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RONALD L. WOOD, Fargo, N.D., holds a First Class FCC License and is employed as a studio and master control engineer/technician with station KXJB-TV. He wrote to NRI to say, "Many thanks to NRI for the Electronics training I have received."

RANDY ACERMAN, Camden, N.J., has his own TV service business. He is the official TV repair center for the Radio Shack store and Goodyear Tire Co. in his area. He says, "I have seen other schools' texts and most can't hold a candle to NRI lessons."

BERNARD SMOLKOVICH, Ft. Knox, Kentucky, is a Staff Sgt. with the U.S.A. Armor & Engineering Board. "Thanks largely to the NRI diploma I hold, I am a very successful and upcoming Communications Technician. My thanks to your fine staff for their unfailing assistance during my course."

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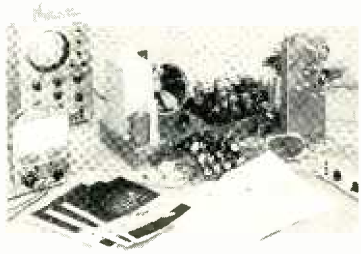

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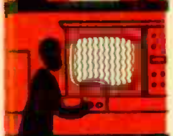

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CIRCLE NUMBER 8 ON PAGE 11

Feedback from Our Readers

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

● WHICH TWIN HAS THE TOMMY?

It's funny that fellow in Texas thought Tom Kneitel looked like the man wanted for murder in the poster [A Peek in Uncle Tom's Corner, Jan. '68 EI]. I've been thinking for months that he looks like an old Navy buddy of mine I first ran into in Samoa in the twenties.

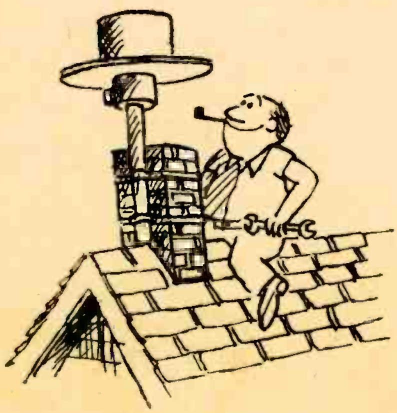
Ralph Pescatore
San Jose, Calif.

● WAY OUT

Your article on the SIA antenna [Jan. '68 EI] says that unless somebody can find a way of making it work like it's supposed to the only way of getting more signal is to stick up more metal. How about making the SIA with more metal in *it?*

Merlin U. Filbert
Menlo Park, N.J.

Yes, how about it?



● HOW'S THAT?

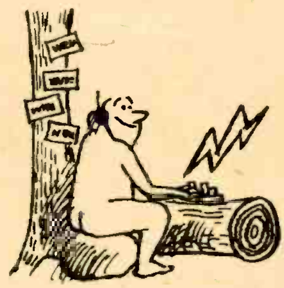
At fortieth of a kilowatt what radio wave (frequency) would this generate?

Don Dreis
Wheaton, Ill.

Depends.

● AH, SIMPLICITY!

Your Bare Essentials transmitter [March '68 EI] is just what the doctor ordered. I think amateur radio needs to get away from all the store-bought frills and back to the



greatest possible simplicity. I've reduced my own shack to essentials to such an extent that there's nothing more to remove.

Adam Nudelman
Cape May, N.J.

● LIST FOR LISTENERS

I don't know how many of your SWL readers can copy CW and are interested in QSLs from CW stations but perhaps I can assist those who do.

As a rule, it is difficult to determine the location of non-ham CW stations. As a result of several years' work in marine and aviation radio I have acquired listings of the city and often the mailing address for most of the stations in those fields.

If any of your readers are interested I will gladly supply whatever data I can. But a self-addressed, stamped envelope or international reply coupons will be necessary.

Walter H. Treftz, KL7GGU
Box 8259
Anchorage, Alaska 99504

[*Continued on page* 8]

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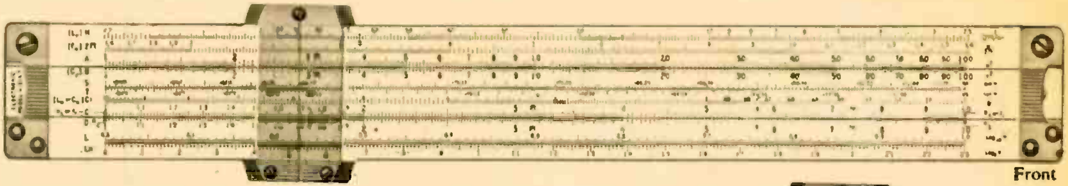

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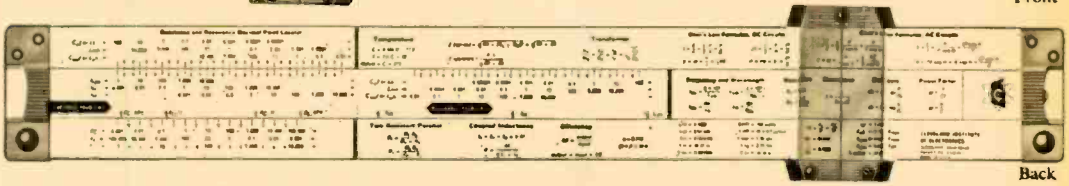

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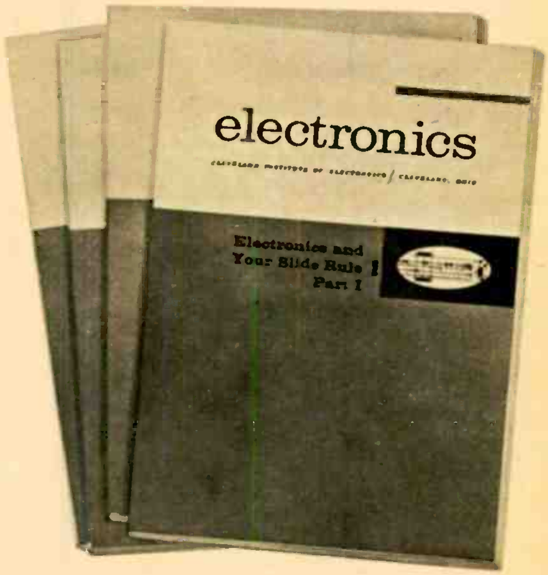

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CIRCLE NUMBER 25 ON PAGE 11

Feedback from Our Readers

Continued from page 6

● COME ON UP!

Three articles EI published can be tied together to solve three problems they raise. The articles: Wanna Get in Trouble with the FCC?; FM Hams, the New Breed; Wayne Green's column, the Ham Shack. The problems: how to get CB ragchewers a spot where they can operate legally without exposing them to the often technical, often dull aspects of amateur radio; how to attract more operators to the newest (and most CB-like) mode of amateur radio; how to convert more CBers to the ham ranks, particularly in the little-used VHF spectrum.

