portion of the channel occupied by the upper video-brightness-information sideband does not consist of wall-to-wall signal. Instead, the sideband energy is clumped at regularly-spaced intervals that are harmonics of the frame-scanning and linescanning frequencies. If we can insert the chrominance information between those clumps of luminance information, neither will interfere with the other.

We need a carrier on which to hang our color signals but the main carrier already is working full time with the luminance information. Suppose we generate a new *subcarrier* by amplitude-modulating the main carrier with a single frequency, say about 3.5 mc. This will produce a sideband, or subcarrier, 3.5 mc above the main carrier. Next, let's phase-modulate color information on the subcarrier. At the receiver, subcarrier sidebands can be separated out and *synchronous phase detectors* used to recover the color information. Tricky but neat, huh?



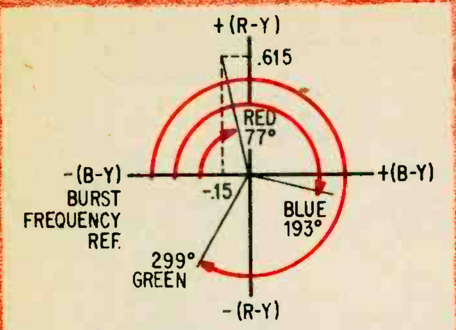
BALANCED MODULATOR CIRCUITRY
FIG. IV-3

The subcarrier frequency has to be far enough from the main carrier to minimize beat interference between the two; yet it can't be pushed too near the audio carrier. Finally, it must be an odd multiple of half the horizontal sweep frequency to *interleave* the chrominance information precisely between the luminance information. How this has been worked out is too involved for this limited discussion, but the upshot is a subcarrier frequency of 3.579545 mc (usually called 3.58 mc for short). To make everything jibe, the horizontal line frequency is lowered from 15,750 cps to 15,734.246 cps and the field frequency is lowered from 60 cps to 59.54 cps. A B&W receiver has no trouble adapting to these slight changes. Since the subcarrier frequency and both sweep frequencies must all be held to ±0.0003 per cent tolerance for the interleaving process to work, in practice all three frequencies are developed from the same source.

But how can we modulate *one* subcarrier with *both* the R-Y and the B-Y chrominance signals? By splitting the subcarrier into two parts, modulating each part with a separate signal, and then recombining the subcarrier, that's how! (See Fig. IV-3.)

The subcarrier is effectively split by feeding it straight to the B-Y modulator and through a 90° phase shifter to the R-Y modulator. The resulting subcarriers are identical in frequency but there is a quarter-cycle difference in the timing of their alterations. We lack space to discuss the circuitry of the *doubly-balanced modulators* but each consists of two tubes with one pair of opposite-polarity inputs receiving a color signal, another pair of opposite-polarity inputs receiving the subcarrier and a common output. This kind of operation cancels both inputs and allows only the sidebands resulting from amplitude modulation of the subcarrier by the color signal to appear in the output. The phase of these sidebands is related to that of the subcarrier feeding the particular modulator and reverses—shifts through 180°—whenever the polarity of the color signal reverses. If we consider the phase of the subcarrier as 0°, the phase of the B-Y modulator output can be either 0° or 180°. Output of the R-Y modulator can be either 90° or 270°.

The amplitude of each modulator output varies directly with the color-signal input. To prevent over-modulation of the subcarrier the amplitude of the chrominance signals are attenuated by carefully-specified factors—0.877 for R-Y and 0.493 for B-Y—before being fed to the modulators. Fig. IV-4 shows what this looks like on Cartesian coordinates. Since the outputs of the R-Y and B-Y modulators are always 90° apart, we can use them for the axes of our system. All phase angles are measured from the negative B-Y line (labelled



VECTOR DIAGRAM
FIG. IV-4

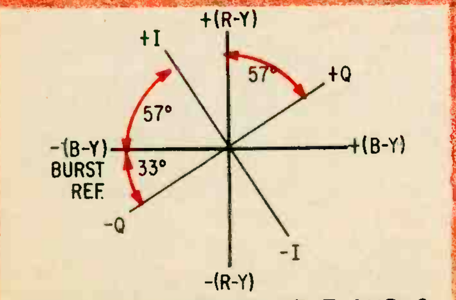
burst-frequency reference) around in a clockwise direction to the color vector. While the modulator outputs are tied together, their combined amplitude cannot be calculated by simple addition because of their difference in phase. They must be added as vectors.

There's nothing really tough about vector addition, especially when you're dealing with two quantities operating at right angles to one another, as they are in this instance. Measure off on the B-Y axis a distance representing the amplitude of the B-Y signal fed the modulator. (Measure to the right of 0 if the signal is positive, to the left if negative.) Mark a point on the axis to indicate the distance. Do the same thing on the R-Y axis for the R-Y signal, using the same scale of measurement—up from 0 if the signal is positive, down if negative.

From each of the points thus located on an axis draw a line parallel to the other axis. Where these lines meet is the end of the resultant vector (which begins at the intersection of the axes). Its length in your chosen scale indicates the amplitude of the combined B-Y and R-Y signals. Its direction determines the phase angle of the combined chrominance signal.

Let's say the camera is scanning a saturated red. Since blue and green tube outputs will be zero you will find by studying Fig. IV-2 that the R-Y signal is 0.70R and the B-Y signal −0.30R. Multiplying these by the attenuating factors, 0.877 and 0.493 respectively, yields 0.615R for the R-Y signal and −0.15R for the B-Y signal. When these are plotted as shown you will discover that the amplitude of the chrominance signal is 0.63; applying a protractor will show the phase angle to be about 77°.

As the R-Y and B-Y signals go through separate amplitudes and polarities, phase angles (vectors) from 0° to 360° result. The polarities of the two signals determine the quadrant in which the resultant vector falls and their amplitudes determine its direction. Suppose both R-Y and B-Y are positive and equal. The chrominance vector will lie in the first quadrant, 45° from either axis. Increasing both signal amplitudes equally increases the amplitude of their resultant vector without changing its phase angle. Unequal changes in signal amplitudes may or may not change the vector amplitude but they are certain to shift its direction—that is, its phase angle.

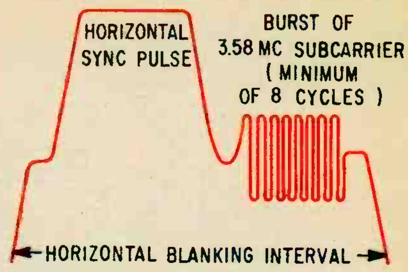


VECTOR DIAGRAM OF I AND Q
FIG IV-5

Amplitudes of the R-Y and B-Y signals increase equally if the saturation of the color being viewed increases. Relative amplitudes of the two signals change if the hue of the color changes. *Thus we see that the color vector's amplitude is a function of color saturation and its phase is a function of hue.*

We don't really transmit R-Y and B-Y signals, however. Instead we transmit the related I and Q signals shown in Fig. IV-5. There's a reason.

Since the upper end of the video passband is only about 0.5 mc away from the 3.58-mc subcarrier, information exceeding 0.5 mc in bandwidth cannot be double-sideband-modulated on the subcarrier without having the upper sideband sharply attenuated beyond 0.5 mc. But attenuating one sideband of a DSB signal alters the phase of the signal which in color work means alteration of the hue. On the other hand, restricting the bandwidth restricts the color detail that can be transmitted. Since smallest color details can be seen only in the orange-red and cyan-blue segments of the spectrum, extended bandwidth is required only for colors lying along this orange-cyan line.

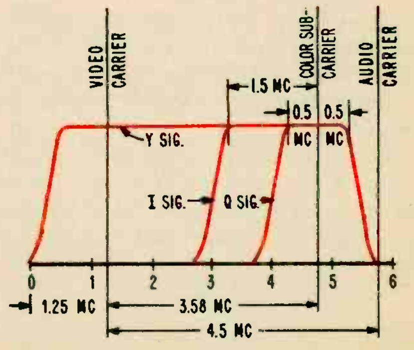


COLOR BURST ON HORIZONTAL SYNC PULSE
FIG. IV-6

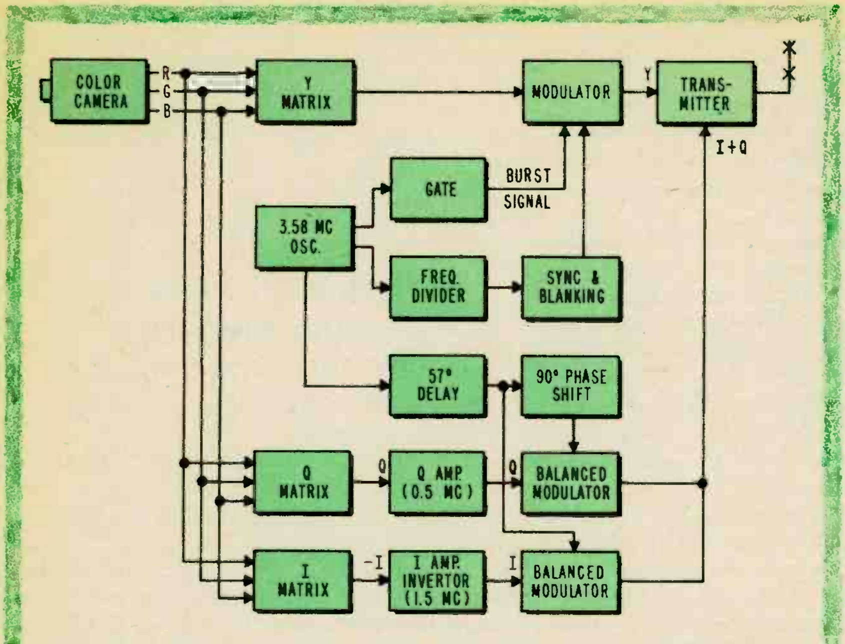
Suppose we rotate our modulator axes through 57° so that a new axis (called the I axis) falls on the orange-cyan line. Now we need extend the bandwidth of this new I signal only. Since changes in color in small areas along this line—those represented by sidebands lying between 0.5 and 1.5 mc from the subcarrier—are seen only as changes in saturation of the orange-red and cyan-blue hues, we needn't worry about phase shifts caused by that lopped-off upper sideband. To keep our modulators *in quadrature* (90° apart in phase) we have to shift the other axis 57°, too; it now becomes the Q axis. Shifting the axes is simply a matter of juggling R-Y and B-Y amplitudes properly and delaying 57° the phase of both parts of the subcarrier fed to the modulators.

Several operations we've treated separately—producing the Y signal, inverting it, producting the R-Y and B-Y signals, limiting and changing their values—actually are performed in a matrix section at the transmitter. Out of this comes a Y signal, a Q signal and a —I signal that is inverted before being fed to the modulator. The equation for the I signal is $0.74(R\text{-}Y) - 0.27(B\text{-}Y)$. For the Q signal it is $0.48(R\text{-}Y) + 0.41(B\text{-}Y)$. When the formula for Y ($0.30R + 0.59G + 0.11B$) is substituted in these two equations we get $I = 0.60R - 0.28G - 0.32B$; $Q = 0.21R - 0.52G + 0.31B$. From these you can see that when white is being televised and all camera tubes are at full output, both I and Q values are zero and no color information is sent.

We don't transmit the subcarrier (remember we eliminated it in the doubly-balanced modulator) but we'll need it at the receiver for determining the phase angles of the chrominance signals. So we supply the receiver with a crystal-controlled oscillator whose exact frequency and phase are controlled by *color bursts*—transmitted samples of the transmitter subcarrier. These



PASSBAND OF COLOR PICTURE SIGNAL
FIG. IV-7



PARTIAL BLOCK DIAGRAM OF COLOR TV TRANSMITTER
FIG. IV-8

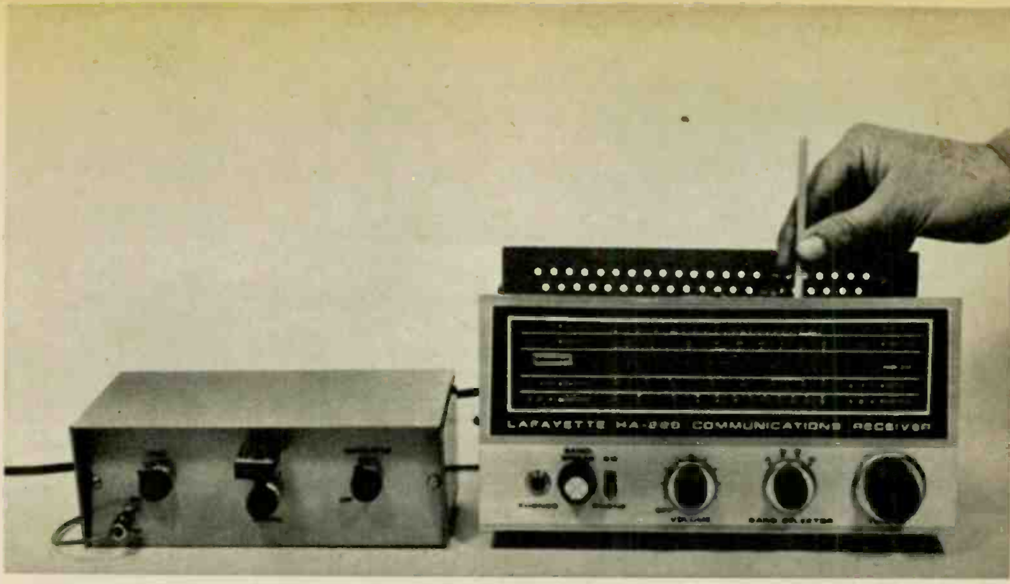
bursts are rendered invisible by placing them on the *back porch* of the horizontal blanking pulses (Fig. IV-6) so they occur when the screen is blanked out.

In summary, our complete transmitted color video signal (Fig. IV-7) consists of: (1) a vestigial sideband luminance signal with 0- to 4-mc bandwidth (carrying color burst, sync and blanking signals between picture scans), (2) a vestigial sideband I chrominance signal with a 1.5-mc bandwidth, (3) a double-sideband Q signal with a 0.5-mc bandwidth. This means that large color areas, represented by a bandwidth up to 0.5-mc, are transmitted in full color. Smaller areas, calling for bandwidth from 0.5 to 1.5 mc, are transmitted as shades of orange or cyan. Still smaller areas get no color representation but are transmitted merely as degree of brightness. Our transmitted color signal puts out just what the eye can take in—and no more! Fig. IV-8 shows, in simplified form, how it is all accomplished.

One difference would be apparent if we were to substitute a four-tube color camera for the three-tube camera we have been using for purposes of this discussion. In addition to the three color-information tubes the four-tube camera has a high-resolution tube that supplies the Y signal independently of the three color tubes.

I suggest you study this explanation of color broadcasting until you have it down pat. Play with the formulas. Work out different color vectors. Get a good grasp on exactly how the transmitted color signal is put together. If you do, the next (and final) part will be easy, for we shall be disassembling there what we have put together here.

NEXT ISSUE: THE COLOR RECEIVER



CRYSTAL-CONTROLLED SW SIGNAL GENERATOR

By LAWRENCE GLENN

THE short-wave bands are as jammed as a discothèque's dance floor these days. With no big holes anywhere, you either tune to a station's exact frequency right off or waste hours in dial twisting. But with a precisely calibrated receiver, tedious station-hunting becomes a thing of the past.

While a better-quality, expensive signal generator is capable of doing a reasonably accurate alignment job on your receiver, few experimenter-grade generators have the necessary stability and accuracy.

Most SW receiver alignment (or calibration) procedures require you to skip back and forth several times between the high and low end of each band. Rare is the experimenter-grade generator that can be reset to, say, exactly 20 mc. But our generator puts you right on frequency every time because it's crystal controlled. Sure, it takes a handful of crystals to cover all the bands on your receiver but at least you'll have the equipment to get the maximum calibration accuracy your receiver is capable of.

The generator is designed specifically for SW receivers. Its frequency range is from 1 to 20 mc on fundamentals. The circuit provides an output rich in harmonics. This means that a crystal can be used to provide more than one spotting frequency. For example, using a 2-mc crystal, the generator will deliver harmonics at 4, 6 and 8 mc. Naturally, the higher the harmonic the lower the output. Though 20 mc is the recommended upper limit, a 14-mc crystal will produce a harmonic output at 28 mc. (The oscillator circuit is designed for fundamental crystals.)

To prevent feeding too great a signal to the receiver (alignment should be done with the minimum usable signal level) our model's maximum output level is approximately 100,000 μv. However, if you really need a big signal, reduce the value of R3 to increase the output level to 2 V (at 1600 kc). R3 should not be less than 560 ohms.

To permit easy spotting of the signal and to enable you to align by

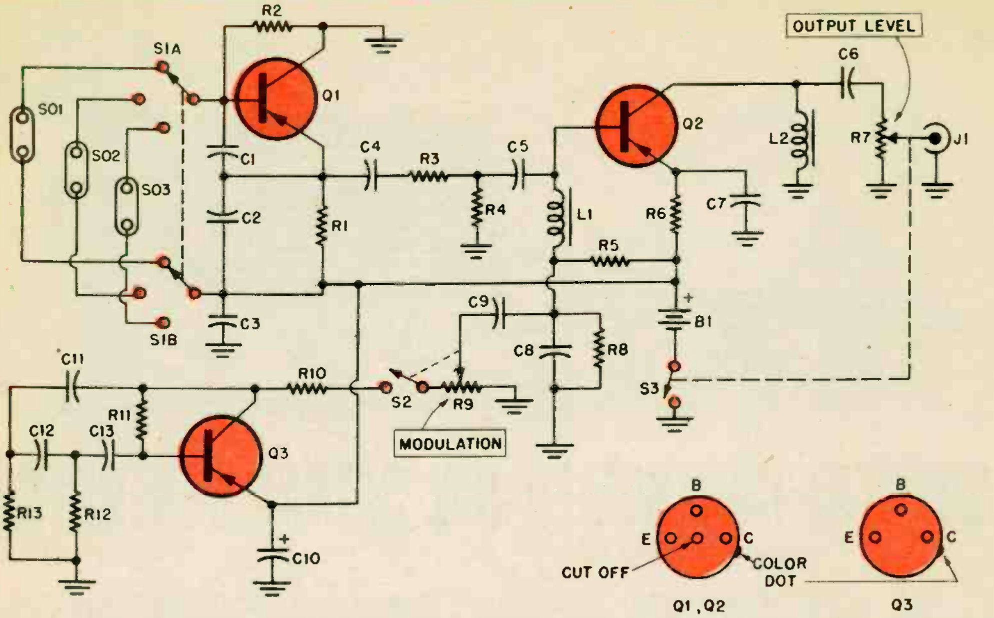


Fig. 1—Signal from RF oscillator Q1 is combined with signal from AF oscillator Q3 in mixer Q2. R9 controls modulation level: R7 sets output level. Lowering R3's value will increase ouput to 2 V.

CRYSTAL CONTROLLED SW SIGNAL GENERATOR

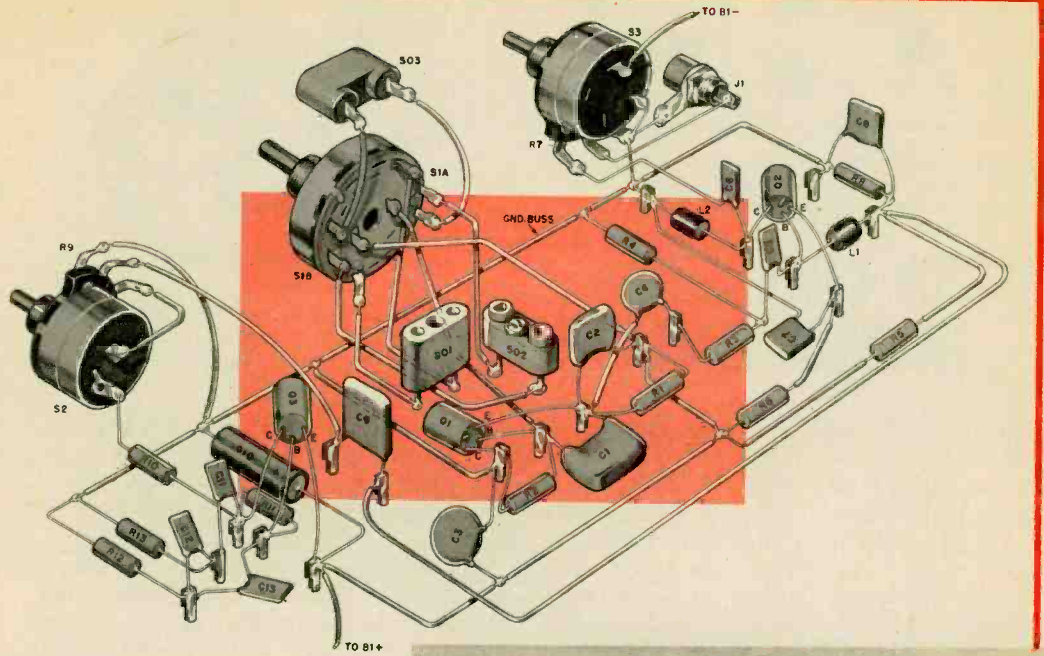
adjusting for maximum audio output, an adjustable-level modulation signal at approximately 1 kc is provided. The modulator can be turned off if you don't need it.