Amateur FM enthusiasts (I am one) have a great deal more in common with CBers than they do with their fellow ham operators, although most of us are reluctant to admit it. The typical FMer uses the 10-code rather than Q-signals; he doesn't identify his station each time he presses the mike button; his transmissions usually are terse; he often finds himself performing public-service functions.

CBers who enjoy rag chewing but don't want to run afoul of the FCC should be told that on the FM ham channels that type of activity is not only sanctioned but encouraged. And obtaining a license for VHF operation is considerably simpler than getting one for the lower frequencies. I took my technical exam after studying one of the question manuals more or less diligently with a few friends over a two-week period. We passed, although the theoretical grasp of electronics only came later.

The FCC also requires an amateur to be familiar with the Morse code but it recognizes that this requirement may pose a formidable threat to many who are potentially serious and competent amateurs. So they have made available the Technician license for those who can send and receive the code at only 5 wpm. With serious practice, anyone can learn that much code in less than a week.

You CBers who like to ham it up but want to avoid trouble with Friendly Cousin Charlie are more than welcome to join us on VHF.

Ken Sessions, K6MVH
Ontario, Calif.

Broadsides

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

Catalog 681 is the current edition of a perennial contender for some sort of Most-Intriguing award in the **scientific fun-and-games** department. It offers everything from rechargeable nickel-cadmium cells to holograms, from kaleidoscopes to telescopes, from gyroscopes to Van de Graaff generators. You can get a free copy by writing Edmund Scientific Co., 301 E. Gloucester Pike, Barrington, N.J. 08007.

Welcome to the Exciting World of **Citizens Band** Two-Way Radio Communications, says the title of a pamphlet describing a line of CB transceivers and accessories. In addition to the hardware, it gives a brief account of how you go about getting a CB license and describes the HELP and marine watch programs. For a free copy write Pace Communications Corp., 24049 Frampton Ave., Harbor City, Calif. 90710.

A catalog of Television Tube Brighteners and Service Accessories describes **picture-tube servicing devices** for both color and B&W receivers. Included are a gun-killer for individual element testing of color tubes and an adaptor for gun-by-gun checking of color tubes on a B&W tube tester. Free from Perma-Power Co., 5740 N. Tripp Ave., Chicago, Ill. 60646.

The Radio Amateur's License Manual, a classic guide to **ham-ticket getting,** has been updated to include questions for the Advanced and Extra Class licenses. In addition, you'll find an FCC examination schedule, U.S. and international regulations and a list of U.S. radio districts. It costs 50¢ at equipment dealers or direct from the American Radio Relay League, 225 Main St., Newington, Conn. 06111.

A booklet called **Business/Industrial Two-Way** Radio Communications Systems describes typical applications for base and mobile units. Hints on frequency and antenna selection and a brief explanation of license requirements are thrown in. It's free from E. F. Johnson Co., Waseca, Minn. 56093.

A recent 156-page catalog of **induction devices**—coils, IF transformers, RF chokes, filters and so on—contains a coil replacement guide for servicing well-known TV receivers and home and auto radios. For a free copy of Catalog 167 write J. W. Miller Co., 5917 S. Main St., Los Angeles, Calif. 90003.

A Cross-Reference and Selector Guide is available for **zener diodes and temperature-compensated diodes.** Free from Motorola Semiconductor Products, Inc., Box 955, Phoenix, Ariz. 85001.

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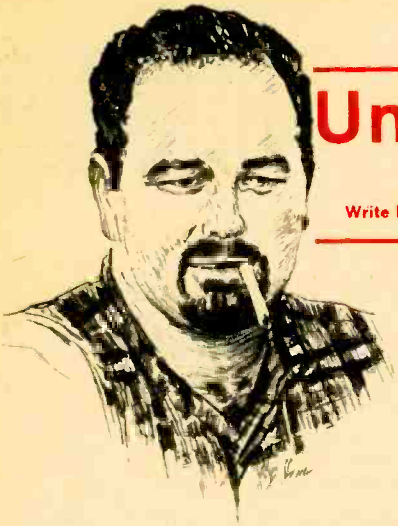

Uncle Tom's Corner

By Tom Kneitel, K2AES/KQD4552

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

★ *Being an ex-merchant seaman, I've tried to concentrate my DXing activities on commercial and military ships and coastal stations. One thing puzzles me, though. I always hear U.S. Navy shore stations calling a vessel with the call-sign NERK. But among the hundreds of Navy vessels I've logged I never come across this NERK station.*

Warren Hagemar
Bangor, Me.

NERK is the U.S. Navy's version of a CQ call. It means calling all U.S. Navy ships. The call-sign was assigned to the Navy's giant dirigible Shenandoah (ZR-1). The airship broke apart over Ohio in 1925 (exactly two years after its maiden flight) killing 14 crew members. Its radio call-sign was then given what amounts to immortality in its present use. It has been buzzing over Navy radio circuits hundreds of times each day for the past 43 years. But I've never met a Navy man who was aware of this vignette of Navy tradition.

★ *My portable TV set has been at the service shop for months. Problem seems to be a 12BR3 tube. which the serviceman tells me can't be obtained through any of his suppliers. Do you think that I'm being given a snow job?*

Ted Oldorf
Charleston, S.C.

Tell the guy to forget the 12BR3 and plug in an American-made 12AF3, which he can buy at the tube-checking device in a large drug store. Better yet, get your set back from the clod and make the repair yourself. Any TV serviceman who doesn't know about tube substitutions ought to go back to school.

★ *Over a year ago I sent $4 to an outfit called Operation Match. They were going to run my vital statistics through a computer and find me the girl of my dreams. Six months later they told me that I would soon be hearing from them. Here it is 1968 and I'm still waiting. Maybe I broke the computer.*

Sam Wanowski
Palisades Park, N.J.

You'll be happy to hear you didn't break the computer, unhappy about the fact that the company went broke last June, leaving $120,000 worth of debts—including your $4.

★ *Can you honestly say that your tidbits of international intrigue come only from SWLing? I once heard a rumor that you're a CIA agent sent to pass out false information to the public!*

Morrie Goldman
Chicago, Ill.

Morrie, old boy, have you got a friend name of Richard in Philadelphia? He not only thinks (?) like you do but this fink sends me a pin—maybe to make sure I get the point (see photo at left). A couple of days after this came in a friend of mine called me from Greenwich Village and said he'd seen one down there. Maybe the CIA bought into a button factory and takes this way to make announcements. I hope so. Actually, the big reason why I never have taken CIA money is they haven't offered me any.

★ **TV DX-Ray Note.** Only months ago Uncle Sam's electronics test labs detected no possibly harmful X rays coming from a GE TV set. But now the industry is humming with news that the Consumer Union lab has discovered X rays exceeding generally-ac-

[*Continued on page* 14]

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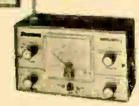
Electronic Siren $4.95, Burglar Alarm $6.95, Fire Alarm $6.95, Intercom $3.95, Audio Power Amplifier $4.95, Metronome $3.95, Tremolo $8.95, Light Flasher $3.95, Electronic "Mystifier" $4.95, Photo Cell Nite Lite $4.95, Power Supply $7.95, Code Oscillator $2.50, FM Wireless Mike $9.95, AM Wireless Mike $9.95, Electronic VOX $7.95, FM Radio $9.95, AM Radio $7.95, Electronic Bongos $7.95.

Citizen's Band

Two years ahead! Model 7923
All Solid-State 23-Channel 5W Transceiver. 4 exclusives: dual-crystal lattice filter for razor-sharp selectivity; efficient up-converter frequency synthesizer for advanced stability; precision series-mode fundamental crystals; Small: only 3"H, 8"W, 8¼"D. $189.95 wired only.

The best buy in tube-type CB—"Sentinel-Pro" 23-channel dual conversion 5W Transceiver $169.95 wired only.

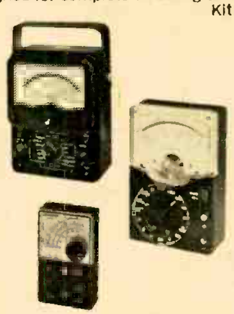
EICO Trans/Match (Model 715) is a professional test set designed for complete checking of ham and CB equipment. Kit $34.95; Wired $49.95.



Truvohm

Professional Portable Multimeters by EICO.
The industry's *greatest* V-O-M values. Designed, made to Eico's high standards of professionalism. Each *complete* with batteries & test leads. Backed 100% by famous EICO warranty.

Model 100A4, 100,000Ω/V, $34.95.
Model 30A4, 30,000Ω/V, $19.95.
Model 30A3, 30,000Ω/V, $15.95.
Model 20A3, 20,000Ω/V, $12.95.
Model 4A3, 4000Ω/V, $9.95.
Model 1A1, 1000Ω/V, $5.95.



Automotive

EICO 888—Car/Boat Engine Analyzer.
For all 6V/12V systems; 4, 6, 8-cyl. engines.

Now you can keep your car or boat engine in tip-top shape with this solid-state, portable, self-powered universal engine analyzer. Completely tests your *total* ignition/electrical system.

Complete with a Tune-up & Trouble-shooting Manual. Model 888; $44.95 kit, $69.95 wired.

Test Equipment EICO®

100 best buys to choose from.

"The Professionals"
—laboratory precision at lowest cost.
Model 460 Wideband Direct-Coupled 5" Oscilloscope. DC-4.5mc for color and B&W TV service and lab use. Push-pull DC vertical amp., bal. or unbal. input. Automatic sync limiter and amp. $109.95 kit, $149.95 wired.

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

FREE 1968 CATALOG EI-5
EICO Electronic Instrument Co., Inc.
283 Malta St., Brooklyn, N.Y. 11207
☐ Send me FREE catalog describing the full EICO line of 200 best buys, and name of nearest dealer.
Name________
Address________
City________
State________ Zip________

CIRCLE NUMBER 6 ON PAGE 11

cepted limits in a Packard Bell model CRW-502 and an Admiral model L5411 color set. Radiation was coming out of set tops and sides when they were operated with the line voltage raised to 125 V. Consumers Union has rated both of these sets Not Acceptable.

★ *Your articles about radio stations in the Caribbean have given many SWLs the idea that there actually was a commercial station on Navassa Island. Hogwash! There never was.*

Harold Franzman
Cleveland, Ohio

Callbooks of 1919 credit the island with no less than two radio transmitters. One station called itself NKC, the other was WQN. As for the now-legendary Radio Navassa broadcasting station, I'm afraid you'll have to look it up in Mad Magazine.

★ *What's the use of the standby switch on a Heathkit HX-11 transmitter? I had the switch turned on for hours and nothing seemed to happen.*

Lee Dumond
Thousand Oaks, Calif.

You stood by, didn't you?

★ *I've heard all sorts of stories about people getting their names on CIA lists for sending letters to Communist countries. I've received schedules from R. Havana, R. Prague, R. Budapest, R. Moscow, R. Belgrade and R. Berlin International. Do I get my name on any CIA list?*

Tim Leinroth
Ithaca, N.Y.

No, Bunky, they don't send out schedules.

★ *As a high-school senior interested in going going into advanced electronics, I'd like to make three-dimensional pictures known as holograms which are produced with a laser beam. Where can I get parts to build this device and how much would it cost?*

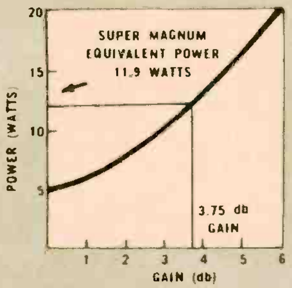
Tim Margolis
Seattle, Wash.

You couldn't do this for less than $300 and shouldn't even attempt to tinker around with dangerous laser beams without trained supervision. Why not ask your science teacher to contact an outfit such as Optics Techniques (901 California Ave., Palo Alto, Calif.) for information on laser techniques and supplies? They might be able to suggest a fairly low-cost, safe class project.

IS THERE A WAY TO OPERATE ON CB LEGALLY AT 11.9 WATTS??

"stati-lite noise reducer!"

Drastically reduces receiver noise. No pointed ends to create sparking.



You know the FCC strictly prohibits putting more than 5 watts of RF into your CB set's final amplifier or using a linear amplifier. But there is a way of making your CB system perform exactly as if your set had 11.9 watts of RF power. And it's completely legal!

Model M-117 omni-directional

SUPER MAGNUM

citizens band base station antenna

HERE'S HOW. The Antenna Specialists' Super Magnum base station antenna gives you an unprecedented 3.75 omni-directional gain—**at least 10% more true gain than any other omni-directional CB base antenna made.** The Super Magnum will reach out—like you had a 11.9 watt transmitter. HERE'S WHY! Db antenna gain can be translated to input power equivalent by this chart.

Equally important is the Super Magnum's tremendous signal to noise improvement by 6-20 db. It's the world's most popular CB base antenna by far, and over 200,000 legal owners know why.

far more rugged construction!

Over twice the contact area at telescope joints (no swaging!) Heavier-gauge seamless tubing.

full ½-wave "solid state" radials for maximum RF decoupling!

We simply mean solid aluminum, 108" radials (four of em!) for maximum RF decoupling of radiator.

super "Power-Play" transformer!

Super-heavy coil permanently encased in water-proof, rugged housing. VSWR: a fabulous 1.17—best by far.

SPRING TUNE UP TIME

Perfect Match for MAXIMUM RANGE

FAMOUS MAGGIE MOBILES

The world's most popular mobile antennas. (You'll see them everywhere you turn.)

the antenna specialists co.

Div. of Anzac Industries, Inc.