The generator also can be used as an accurate frequency spotter. For example, suppose your favorite SW station is R. Ivorienne (Abidjan, Ivory Coast) on 11820 kc. This signal hardly gets out of Africa's back yard, let alone into your antenna. How can you find it on a crowded band? Simple. Get a crystal cut for 11820 kc and put it in the generator. To find or spot R. Ivorienne you simply turn on the generator, tune the receiver for the generator's signal, turn off the generator then wait for the voice of the Ivory Coast to come in.

Our model has three crystal sockets—two inside the cabinet and one on the front panel. The panel-mounted crystal socket permits any crystal to be installed immediately in the circuit. Within the allowable interior and front-panel space there is no limit to the number of

PARTS LIST

B1—9 V battery (Burgess M6 or equiv.)
Capacitors: 15 V or higher
C1—1,200 μμf silvered mica
C2—75 μμf silvered mica
C3—.05 μf
C4—250 μμf
C5—.001 μf
C6,C7,C11,C12,C13—.01 μf
C8—.005 μf
C9—.25 μf
C10—160 μf electrolytic
J1—Phono jack
L1,L2—1 mh RF choke (J. W. Miller 70F103A1 Allied 54 D 1885, 75¢ plus postage. Not listed in catalog)
Q1,Q2—2N274 transistor
Q3—2N2613 transistor
Resistors: ½ watt, 10% unless otherwise indicated
R1—1,000 ohms
R2—220,000 ohms
R3—4,700 ohms (see text)
R4—560 ohms
R5,R6—470 ohms
R7,R9—500 ohm linear-taper potentiometer with SPST switch
R8—68,000 ohms
R10—2,200 ohms
R11—470,000 ohms
R12,R13—4,700 ohms
S1A,S1B—2 pole, 3 position, non-shorting rotary switch (Mallory 3223J)
S2,S3—SPST switch on R9,R7
SO1,SO2,SO3—Crystal sockets (see text)
Misc.—3 x 8 x 6-in. cowl-type aluminum Minibox (Bud SC-2132. Allied 42 A 8686 or equiv.), knobs



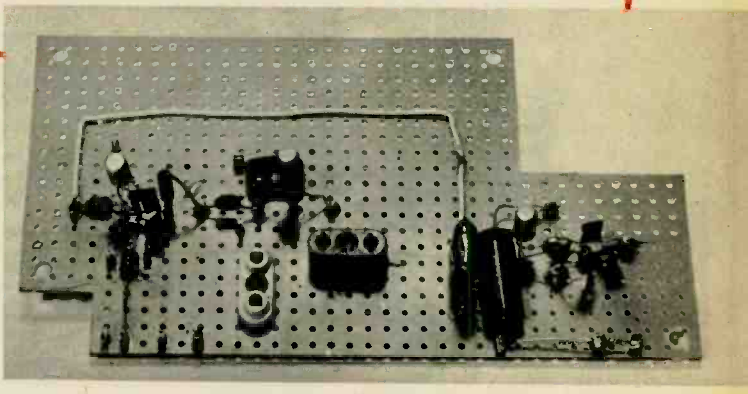


Fig. 2—While it is possible to mount all components on top of perforated circuit board as shown, we installed the following parts on the underside: capacitors C2,C3,C5,C7,C8; resistors R1,R3,R4,R5,R6,R8,R11,R12 and R13.

Fig. 3—Photo of top of board shows location of components. Note how most of the resistors are mounted on end. Cutout in upper right corner is for battery. Cutout at lower left corner of board is for output jack J1.

built-in or external crystal sockets you can use.

Crystals can be purchased ground to virtually any frequency from Texas Crystals, 1000 Crystal Dr., Fort Myers, Fla. 33901 and International Crystal Mfg. Co., 18 N. Lee, Oklahoma City, Okla. Since a crystal's price is determined by tolerance and holder, we suggest you write to each company for a catalog then select what you need. We recommend Texas Crystal's FT-241 or FT-243 holders or International Crystal's FA-5 holders as they are low in cost running from under $2 to roughly $6, depending on frequency and tolerance. When ordering, be sure to specify parallel-resonant crystals.

While some overtone crystals, such as CB crystals, will work in the generator, keep in mind that the indicated overtone frequency generally is not an exact multiple of the fundamental frequency. For example the fundamental output of a 27-mc third-overtone crystal will not be 13.5 mc (½ of 27 mc). It will be slightly lower.

Construction. The generator is built in the U-section of a 3 x 6 x 8-in. cowl-type Minibox. All parts values are critical: no substitutions should be made.

To avoid a parts jam, with resultant improper operation, the three circuits (AF oscillator, RF oscillator, mixer-modulator) are spaced widely on a piece of perforated circuit board. Since there is enough room inside the cabinet we suggest you follow the pictorial

Fig. 4—Controls from left to right are output level, crystal selector, modulation level. Larger cabinet permits more front-panel crystal sockets.

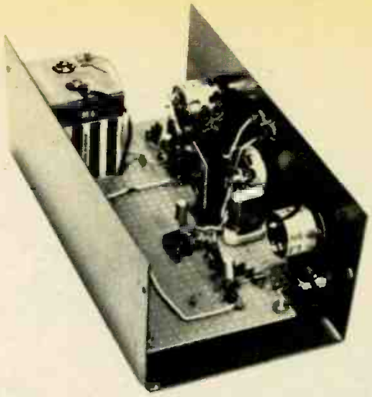


Fig. 5—Inside of generator. Note location of battery and how it's held in place. Also notice how board is raised above bottom of the cabinet.

CRYSTAL-CONTROLLED SW SIGNAL GENERATOR

and photographs and do not crowd the components together. Similarly, install on the underside of the board those components not visible in the photo of the top of the board in Fig. 3. Don't put them atop of the board.

Cut a piece of perforated-board so it will just about cover the bottom of the cabinet. Then trim the board about ¼ in. all around to clear the cabinet's top-cover mounting flanges. Cut a notch out of one corner of the board for the battery and another near output jack J1.

Before mounting any components, install all of the panel controls, crystal sockets and J1. Mark the board directly under each control to make certain you do not install any components under the controls.

Crystal sockets SO1, SO2 and SO3 should match the crystal used. In general, the Texas Crystal type SSO-1 socket is preferred since it matches the FT-243 and FT-241 crystal holders.

Note in Fig. 3 that several resistors are mounted on end. (For the sake of clarity we show them mounted flat in the pictorial.) Either flea clips or Vector T28 terminals can be used for tie points. To avoid soldering heat damage to the transistors, do not trim their leads shorter than ¾ in. and use a heat sink.

Connections to the crystal sockets are made by soldering No. 22 solid wire to the terminals and passing the wires down and up through holes in the perforated board. The other ends are soldered to selector switch S1 after the board is installed in the cabinet. If you want to use more than three crystal sockets, substitute for S1 a two-pole rotary switch having the appropriate number of positions.

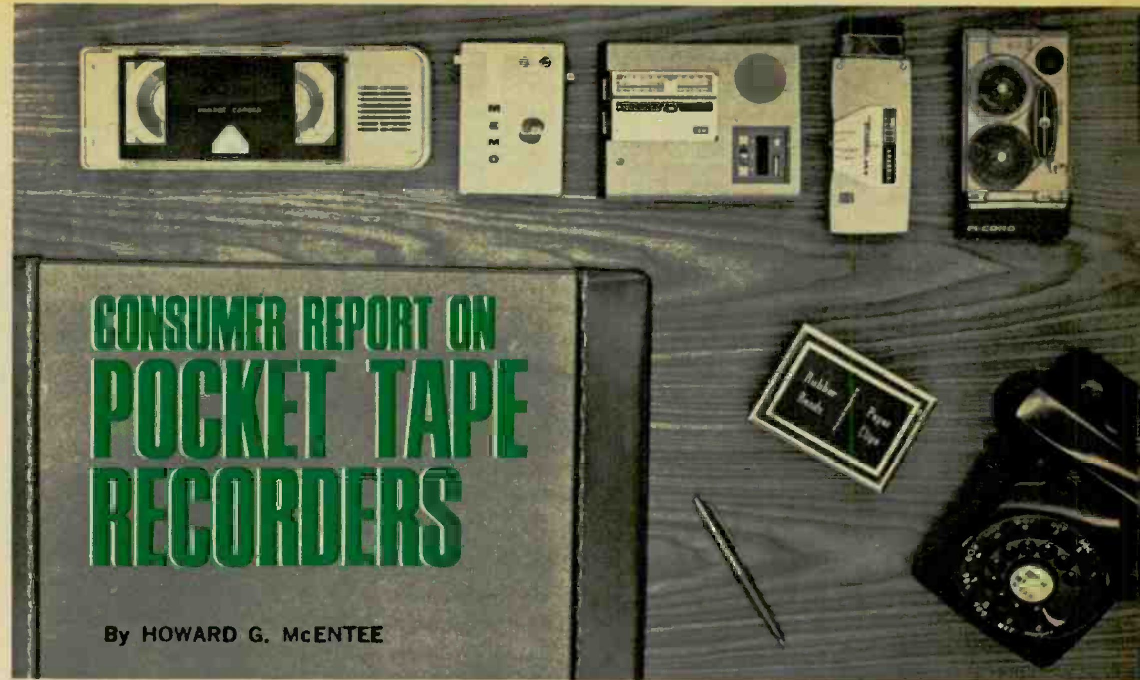
Final Assembly. Slide the perforated board under the controls and secure it to the cabinet with screws at four corners. To prevent the tie points and parts on the back of the board from shorting to the cabinet, place a ¼ in. spacer or stack of washers between the board and the cabinet at each screw.

Checkout. Do not plug in any crystals yet. Set *output level* control R7 and *modulation* control R9 counterclockwise so their switches click off. Connect the battery's negative lead to the generator and connect the positive lead to the positive terminal of a DC milliammeter set to indicate 10 ma or higher. Connect the meter's negative terminal to the battery terminal on S3. There should be no meter indication. If there is, check for a wiring error.

Apply power by turning R7 clockwise; the meter should indicate about 5 ma, though it may be somewhat higher or lower. If the meter indicates more than 10 ma look for a wiring error in the oscillator (Q1) or the mixer (Q2) circuit. Next, apply modulator power by advancing R9; the meter indication should rise 1 or 2 ma. If the total meter indication exceeds 10 ma look for a wiring error in the AF-oscillator (Q3) circuit.

Connect J1 to your receiver's antenna terminals through a section of thin coax such as RG58/U and plug a crystal into any of the crystal sockets. Set S1 to the appropriate position and tune the receiver until you pick up the generator's signal. Then check the operation of R7 and R9. Adjusting R7 will vary the amount of modulation.

Receiver Alignment. Since short-wave receivers are all aligned differently, it's best for you to follow the alignment instructions supplied with your model. Because our generator does not supply a 455-kc IF signal, you simply align the IF transformers by peaking them on a signal fed to the antenna terminals.



CONSUMER REPORT ON POCKET TAPE RECORDERS

By HOWARD G. McENTEE

AN Electronic Notebook is what one distributor has called a tape recorder that managed to squeeze everything—including the microphone—into a package smaller than the average walkie-talkie. Other makers use other names—Pocket Electronic Diary, Pocket Dictator and so on—usually suggesting an accessory for the tireless tycoon (which helps to justify some fairly fancy price tags) but the real appeal still is that of the glorious gadget.

There are several dozen extremely compact tape recorders on the market, many small enough for pocket parking. But most require a separate microphone on the end of a cable. Now it may be easy enough to hang the recorder over a shoulder or stow it beside you on the seat of your limousine so that you need only one hand to operate mike-mounted controls—but mike cables have a way of getting tangled. If the mike is built into the recorder (as it is in all units covered by this report) you know it is always there, ready to go.

This convenience feature takes trickier engineering than might at first be evident for the sound of the machinery grinding away in the case must be prevented from reaching the tape or you'll have high background noise on playback.

An attractive feature of most of these recorders is that they permit one-hand operation. Another is compactness itself. But small size and high quality don't come cheap. You could get a good full-size stereo recorder for what some of these handfuls cost.

Though our recorders all have attached mikes you can obtain mikes with extension cords for most of them. For many you can buy a surprising range of accessories, as we'll mention when describing individual makes. While some manufacturers list frequency-range specifications it should be noted that all are designed strictly for voice—music reproduction on any of them would be pretty low-fi. In several makes the mike also functions as a speaker (again, a factor that prohibits wide-range audio). One unit (Fi-Cord 300) has a mike/speaker only about ¾ in. across but it's fine for the intended purpose.

Now let's look over the entries in the specifications table (Fig. 5). Weights are given with batteries but less carrying case where this accessory is offered. Sizes, likewise, are less case. For all but two of the units a leather case is an extra. With the IBM 224 it's standard equipment. No carrying case is offered, of course, for the Lafayette unit which is made to resemble a hard-bound book.

It should be understood that those recorders listed as having variable speed and no

POCKET TAPE RECORDERS

Fig. 1—Basic model of EDI recorder, now used for security work has sophisticated design, simple controls. Consumer models will be somewhat restyled, can be bought with cordless plug-in mike.

governor vary the tape-to-head speed constantly, depending on battery condition and the quantity of tape wound on the driven take-up reel. The solution to this latter problem is, of course, to provide a capstan to drive the tape rather than the reel. Capstans are, in fact, used on the expensive units. While the DeJur-Grundig does not have a capstan (and hence tape speed varies constantly at is winds onto take-up) it has a governor that compensate for changes in battery voltage. Machines without a governor lose speed gradually as battery voltage drops.

Cartridge loading makes for faster and more convenient tape changing. It also means, however, that your tapes can be played only on the one make of machine. Recording times in the table are based on the tape supplied by the recorder manufacturer and are listed both for one uninterrupted pass and for the total—two passes in all cases except for the magnetic-belt IBM unit and the four-track Memocord.

Most tape-recorder makers urge users to shun the ordinary type of flashlight cells in favor of alkaline cells. Some makers specify mercury cells, which are costly but have much longer life and more uniform voltage during that life. With carbon-zinc or alkaline cells, usable life with a given set of cells depends upon how much rest you give the battery between periods of use. Mercury cells will give about the same length of use, whether you let them rest or not. Some recorders can be fitted with nickel-cadmium rechargeable cells.

All recorders performed adequately on voice. Some showed enough flutter to be noticeable even on voice but not enough to interfere with intelligibility—the final and only reasonable criterion.

So much for general observations. Now let's take the recorders one at a time for a closer look.

EDI M60 (ElectroData, Inc., Box 322, Fort Lee, N. J. 07024). This is the only unit of which we were not able to obtain a sample for extensive examination and test. The maker has just started production for public sale and no samples were yet available. The same basic unit has been in use for some ten years (solely by law-enforcement agencies) for security, surveillance and intelligence work. It was designed to be worn rather than held in the hand so it has no knobs or switches on the case. The only external control is a stop/start button switch on a cord about 2-ft. long. To switch from record to playback you unplug the mike and plug in the stethoscope-style earphone set supplied with the unit.

Perhaps we should note right here that the rig is available in two forms, both with the same size and external appearance. The M60 in our table of specs is mono. The stereo B60 ($585, including two mikes and stereo phones) seems to be the unit most favored by law agencies. The B60 has most of its electronic circuitry, equivalent to 26 transistors and associated parts, in two integrated circuits designed expressly for this recorder—the first to use ICs, according to EDI.

The M60 employs 13 transistors in a more standard printed-circuit assembly. Only two disc cells are required (one each, Mallory RM630 and 822) to give the 35 hours of use we list. Tape is made of special extra-thin base material but its otherwise standard dimensions allow it to be played back on larger recorders. Tape speed presently is 1⅞ ips but models soon will be available with 15/16 ips for those who need extra playing time.

The case is all metal and extremely thin; the unit is easily accommodated in a shirt pocket and due to the light weight there isn't much sag. The set pictured (Fig. 1) is of the law-enforcement variety, housed in a plain

Fig. 2—IBM takes honors for elegance. Magnetic belts can be used interchangeably on other IBM Executary dictation equipment. Object in left foreground is permanent-magnet bulk-erase device.

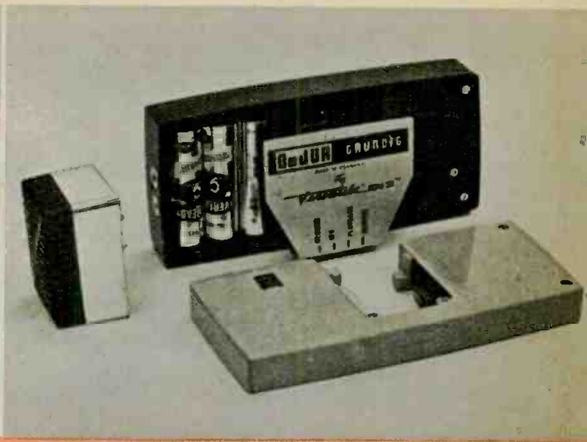


Fig. 3—DeJur-Grundig has tape cartridge (foreground) that is slipped out and reversed for use on second side. Plug-in mike/speaker head (left) can be replaced by several accessory extension units.

anodized aluminum case. Models produced for the consumer market will be dressed up to some extent.

There is no volume control. A built-in automatic volume control (AVC) does an amazing job of compensating for different sound levels. Ordinary voice levels in moderately quiet surroundings can be picked up at distances from 75 ft. to a few inches with perfect clarity and at constant level. The mike normally supplied with the unit is at the end of several feet of cord (making it easier to conceal) but it can be supplied directly attached to the plug, for a one-piece unit.

No erase facilities are built in. Tapes must be erased with a bulk eraser. Rewind is accomplished by pulling out the rectangular lever inside the case, between the tape reels. Pulled about half way it provides fast forward winding.

Fi-Cord (Karl Heitz, Inc., 979 Third Ave., New York, N.Y. 10022). Complete single-hand operation is possible with this Swiss import (illustrated on the cover). It has AVC on the record position, but there is a manual volume control for playback. Governor action is transistorized and permits tapes to be played back on standard 2-track recorders.

Designed especially for business uses, the Fi-Cord boasts a wide variety of accessories. You can get an external amplifier/loudspeaker. Its case attaches to the end of the re-

Fig. 4—Recorders for business use accept many accessories. Clockwise from Memocord recorder are extension speaker unit, conference microphone, stethoscope-type earphone, single earphone, telephone pickup, transcription pedal switch. Some recorders also have lapel mikes, carrying cases, holders for spare tape reels.

	EDI M60	Fi-Cord 300	DeJur-Grundig EN-3	IBM 224	Lafayette AT-1	Memocord XJE IV
List price	$345	$209.95	$59.50	$425	$14.95	$79.95
Weight	11.5 oz.	26.5 oz.	13.2 oz.	27.5 oz.	35 oz.	11.5 oz.
Size (in.)	6⅛x2¾x1	6½x3½x1¾	6½x2½x1½	6⅛x4¾x1¾	9x6½x1½	4½x3x1½
Tape drive	Capstan	Capstan	Reel rim	(see text)	Reel flywheel	Reel rim
Tape speed	1⅞ ips	1⅞ ips	Variable (no adjust)	2.12 ips	Variable (no adjust)	Variable (adjustable)
Governor	Yes	Electronic	Centrifugal & electronic	Centrifugal	None	None
Freq. range	100-5,500 cps	300-4,500 cps	n.s.	300-3,000 cps	n.s.	n.s.
Time per pass	60 min.	24 min.	22 min.	10 min.	5 min.	15 min.
Total time	120 min.	48 min.	44 min.	10 min.	10 min.	60 min.
Batteries	2 mercury disc cells	3 size AA merc. or alka.	3 size AA	Spec. 10.7-V mercury	2 size C 1 9-V	1 size AA 1 9-V
Approx. battery life	35 hr.	n.s.	n.s.	16 hr.	n.s.	n.s.
Battery cond. meter	No	No	No	Yes	No	No
Erase	None	DC	PM	DC	PM	DC
Reel size	2-3/16 in.	2 in.	Spec. cart.	Spec. belt	3 in.	Spec. 1¾ in.
Playback on std. recorder	Yes	Yes	No	No	No	No
Tape-end warning	None	Automatic tone	Visual	Automatic tone	Visual	Visual
No. of transistors	(see text)	11	4	7	4	n.s.
Fast forward	Yes	Yes	No	(see text)	No	Manual

Fig. 5—Spec. table is based on manufacturers' data. Listings shown as n.s. indicate no spec. available.

POCKET TAPE RECORDERS

corder, and works off the internal battery so you still have a single-unit machine with no dangling cords. A transcribing control unit holds the Fi-Cord 300 for desk-top use. Double foot pedals allow complete control for transcription purposes. The maker offers a variety of carrying cases, microphones and other units.

The Model 300 uses ¼-in. tape (two-track). Another model, the 303, designed for use with Stenorette office machines, costs the same.

DeJur-Grundig EN-3 (in U.S. through DeJur-Amsco Corp., Long Island City, N.Y. 11101). Very well engineered and built (in Germany), the EN-3 (Fig. 3) is extremely simple with no frills whatever. A single lever on one edge makes it possible to operate with a single hand, almost like using a cordless electric shaver. Its plug-in head is a combination mike and earphone (hardly a loudspeaker considering its output—but then it's meant for close-up use). You can get an extension cord for it or a lapel mike, if you want.

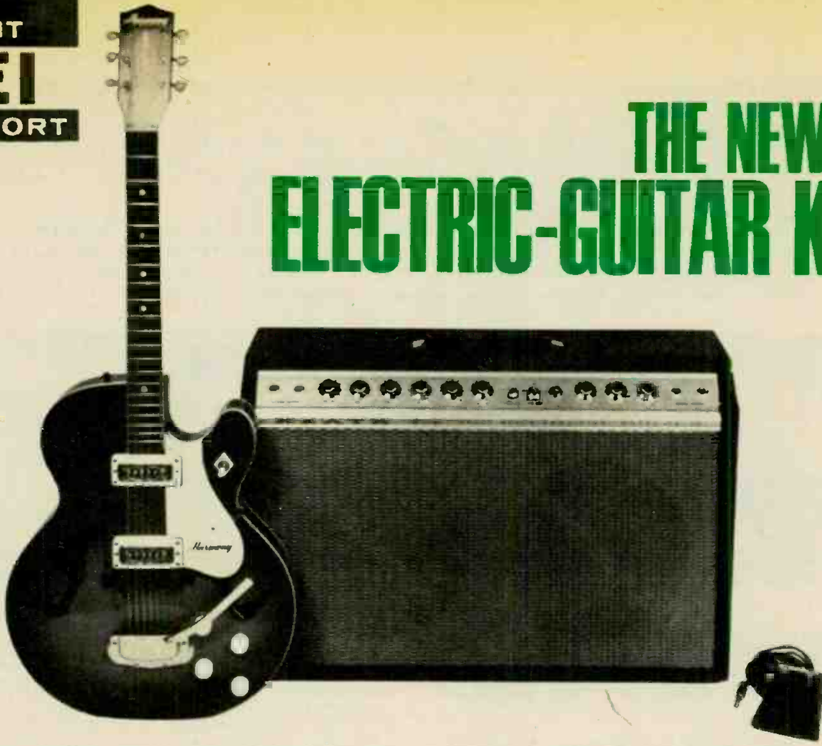
IBM Executary Model 224 (Office Prod. Div., IBM 590 Madison Ave., New York, N.Y. 10022). Although designed for one-hand operation, the 224 (Fig. 2) is entirely different from the other recorders checked. In the first place, it is not a *tape* recorder. In place of tape it uses a single Mylar belt with a magnetic coating. Mechanically it is therefore similar to other belt-type dictation machines. In fact, its belts may be transcribed on other IBM Executary office units.

It is a comfortable handful, with an aluminum case designed to fit the right hand (left-handers may have a problem). There are separate mike and speaker and separate volume controls for record and playback. No rewind is provided—and none is needed since the scanning head may be lifted and manually respositioned on any of the 100 scan-lines of the recording. This facility is quite accurate and is complemented with a card on which notations can be made as an index to the contents of the recording.

The unit erases as it records in the normal way making it possible to re-record a sentence or a paragraph in the middle of what you have already dictated. For bulk erasing there

[*Continued on page* 117]

THE NEWEST! ELECTRIC-GUITAR KITS



As the hottest-selling musical instrument now on the scene, the electric guitar is growing in popularity at a fantastic rate. It's the lead instrument in virtually all popular rock bands and is the catalyst of sociability of almost every age group. At resort, pool, nightclub, ski resort or stay-at-home parties or at practically any social happening, a guitar is the focus of attention. It even upstages the piano.

To support the do-it-yourself trend in guitar music is a do-it-yourself guitar and amplifier. Right in there swinging is Heath with its $94.50 kit (TG-36) version of the Harmony Model H56 guitar (suggested retail price of the assembled guitar with extras is $160) and a two-channel solid-state amplifier.

Does it make sense for an aspiring amateur or professional guitarist to assemble his own instrument and amp? After all, how many people combine both musical and electronic talents? To get a clue, EI built the $129.95 Heath Model TA-16 amplifier and TG-36 guitar.

Our builder, high on musical aspirations and low on kit-building experience, tackled the job with a spirit of adventure and dreams of starting his own combo. It was the first kit of any kind he ever built. But before we talk about putting the guitar and amp together, let's look at the features.

The amplifier has two inputs on each of two channels. The inputs on each channel are paralleled to provide for the simultaneous connection of two instruments, such as two guitars or a guitar and an accordion, or an instrument and a dynamic microphone.

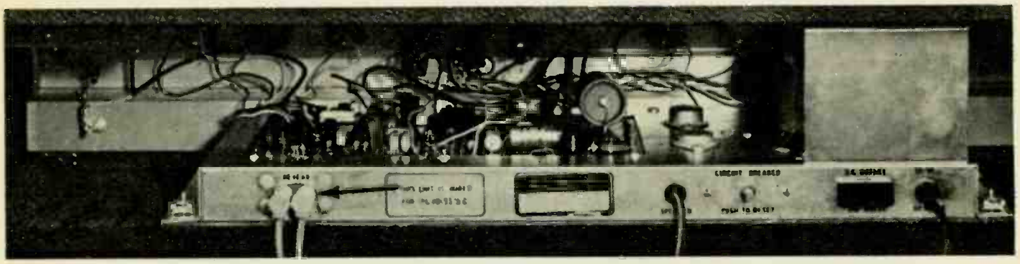
One channel, called the *normal channel*, provides straight-through amplification with just bass, treble and volume controls. The second channel, called the *reverb channel*, also provides straight-through amplification with tone and volume controls and has tremolo and reverb, besides.

The tremolo has a rate control that adjusts the pulsation from about 4 to 15 cps. The depth control sets the intensity of the tremolo effects. The reverb is produced with spring delay lines mounted in the bottom of the speaker cabinet. It is connected to the amplifier with two plug-in cables.

While tremolo and reverb can be turned on and off with top-panel controls, they can also be switched on and off with a plug-in foot switch. Although tremolo and reverb are intended for use with a guitar (or other instrument), you could use them with a mike for unusual vocal effects.

The guitar has a hollow body, two pickups, vibrato tailpiece and a volume and tone control for each pickup. A switch lets you use either or both pickups. Construction of the guitar involved first building an external harness of which tone and volume controls and

Although the control panel is the width of the cabinet, the 20-watt (sine-wave), 13-transistor amplifier is relatively small and straightforward. From left to right controls are reverb-channel volume, bass, treble, tremolo rate, tremolo depth, reverb. Next are foot-switch jack, power switch, pilot light. Normal-channel controls are treble, bass, volume. Cables (arrow) connect to preassembled reverb unit at bottom of cabinet.



ELECTRIC GUITAR KITS

pickup-selector switch are a part. After the harness was snaked through one of the *F* holes into the guitar's body, the pickups, tuning-key assemblies, bridge assembly, strings and tailpiece were installed. It took our man about eight hours to complete this phase of the job. No problems were encountered; the manual was quite clear.

While the amplifier appeared to be a formidable construction job because of the large cabinet, such was not entirely the case. The cabinet is large because it contains two heavy-duty 12-in. Jensen musical-instrument speakers and a long front panel for the controls and jacks. Except for the panel-mounted controls and the two output transistors, the entire amplifier, including tremolo circuit and reverb driver, is assembled on a single circuit board. Construction consists of installing the components in holes on the board and attaching the connecting leads to the panel-mounted controls and jacks.

The most difficult job for our man was trying to locate the right resistors and capacitors. Numbers on some capacitors didn't match the ones in the manual.

Being a rank amateur at building electronic kits he found it took an hour of practice to learn to use a soldering iron. The circuit board, he felt, was the easiest part of the job so far as soldering was concerned. But when it came to the straight wiring, he was caught in a maze of spider webs. And when he turned on the amplifier it didn't work because he failed to solder about one-third of the connections on the circuit-board properly. With the assistance of an experienced kit builder, everything was straightened out. We strongly recommend that you use at least a 40-watt soldering iron and have at least two other kits under your belt before tackling this one.

Another difficulty was that the tremolo circuit did not produce more than a very faint pulsation. This was caused by the low gain of the transistor used to drive the tremolo circuit's light-dependent resistor. Replacement with a transistor (supplied by Health) having higher gain solved the problem. If you have trouble getting a good tremolo, write to Heath for a new transistor—the part No. is 417-110. It took our man (men) about 30 hours to build the amp and get it working.

The performance of the guitar and amplifier sent us swinging right up to cloud seven. The sound was clean and had *solid* body. While the amplifier is rated at only 20 watts (continuous, or sine-wave power), combined with the heavy-duty musical instrument speakers, the undistorted maximum volume level can be deafening. Tremolo and reverb are excellent. Hum and noise were low.

In every respect we consider the amplifier to be an excellent value and capable of holding its own with professional amplifiers in the $200 class. The guitar also is an excellent instrument. However, if we had to do it all over again, we'd purchase an assembled guitar. Musician friends tell us we probably could buy an assembled one of comparable quality for about the same price as the kit.

CB but not CB

FRANTIC reports that the FCC will bounce unlicensed walkie-talkies from 27 mc up to 50 mc hardly were welcomed by manufacturers. But CBers have little cause to panic. Though they share some frequencies, the Part 15 gadgets are not CB. Moving them off 27 mc (*if* they're moved) should benefit CB by reducing interference. Walkie-talkies that meet CB requirements (as they must if input power is greater than 100 mw) wouldn't be affected so long as they're used in regular CB operations.

What would a new unlicensed band be like? First reports suggest a single frequency between 49.9 and 50 mc and a power limit of 60 mw with antenna length restricted to two ft. (as opposed to 100 mw with a five-ft. antenna). But these are speculations—not specifications.

The future of walkie-talkies was a hot topic at a recent FCC hearing in Washington. Just two weeks earlier a New York Times headline frantically reported, "FCC Takes Steps to Outlaw Most Walkie-Talkies." The welter of manufacturers at the meeting sobbed over cancelled orders and complained of the advance notice necessary to alter designs of imported items. One pointed an accusing finger at the chairman and declared ominously, "You have created a monster, sir, and now you can't control it."

Presiding over that hearing was FCC staffer James E. Barr. Seems the walkie-talkie story, like many out of Washington, was leaked prematurely to the press. Barr explained that proposals were merely in draft form and not even the FCC commissioners had known what the staff was mulling over when the news broke. When (and if) the commissioners see those recommendations there is no telling when (and if) they would take action.

Until they do, Barr said, there's nothing to discuss.

Disappearing Antenna . . . A novel kit enables you to convert a regular car whip into a center-loaded antenna that operates for both CB and broadcast-band reception. The kit consists of the top section of a CB antenna with a loading coil to make the whip resonate on 27 mc (see photo). A splitter network under the dashboard funnels CB and AM signals to the appropriate equipment.

The car's regular antenna is telescoped down and the new top section fastened to the antenna tip. Then it's simply a matter of plugging cables into CB and AM sets. Tune-up is done with an SWR meter and adjustable whip sections supplied in the kit. A slight touch-up of the AM radio's antenna trimmer is necessary to compensate for the splitter. The system, an import by Lafayette Radio, is another sign of the growing trend to simplicity of mobile installation.

Go Fight City Hall . . . The FCC has hauled many a radio violator before the bar of justice. Now it could be the Commission's turn. Charging the FCC with nine errors of law, the California Citizens Band Association has filed suit to try to get the court to set aside the Commission's restrictive 1965 changes in CB rules—rules the CCBA con-

[*Continued on page* 116]

Adaptor antenna with loading coil simply clips to car's whip, feeds AM and CB through a splitter.

"He's a good worker. I'd promote him right now if he had more education in electronics."

Could they be talking about you?

You'll miss a lot of opportunities if you try to get along in the electronics industry without an advanced education. Many doors will be closed to you, and no amount of hard work will open them.

But you can build a rewarding career if you supplement your experience with specialized knowledge of one of the key areas of electronics. As a specialist, you will enjoy security, excellent pay, and the kind of future you want for yourself and your family.

Going back to school isn't easy for a man with a full-time job and family obligations. But CREI Home Study Programs make it possible for you to get the additional education you need without attending classes. You study at home, at your own pace, on your own schedule. You study with the assurance that what you learn can be applied to the job immediately.

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You're eligible for a CREI Program if you work in electronics and have a high school education. Our FREE book gives complete information. Airmail postpaid card for your copy. If card is detached, use coupon below or write: CREI, Dept. 1729-E, 3224 Sixteenth Street, N.W., Washington, D.C. 20010.

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APPROVED FOR VETERANS ADMINISTRATION TRAINING

GOOD READING

By Tim Cartwright

*E*LECTRICITY ONE-SEVEN. *Harry Mileaf (editor). Hayden Book Co., New York. 976 pages. Cloth, $12.76; paperback, 7 vols., $16.95*

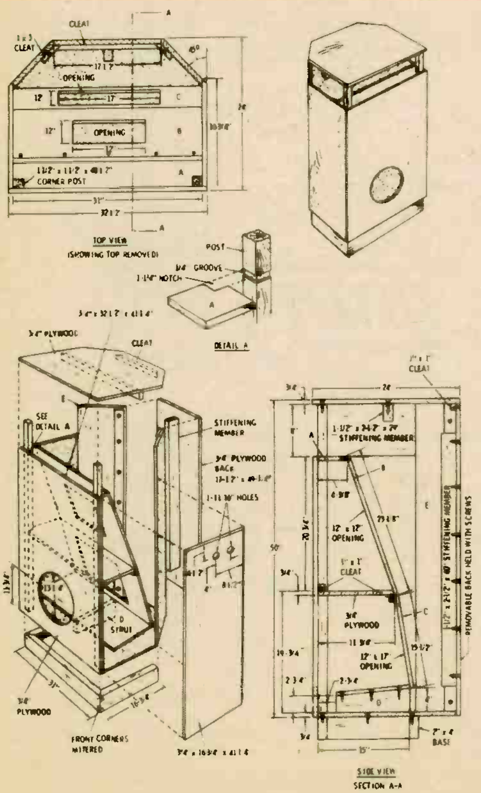
It's rare to find a book on basic electronics that you could hand confidently over to someone who really wants to learn from the ground up without any other kind of instruction. This is one of those rare books. It begins with the atomic basis of electricity and heads on to really meaty treatment of theory, circuitry, power sources, measurements and motors. (Paperback volumes are available separately.) And in many respects it's unique.

Instead of the programmed approach to instruction that's become so popular, this book takes a parallel kind of tack that probably should be called sequential. With the aid of sharp and vivid two-color diagrams it teaches the reader in short, simple, pertinent doses, beautifully planned. Everyone involved deserves congratulations.

*H*OW TO BUILD SPEAKER ENCLOSURES. *By Alexis Badmaieff and Don Davis. Howard Sams & Bobbs-Merrill, New York and Indianapolis. 144 pages. $3.25*

With hi-fi tending more and more toward complete, fully integrated products, there's a dearth of how-to material for the hobbyist who would like to do things with his own hands. This reasonably good book on the theory and construction of speaker cabinets with diagrams, tables and other good illustrations, contains plenty of information and a good deal that the would-be enclosure-builder won't find easily anywhere else.

I do have some reservations about coverage. There is, for example, only one short paragraph on the acoustic-suspension principle and a strong implication throughout that you can't really expect big sound from any but a big-speaker system. Since that theory has been disproved many times and both authors are, I believe, associated with a company long a proponent of big boxes for speakers I can understand the point of view. But I can't agree with it.



Construction illustration from Speaker Enclosures.

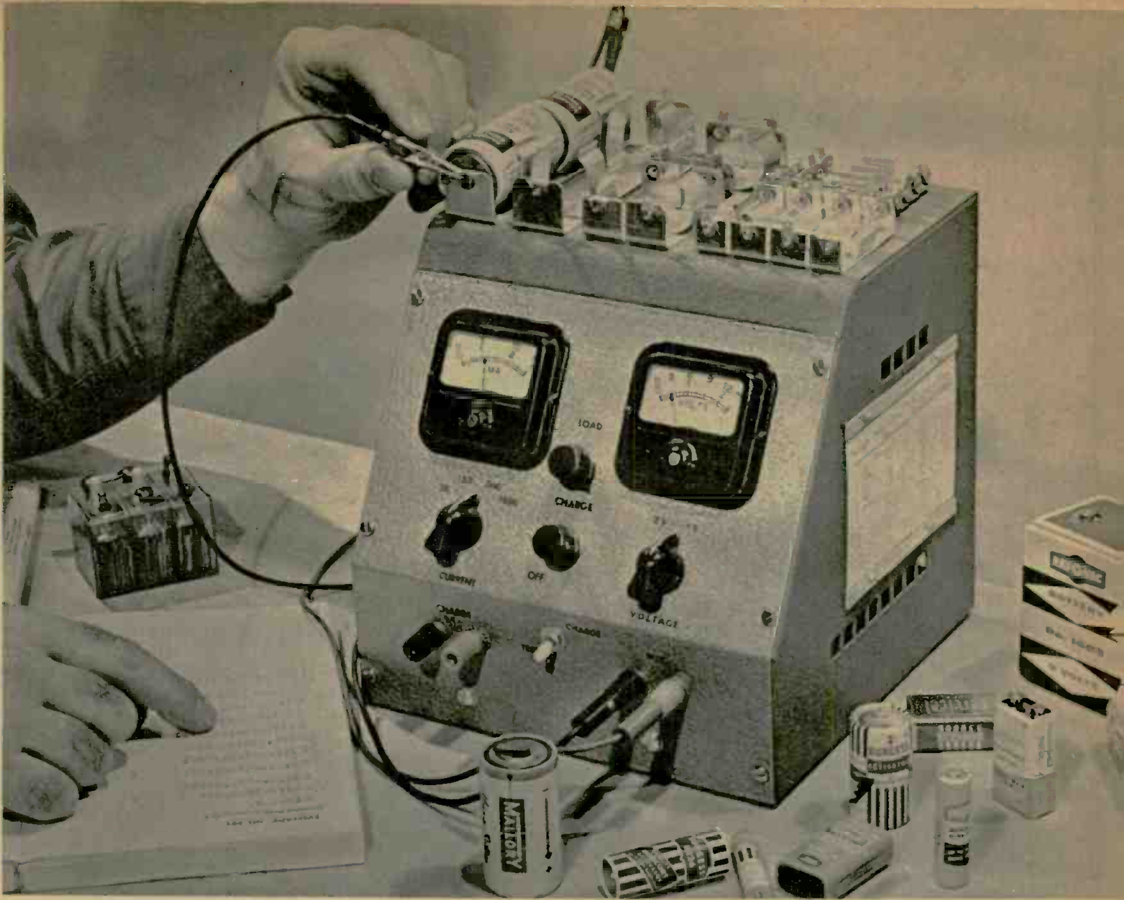
99 WAYS TO IMPROVE YOUR CB RADIO. *By Len Buckwalter. Howard Sams and Bobbs-Merrill, New York and Indianapolis. 128 pages. $2.50*

Len Buckwalter's latest is a good, highly practical set of suggestions for CBers. Covering antennas, interference suppression, maintenance, accessories and other down-to-earth subjects, he provides pertinent information and *dos* and *don't*s for some common practices.

*W*ESTINGHOUSE BASIC ELECTRONICS COURSE. *Westinghouse Electric Corp., Electronic Components and Specialty Products Group, Pittsburgh. $3*

This column is called *Good* Reading and

[*Continued on page* 112]



Char-Analyst for Batteries

Banish your battery budget forever (well, almost) with our super-duper do-all and end-all tester/charger (phew!).

BY BERT MANN

BATTERIES by the carload! That's almost the way you have to buy them these days to keep everything from junior's toys to dad's heavy-duty flashlight running all the time.

Before you discard those apparently-dead batteries, however, connect them to the Char-Analyst. In quick time it will check them under load and show you the true condition. If the battery is on its last legs, merely shift a pair of leads, flip a switch or two and the Analyst will charge the battery, making it almost as good as new.

Often a battery no longer may be able to power a particular piece of equipment; however, it usually is capable of giving several more months of service in other gear which pulls less current.

For example, an old C cell required to supply 200 ma to a walkie-talkie might be too pooped to push the signal 10 ft. down the block. Recharge that battery and put it in a transistor mike mixer that pulls about 10 ma and months later the same battery will be going strong.

Reason for this is that as the battery ages its internal resistance increases. When the battery is connected to a load that pulls a lot of current the high internal resistance causes the terminal voltage to drop.

When terminal voltage falls to the cutoff value—the voltage below which the equipment will not operate—the battery is said to be dead. But in a device that draws little current it will take much longer for the terminal voltage to drop to cutoff value. The

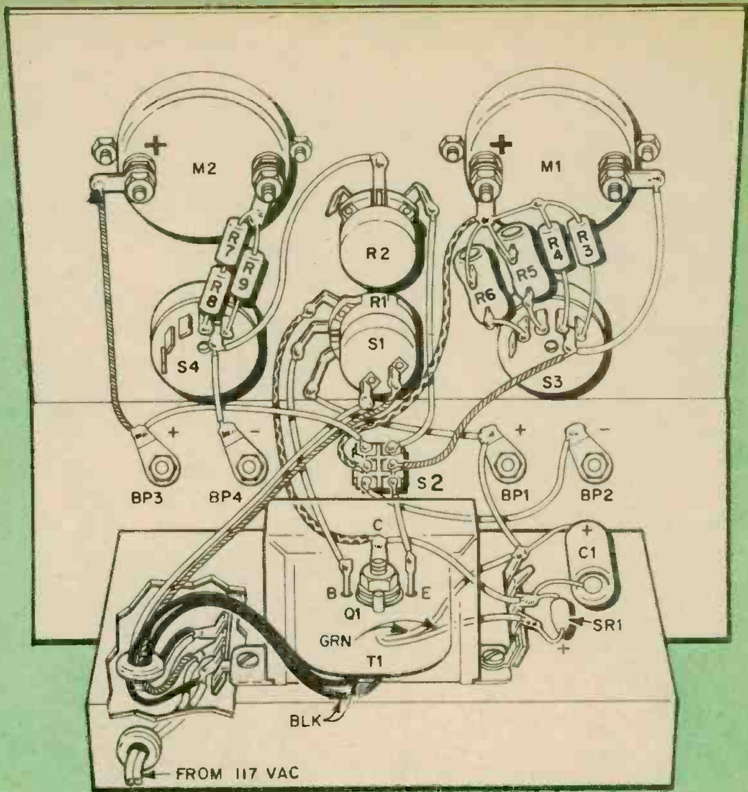


Fig. 1—Because of the angle at which the front panel slants back, it will be more convenient to install the meters, controls and binding posts on the panel before bolting panel and chassis together. When wiring to the terminal strip at the right of T1 make sure you don't make any connections to the ground lug since the circuit must be isolated electrically from the metal cabinet.