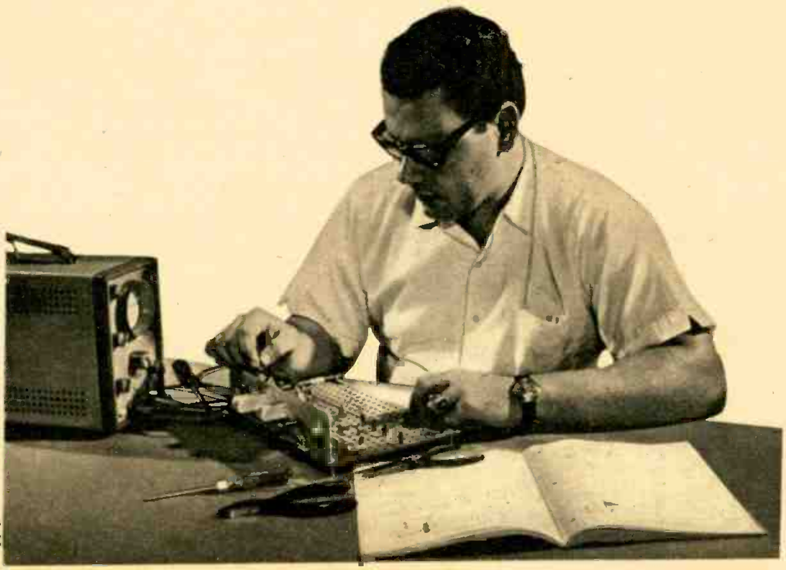
12435 Euclid Avenue, Cleveland, Ohio 44106

"Stripes of Quality"®

CIRCLE NUMBER 21 ON PAGE 11

10 Reasons why RCA Home Training is

your best investment for a rewarding career in electronics:



Performing transistor experiments on programmed breadboard — using oscilloscope.

1 LEADER IN ELECTRONICS TRAINING

When you think of electronics, you immediately think of RCA...a name that stands for dependability, integrity and pioneering scientific advances. For over a half century, RCA Institutes, Inc., a service of Radio Corporation of America, has been a leader in technical training.

2 RCA AUTOTEXT TEACHES ELECTRONICS FASTER, EASIER, ALMOST AUTOMATICALLY

Beginner or refresher, AUTOTEXT, RCA Institutes' own method of programmed Home Training will help you learn electronics more quickly and with less effort, even if you've had trouble with conventional learning methods in the past.

3 THOUSANDS OF WELL PAID JOBS ARE NOW OPEN TO MEN SKILLED IN ELECTRONICS

RCA Institutes is doing something positive to help men with an interest in electronics to qualify for rewarding jobs in this fascinating field. Every year, literally thousands of high paying jobs in electronics go unfilled just because not enough men take the opportunity to train themselves for these openings.

4 WIDE CHOICE OF CAREER PROGRAMS

Start today on the electronics career of your choice. On the attached card is a list of "Career Programs", each of which starts with the amazing AUTOTEXT method of programmed instruction. Look the list over, pick the one best suited to you and check it off on the card.

5 SPECIALIZED ADVANCED TRAINING

For those already working in electronics or with previous training, RCA Institutes offers advanced courses. You can start on a higher level without wasting time on work you already know.

6 PERSONAL SUPERVISION THROUGHOUT

All during your program of home study, your training is supervised by RCA Institutes experts who become personally involved in your efforts and help you over any "rough spots" that may develop.

7 VARIETY OF KITS YOURS TO KEEP

To give practical application to your studies, a variety of valuable RCA Institutes engineered kits are included in your program. Each kit is complete in itself. You never have to take apart one piece to build another. At no extra cost, they're yours to keep and use on the job.

8 FROM RCA INSTITUTES ONLY—TRANSISTORIZED TV KIT, VALUABLE OSCILLOSCOPE

Those enrolled in RCA's television course or program receive complete transistorized TV Kit. All students receive a valuable oscilloscope—both at no extra cost and only from RCA Institutes.

9 UNIQUE TUITION PLAN

With RCA Home Training, you progress at the pace that is best for you! You only pay for lessons as you order them. You don't sign a long-term contract. There's no large down-payment to lose if you decide not to continue. You're never badgered for monthly bills. Even if you decide to interrupt your training at any time, you don't pay a single cent more.

10 RCA INSTITUTES GRADUATES GET TOP RECOGNITION

Thousands of graduates of RCA Institutes are now working for leaders in the electronics field; many others have their own profitable businesses. This record is proof of the high quality of RCA Institutes' training.

CLASSROOM TRAINING ALSO AVAILABLE

If you prefer, you can attend classes at RCA Institutes Resident School, one of the largest of its kind in New York City. Coeducational classroom and laboratory training, day and evening sessions, start four times a year. Simply check "Classroom Training" on the attached card for full information.

JOB PLACEMENT SERVICE, TOO!

Companies like IBM, Bell Telephone Labs, GE, RCA, Xerox, Honeywell, Grumman, Westinghouse, and major Radio and TV Networks have regularly employed graduates through RCA Institutes' own placement service.

SEND ATTACHED POSTAGE PAID CARD TODAY! FREE DESCRIPTIVE BOOK YOURS WITHOUT OBLIGATION! NO SALESMAN WILL CALL!

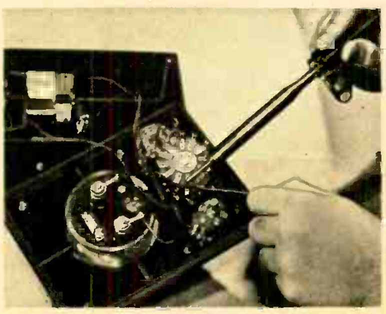
All RCA Institutes courses and programs are approved for veterans under the New G.I. Bill.

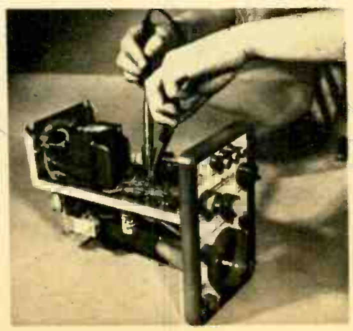
RCA INSTITUTES, DEPT. EI-58
320 West 31st Street,
New York, N.Y. 10001

Accredited Member National Home Study Council

RCA

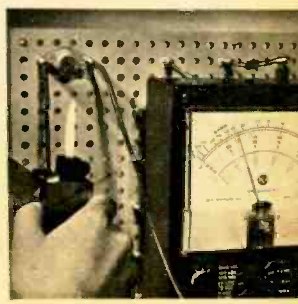
Construction of Multimeter.