Char-Analyst for Batteries

Analyst's test section shows you a battery's true terminal voltage by simulating loads that pull up to 1½ A.

The Analyst tests and charges AA, AAA, C and D zinc-carbon, mercury, alkaline and nickel-cadmium cells. Charging current can be adjusted over a wide range of values.

PARTS LIST

BP1-BP4—5-way binding post
C1—100 μf, 50 V electrolytic capacitor
M1—0-3 ma DC milliammeter (500 ohms). Shurite Type 950 (Lafayette 38 C 6083).
M2—0-1 ma DC milliammeter. Shurite Type 950 (Lafayette 38 C 6081)
Q1—40 watt PNP power transistor (Lafayette 19 R 1503)
R1—2,000 ohm, linear taper potentiometer with SPST switch
R2—2,000 ohm, linear taper potentiometer
R3—56 ohm, ½ watt, 10% resistor
R4—10 ohm, ½ watt, 10% resistor
R5—5 ohm, 5 watt wirewound resistor
R6—1 ohm, 5 watt wirewound resistor
R7—2,000 ohm, ½ watt, 5% resistor
R8—13,000 ohm, ½ watt, 5% resistor
R9—1,500 ohm, ½ watt, 10% resistor
S1—SPST switch on R1
S2—DPDT toggle or slide switch
S3, S4—1 pole, 5 position rotary switch (Mallory 3215J or equiv.)
SR1—Silicon rectifier; minimum ratings: 500 ma, 100 PIV
T1—Filament transformer; secondary: 24 V @ 1 A (Lafayette 99 C 6266 or equiv.)
Misc.—Power transistor (TO-36 size) mounting kit (Lafayette 19 C 1532 or equiv.), 4 x 6⅛ x 1-in. open-end aluminum chassis (Premier ACH-1360), 8 x 8 x 8-in. sloping-panel cabinet (Premier SFC-500).

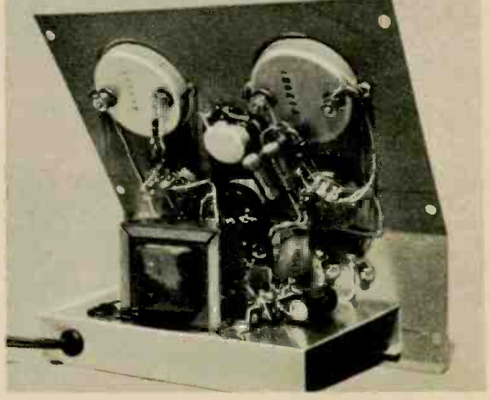


Fig. 2—Chassis is attached to front panel with machine screws. Note the 3/16-in. space between the bottom of chassis and bottom of front panel.

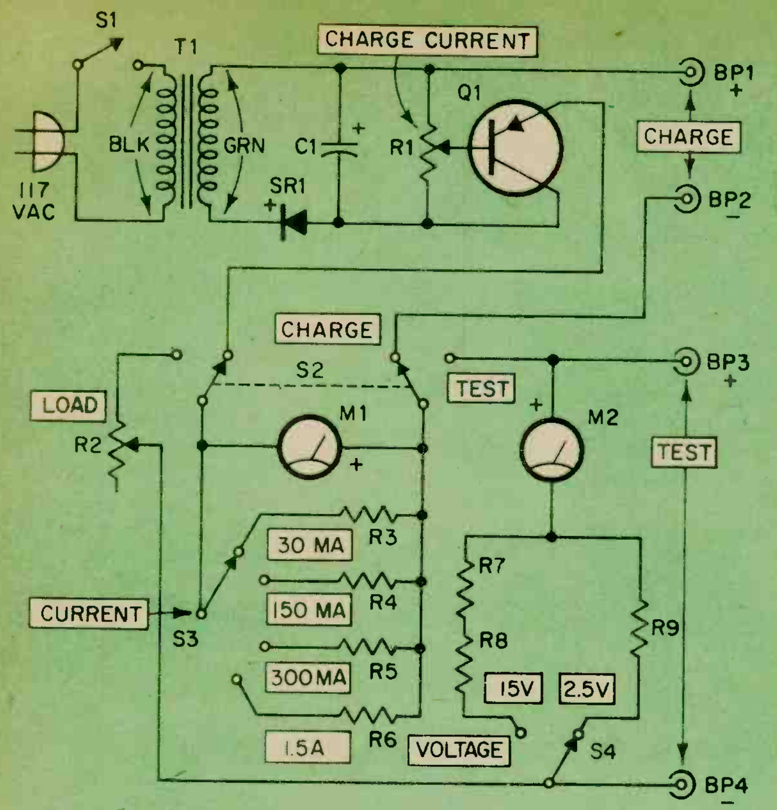


Fig. 4—T1, SR1, C1, R1 and Q1 constitute power supply whose output is controlled by varying Q1's bias voltage with R1. When S2 is in charge position (shown), M1 is connected in negative buss to measure charge current. S3 connects appropriate shunt resistor (R3-R6) across M1. When S2 is set to "test," R2, M1 and selected shunt resistor (R3-R6) are connected across battery terminals. M2 then indicates battery voltage as R2 increases test current.

To simplify connections to the batteries, we mounted several different size holders on the top of the cabinet. If you have a specific need, say, to charge ten D cells together, the holders can all be for D cells.

Construction. Our Analyst is built in an 8 x 8 x 8-in. sloping-panel cabinet. All components (except those in the power supply, which are mounted on a 4 x 6⅛ x 1-in. open-end chassis) are mounted on the cabinet's front panel.

Note that transistor Q1 is mounted under the chassis so connections can be made to its terminals on top of the chassis. The entire circuit is isolated electrically from the cabinet to prevent damage to Q1 should a test lead touch the cabinet.

As supplied, the transistor mounting kit does not include an insulator for Q1's threaded mounting stud, which also is the collector lead. Drill an oversize hole (9/16 in.) for the threaded stud. Then insulate the stud with a few turns of electrical tape or an insulating sleeve. Make no connections to Q1 until you measure the resistance between its base, emitter and collector leads and the chassis. If you measure any resistance at all track down the trouble before going on.

The specified meters (substitutes are not permitted) must have their scales changed. To remove them, *gently* take off the front cover by bending back the tabs at each corner. Then remove the two screws holding

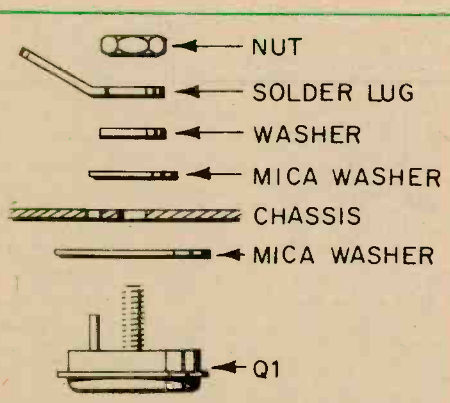


Fig. 3—Q1 mounting details. Wrap tape around threaded stud to prevent a short to chassis. Base, emitter leads are not shown.

Char-Analyst for Batteries

the scale and *slide* the scale out, taking care you don't bend the pointer.

Using rubber cement, cover the existing meter scales with the scales in Fig. 5. The 3-ma meter, M1, now has two scales: 0-3 and 0-15 ma. This provides 30, 150, 300 and 1,500-ma ranges. The 0-1 ma meter, M2, will have two voltage scales, 2.5 and 15 V.

Mount the chart in Fig. 6 on the side of the cabinet. The chart shows test currents and the 16-hr. charge currents for many popular batteries. If you plan to charge nickel-cadmium batteries, use the charge current specified by the manufacturer.

Testing. Set S2 to *test*, R2 to full counterclockwise and S3 and S4 to the appropriate current and voltage ranges. Then connect the battery to BP3 and BP4 with clip leads. Rotate R2 until M1 indicates the exact test current. Batteries that indicate above 1.2 V per cell are good. (To determine the number of cells divide the battery voltage by 1.5). An indication less than 0.8 V for each 1.5-V cell in the battery means the battery is exhausted and should be recharged. If the voltage is between 1.0 and 1.2 V per cell, the battery can be pepped up with a charge at about half the recommended rate (precise charge rate is determined by experience).

Charging. The recommended charge current usually is 150 per cent of the energy removed, distributed over a 16-hr. period. For example, suppose a D cell was used in a circuit that pulled 300 ma for ten hrs. This amounts to 3 ampere-hours (ampere-hours, A-H, = current in amperes x time in hours). To recharge the battery, 150 percent of the exhausted energy of 3 A-H (4.5 A-H) must be put back in. At the recommended charge time of 16 hrs. the charge current (A-H divided by time) is 4.5/16 or 0.28A (about 300 ma).

To charge, set S2 to *charge* and connect the batteries to BP1 and BP2. Turn R1 from the full counterclockwise position until power switch S1 clicks on. Set S3 to the appropriate charge-current range and adjust R1 until the exact current is indicated on M1. Keep your eye on the current for the first minute or so to prevent its creeping to too high a value.

Note. Always set S3 to the current range *before* testing or charging. Since the shunts affect the operation of both circuits it is normal for S3 not to decade accurately when switching from range to range when testing or charging. For example, if testing at 200 ma with S3 set to the 300-ma range, the test current might shoot up to 500 ma when S3 is changed to the 1.5-A position.

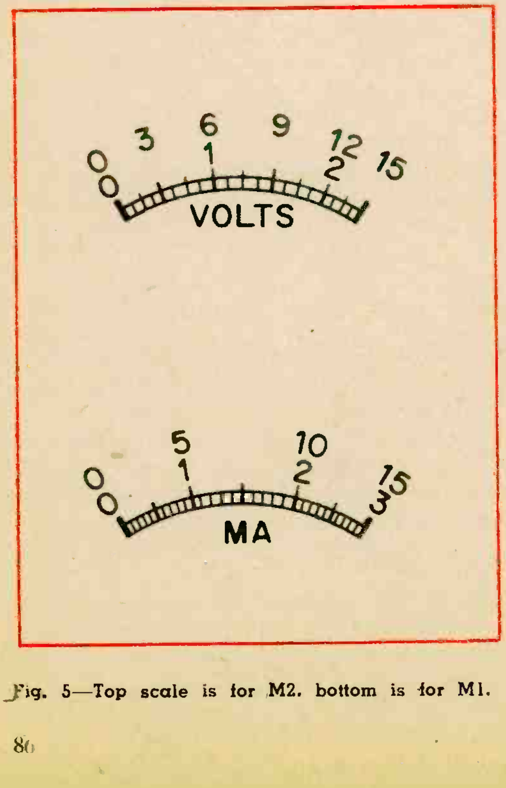


Fig. 5—Top scale is for M2, bottom is for M1.

TYPICAL TEST AND CHARGE CURRENTS

Battery Voltage	Test Current (ma)	Charge Current for 16 hrs. (ma)
1.5 (AAA)	30	20
1.5 (AA)	50	50
1.5 (C)	50	150
1.5 (D)	270	150
1.5 (D)*	50	150
4.5	100	150
4.5*	50	80
6.0**	270	150
6.0*	50	50
9.0*	9	16
13.5	9	16

*Transistor radio or electronic-applications type
**Lantern or heavy-duty type

Fig. 6—For future reference, attach this chart of typical battery test and charge currents either on the front or on the side of the charger's cabinet.

FM HAMS—THE NEW BREED

By MARSHALL LINCOLN, W7DQS

HAVE you met the new breed of ham? Better get acquainted because he's becoming an important voice on the bands.

This guy looks like any other ham and his license is the same. But you'll notice a big difference if you listen to him for a while. He isn't interested in DX certificates or ultra-stable VFOs or the latest in trap antennas. Those are for the fellows down on the DC bands (to a VHF-UHF man, anything below 50 mc is DC).

This new chap has gone all the way to commercial FM communications equipment—the two-way mobile stuff like cops and cab drivers use—but he runs it on amateur frequencies. His QSOs generally sound like dispatches—short, terse transmissions with little of the long-winded rag chewing you hear on AM fone. Gone, too, are the whistles and burps and howls of a dozen lids trying to operate on the same frequency. Gone is the bedlam of competition between SSB and AM, between CW and RTTY. Gone is the strained, tinny music of foreign BC stations fading in and out among the hams.

All you hear is one voice, loud and clear. When the operator finishes talking and releases his mike button you hear a short burst of hissing noise (called the *squelch tail*) as the receiver senses there is no longer an incoming FM signal and mutes itself. Then there's silence.

And you won't hear anyone calling CQ. Most calls are made to a specific station. If a guy wants to chew the fat he may jab the mike button and say, "This is WØXXX." That's all. Anyone who wants to talk to him will answer.

Once a QSO gets started it generally is fast-moving. In some areas FM hams sprinkle their conversations with 10 code to help keep transmissions brief and simple. There is no need to give a verbal go-ahead at the end of each transmission—the squelch tail gives the receiving operator his cue.

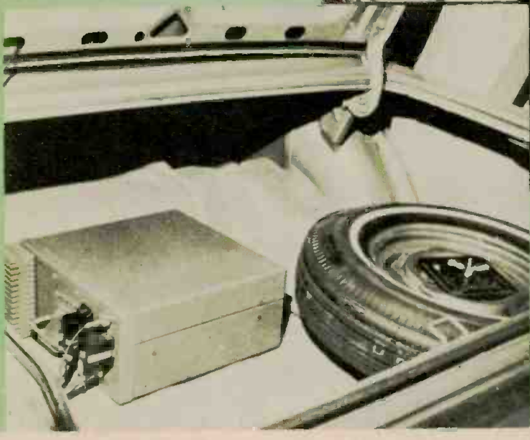
Most FM hams in a given area operate on the same frequency and many leave their home rigs on all the time. Auto installations often are wired through the ignition switch and come on when the car is started. If a ham wants to yak, get information or maybe call for help there's usually someone monitoring.

When no one is talking on the frequency the receiver is quiet—no hiss, static or distracting noise. In FM communications the strongest signal prevails so there is little QRM. For hams who are tired of the rat race of congested bands this feature alone is worth the price of admission.

Virtually all FM hamming is done in the 6- and 2-meter bands, with a little operation

Both men and women can be found at the mikes of FM ham stations. Many base stations have a mobile look, as this YL's rig does, with control head and microphone the only evidence desk doubles as ham shack. Power supply, transmitter and receiver may be hidden in a closet.

FM HAMS— THE NEW BREED



W7JCH uses two separate mobile FM rigs on different frequencies (above). Common speaker for both is on the transmission hump above the control heads. Trunk unit (left) houses receiver, transmitter, power supply.

on the 450-mc band. These bands usually are considered local—good only for communicating in one city or between nearby cities. Skip openings do occur sometimes, of course, making possible QSOs over several hundred miles. But VHF band openings aren't reliable and reliability of communications is what the FM ham dotes on.

In some of the larger cities FM hams have taken to using 2-meter automatic repeater stations—often on a tall building or a mountain top—whenever they want to be heard over a greater distance. A signal picked up by the repeater's receiver (usually on 146.34 mc) is fed to the repeater's transmitter (usually on 146.94 mc) and rebroadcast.

FM ham rigs seem like flea-power outfits to low-band fone operators. A typical mobile rig has an output of about 25 watts and some run only 10 or 15. A base station (that's what the FM ham calls his rig) generally has about 25 or 30 watts output. Some have more but it's seldom as much as 100 watts.

It's not at all uncommon to work mobile-to-mobile across a good-size city using only 10 watts. Base stations with 25 watts can work 30 mi., even with non-directional antennas that are only 20 ft. off the ground.

Because practically all FM hams operate mobile, those with base stations usually use non-directional ground-plane antennas at home. This way, they will be sure to hear a mobile calling, no matter his bearing.

A 6-meter ground plane looks similar to a CB ground plane but the radiator and radials are only about 4½ ft. long. For 2 meters they run about 1½ ft. Mobile operators use quarter-wave whips, usually on the roof or rear deck. On 2 meters or 450 mc they may use either a quarter-wave whip or a ⅝-wave whip with an impedance-matching coil at the base.

One reason these fellows can use low power and simple antennas is that commercial rigs have sensitive receivers. A series of limiter stages in the receiver clips off AM noise pulses. Receivers are superhets for good selectivity and have considerable RF and IF gain. Most are double-conversion jobs with crystal-controlled oscillators.

A couple of frequencies have become fairly standard across the country for most amateur FM operation. On 6 meters it's 52.525 mc. On 2 meters 146.94 mc is used most. In

Coil-matched whips designed for ⅝-wave mobile operation (above) are being used by increasing numbers of hams on 2 meters. The greater length gives it an advantage on both transmit and receive over standard ¼-wave mobile whip (right).

large cities, where one frequency can get congested, some hams use the common frequency for calling, then switch to a different frequency for a QSO.

When a ham makes use of an automatic repeater his receiver would be tuned to 146.94 mc. So would transmitter when he is working another ham direct. To work through the repeater he would switch his transmitter to 146.34 mc. The repeater would pick him up and simultaneously retransmit on 146.94, where other hams are listening.

All this sounds fine and dandy, you may say, but where does this kind of equipment come from? If you have enough long green you can buy the stuff off the shelf the way commercial users do. Good units run from $200 up—and up and up.

There are, however, cheaper ways to skin this cat. Hams often get acquainted with a commercial distributor of FM gear and buy up the older equipment as new models come in. Some dealers don't like to bother selling individual units but will deal through groups that will buy several at one time.

One radio club bought from a commercial dealer about a dozen units that were being replaced by newer equipment in a fleet of trucks. The individual hams in that club got some nice equipment for just $10 apiece (shipping charges) plus about $11 per unit for new crystals. Police departments or companies with radio-equipped vehicles often sell off old gear as low as $50 per unit. In almost every case the price on commercial FM equipment includes all accessories: mike, speaker, power and control cables and mobile mounting brackets.

Converting commercial equipment to amateur frequencies is fairly simple. Units that have been in use on the 150-mc band usually may be switched over by installing a new set of crystals and retuning the receiver and transmitter oscillators, transmitter multiplier, driver and final stages. Conversion from 30-50 mc to 6 meters sometimes requires a little coil pruning as well.

That's all it takes to join the new hams. Some are bright-eyed newcomers who want to get their start in ham radio with the newest possible techniques. Others are veterans who have grown tired of chasing DX or fighting low-band QRM and want to try something different. In any case, it all adds up to FM.

The LISTENER

C. M. STANBURY II

THE CLANDESTINE VOICE OF RADIO

STATIONS like R. Americas, R. Libertad, Blue Eagle, Peyk-e-Iran and (would you believe it?) Kiss Me Honey have been receiving the lion's share of the limelight from serious short-wave listeners in recent years. These stations have become a major battleground partly because every time an SWL locates one of them he may find he is stepping on someone's toes. The unmasked transmitter often turns out to be somebody else's SW broadcast station in disguise. Still, we're going to try to unmask one such operation before we're finished with this column.

Let's start with the relatively harmless cases (now solved) of Peyk-e-Iran and Kiss Me Honey. Peyk is a communist transmission in Persian, Kurdish and Arabic beamed to Iran at 0800-1340 EST on approximately 11697, 9555 and sometimes 11410 kc. For years reports were circulated that Peyk used the transmitters of R. Berlin International in East Germany. But evidence derived from a two-antenna direction-finding technique show that the 11697-kc transmitter is not RBI's. The U.S. Government and several other sources subsequently have announced that Peyk is, in fact, using transmitters of R. Sofia.

Kiss Me Honey is a musical jammer directed against Peyk. At first it played, continuously, a record with that title, sung in English by a sexy German fraulein. Since then the format has varied somewhat and at last report a Latin American record, spun above normal speed, was the weapon of the day. It also has been established (by members of the American SWL Club) that only the Iraqi portions of Peyk's transmission are jammed. This seems clearly to mean that Kiss Me Honey is simply powerful R. Baghdad in disguise. And Iraq is one of the few non-communist nations to use jamming.

It is now taken as established fact that the CIA has operated in the Near East as well via V. of Iraq and V. of Justice, two apparently Arab stations that bid against Nasser at the time of his takeover in Egypt. At present, however, the CIA does not seem to have any transmissions from that area.

Clandestine and pseudo-clandestine operations that North American DXers should watch for around dawn are various R. Liberation Army operations of the Vietcong, China, the CIA and the U.S.S.R. Frequencies include 2440, 3900 and 4365 kc.

Propaganda about the war in Vietnam suggests that R. Portugal Libre also is a Communist operation. Although heavily jammed, it can be heard on 8340 kc until its 1840 EST sign-off. The transmitter probably is in eastern Europe.