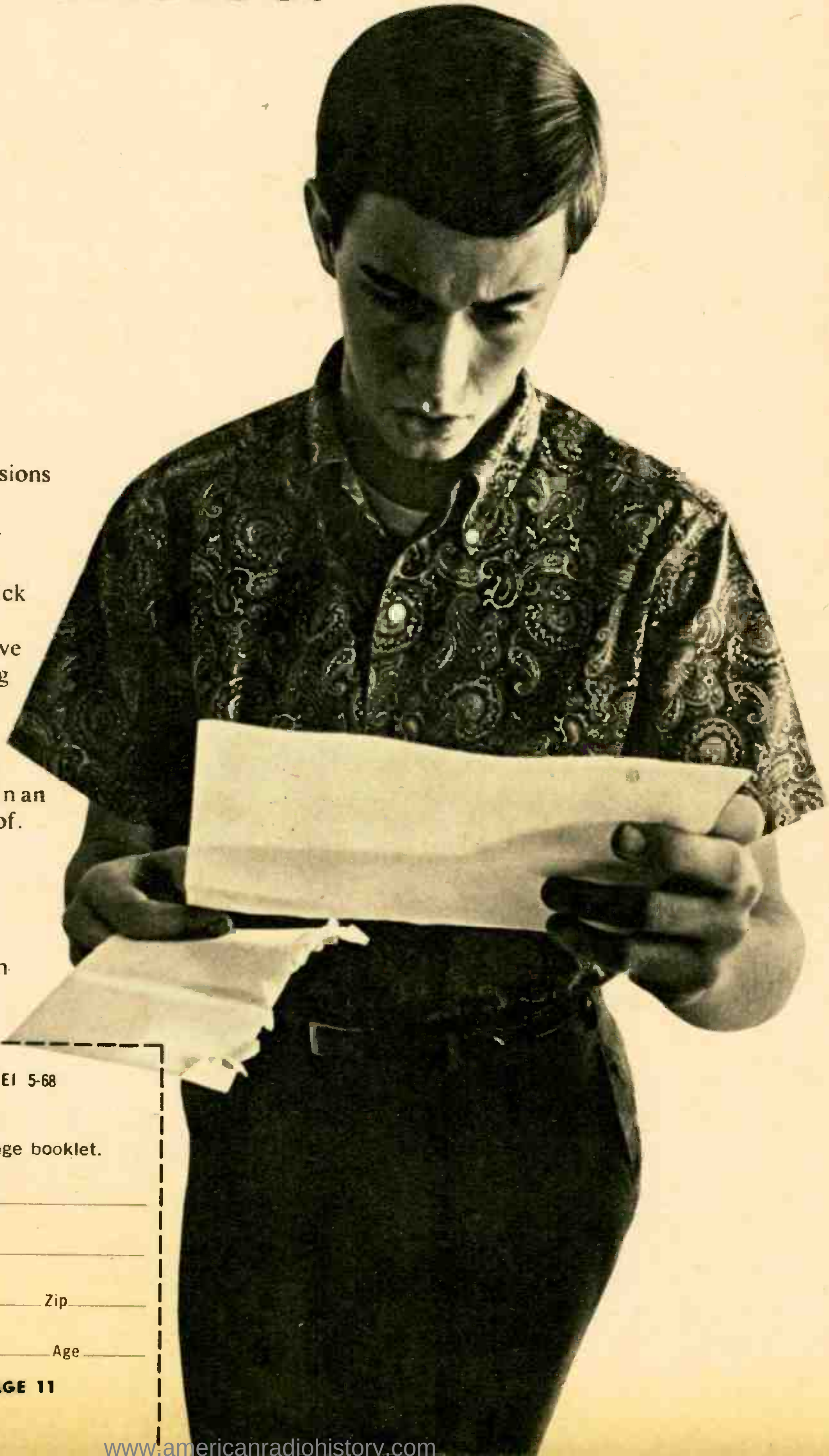


Construction of Oscilloscope.

Temperature experiment with transistors.



He just lost his chance to make a choice.



His induction notice caught him with his decisions down. He waited too long to choose Army.

If he had acted sooner, he would have had his pick of more than 300 jobs. And his choice would have been guaranteed in writing *before* he joined up.

So don't wait. Choose your specialty and get the best training in the world. In an outfit you can be proud of. There's no better way to become highly skilled. No better way to fulfill your military obligation.

Your future, your decision . . . choose **ARMY.**

Army Opportunities EI 5-68
Dept. 200
Hampton, Va. 23369

Please mail me your free 40-page booklet.

Name____________________

Address____________________

City__________ State________ Zip________

Phone__________ Education________ Age________

CIRCLE NUMBER 11 ON PAGE 11

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

"the ANTENNA that captures the RAINBOW"

FINCO has developed the Color Spectrum Series of antennas— "Signal Customized" — to exactly fit the requirements of any given area. There is a model scientifically designed and engineered for your area.

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

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

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

FINCO

THE FINNEY COMPANY
34 West Interstate Street
Dept. EI • Bedford, Ohio 44146

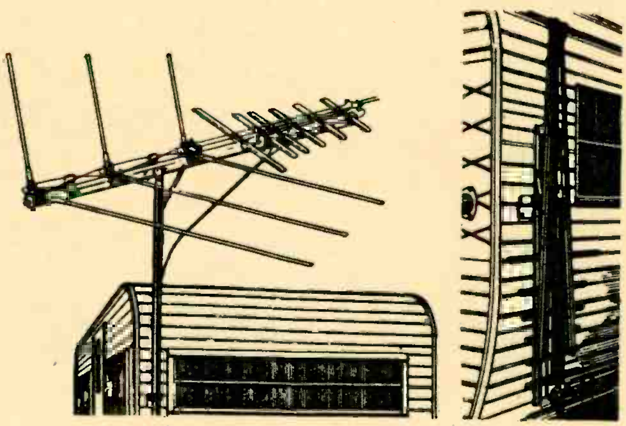
Send for free brochure
Name ____________
Address ____________
City ________ State ________ Zip ______

CIRCLE NUMBER 26 ON PAGE 11

DOMESTIC HARMONY. . . The family of components above is unusual not only in being introduced as a single system but also in design. Power amplifiers built into each 3-way speaker have a crossover at the input to split bass from treble for separate amplification, another at treble output to split mid-range from highs. While system compatibility is stressed, flexibility permits use with components of other manufacturers. Turntable/arm, $199.50; preamp, $375; power amplifier/speaker systems, $375 each. Pioneer Electronics U.S.A. Corp., 140 Smith St., Farmingdale, N.Y. 11735.

Electronic Marketplace

Travel Folder. . . The TTR-1 TV antenna, made for travel trailers and mobile homes, can be folded up like an Arabian tent so you can silently steal away without snagging low-hanging trees along the way. It is gold corodized and has nine elements (three for VHF and FM, six for UHF). The design is one of the manufacturer's Color Spectrum series. It comes with lead, hardware, splitter and a 360° rotator. For travel, it folds down and locks in place without disassembly. $54.95. The Finney Co., 34 W. Interstate St., Bedford, Ohio 44014.



Tone Check. . . This audible continuity tester also gives a rough indication of resistance to about 50 ohms. As resistance increases from full short, the pitch of the indicator tone drops progressively. Advantages claimed include low battery drain, freedom from the inductive kickback of bell or buzzer coils, protection of delicate circuits under test through the use of low power in the tester. A 9-V battery delivers 2.5V at the probe on open circuits, 6 ma on shorts. Probes with 30-in. leads are included. $9.95. CalComp Consumer Products, 626 W. Brookhurst St., Anaheim, Calif. 92801.