Also heavily jammed and unequivocally communist is R. Espana Independiente, aimed at Franco's Spain from R. Moscow transmitters (which could be located almost anywhere in the U.S.S.R.). They use 17700 kc during the morning and switch to a frequency between 6950 and 7050 kc late in the afternoon (EST). The station has been

known to share a transmitter with the R. Moscow home service for the 17700-kc transmissions. While that frequency also is used by R. Berlin International in East Germany it may not be the same transmitter.

R. Euzkadi is a nationalist (i.e., non-communist) operation seeking independence for the Basque region of Spain. It seems to be one of the few clandestine stations that is not simply someone else's pawn in the game of international politics. It is on the air at 1530 and 1630 EST, using various frequencies between 13200 and 13300 kc and between 15000 and 15100 kc from transmitters somewhere in Latin America.

R. Libertad, La Voz Anti-Communista de America, is on the air daily at 0600 to 1015 and 1900 to 0100 EST. It uses 1406, 7305, 9300, 11865 and 15050 kc—but not necessarily all at once. At first everyone (including me) believed that R. Libertad was in Venezuela. The two-antenna technique has now eliminated this possibility and the best bet seems to be an area bounded by Haiti, S. Caicos Is. and Guantanamo Bay.

It is difficult, of course, to derive reliable information about these operations. A clandestine station will not, by definition, give away any more than it can help.

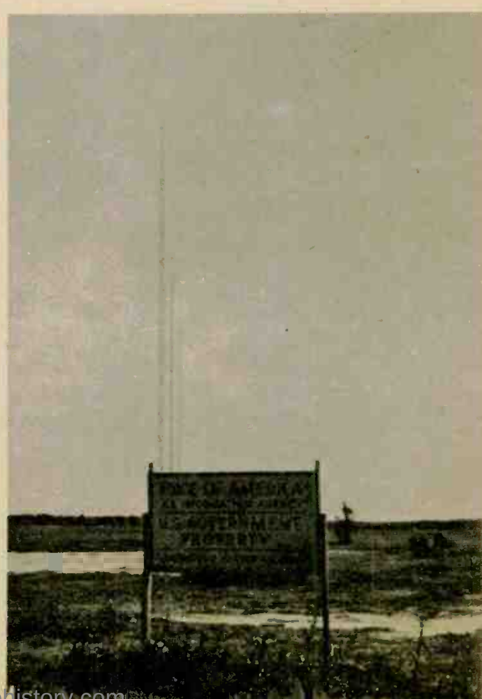
A will-o'-the-wisp clandestine that has become outrageously famous is R. Americas which, we all know, claimed to be located on Swan Island. But last September, at the height of the controversy over its true location, RA suddenly shut down its short-wave transmitter. Keep that in mind.

During the first week of December 1965 the BBC announced that it was flying to Francistown, Bechuanaland (now Botswana), a portable 50-kw BCB transmiter for broadcasts to Rhodesia. There also was to be a 10-kw SW outlet. CBS news later displayed a film of the construction site. It showed equipment that hardly suggested a capacity of 10 kw, let alone 50. Despite this, some kind of SW facility and the BCB station were on the air by Dec. 30, 1965. The Francistown facility was not complete until Jan. 22, 1966. It now includes a second 50-kw BCB station, presumably, non-portable.

Now to the best of anyone's knowledge, the only truly portable high-powered BCB station in the world is owned by the VOA. It consists of two easily-dismantled towers, two diesel generators (combined capacity, 400 kw), and a trailer-full of transmitting gear. Had the VOA secretly lent this unique station to the BBC?

A letter from the BBC claimed their Francistown station was neither owned nor operated by the BBC. They said it was *run* by Diplomatic Wireless Service (another British government agency). They never did say who owned the transmitter although they later confirmed my reception on 7295 kc at 2300 EST, referring to the station's location

A SW mystery seen from the Florida end. Power connections that once fed VOA's Sugarloaf transmitter (left) now go nowhere. R. Americas (whose unmarked Coral Gables office is below) has shut down their SW transmissions. Marathon site (right), identified by VOA as having two-mast portable facilities, now sports three permanent masts.



simply as Africa.

A letter to the VOA brought a detailed response that made it appear all the portable equipment was accounted for but never specifically answered the Bechuanaland question. They said that "in October, 1962, the standard-band transmitter and a directional antenna were installed at Marathon, Florida, and operated on 1180 kc for coverage of the Caribbean area." So I contacted photographer Paul Kassay, Jr., and asked him to have a look.

His pictures show that the two portable antenna towers have been replaced by three permanent ones. Power lines running to the transmitter (now appearing to be in a permanent building) suggested that the portable power supply has also been replaced. In short, without the knowledge of either the press or SWLs, the Voice has quietly removed its portable BCB gear.

The Francistown facility consists of two 50-kw BCB transmitters, the second taking (as we saw) considerably longer to get on the air. But a second 50-kw BCBer is also missing from the VOA arsenal. It formerly operated at Sugar Loaf, some 20 miles west of Marathon. The station was shut down at the end of October, 1965 and the site has been bulldozed—towers and all.

Okay, is there also an American 10-kw station missing? The answer is yes—Blue Eagle. The TV-equipped Blue Eagles showed up in Vietnam but nothing was heard of their SW counterpart (power, 10 kw) since tests in 1965. According to Lockheed (who built them) all three aircraft left the U.S. Jan. 21, 1966. The very next day the British officially brought into operation their Bechuanaland relay—a facility that includes a 10-kw SW station of which they will release no pictures.

But if Blue Eagle's SW station has been in Africa since Jan. 22, 1966, we are confronted with another mystery. On Oct. 8, 1966, a SW station showed up over the Racine, Wisconsin, area also calling itself Blue Eagle. This was just 2½ weeks after the deletion of our old friend, the R. Americas SW station.

How do you like *them* apples?

That 50-mile bit . . . When determining whether an island counts as a separate country for DX purposes, the crucial factor is the separation between the island (or group of islands) and other territory of the same nationality. The EI DX Club standard is 100 miles while the National Radio Club (an all-BCB outfit) has adopted a 50-mile standard.

When The Listener first dealt with this subject we stated that under the 50-mile rule Dry Tortugas (part of the Florida Keys) counted as a separate country because it is 75 miles from Key West. The NRC promptly came charging back, pointing out that between Key West and Dry Tortugas lie the tiny Marqueses Keys—which means that Dry Tortugas would *not* count separately. Tiny they may be but the NRC was absolutely right and we had indeed run aground in the Keys.

We should have picked Hawaii as our case. No matter which standard you choose, Hawaii always counts as at least one separate country; under that 50-mile rule it counts as several.

Although many DXers object to the idea, there is no reason you can't count a U.S. state as several different countries. The Association of North American Radio Clubs (a loose federation of DX clubs) has, in fact, adopted the 50-mile standard. The big question is, will a majority of ANARC clubs (especially the NRC) carry it out? If the answer turns out to be yes, don't be surprised if we adopt this standard, too.

[*Continued on page* 119]

EI's GUIDE TO CLANDESTINE RADIO

FREQ. (kc)	STATION NAME	COMMENTS
1157	R. Americas	
1404	R. Libertad	
2440	R. Liberation Army	
3900	R. Liberation Army	
4365	R. Liberation Army	
7000	R. Espana Independiente	Frequency varies
7305	R. Libertad	
8340	R. Portugal Libre	
9300	R. Libertad	
11500	R. Free Russia (N.T.S.) and R. Omega	Supposedly in West Germany
11695	Peyk-e-Iran	Regularly jammed
11865	R. Libertad	
13250	R. Euzkadi	Frequency varies
15050	R. Libertad	
15055	R. Euzkadi	Frequency varies
17700	R. Espana Independiente	

RADIO'S INVISIBLE DOCTOR

ROME

THE WIRELESS operator lifted the earphones from his head and handed a message to a little man wearing a white coat. The physician, a balding Italian in his 60's, sat down next to the maze of radio controls and pondered over the short-wave note. "Request Medical Aid Re Two Hunger-Crazed Men Drifted Open Boat Seventy-Four Days Indian Ocean."

Then, with fingers that were sure of themselves, the doctor snuggled his head into a set of earphones, adjusted some controls and began dictating medical instructions to the ship which, 4,000 miles away, had fished the half-dead castaways out of the water.

Such medical distress signals from some faraway ocean are all part of the unusual office practice of Dr. Guido Guida of Rome. Running by radio the only remote-control hospital in the world, Dr. Guida every year receives some 8,000 medical SOS messages. Their plea is for help to save the lives of patients Dr. Guida never has seen—sailors and passengers on the high seas in desperate need of medical treatment.

On a typical morning, Rome's medical SOS clinic may get a call from a fishing boat off the coast of Portugal wanting to know how to care for a man with gallstones. Or the message may come from a Norwegian freighter in the Caribbean seeking advice on glandular fever. Or it may originate with a Greek passenger liner near Australia and ask for information on how to handle a hemorrhage. And, thanks to Dr. Guida's world-girdling radio center in The Eternal City, rough-cut deck officers thousands of miles away successfully have pulled teeth, cut out appendixes, set broken legs, treated mental patients and delivered babies.

Most of the cases that come in offer what is considered one of the trickiest challenges any physician can face—making a diagnosis on a patient he can't see. But Dr. Guida and

Treating the injured and sick on ships of all nations in any of the seven seas is the unusual medical practice of an Italian doctor/ham. And despite the equipment now at his disposal, Rome's Dr. Guido Guida, IRM, still finds use for the A80 transmitter that first put him on the air some 30-odd years ago.

his staff have developed a remarkable ingenuity over the years. They rarely make a wrong decision.

Messages that flash to Guida's center take priority over all long-range radio communications except the SOS. In a single year, Dr. Guida's air-wave clinic, known as the International Radio-Medical Center (in Italian, CIRM), received 8,161 wireless appeals for help. Of these, 1,018 were life-and-death cases. And each was handled successfully by the 50 specialists who donate their services to Italy's radio medicine man.

"Our experience has shown," says Dr. Guida, himself one of Rome's top surgeons and an eye-ear-nose-and-throat specialist, "that in an emergency a ship's officer can follow medical and surgical directions and work wonders.

"When I was a boy in Sicily," Dr. Guida relates, "I used to listen to my seafaring father and brother spin terrifying yarns about people on the high seas who died before they could reach port because there was no doctor aboard ship. I have never forgotten those harrowing tales."

Years later when Guida became a top-flight specialist and was teaching at the University of Rome, he decided to combine medicine with ham radio. Soon he was beaming out, gratuitously, prescriptions, medical counsel and diagnostic advice to Italian ships. And Guida's ocean practice grew like any other medical practice.

From such humble beginnings grew CIRM. Today it can receive calls from nearly every spot on the globe, thanks to the free-message service many organizations have granted Guida. And with the help of the Italian Navy and Air Force, CIRM just lately has established a medical helicopter and seaplane service that operates among doctorless ships and islands in the Mediterranean

—*Nino Lo Bello*

THE HAM SHACK

BY
WAYNE GREEN
W2NSD/1

REASON FOR IT ALL. . . When I took on this column I saw it as an opportunity to stir up interest in ham radio among the ranks of the experimenters and CBers. Ham radio needs all the help it can get these days when, through gross stupidity and malfeasance in high places, our interesting and valuable hobby has been badly damaged.

The climate seems propitious for growth in hamming right now, what with the sun spots returning for another performance (and a drop in the hobby use of CB—no doubt a result of the new license fees and an upswing in FCC policing activities). And good ham gear has never been less expensive or easier to use.

But, rack my brain as I will, I am stumped by a question that has bugged me for a long time. What, I want to know, is so damned intriguing about ham radio?

For some thirty years, off and on, I've been a semi-slave to the hobby and I still don't understand why. For several years I built things. I spent all my spare time in my workshop making gear, testing it and then going on to some other building project. I loved it. A lot of hams are like that; they go on the air for a day or two to get live reports on their new rig or gimmick and then rush back to the workbench.

Ask the suffering wife of any ham builder about the virulence of this aspect of the hobby and you'll hear bitter stories of unheeded calls to dinner or to bed. "You love that lousy thing you're working on more than you do me," they say. (I wonder how the ham divorce rate compares with the average.)

Then there's the rag chewer. I, frankly, have no rational explanation for talking almost every night for a year or so with W1MLJ, W2MSZ, W1KPL, and W1IF. We never talked about much, yet all of us looked forward to it every night.

The DX nut normally won't build or even rag-chew. His oyster is the new country. This is difficult to explain to anyone outside the ham ranks. Even the term DX is not really definable. But a few thousand hams class a new country over politics, war, dinner or bedtime.

And there are thousands of hams hung up on soliciting, relaying and delivering messages. Every day some of these fellows (and gals) handle a lot more traffic than a good many Western Union offices. Any theory of ham radio should take this phenomenon into consideration. Our country is criss-crossed with traffic networks that nothing seems to discourage—neither lost messages, slow delivery nor the inconsequence of the text. There is no rest until the hook is clean.

It would only add further confusion if our explanation of why amateur radio grabs us had to cover things like ham-RTTY, ham-TV, moonbounce, VHF DXing, meteor scatter contacts, and mobile CW.

Perhaps, thought I, it is the thrill of talking to foreign countries that gets most newcomers trapped. I find it fascinating to sit and chat with someone several thousand miles away. But then I watch in dismay as a visitor to whom I had hoped to demonstrate the marvels of our hobby opens a magazine to pass the time while I finish up a contact with someone in Ethiopia.

But we need to know just what it is we have to sell if we are to push ham radio.

The other day I mentioned on the air that I thought ham radio would be a lot better off if we had at least twice as many active hams as we have today. The chap I was talking to recoiled. Wasn't I aware of the terrible interference we have today? How could I suggest that we should have even more hams? Well, thirty years ago when we had about one fifth as many hams as today the complaint was exactly the same. Rotten QRM, they grumbled.

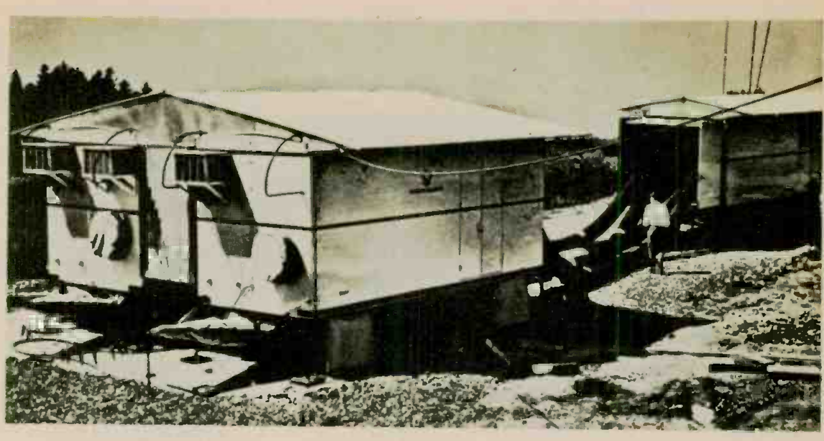
Balderdash. Our bands have all kinds of room. We could easily open another hundred kc for phone on 80 meters without seriously affecting the CW gang. Ditto on 40—and 15 meters. Each band is good for a long and thoughtful investigation and each, I think, can be better attuned to the times. Six meters is 90 per cent unused most of the time; two meters is 99 per cent unused.

But how, I ask again, do we get new fellows involved?

BEACON . . . The trusty, brandy-toting St. Bernard looks like the latest victim of technological unemployment. His replacement may not provide the brandy but it can do something its canine colleague can't, so far as we know. It can locate an avalanche victim under 6 ft. of snow. A portable magnetometer (made by Varian Associates) sniffs for the victim—or rather for a 3-in. magnet (arrow) on his boot. Varian calls it the Ullr Ski magnet in honor of the Norse god of skiing. Buried skiers have been known to survive up to ten days although discovery within a few hours is important to survival. In rescue work the operator, who needs no technical training, carries a headphone-equipped magnetometer. He hears steady tone until he reaches a change in the field due to skier's magnet.

ELECTRONICS IN THE NEWS

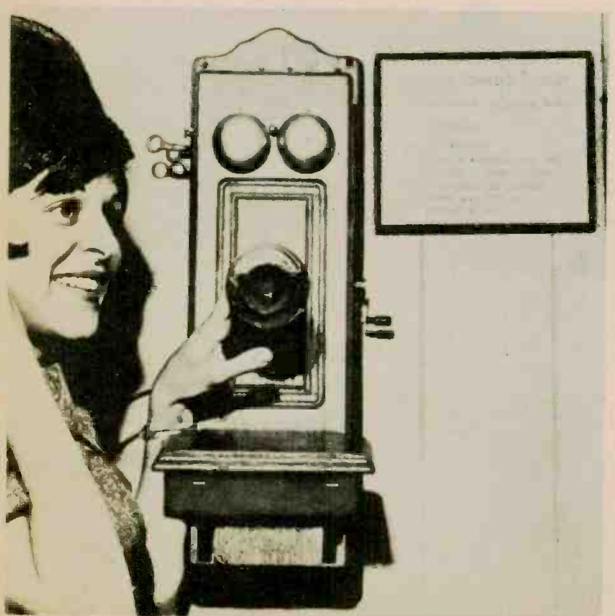
Tubeless, Wireless . . . 32,400 microscopic dots of photoconductive material replace the picture tube in this wireless TV camera developed by RCA Laboratories in Princeton, N.J., for the Air Force Avionics Laboratory. A total of 132,000 thin-film elements is deposited on four glass slides, each 1-in. square, to perform functions similar to those of pickup tube and picture processing elements in a conventional video camera. Resolution of this experimental model is 180 lines. The rectangular box at the bottom is a transmitter feeding the video signal to the loop antenna in the background. Its signal can be picked up across the room, giving the cameraman complete freedom of movement. RCA says it sees the development as the first step toward personal TV.



Traveling Telecaster . . . Ever heard of a portable TV station—besides the Blue Eagle project, that is? This one consists of three trailers. The two joined together at left house complete audio and video transmitters (250 kw). That at right provides air conditioning. They were built by an ITT subsidiary for the German postal service (which operates TV network) and are used in remote locations like this in the Black Forest near Freiburg until permanent installation can be built.

Good Listener . . . If you have a complaint at Laughner's Cafeteria in Indianapolis you can go up to the old-fashion wall phone and tell it your woes. When you crank the bell handle it alerts the manager (in case he wants to listen in). Then you have 30 seconds to speak your piece. It all goes on tape for playback to the staff over the PA system while they are cleaning up. That way everyone can profit from customer comments without the irksome and time-consuming job of shuffling through customer complaint cards.

Shocker . . . That hairy object shown at the upper left in this picture is a bug that Westinghouse is seeking to eliminate from power transmission lines—figuratively speaking. It was produced on photographic film by nearby lightning bolt and proves that surge induced by lightning, even though it scores no direct hit, can be hazardous. Spidery trace was made on klydonograph (bottom) during a five-year research program. Surge induced in vertical wire causes flow of electrons through film in base.



CB CONTROL CONSOLE

By LEN BUCKWALTER, KBA4480

IT gets tiring when you have to do the watusi every time you check out your CB rig. First you connect one antenna, then disconnect another and . . . well, you know how long that can go on.

But mount your rig on our CB Control Console and you'll be able to sit back and simply twist switches. The console places at your fingertips a half-dozen different measuring instruments. No need to haul out a lot of separate meters and connecting cables when a turn of a switch lets you see everything from antenna efficiency to transmitter power and modulation. And you won't need your rig's schematic to hook up the console. It just plugs into the antenna socket.

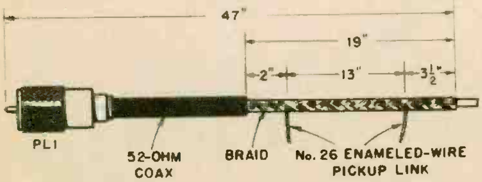
The console is designed for convenience. First, it raises a set off the table, making knobs a snap to grasp and turn. And the panel meter will be elevated so numbers are easier to read. The slight tilt upward aims the panel at your eyes, not your tummy. There are other benefits, too. You can store crystals and other small items under the console and there's an antenna-selector switch that lets you connect to either of two outdoor antennas.

Then there's a field-strength meter to enable you to tune up a rig or check its output. A built-in dummy load lets you work on a transceiver without radiating a signal. Finally, the console will make your set look less like a table radio and more like a communications center.

Construction

The console's panel must be a sturdy piece of metal. You can save a lot of work by using a standard 5¼ x 19 x ⅛-in.-thick aluminum rack panel. Using a hacksaw, cut the panel width to 14 in. Most difficult cut to make is the 2½-in-dia. hole for the meter. Cut it by drawing a circle on the panel, then drill a series of small holes on the circle until the center piece drops out.

The two legs for the console are heavy



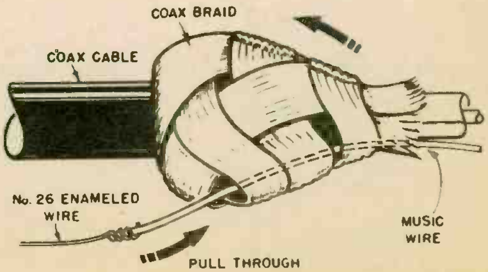


Fig. 1—Top diagram shows how to prepare a 47-in. length of coax for pickup link. Sketch at right shows how to bunch braid to insert the piano wire. Pull braid tight after installing the pickup link.

strips of ¾ in.-wide aluminum. Bend the strips as shown in Fig. 2 and drill holes for No. 6 mounting screws. The support platform is a piece of 8 x 11¾ x ⅛-in.-thick Masonite. This size should support just any set. At the rear of the console is an L-shape aluminum bracket for antenna sockets SO1 and SO2. Holes for the sockets can be made in minutes if you have a ⅝-in-dia. socket punch.

The Pickup Link. The installation of a 13-in. pickup link inside a length of coaxial cable requires patience and care. Purpose of the link is to take a sample of RF energy to operate the console's SWR meter (to measure antenna efficiency). To make the link, take a 47-in. length of RG58/U coaxial cable and install PL1 at one end. Then prepare the cable as shown in Fig. 1. Note that you strip away 19 in. of the black plastic jacket. Do this with a razor blade, being careful not to nick the braid.

The link is a piece of No. 26 enameled wire inserted *between* the braid and the insulation around the center lead. Since the No. 26 wire is flexible, you'll have to use a stiff piece of wire to snake it through, as shown in Fig. 1. Start by pushing the braid toward the cable's jacket to get it to bunch up. Insert through the braid a stiff piece of wire, such as piano wire, 2 in. from the insulation and push it through until it exits at

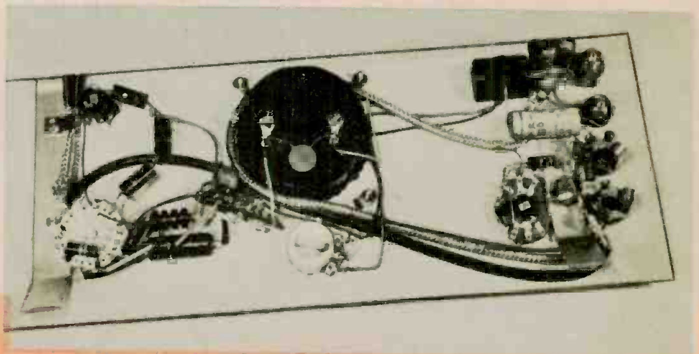
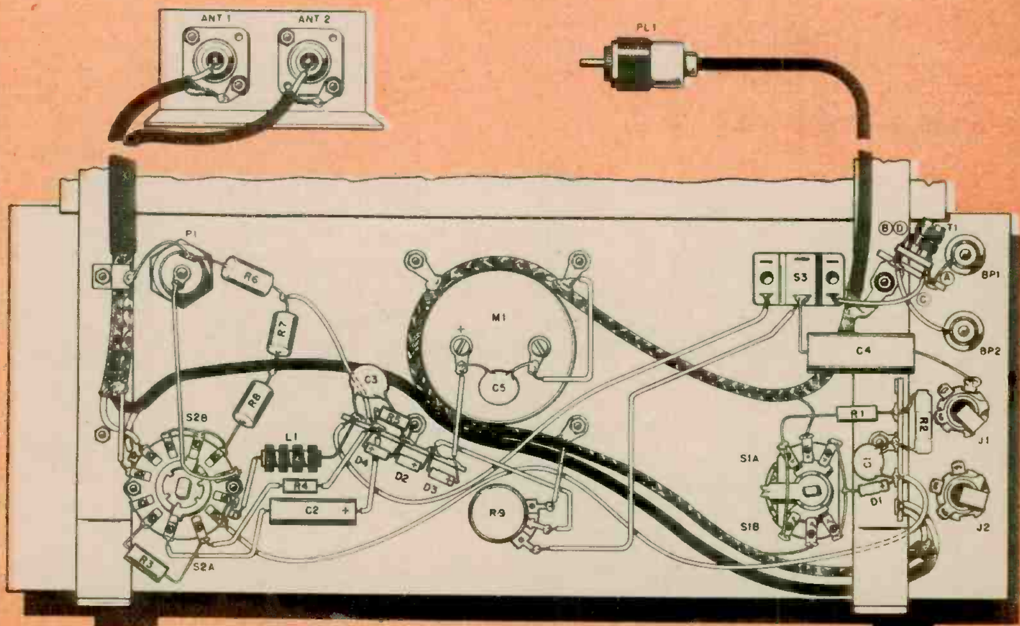


Fig. 2—Rear of console's control panel. Note how coax with the pickup link is routed from upper-right corner, where braid is soldered to ground lug, around the meter and down to lower-right corner. Braid is not grounded at end but is soldered to the braid of coax cable coming from the rotary selector switch, S2.



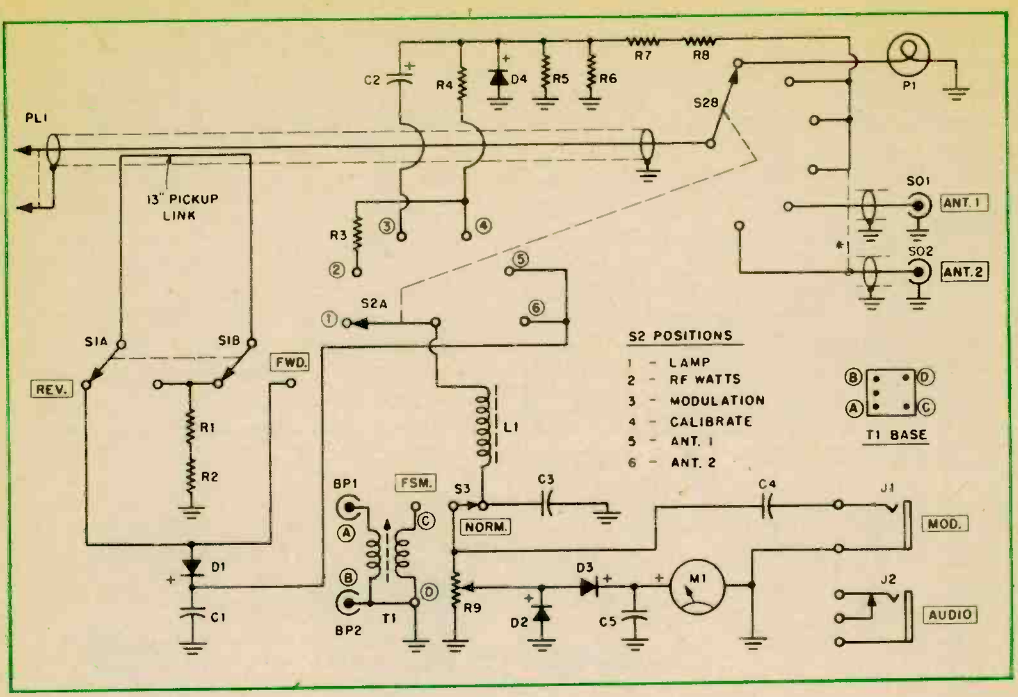


Fig. 3—Connect PL1 to rig's antenna connector and connect audio jack J2 to the transceiver's speaker.

CB CONTROL CONSOLE

a small hole in the braid 13 in. away. Once the wire is through, attach a length of No. 26 enameled wire to it and pull both wires through and out. Scrape the insulation from the ends of the enameled wire and it's ready to be soldered to the appropriate points.

Note in the pictorial in Fig. 2 that the braid is soldered to several solder lugs which are grounded to the panel. There are two at the top of the meter, one above R9 and one near S3. At the end of the cable that connects to a terminal strip at the lower right, the braid must be pulled back, twisted and soldered to the braid of the other coax cable which also connects at this point. The braids are not soldered to ground at this end. The same treatment is given to the coax braids near S2. These two braids are grounded under the metal clamp next to pilot lamp P1. Note that one lamp wire also goes to this point and is soldered to both clamp and coax braids.

Protective Jumper. There's one important precaution to take if you intend to operate the console with only one antenna. You must install a short piece of hookup wire (see asterisk in Fig. 3) between terminals 4 and 6 of S2B. Switch S2 can select one of two external antennas. If you hook up only one antenna you accidentally might switch to the unused antenna socket with the transmitter on. This would not bother a tube rig but lack of a load on a transistor job might cause damage. The jumper prevents accidents. If you mistakenly switch to *ant 2* (the unused socket) a dummy load automatically will be connected to the transmitter. Of course the jumper should be removed when you connect another antenna.

Installation

Place the CB rig on the console's platform and connect PL1 to the set's antenna socket. If one external antenna is used, connect it to SO1. This corresponds to the *ant 1* position of switch S1. The other socket is for *ant 2*.

Since the CB rig is at an angle, it may tend to slide toward the rear of the console. This can be cured with the backstop shown in

PARTS LIST

BP1,BP2—Five-way insulated binding post
C1,C3,C5—.005 µf, 1,000 V ceramic disc capacitor
C2—4 µf, 50 V electrolytic capacitor
C4—.1 µf, 400 V tubular capacitor
D1,D2,D3,D4—1N60 diode
J1,J2—Phone jack
L1—2.5 mh RF choke
M1—0-50 µa microammeter (Lafayette 99 C 5042 or equiv.)
P1—No. 47 (6 V) pilot lamp and socket
PL1—PL-259 coax connector
R1—33 ohm, 1 watt 10% resistor
R2—18 ohm, ½ watt, 10% resistor
R3—12,000 ohm, 1 watt, 10% resistor
R4—5,600 ohm, ½ watt, 10% resistor
R5—1,000 ohm, ½ watt, 10% resistor
R6,R7,R8—16 ohm, 2 watt, 5% resistor
R9—50,000 ohm, linear-taper potentiometer
S1—2-pole, 2-position shorting-type rotary switch (Centralab 1462. Allied 56 A 4082 or equiv.)
S2—2-pole, 6-position shorting-type rotary switch. (Centralab PA-2002. Allied 56 A 4901 or equiv.)
S3—SPDT toggle switch
SO1,SO2—SO-239 coax connector
T1—27-mc antenna coil (Lafayette 99 C 6200)
Misc.—RG58/U coax cable, No. 26 enameled wire, knobs, aluminum panel, terminal strips

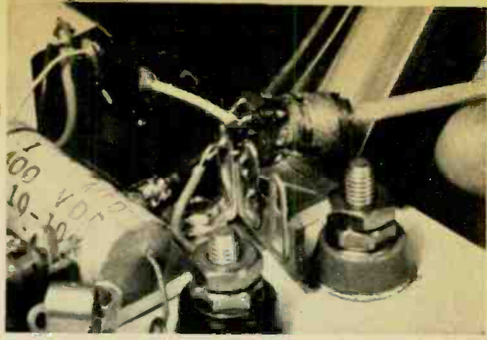


Fig. 4—To peak T1, supported by soldering its lugs to terminal strip, set up for FSM measurements and adjust the slug with alignment tool.

Fig. 5—Finger points to weatherstripping at back of deck. It prevents rig from slipping off. The antenna-connector bracket is at the lower left.

Fig. 5—a piece of weatherstripping coated with an adhesive on one side. Now you're ready to put the console into operation.

Operation

Normal. Here's how to set up the switches for normal CB operation: set *fsm.-norm.* switch S3 to *norm.* Set S1 to *fwd.* and set S2 to *ant 1*. Turn R9 full counterclockwise (lowest sensitivity). Start transmitting and turn R9 clockwise until M1 indicates about halfway up the scale.

With the console so set up, it will indicate the relative power sent to the antenna. The needle falls to zero during receive, then rises each time you press the transmit button. If you wish to tune the output stage of the CB rig the meter becomes an output indicator.

SWR Measurements. Here the console measures overall efficiency of your antenna system. It can detect trouble, for example, such as broken elements or poor cable connections that might originate in the roof antenna. Any problem along the line or at the antenna is apt to affect the system's standing-wave ratio (SWR).

To check SWR set up the controls as before. Turn on the CB rig to transmit and adjust R9 until M1 indicates exactly full scale. Then, with the transmitter still on, flip S1 to *rev.* M1 should drop below 10 if efficiency is high and SWR is low. If you want to know the true SWR reading, the meter scale in Fig. 6 (it fits over the scale of the meter specified in the Parts List) gives the three most important values. Any SWR indication under 1.5 is fine. It isn't serious if the indication goes nearly to 2. But check for trouble if the SWR is anything over 2. Readings over 3

[*Continued on page* 115]

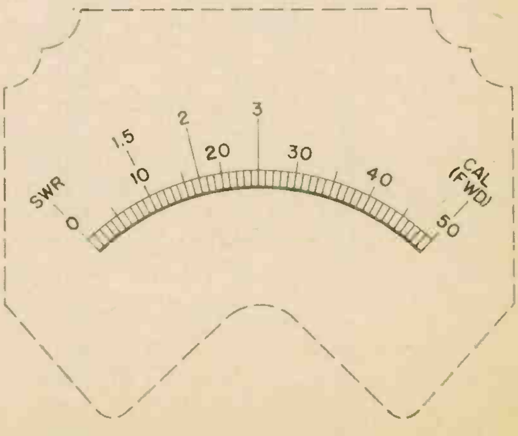
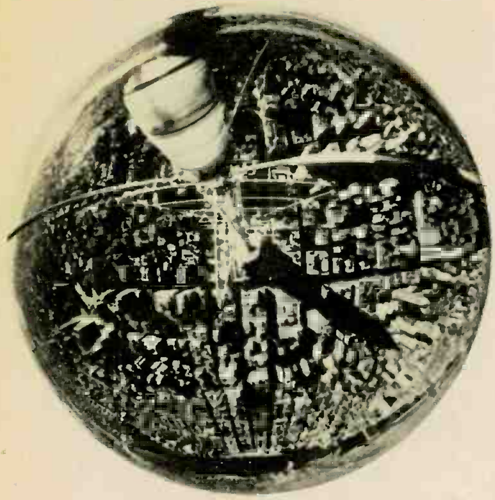


Fig. 6—Cut out and paste over meter's scale.

NO ROOM



AT THE TOP

THE dizzying sight of Manhattan Island 1,472 ft. straight down doesn't slow traffic in one of the busiest spots in the world —the antenna farm atop the Empire State Building. Fortunately, the traffic is almost entirely RF but it's still pretty incredible.

The Empire State Building was for years the world's tallest antenna-supporting structure (a Texas TV tower now beats it by a few feet). In terms of fame and glamour it can be compared only to the Eiffel Tower in Paris and Tokyo Tower, which is almost as tall and holds a similar complex of TV and communications antennas.

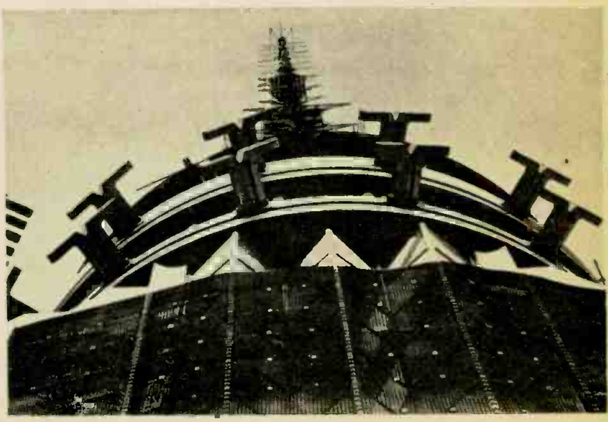
When the Empire State was built its designers conceived the idea of letting the observation tower double as a mooring mast for dirigibles. The idea had publicity value but little more—high winds and the waning popularity of dirigibles saw to that. But with the coming of FM, TV and microwave the heavily reinforced tower turned out to be the most likely location in New York City for an antenna farm. By now it holds facilities for the city's seven VHF and two UHF television channels, a master antenna that can accommodate 17 FM stations, telephone microwave equipment and many other miscellaneous installations.

The master FM system, one of the newest things on the tower, consists of two rings of 16 dipoles each—one ring directly below the 102nd-floor observatory window and the other directly above. The dipoles are positioned at 45° angles so signal polarization will produce good results with both horizontal home receiving antennas and with vertical auto whips. So far the antenna carries the broadcasts of WHOM-FM (92.3 mc), WNYC-FM (93.9), WQXR-FM (96.3), WOR-FM (98.7), WBAI (99.5), WPIX-FM (101.9), WNCN (104.3), WRFM (105.1) and WLIB-FM (107.5). (The WNEW-FM antenna is mounted higher up the mast.)

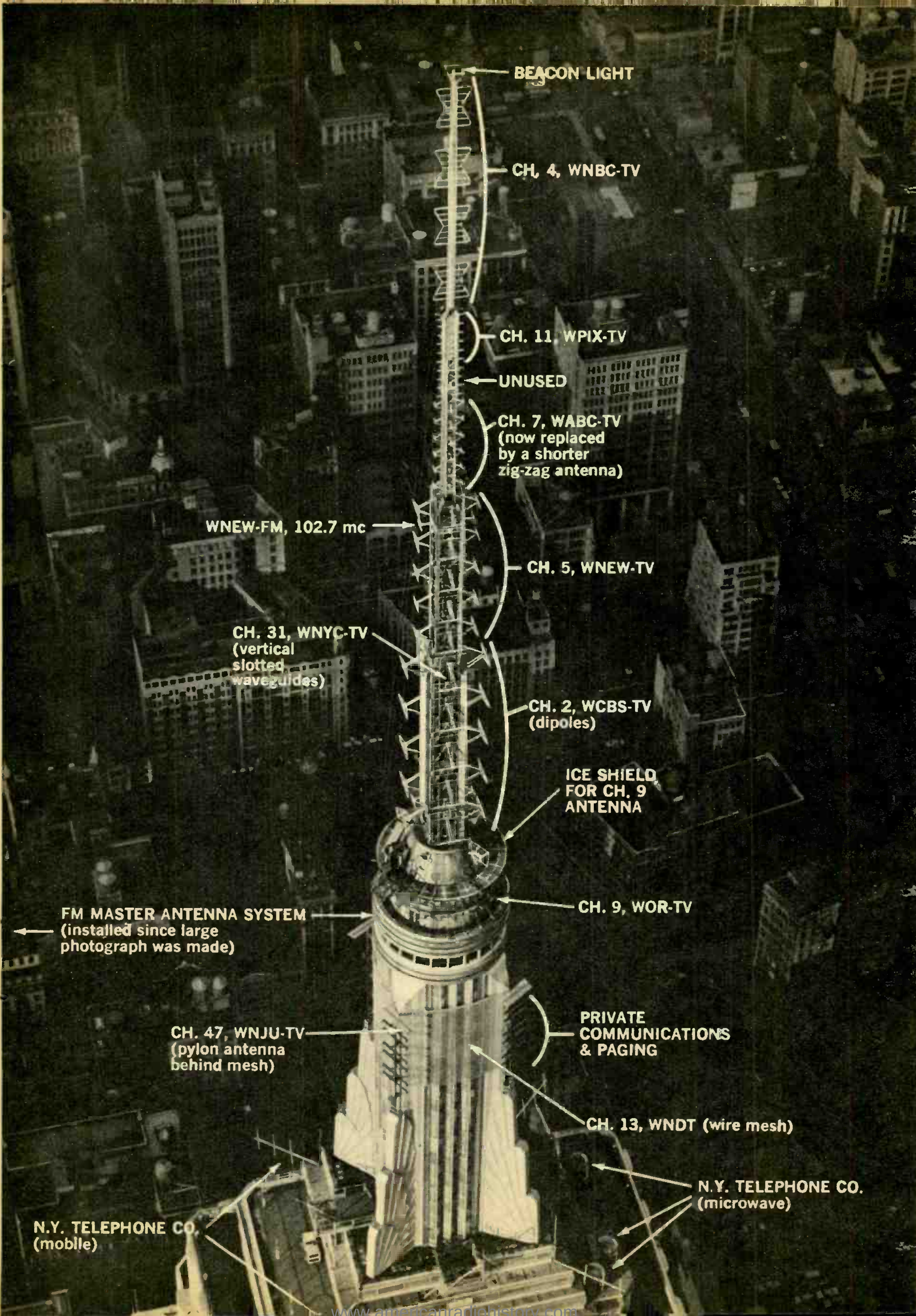
Below the FM antenna is what looks like a sleeve of screening around the tower. This is the Channel 13 TV antenna. Behind it on the four corners of the building are pylon antennas carrying programs of TV Channel 47. And mixed in with the TV channels are clusters of dipole arrays and modified yagis used by two services, the Port of New York Authority and the New York Telephone Co.

Hanging lazily out over the corners of the 86th-floor observation deck are four dipole arrays used for mobile telephone service. On the 87th floor of the building is a strange-looking plastic penthouse covering an array of 12 microwave antennas. This facility is used also by New York Telephone. Some antennas pick up relayed TV broadcasts from studio sites and feed the TV-station transmitters on the 80th through 85th floors.

No room at the top? Well, hardly any. But one thing's sure—it's no place to moor a dirigible.—*Walter Salm*



A recent installation is the array of 32 angled dipoles that make up the FM master antenna system. It already handles nine stations, can handle 17.


BEACON LIGHT
CH. 4, WNBC-TV
CH. 11, WPIX-TV
UNUSED
CH. 7, WABC-TV (now replaced by a shorter zig-zag antenna)
WNEW-FM, 102.7 mc
CH. 5, WNEW-TV
CH. 31, WNYC-TV (vertical slotted waveguides)
CH. 2, WCBS-TV (dipoles)
ICE SHIELD FOR CH. 9 ANTENNA
FM MASTER ANTENNA SYSTEM (installed since large photograph was made)
CH. 9, WOR-TV
PRIVATE COMMUNICATIONS & PAGING
CH. 47, WNJU-TV (pylon antenna behind mesh)
CH. 13, WNDT (wire mesh)
N.Y. TELEPHONE CO. (microwave)
N.Y. TELEPHONE CO. (mobile)

ELECTRONIC SWAP SHOP

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

AMATEUR RADIO

VIKING Adventurer transmitter. Swap for ham gear. Curt Britton, K1QQJ, 78 Laurel Ave., Bradford, Mass. 01830.