Now at your RCA Distributor's:

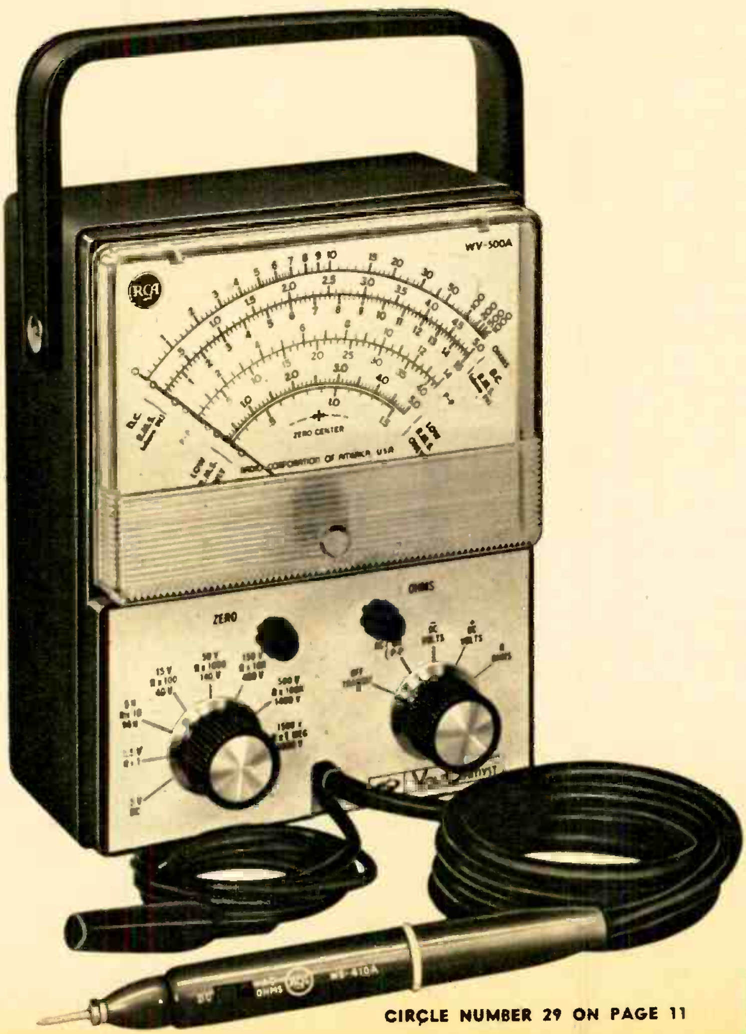
All solid-state battery operated voltohmyst® WV-500A

Eliminate warm-up time! Eliminate Zero-shift that can occur in tube-operated voltmeters! RCA's new WV-500A VoltOhmyst is an all solid-state battery operated, completely portable voltmeter that is ideal for service, industrial and lab applications. Seven overlapping resistance ranges measure from 0.2 ohm to 1000 megohms. Eight overlapping dc-voltage ranges measure from 0.02 volt to 1500 volts (including special 0.5 dc volt range), ac peak-to-peak voltages of complex wave-forms from 0.5 volts to 4200 volts, and ac (rms) voltages from 0.1 to 1500 volts. Input impedance of all dc ranges is 11 megohms.

All measurements are made with a sturdy, wired-in-single-unit probe with fully shielded input cable. The probe is quickly adapted to either dc measurement or ac and resistance measurement by a convenient built-in switch. And an accessory slip-on high-voltage probe is also available to make possible measurements up to 50,000 dc volts.

Solid-state reliability and convenience for only $75.00*

See it at your Authorized RCA Test Equipment Distributor, or write RCA Commercial Engineering Department E134-W, 415 South Fifth Street, Harrison, N. J.



CIRCLE NUMBER 29 ON PAGE 11

RCA

Electronic Marketplace

Build and Learn. . . The Custom 600 color TV receiver kit was, says the manufacturer, designed specifically for use in the training of electronic technicians (the set is basically the same as that

offered in an NRI course, together with the service equipment included in the photograph above). Therefore, we are told, the kit will both help its builder learn about color TV and make it easy for him to service it later on. The set has an 18-in. diagonal (180 sq. in.) picture area, contains 21 tubes, 20 diodes and 3 transistors (UHF tuner is solid-state). $366 (receiver only). Conar Div., National Radio Institute, 3939 Wisconsin Ave., Washington, D.C. 20016

Mini CB. . . The Traveller, according to the manufacturer, is the miniest (5¾ x 6¼ x 1⅞ in.) 23-channel CB transceiver on the scene today. It features a front-panel indicator light that comes on when the set receives signals of 10

µv or better. Adjacent-channel selectivity is rated better than 50db. Other features include illuminated channel selector, auxiliary speaker jack, single-knob tuning, DC cord and microphone. Comes with crystals for all 23 channels and mounting bracket. The Traveller can be used as a base station with optional Power Charger model PS-1. Traveller $149. Power Charger $29.95. Courier Communication, Inc. 56 Hamilton Ave., White Plains, N.Y.

CIRCLE NUMBER 19 ON PAGE 11

Electronic Marketplace

Totable Tester. . . This compact tube tester can be used for more than 1,800 tube types. Meter indicates cathode emission; neon light indicates filament continuity, shorts or leakage; meter scale (0-100) can be used for tube matching.

Also contains straighteners for 7- and 9-pin tubes. Comes in a wooden carrying case with leatherette finish. $27.95. Lafayette Radio Electronics Corp., 111 Jericho Tpk., Syosset, N.Y. 11791.

Big Bow. . . The Studio Pro 120 stereo FM receiver is the first piece of hi-fi electronics to come from University—long known as a speaker manufacturer. It includes state-of-the-art features like ICs, all-silicon circuitry, MOS FET front end. Measured under the IHF standard, output is rated at 60 watts per channel with 0.8 per cent THD at 4 ohms (rms output per channel is 30 watts at 0.3 per cent THD). IM distortion is rated 0.5 per cent for any combination

of frequencies to rated output. Power bandwidth is listed as 10 cps to 40 kc under the IHF standard. Noise ratings vary from —83db on the auxiliary input (with 0.4-V sensitivity) to —60db for the tape head input (1 mV sensitivity). Three 1-A circuit breakers are used for circuit protection. Tuner sensitivity is rated 1.6 V for 20db quieting, $379.50. University Sound, 9500 W. Reno, Oklahoma City, Okla. 73101.

Swap Shop

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

AUDIO & HI-FI

CLARICON portable tape recorder. Will swap for Benson Gyrocopter plans or R/C equipment. Michael Sousa, Monson Academy, Monson, Mass. 01057.

MISCELLANEOUS mono phono cartridges—magnetic, ceramic. Will swap for stereo headphones. Kenneth Kepler, Prairie Bible Institute, Three Hills, Alberta, Canada.

OLSON RA-829 tape recorder. Will swap for Knight C-22 or C-540 CB transceiver. S. F. Kachmarsky, Jr., 10 Sisson Ct., Bayonne, N.J. 07002.

REALISTIC 203 stereo amplifier. Will swap for surplus transmitter, receiver or best offer. Robert Mason, 2285 Victory Rd., Caro, Mich. 48723.