HEATH VF-1 VFO, 10-160 meters. Will trade for VOM or speaker cabinet. Peter Zanger, 533 Macungie Ave., Emmaus, Pa. 18049.

HAM STATION. Will swap for darkroom equipment, motor scooter or R/C set. Jay E. Schwartz, 4 Rickcliff Rd., Marblehead, Mass. 01945.

LAFAYETTE HE-30 communications receiver. Will swap for tape deck or hi-fi speakers. James Mozzillo, 3144 Schley Ave., Bronx, N.Y. 10465.

BRAND NEW HY-GAIN model 153BA antenna for 15 meters. Will swap for Heathkit IM-11 VTVM or VOM. Al Noone, 1189 S. Muirfield, Los Angeles, Calif. 90019.

VIKING Valiant transmitter. Want guitar and amplifier. Robert Del Castilho, 53 Spruce Ave., Floral Park, N.Y. 11001.

HAM STATION. Swap for General SB-72 or similar gear. John Harding, 24 Bertram St., Beverly, Mass. 01915.

TRANSMITTER, BC-696-A. Will trade for Knight Star Roamer or similar. Gerald Ano, 4212 Plumtree Way, Austell, Ga. 30001.

HALLICRAFTERS SX-140 receiver and HT-40 transmitter. Will swap for Polycomm PC-6 CD or similar six-meter transceiver. Page Pyne, 540 N. Locust St., Hagerstown, Md. 21740.

HEATHKIT DX-100 transmitter. Make an offer. F. W. Coffman, 409 Davis St., Clarksburg, W.Va. 26301.

COMMAND T-19 transmitter, 3-4 mc. Swap for other ham gear or best offer. Patricia A. Garner, 208 Little Farms, New Orleans, La. 70123.

NOVICE transmitter, Swap for best offer. Joe Rick Jr., WN3GLP, Box 162, Knoxville, Md. 21758.

COLLINS mechanical filter for 455-mc IF. Will swap for 3BP1 CRT or similar. Lester P. Sebay, 516-J Buena Vista Ave., Alameda, Calif. 94501.

TRANSMITTER, 40-meter. Will trade for regenerative SW receiver or six-meter converter. Dan Lightfoot, WN6UUF, 1009 Winchester Ave., Glendale, Calif. 91201.

CONVERTER for two meters. Will swap for phone patch or best offer. Jerry Linden Jr., WA9PUR, Rt. 2 Box 141, Cedarburg, Wis. 53012.

HAM TEST GEAR. Will swap for pre-1926 radios, parts and literature. Alan Douglas, Box 275, Pocasset, Mass. 02559.

NOVICE transmitter for two meters. Will trade for amplifier or SW receiver. Ralph Irace Jr., 4 Fox Ridge La., Avon, Conn. 06001.

ANTENNA ROTATOR with control box and cable. Will trade for CB transceiver, 12-VDC or 117-VAC. Jerry Van Vactor, 811 10th St., Spearfish, S.D. 57793.

SMITH Code Course. Make swap offer. Earl Thompson Jr., Rt. 2 Box 325, Powell, Tenn. 37849.

SHORT-WAVE LISTENING

RCA receiver for BC & SW (80 meters). Want Lafayette HE-75 or Knight KG-4000A walkie-talkie. Jack Tiggleman, 1300 Herrick, Grand Rapids, Mich. 49505.

HALLICRAFTERS S-38 receiver. Will swap for Knight R100A or other ham gear. John Epler, 1626 Moss St., Reading, Pa. 19604.

SHARP TR-203 BCB/SW receiver. Want Heath Twoer or similar. Dennis Tolomei, 577 Carlisle Way, Sunnyvale, Calif. 94087.

KNIGHT Star Roamer. Want Electro-Voice 644 microphone and floor stand. L. Lindenbaum, 10320 Haywood Dr., Silver Spring, Md. 20902.

HALLICRAFTERS S-38C receiver. Want Knight Star Roamer or Span Master. Richard Clark, 4302 Obispo Ave., Lakewood, Calif. 90712.

HEATH Twoer. Swap for two-meter transmitter or transceiver. Louis Laderman, WA8UUR, 219 Sixth St., Findlay, O. 45840.

KNIGHT KG-221, new. Swap for 108-136 mc monitor. L. R. Osgood, 2006 Smith Pl., Scranton, Pa. 18509.

HALLICRAFTERS S-120 receiver. Will trade for FM stereo tuner with amplifier. Paul T. Judkins, 1200 Stuart Rd., Herndon, Va. 22070.

AM/SW receiver kit. Make swap offer. Howard Katseff, 179 Paulson Rd., Waben, Mass. 02168.

HALLICRAFTERS S-40. Will trade for Heath VF-1 and DX-40. Ray Ferreira, 3644 Anuhea St., Honolulu, Hawaii 96816.

KNIGHT KG-220 VHF receiver. Swap for color bar generator or wide band oscilloscope. Forest N. Motto, 2240 Warren St., Petersburg, Va. 23803.

HALLICRAFTERS SX38E receiver. Swap for best offer. E. Romney, 58 Prospect St., Milford, N.H. 03055.

KNIGHT Space Spanner receiver. Will trade for 10 x 50 or 20 x 50 prism binoculars. B. Ziegler, 9416 Glenwood Rd., Brooklyn, N.Y. 11236.

HALLICRAFTERS S-40B receiver. Want transistor SW radio or SW Convertor. William H. Patrick, Box 23, Booneville, Ky. 41314.

CITIZENS BAND

MIDLAND 13-110 walkie-talkie. Swap for SW receiver. Ronald Cacialli, 616 Taft Ave., Endicott, N.Y. 13760.

LAFAYETTE HE-75 walkie-talkie. Swap for TV camera or mini TV set. Ronald L. Carr, 1627 S. Broadway, Wichita, Kan. 67211.

HEATHKIT transceiver. Want Lafayette CB transceiver. Don Gowin, KLC1763, 131-2nd St. N. Ext., Nampa, Id. 83651.

LAFAYETTE HB-115A transceiver. Swap for stereo tape recorder. Allen Brown, 2529 Fureen Dr., Louisville, Ky. 40218.

JOHNSON Messenger I transceiver. Trade for tape recorder. B. Voight, 11040 S. Drake, Chicago, Ill.

GLOBE STAR dual conversion transceiver. Will swap for 16-mm sound projector. F. Knapp, Box 854, Scottsdale, Ariz. 85252.

LAFAYETTE Comstat 9 transceiver. Swap for 6-meter transceiver. Howard Levine, 750 Hayworth Ave., Los Angeles, Calif. 90046.

HEATH CB-1 transceiver, 12-VDC power supply. Swap for Heath Twoer or tube-type tape recorder. James H. McCracken, Box 4179-R1, Redding, Calif. 96001.

LAFAYETTE HA-150 walkie-talkie. Want Knight T-60 or similar ham transmitter. Don Strickler, WN6UZP, 835 S. Curson Ave., Los Angeles, Calif. 90036.

CHANNEL MASTER walkie-talkie. Swap for CB transceiver. Lynn Bradley, RR 5 Box 254, Elkhart, Ind. 46514.

LAFAYETTE HE-20C and HE-77 CB test gear. Want shotgun, course for FCC ticket or best offer. Jeff Strieter, 1708 S. Kiesel St., Bay City, Mich. 48706.

JULIETTE walkie-talkies. Want four-tube Templehof radio. F. A. Winders, 209 Brandywine Rd., Savannah, Ga. 31405.

HEATH GW-52 walkie-talkies. Swap for best offer. Mark Baugh, WA7EKQ, Box 191, Roy, Utah 84067.

LAFAYETTE 100-mw transceiver. Swap for Radio Shack Selectacom or similar. Gordon Woroshelo, 15 Grandmont Ores., Sault Ste. Marie, Ont., Canada.

AUDIO & HI-FI

MAYFAIR transistor tape recorder. Will swap for Polaroid Swinger camera. Jesse Lee Gay, 673 Highland Ave., Henderson, N.C. 27536.

RCA cartridge stereo tape recorder. Need similar mono recorder or film-strip projector. W. H. Williamson, 3007 N.E. 25th St., Amarillo, Tex. 79107.

BOGEN 10-watt PA amplifier. Swap for CB or SW receiver. George Merino, 6203 Ferguson Dr., Los Angeles, Calif. 90022.

EMERSON tape recorder. Trade for SW receiver. Keith Toleman, 5258 Newcastle Ave., Encino, Calif. 91316.

REALISTIC model 707 tape recorder. Swap for four-track stereo recorder or best offer. Bill Bodkin, 46 Speedwell St., Dorchester, Mass. 02122.

SILVERTONE phonograph chassis. Want SW receiver with BFO and bandspread. Al Curtis, 1337 Brookline, Cleveland Hts., O.

RCA 100-watt amplifier. Will swap for Polaroid model 103 or 104 camera. M. H. Zeiders, 391 Knickerbocker Ave., Brooklyn, N.Y. 11237.

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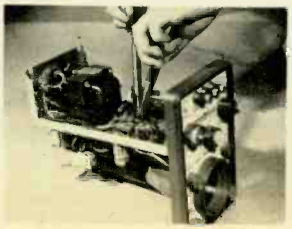
Construction of Oscilloscope.



Construction of Multimeter.

how good are TV SPLITTERS?

By GEORGE F. HELD

LIFE was so much simpler back in the early days of TV. There was just VHF (channels 2 through 13) then and one multi-channel antenna did the job beautifully. But now that UHF-TV and FM stereo have taken hold, life with antennas has become more complicated.

Let's say your horse came in and you bought a new VHF-UHF TV set as well as a stereo FM tuner. The first disturbing thought that comes to mind is that you're going to have to install three separate antennas on the roof. That, of course would be the ideal way to provide a separate signal to the VHF and UHF inputs on the TV set as well as to the FM tuner.

But with three antennas on the roof your house could easily end up looking like a power company's substation. Just imagine its appearance with the lead from the FM antenna running down the back wall, the lead from the VHF-TV antenna going down the side of the house and the lead from the UHF antenna zig-zagging down the front. Or worse, all three could drop down the front where they'd look like spilled paint.

You don't have to do it this way. Antenna manufacturers came up with a solution to the multiple antenna farm—the broadband or all-channel antenna. Designed to pick up everything from channel 2 through 83, these monsters generally can do away with separate antennas. So forget about separate VHF-TV, UHF-TV and FM antennas—skyhooks for each band are becoming history.

Let's say you install an all-channel antenna on the roof. What do you do with that single twinlead coming in the living room window? Splice two other pieces of twinlead to it to connect it to the UHF input on the TV set and the FM tuner? Not on your life if you want a decent picture. Such a mismatch will cause mish-mosh. A multi-set coupler won't do the job either. You shouldn't use one because the level of the signal going into it will be divided by the number of outputs. The answer: a less-than-$5 gadget called a *splitter*. It's also known as a splitter/combiner because it can be used two ways. When used at the antenna it's called a combiner. But when it's used at a TV or FM set it's considered a splitter.

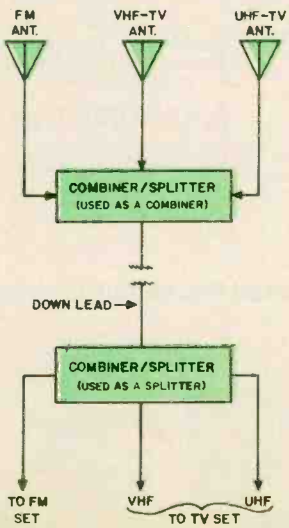


Fig. 1—Splitter on roof combines and feeds signals from three antennas into one down lead the output of which is divided by splitter in house.

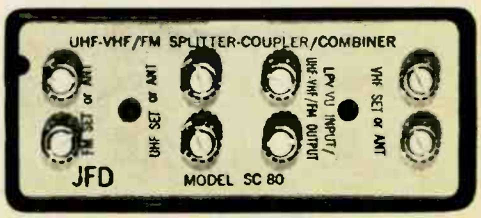


Fig. 2—Underside of a VHF-TV, UHF-TV and FM splitter/combiner. Note from markings how connections can be used as either inputs or outputs.

Why Use a Splitter?

Any transmission line, be it a single piece of wire, two parallel wires like twinlead or concentric conductors like coaxial cable will carry an almost infinite number of signals simultaneously. If the signals are at different frequencies they will not interfere with each other. The only additional device required to send signals from several sources over a single transmission line to several receivers is a matching network at each end of the line.

The matching device located at the TV-set (output) end of a line is a *splitter* and the network at the antenna end (input) of the transmission line is known as a *combiner*. Both units are physically and electrically the same—they can be used at either end of the line. Where they're used determines their name. (See Fig. 1).

How it Works

When a splitter/combiner is used as a splitter it does the same thing at radio frequencies that a loudspeaker crossover network does at audio frequencies (see Fig. 3). Recall for a moment how, in a three-way speaker system, the crossover network is used to split the output from an audio amplifier into three bands. It feeds the low-frequency band of signals to the woofer, the mid-range frequencies to the mid-range speaker and the high-frequency band of signals to the tweeter.

If the amplifier's output were fed to the three speakers without using a crossover network, much of the low-frequency energy would be wasted in the tweeter (which might be damaged), the high-frequency signals would be wasted in the woofer and the mid-range speaker would squander a little of both. In other words, when a crossover network is employed each speaker receives only the band of frequencies it can use. There is no signal waste.

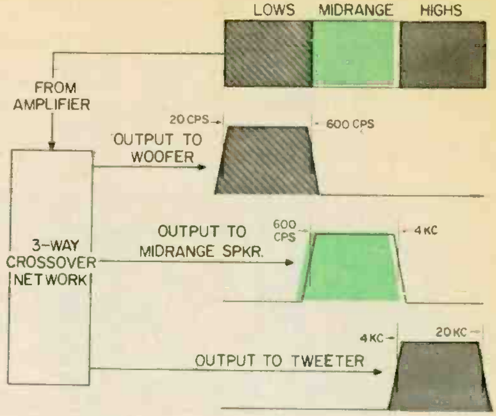


Fig. 3—A loudspeaker crossover network divides the audio spectrum into three bands. A splitter does exactly the same thing at RF frequencies.

Fig. 4—Equipment used to test splitters. Below marker generator (top) is Dumont 340-R scope which sits on Jerrold 900B sweep signal generator. At right of test fixture is precision attenuator.

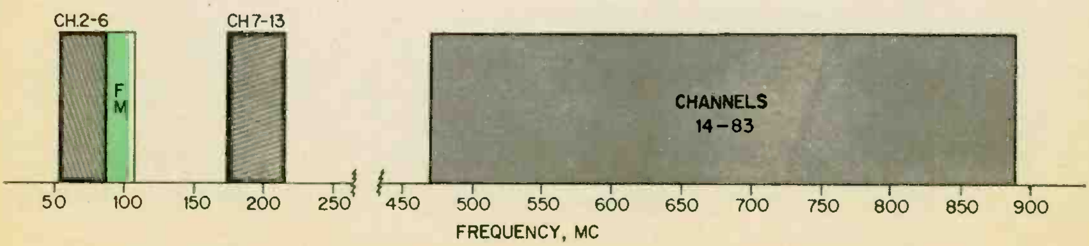


Fig. 5—Spectrum of signals handled by all-band antenna and splitter/combiner goes from 54 to 890 mc.

how good are TV SPLITTERS?

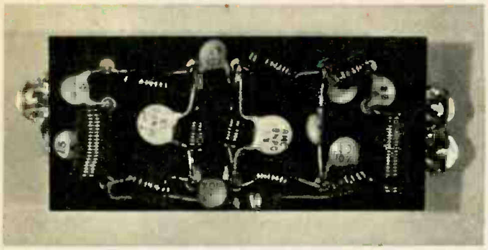


Fig. 6—Open a splitter and you'll see this on one side of a board. On the other side of board are more capacitors, resistors and inductors.

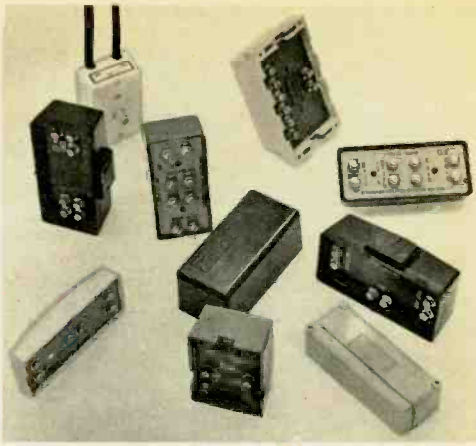


Fig. 7—Several of the splitters we tested. When you mount a splitter on an antenna mast, aim its connecting screws downward to keep out water.

And so it is with a splitter. It separates VHF-TV, UHF-TV and FM signals which are fed from the antenna down one feed line and directs them to the VHF-TV set input, the UHF-TV set input and the FM receiver input (see Fig. 8).

When a splitter is used as a combiner, it is connected so that it behaves electrically in just the opposite manner as when used for signal splitting. Now, it accepts signals from several broad-band antennas (which can be individually oriented for optimum reception) and couples these signals to the single down lead.

The Different Types

Splitter/combiners are available in three different designs. The *VHF-TV, FM splitter/combiner* will feed signals from one antenna to the VHF-TV set and an FM set. Installed at the antenna, it will couple one VHF-TV antenna and one FM antenna to a single down lead.

VHF/UHF-TV splitter/combiner. One of these units located at the antenna end of the line will couple a VHF antenna and a UHF antenna to one transmission line. If the TV set has separate UHF and VHF input terminals a splitter must be used at the set.

VHF/UHF-TV, FM splitter/combiner. A unit of this type, located at the set end of the transmission line will allow a VHF/UHF-TV set and an FM set to be fed by an all-channel antenna. When installed at the antenna end of the line, it can be used to couple VHF, UHF and FM antennas to one down line.

Now that we have gotten rid of yards and yards of unsightly transmission lines, what price must we pay (other than money) for this performance? To find out, EI tested several of the most popular splitter/combiners on the market to see how much signal they lost.

Ideally, nothing should be lost in a splitter. You should get out of it exactly what you put into it. Unfortunately, things didn't quite work out this way. That's not to say splitters introduce the same sort of loss the more familiar multi-set coupler introduces. Splitters introduce some losses but they can be tolerated.

A two-set coupler for example, will divide the input signal in half for each output. A four-set coupler would divide the signal by

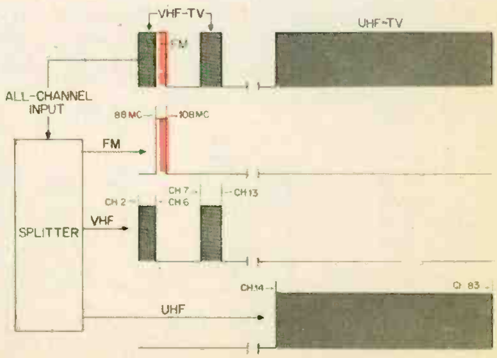


Fig. 8—Note how a splitter divides its band of input frequencies three ways the same way that the loudspeaker crossover network did in Fig. 3.

Manufacturer or Distributor	Model	Range	Average Signal Loss in db Across Band		
			VHF	FM	UHF
ARCHER	15-1137	VHF, UHF	.2	—	.3
ARCHER	15-1141	VHF, FM	2.0	1.8	—
BLONDER-TONGUE	A-107	VHF, UHF	.2	—	.4
FINCO	3006	VHF, FM	.4	5.2	—
FINCO	3014	VHF, UHF	.2	—	.7
FINCO	3018	VHF, FM, UHF	.8	2.7	1.0
FINCO	3019	VHF, FM, UHF	1.0	5.0	1.1
JERROLD	TX-FM	VHF, FM	.9	4.5	—
JERROLD	1460B	VHF, UHF	.1	—	1.4
JFD	SC80	VHF, FM, UHF	.5	4.3	.8
JFD	SSTVFM	VHF, FM	1.0	2.3	—
KNIGHT	91 U 158	VHF, UHF	.2	—	1.1
KNIGHT	11 A 1665	VHF, FM	*	5.0	—
KNIGHT	11 A 1340	VHF, FM	1.0	4.1	—
WINEGARD	CAFM	VHF, FM	.6	2.8	—
WINEGARD	CA-283	VHF, UHF	.1	—	.8
WINEGARD	CA-314	VHF, FM, UHF	1.2	4.8	1.6
WINEGARD	CS-283	VHF, UHF	*	—	1.1

* Negligible

Fig. 9—Table shows average amount of attenuation of each splitter's band in representative sampling we tested. Note that the VHF and UHF attenuation is slight compared to FM attenuation. Price of almost all splitters is less than $5. Archer is sold by Radio Shack; Knight by Allied Radio.

four—in both cases a considerable loss to each set.

The splitter does not introduce this great a loss. The table shows the signal lost at each output—VHF-TV, UHF-TV and FM. It's not much. Remember, though, if you use a combiner on the roof, you must add the losses of each to get the total loss. For example, if the VHF loss for a splitter alone is 0.6db, the loss for a combiner *and* a splitter is 1.2db. Also notice that it is the FM band that seems to suffer the most in both the three-way splitters and in the two-way splitters.

Method of Test

The splitters were tested with a VHF/UHF sweep generator, oscilloscope and marker generators. (See Fig. 4.) A fixture was constructed into which the splitter being tested could be conveniently inserted. Four networks were installed in the fixture to match the splitter under test to the sweep generator and to the detector.

To test a splitter, input and output terminals on the fixture were jumpered with a short piece of 300-ohm twinlead. Then the scope was adjusted to produce the nearly flat

[*Continued on page* 112]

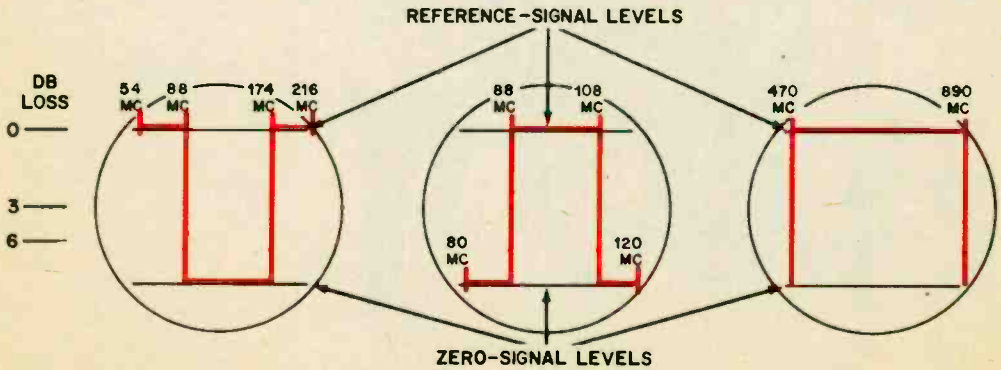


Fig. 10—Ideal output at VHF terminals of splitter would appear as in sketch at left. Output at FM terminals would appear as in the center sketch and UHF output would appear as in the sketch at the right.

Good Reading

Continued from page 82

we generally don't waste time with bad books. But this series of loose-leaf volumes, produced by Westinghouse "to have wide application for a broad range of technical, scientific, and management personnel" is really disappointing—badly edited and organized, poorly and simplistically written and of no conceivable interest to its intended audience. It's hard to believe that Westinghouse could let its reputation ride on this kind of publication. Lots of people at the company simply must not know about this series. They should.

And make note of . . .

APPLICATIONS OF NEON LAMPS AND GAS DISCHARGE TUBES. By Edward Baumann. Carlton Press, New York. 160 pages. $2.95

RCA RECEIVING TUBE MANUAL. RCA, Harrison, N.J. 608 pages. $1.25

The newest edition, still one of the best buys for anyone designing (or servicing) anything with tubes.

PRINCIPLES OF RF POWER AMPLIFIERS. TechPress, Brownsburg, Ind. 115 pages. $1.95

How Good Are TV Splitters?

Continued from page 111

horizontal curve at the top of each response curve and the baseline (see Fig. 10). These adjustments established the reference signal. Next, the jumper was removed and the splitter installed. Its loss in decibels was indicated directly on a special scope graticule.

To find what's called average FM signal loss for a particular unit, we determined the loss at 88 mc, 98 mc and 108 mc by inspecting the curve for that unit. We then took the arithmetic average of these three losses. To determine average VHF-TV loss we inspected the VHF-TV curve at 54 mc, 88 mc, 174 mc and 216 mc. The arithmetic average of these four losses was the average VHF-TV loss. We did the same thing for UHF at 500 mc, 700 mc and 890 mc.

IN SEARCH OF THE INCAS

Patric Jordan (WB2QLF, Hazlet, N.J.), James (The Amazing) Randi, Jaime Carvajal (Quito, Ecuador) and Russell Shoub (Montreal, Que.) pose with gear in wintry New York shortly before embarkation.

IT'S not often that a ham gets the opportunity to go off to the Andes looking for a lost city and a hoard of gold. Patric Jordan, who is 16, is an exception. He was chosen by James Randi (known to audiences as The Amazing Randi for his work as a magician and host in various media) to be the communications anchor man for The Randi Expedition to the Land of the Incas.

The four-man party will take a Drake TR-4 ham transceiver and a pair of Lafayette Dyna-Com 5 CB walkie-talkies. In Ecuador, Patric's call will be WB2QLF/HC2RE; in Peru it will be WB2QLF/OA.

After they return EI will publish the exclusive story of WB2QLF in the Andes. On all counts it should be the biggest radio adventure of the year.

Telephone Answering Set

Continued from page 50

ing motor isn't kept running. L2 will stay pulled in, keeping the phone off the hook indefinitely!

Handset-earpiece coil L3 is cemented to the top of the cabinet right under the earpiece. Terminate the shielded wires from L3 and both speakers (unshielded) with miniature phone plugs near the mating recorder jacks. The shielded wires from L1 and unshielded wires from *speaker 1* go to the chassis binding posts.

Power Cable Harness. The tape recorders suited to the TAS use 1.5-V batteries to operate the motor and 9-V for the amplifier. In the TAS, four separate *shielded* cables terminate in a 5-pin plug (PL2) at one end and home-brew connectors at the other end. The schematic of the harness is shown at the bottom of Fig. 4.

Especially important is the use of diodes D2 and D3 and their proper installation. Shielded wire (thin mike cable) is necessary to prevent excessive motor noise pickup from the amplifier power leads. For the 1.5-V battery terminations, cut a 1⅞-in. piece of 1-in. dia. wood dowel and push thumbtacks into the ends for contacts. Solder the wire ends to the thumbtacks. The dowel assembly should be installed in place of a C-cell. Wrap the dowels with tape and label them *recorder 1* or *recorder 2*. If your recorders use two C-cells, make two more dummy batteries from the dowel to take up the space and to maintain the contact pressure.

Parts Substitutions. While the TAS lends itself to modification, take it slowly. The motor, solenoid and microswitches specified work well together in this application. Any 1-rpm motor might be substituted, but you may encounter mounting and shaft-coupling problems. The specified microswitches require very little operating force so they don't cause the cams and motor to stall.

Final Assembly. Insert plug PL2 into chassis socket SO2. Slide the chassis into the back of the cabinet, placing the *recorder 1* C-cell block and one of the 9-V connectors on the bottom shelf. Push cable plug PL1 into cabinet socket SO1. Connect the shielded wire from pickup coil L1 to insulated binding posts BP1 and BP2 on the back of the chassis, and connect the wires from *speaker 1* to BP3 and BP4.

Load the recorders with tape and put their function switches in the *stop* position. Install the dummy batteries and attach the 9-V connectors (made from the connectors of dead 9-V batteries) to each recorder. Slide the recorders onto the shelves in the cabinet, folding the power cables under each recorder so they won't interfere with reel rotation. The miniature plug from the monitor speaker goes into the headphone jack of *recorder 2*. Headset earpiece (recording) coil L3 plugs into the mike jack of *recorder 2*.

Preliminary Checkout. Make sure switch S5 is *off*, and that function switch S7 is in *normal-operation* position. Both recorders should be set at stop. Plug in the line cord—nothing should happen. Now turn on S5—the red pilot light (NL2) should come on. If *cam 1* is not in the neutral position, L2 will actuate the rocker arm and the timer motor will run. Let it complete the sequence, at which time L2 will release the rocker arm and the timer will stop. Now, put function switch S7 in the *recorder 1* position. *Recorder 1* should now operate completely independently of all the other parts of the TAS. You should be able to record, rewind and playback by using the recorder controls in a conventional manner. Try this to be sure your power harness is wired properly. Now put S7 in the *recorder* 2 position. This will allow *recorder 2* to operate independently as just described for *recorder 1*. Try out each recorder for recording, rewinding and playing to verify proper power harness wiring.

Now, turn off S5. Put S7 in the *test/recycle* position. Position the controls of *recorder 1* for playback and of *recorder 2* for recording, with volumes set at low levels. Now turn S5 on. The timing motor should run continuously and all sequencing should take place except the operation of L2. Slight readjustment of the cam positions will correct sequencing problems. Make sure the cam setscrews are tight so the cams don't rotate on the shaft.

Final Checks. Make the máster answering tape on *recorder 1* by placing function switch S7 in the *test/recycle* position and plugging a microphone into *recorder 1's* microphone jack. Set *recorder 1's* control to record. Keep the volume low enough to avoid acoustic feedback from answering speaker. Wait a couple of seconds after *recorder 1* starts and time your answering message to end a few

[*Continued on page* 114]

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Telephone Answering Set

Continued from page 113

seconds before *recorder 1* stops. The message used at the beginning of this article is typical of one you might want to use. Now wait until the sequence has come around again, and when *recorder 1* starts, repeat the answering message. Using 600 ft. of tape on 3-in. reel, you can get almost 30 answers on a tape. *Recorder 2* will have enough tape to record about 15 messages. After the 15th answering message, your message should tell the caller to try again in a few hours, since you *cannot* record the message after the 15th call without resetting the unit.

Near the end of the final message, turn S7 to the *normal-operation* position. This will shut off the timing motor at end of the cycle. Remove the microphone from *recorder 1* and get ready to accept incoming calls. With S7 in the *recorder 1* position, put *recorder 1* in the playback mode and rewind the tape to the beginning. Use a long white leader on the tape to give you a definite starting point and to avoid unreeling the tape by rewinding too far. Set switch S7 to *recorder 2* and rewind *recorder 2's* tape to the beginning, then set it up for recording.

Put S7 in the *normal-operation* position and shut off S5. This is to prevent S6 from being pressed and running the timer as you raise the enable/disable arm to position the phone. Remove the telephone handset and place the phone base so that the spring-loaded arm holds down the phone pushbutton. Place the handset on the wooden cradle, with the mouthpiece over the speaker and the earpiece over L3.

The telephone may be used normally by pushing it slightly backward to release the pushbutton. Call a friend and ask him to call you back. Reposition the phone base under the arm, put the handset back on the cradle, turn on switch S5 and wait. The phone should ring about three times before solenoid L2 pulls in, lifts the arm and . . . well, by now you should be familiar with what happens. Adjust playback and record volumes (you'll be able to hear the caller through the monitor speaker as the recording is being made).

Make certain the phone is really hung up or callers will just get a busy signal. Tighten or shorten the spring and position the phone base under the arm to insure full pressure on the pushbutton.

CB Control Console

Continued from page 101

mean most of your signal is cancelling itself.

Such SWR measurements are accurate enough for most jobs. You simply adjust or repair the antenna system for lowest meter indication. It's possible, though, to improve absolute accuracy by changing the combined value of R1 and R2. You'll need an accurate dummy load of 52 ohms to do this (Lafayette 42 C 0902). Install the load at the *ant. 2* socket and measure SWR. Since the load is correct, SWR should fall nearly to zero. If the reading is below 4 (microampere scale on the meter) consider your console accurate enough. But if the reading is higher you'll need a different value for R2 (specified as 18 ohms) to bring the SWR down. Try other resistors just above and below 18 ohms to see whether you can lower the meter indication. This procedure makes up for differences in circuit layout. If the reading is below 4 (microamperes scale) you can calculate any SWR by doing the following: (1) add the meter indication (in *rev.* position) to 50; (2) subtract the same meter indication from 50; (3) divide (1) by (2).

Checking Modulation. The console gives a choice of two modulation checks. First is with the meter. Set S3 to *norm.*, set S1 to either position; set S2 to *calibrate* and turn R9 fully counterclockwise. Turn on the CB transmitter and, without speaking, turn R9 until M1 indicates 50. Keeping the transmitter on, turn S2 to *modulation* and begin talking into the mike. The needle now should move in step with your voice. When M1 *occasionally* hits about 35, it's equivalent to about 100 per cent modulation. The indication is only approximate since meter ballistics prevent a perfect display of modulation percentage; yet this can serve as a guide. After you're accustomed to a given amount of needle movement, you'll know when something's amiss.

The other modulation check can be made by plugging earphones into *mod.* jack J1. You'll be able to hear speech quality as it would be transmitted over the air.

RF Power. This test indicates the transmitter's approximate output power in watts. Set S2 to *RF watts* and turn R9 full clockwise. With the CB set to transmit, M1 now should indicate transmitter output power directly: that is, 20 on the meter equals 2 watts,

[Continued on page 116]

CB Control Console

Continued from page 115

30 equals 3 watts, etc. Since this is *output* power, an indication of about 3.5 watts is the highest you'll see. (During this test, the power is that developed in the console's internal dummy load and is *not* RF power delivered to the antenna.)

Visual Output Indicator. A quick check on output RF can be made by turning S2 to *lamp*. The red lamp (P1) is a dummy load which is lit by RF power. It should flicker as you speak into the mike. Note the lamp is only a test position.

Field-Strength Measurement. Built into the Console is provision for checking signal strength. M1 will respond to a transmitted signal and indicate its relative strength. Thus the *fsm* function is useful for tuning up a walkie-talkie, for example, or a mobile rig.

Set up the console for this function by setting S3 to *fsm*. (Note that this is the *only* time this switch is moved from *norm*. Be sure to move it back to *norm*. after checking field strength or the meter will not operate for the other functions.) Attach a 10-in. length of stiff wire to BP1. With the CB rig transmitting, adjust T1's core for highest meter indication. If M1 goes off scale, reduce its sensitivity with R9.

Other Functions. Jack J2, marked *audio*, is a spare that can be wired up according to your needs. Some possibilities: connect it to the rig's speaker and you can feed receiver audio to a speaker in the basement.

CB Corner

Continued from page 77

tends are unconstitutional and violate freedom of speech and property rights. The group also says the Commission went beyond its authority when it tried to make changes in frequencies and times of operation without first obtaining CBers' consent—and without a public hearing.

When the U.S. Congress wrote the FCC's birth certificate in 1934 it spelled out the agency's job: it has the power to declare the nature of the service, assign frequencies and times during which a licensee may operate. Getting a court to say otherwise might be as difficult as proving Liberace is really Jack the Ripper.

Pocket Tape Recorders

Continued from page 74

is a wide, flat magnet that can be applied to the entire width of the belt as it turns.

IBM is the only manufacturer that throws in a leather case at no additional charge. Auxiliary hand mike, foot control, phone recording attachment, etc. are offered as accessories. And one very special feature—the unit is available on a lease plan from IBM.

Lafayette AT-1 (Distributed by Lafayette Radio Electronics Corp., 111 Jericho Tpke., Syosset, N.Y. 11791, but similar units are also imported under the name Modernage Book Recorder). Units in this price category would doubtless be considered by many as toys. It may not be fair to place the AT-1 beside units listing at up to forty times as much but it answers to the same basic description. The mike, although clipped into the case and usable in that position, can also be removed to the length of its permanently-attached cord.

The Japanese-made recorder isn't in a class with the others tested—but at the price you shouldn't expect it to be. For close-up use (awkward because of the book-cover design) two hands are needed. It could conceivably be jammed into oversize pockets but it's the largest of the units we tried.

Although standard tape reels are accepted, variations in speed of the recording would make it virtually useless for playback on a standard 2-track machine. Curiously, although a 3-in. reel normally holds 150 ft. of standard tape (or 300 ft. of double-play), the 100-ft. reel supplied with recorder seems to have been the basis for their timing figure of 10 min. (total of two tracks). It timed 4 min. per pass with fresh batteries. After some use and with a 300-ft. tape it could therefore be expected to give 15 min. per pass. Batteries were included with the unit.

Memocord XJE IV (Distributed by Norfolk-Hill, Ltd., 35 Ninth Ave., New York, N.Y. 10014). Stuzzi, in Austria, is the source for the Memocord (Fig. 4). It is the only 4-track recorder on the list. But don't expect to play back its tapes on your stereo recorder. Memocord uses special large-spindle reels. It does, however, have a speed adjustment that might provide adequate short-term compensation for special purposes if you later re-

[*Continued on page* 119]

Pocket Tape Recorders

Continued from page 117

wound the tape on standard reels.

The XJE IV has a couple of special advantages that should be pointed out. The reels do not need to be turned over between passes. The record/playback head (and the two DC erase heads) are mechanically positioned by a clutch lever to select the correct track. The drive shaft shifts from one reel to the other in changing tape travel direction. Another feature is a small hole on each of the spindle hubs. By inserting a pencil into the correct hole and turning in the right direction (which may take a little thought until you get the hang of it) you can rewind or fast-forward the tape without wearing down the single penlight cell that drives the motor.

With the Memocord in your right hand the Play and Record buttons fall under your index finger and the clutch lever falls under your thumb. By using this lever you can rewind what you have just recorded for checking but the tape will take as long to rewind as it did to record. There are, of course, a variety of microphone and playback extensions available, along with a foot switch and an AC adapter.

The Listener

Continued from page 92

FM DX . . . About now is the time to start watching for distant stations between 88 and 108 mc. In fact, FM should be the logical summer replacement for medium-wave DX but unfortunately few BCBers ever seriously work it. No FM receiver is designed just for DX. Some have a hot chassis but other features, intended to improve fidelity and selectivity work against the real dyed-in-the-wool DXer who doesn't give a hoot how a station sounds so long as he can identify it.

If the set has AFC, be sure it can be turned off. Otherwise it will pull you off weak (DX) signals toward the stronger stations nearby. The same thing applies to AGC which can be blocked by a strong station near your DX target's channel. And for a DX FM receiver you want maximum sensitivity and *lack* of wide-range response. That last requirement ought to drive any hi-fi fanatic right up the wall. But hi-fi is just what makes FM DXing so tough.

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• • • FOR SALE

TELEPHONE RECORDER—Actuator (TWI-007). Solid State Module Automatically Turns Tape Recorder, Amplifier, Indicator Light on When Telephone in Use. Connected Anywhere on Line. Simple Installation Instructions Included. Prepaid $22.85. Surveillance Recorders: (TWI-1000), (TWI-1010). Twilight Electronics, Box 11595-E, St. Louis, Missouri 63105.

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.

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

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

COMPUTER CIRCUIT boards containing many valuable componets. Ideal for hobbyists, experimenters. 3 for $1.00 ppd. L. Short, Box 332, Kennesaw, Georgia 30144.

MUSIC LOVERS, continuous, uninterrupted background music from your FM radio, using new inexpensive adaptor. Free literature. Electronics, 11500-W NW 7th Ave., Miami, Florida 33168

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VENDING MACHINES—No selling. Operate a route of coin machines and earn high profits. 32-page catalog free! Parkway Machine Corp., 715EI Ensor St., Baltimore 2, Md.

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50¢ a word
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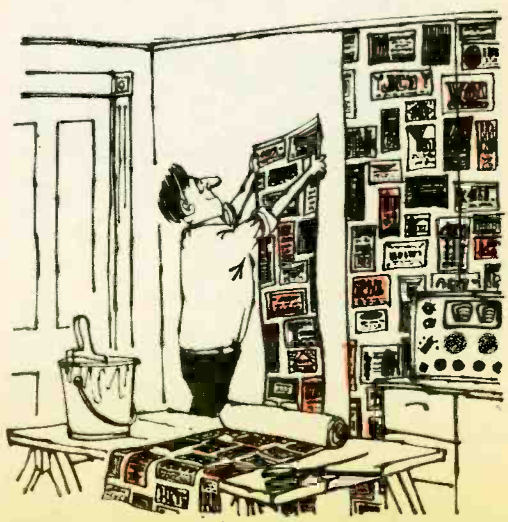

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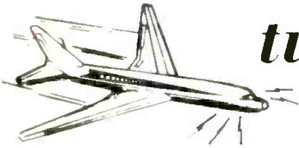

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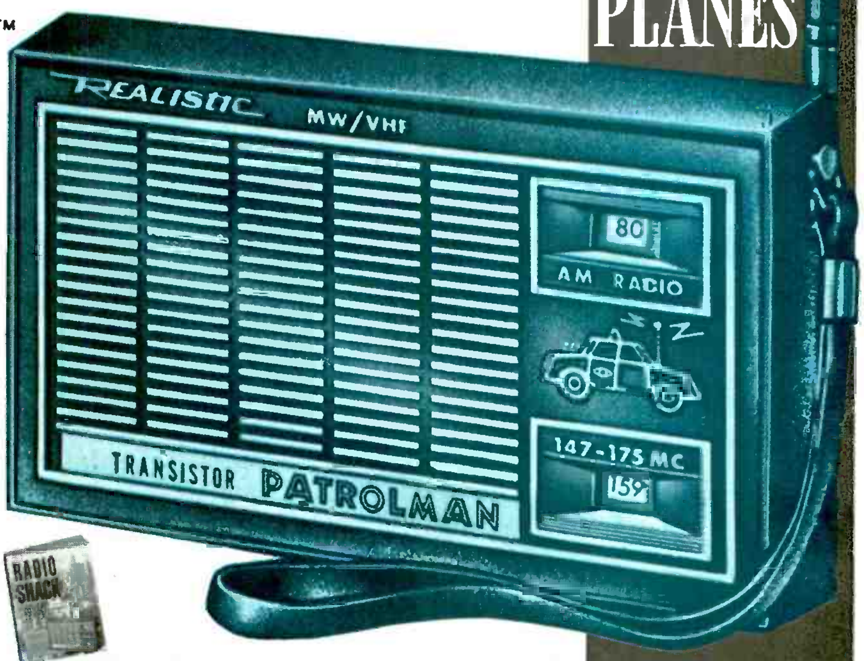

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