TAPE RECORDER—portable. Want ham gear. Randy Bush, 4503 Lowell Rd., Montgomery, Ala. 36105.

CITIZENS BAND

ROSS walkie-talkie/AM radio combinations (pair). Will swap for tape recorder or best offer. Bill Borchers, 336 Brookside Dr., Dayton, Ohio 45406.

LAFAYETTE HA-210A walkie-talkies. Want good surplus BC-348 receiver. Oliver Crandell, 4233 Ave. 404, Kinuba, Calif. 93618.

KNIGHT C-540 transceiver, antenna. Will swap for short-wave receiver or best offer. Neill Heath, 315 W. Windsor St., Monroe, N.C. 28110.

MIDLAND walkie-talkie. Will swap for Heath HG-10 VFO or other ham gear. Tom Woodruff, Richland Rd., Pulaski, N.Y. 13142.

HEATH GW-12, GW-21 transceivers. Will swap for service equipment or best offer. Ed Appleyard, 316 Eagle St., South Haven, Mich. 49090.

TRANSCEIVER, 25-channel—includes all crystals, other items. Will swap for oscilloscope. Robert Edison, 3223 Bay Pkwy., Brooklyn, N.Y. 11214.

HI-GAIN BEAMS—three-element. Will swap for CB transceiver, short-wave receiver or best offer. C. H. Oglesby, 1100 Bryan Ave., Scotland Neck, N.C. 27874.

LAFAYETTE HE-75 transceivers. Will swap for VTVM, oscilloscope or other service gear. Dennis A. Weber, 18210 Garfield St., Detroit, Mich. 48240.

ANTIQUE ELECTRONICS

PARAGON RA-10 receiver, DA-2 detector amplifier with speaker. Will swap for best offer. O. L. Sanders, Box 433, Idalou, Tex. 79329.

MARCONI 49 AM/SW (49-19 meters) receiver, ca. 1934. Will swap for short-wave receiver or best offer. Glenn Hansen, Rt. 2 Box 128-B, Burton, Wash. 98013.

CROSLEY 75 radio. Will swap for electric guitar and amplifier or tube tester. Arthur Dineen, Box 247, Sharon, Wisc. 53585.

RCA Neutrodyne BCB receiver. Will swap for novice gear. Walter Stanis, 7142 Roland, St. Louis, Mo. 63121.

ATWATER-KENT 40 with speaker, extra tubes. Will swap for pair of 100-mw walkie-talkies or service equipment. Walt Trepanier, 178 Intervale Ave., Burlington, Vt. 05401.

VALLEYTONE receiver, manual, log—ca. 1925. Need sine/square-wave generator or ham gear. H. A. Draeger, 533 S. Spring Ave., La Grange, Ill. 60525.

SHORT-WAVE LISTENING

KNIGHT Span Master. Will swap for CB transceiver. R. van Noord, 67 16th St., Arcata, Calif. 95521.

HALLICRAFTERS S-38E. Will swap for 12-VDC mobile CB transceiver. Ralph Kirshner, 115 Stewart Ave., Ithaca, N.Y. 14850.

HAMMARLUND HQ-129X. Will swap for CB transceiver or best offer. Mark Rosen, 13 Trager Rd., Marblehead, Mass. 01945.

ZENITH Transoceanic. Will swap for Silver Ghost,

[*Continued on page* 119]

Cobra

new power!
new punch!
new performance!

This is CB's hottest line of performance-proven radios! Models for homes, offices, cars, trucks, boats. Perfect for business, professional people, farms, hobbyists. Makes work more efficient; makes life more fun. Full 5 watt input power and exclusive Dyna-Boost speech compression for 100% modulation—puts more sock in your talk!

Cobra
the "big 3" in CB!

and introducing . . .

1. Cobra CAM-88. Nothing finer. Double-conversion superhet receiver for extra sensitivity, greater selectivity. Completely self-contained; operates on all 23 channels. Dual-purpose S/RF meter measures signal in, power out. Converts to 3 watt PA system. Works on 117 VAC and 12 VDC. $214.95

2. Cobra V. All solid-state. Miniature size, walnut grained cabinet. Outstanding talk-power gets the message across. 5 crystal-controlled channels. All-weather performance through a wide temperature range. Operates on 12 VDC, negative ground.* Includes mountings, manual, FCC license application, high-impact ceramic microphone. $99.95

3. Cobra 23. All 23 channels with no extras to buy. All solid-state, including antenna switching—no relay contact failures. S/RF meter measures signal in, power out. Top performance from Twin Pi output network. Handsome walnut-grain panel. Maximum talk-power; rugged dependability. Operates on 12 VDC, negative ground.* With all accessories, $169.95

***OPTIONAL:** PAC5 desk-top power supply converts Cobra V and Cobra 23 to 117 VAC, for base station service. $29.95

Hear the difference know-how makes!
Write for the name of a Cobra distributor near you.

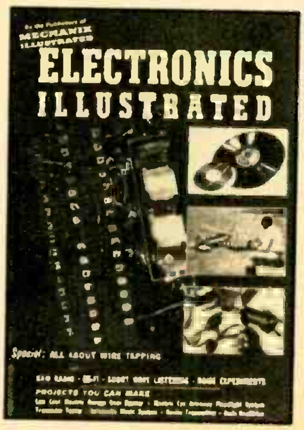
B&K

Division of Dynascan Corporation
1801 W. Belle Plaine, Chicago, Illinois 60613
Where Electronic Innovation Is A Way Of Life

CIRCLE NUMBER 31 ON PAGE 11

EI's 10th Anniversary Issue

IT WAS early spring in 1958 when the first issue of a new magazine, one devoted to electronics as a hobby, was being put together. The magazine later appeared with a May date on its cover. The name that had been chosen: Electronics Illustrated. This copy, dated May 1968, represents our 10th Anniversary Issue and closes out a decade in which so many startling developments have occurred that our first issue looks a little like a pair of spats or an ankle-length skirt. Ten years ago Citizens Band Radio as we know it (Class D) was four months in the future. Hams and short-wave listeners depended on tubes. The transistor, though ten years old, was an experimental device for hobbyists. Hi-fi as a term had been promoted to boredom and the industry, in need of a new idea, had just found it: stereo. EI predicted that stereo records would become generally available that year, though we wondered whether the big sales volume would not be in stereo tapes rather than records. Such is the life of a prophet. If we had taken ourselves too seriously there might not have been a 10th Anniversary Issue. In observance of our first decade we are printing updated versions of what have proved to be the ten most popular construction projects that have appeared on these pages. Just a quick glance at the articles reveals our dependence today on transistors as control devices, on less power and reduced distortion, on sensitive circuitry and on smaller space requirements. In the decade just past EI's circulation has grown to more than 300,000 per issue, reflecting a comparable increase in the ranks of hobbyists—be they hams, Citizen Banders, short-wave listeners, hi-fi/stereo fans, servicemen, general experimenters or other interest groups. What do we predict for the next decade? For one thing, more hobbyists. Widespread use of electronics, increase in leisure time and a growing preoccupation with the sciences all help swell the ranks. As for future developments in circuitry and devices—ten years have taught us that one student prophet is worth two graduates.



Our First Issue
Cover, May 1958 EI

10th ANNIVERSARY 1 SPECIAL

Pages 32-33, Sept. 1959 EI

By JEFF O'DONNELL

Super-Sensitive Metal Locator

BURIED under the sand of the beach, along with old salami sandwiches, fruit pits and Eskimo Pie wrappers, is unclaimed treasure—the money that fell out of people's pockets as they changed into their swimsuits. There's plenty of it there: pennies, quarters, dimes, and maybe even a half dollar. If you don't feel sifting a carload of sand is worth a few pennies and dimes, you can do the job a lot easier and faster with our Super-Sensitive Metal Locator. It's a fraction of the size, weight and cost of the metal locator in our September, 1959 issue.

And it's a metal locator straight out of the junk box. You finally can use those salvaged capacitors and resistors from the shattered transistor radio because the metal locator is just about the least critical project going. Even if you're the world's worst coil winder you'll have no problems for the correct way to make the search-head coil is to scramble-wind the wire.

Just in case your junk box is bare, you can start from scratch with all new components and bring in the project for less than $5.

The locator works on the beat-frequency (BFO) principle. As you see in the schematic, the circuit consists of just a broadcast-band oscillator. Search-head coil L2 is 10½ in. in diameter; as it is swept over the ground any metal within its range causes a change in its inductance which in turn slightly changes the oscillator's frequency.

The usual BFO-type treasure finder has a variable-frequency oscillator and a fixed-frequency oscillator tuned to almost the same frequency. The beat-frequency between the two is amplified and fed to headphones or a speaker. When L2 is passed over metal the change in inductance produces a change in the tone, and you know you've passed over metal.

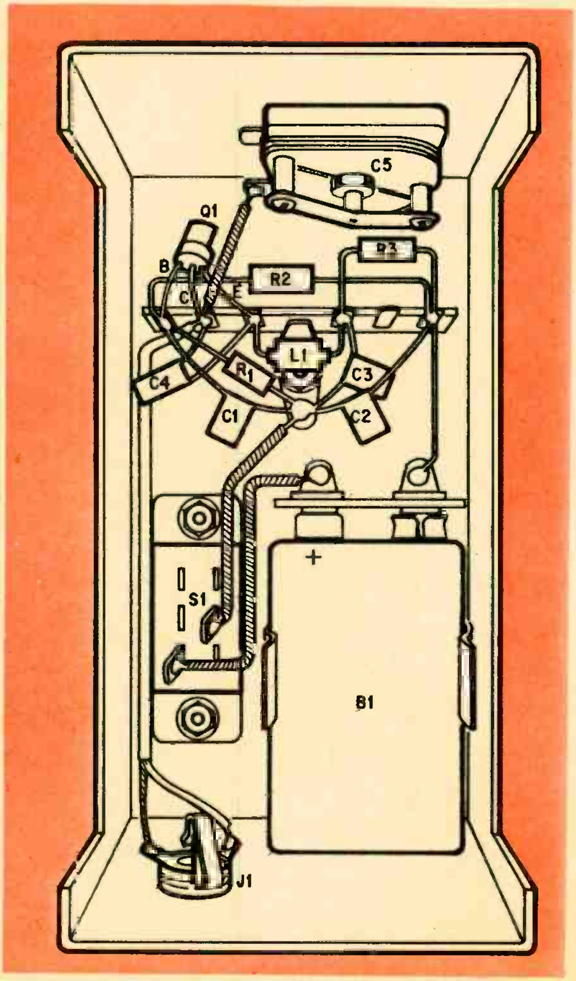
In low-cost BFO treasure finders, the oscillators have a tendency to lock together and this reduces sensitivity. Ambient temperature changes can cause the oscillators to drift apart as the sun heats things up. To avoid both problems, and to keep the cost at rock-bottom, our locator uses a standard transistor radio as the second oscillator, beat frequency detector and audio amplifier.

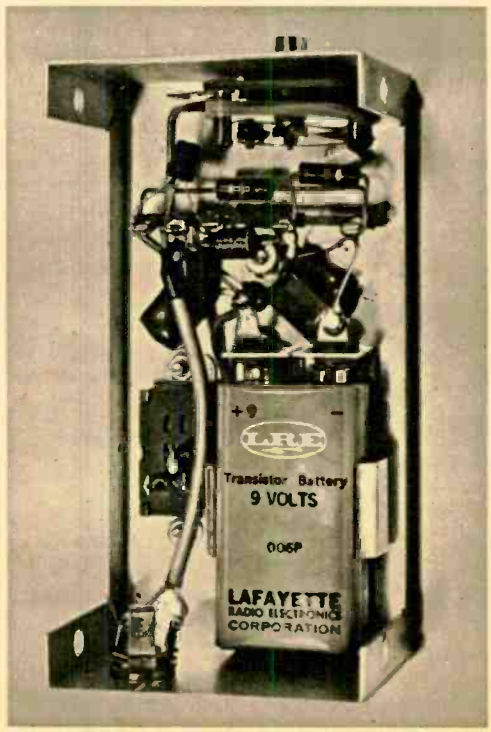
Construction. The unit shown is built on the main section of a 4 x 2⅛ x 1⅝-in. Minibox. If your construction experience is limited, follow the pictorial. If you're an old pro, do what you please, the component layout is not critical. Just don't substitute for the specified transistor.

Start by mounting a battery holder, power switch S1, jack J1 and tuning capacitor C5. The battery holder is a double AA cell holder with both terminals on the same end—this will accommodate a standard 9-V transistor-radio battery, such as a Burgess 2U6, very nicely.

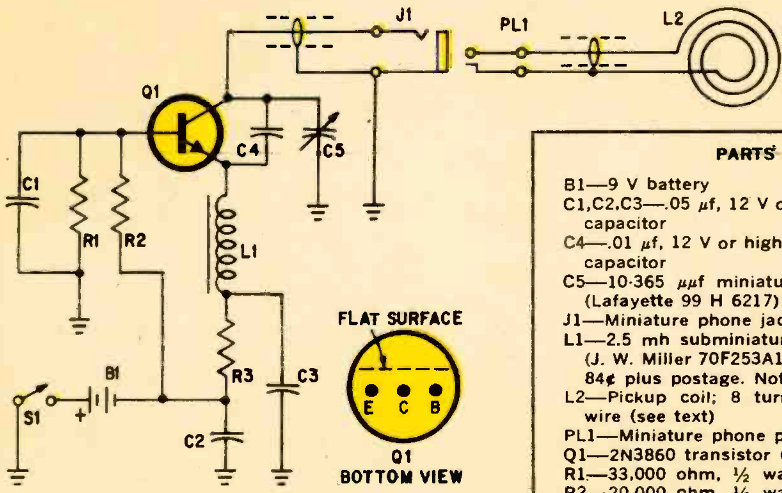
Tuning capacitor C5 can be any miniature type as long as its maximum capacitance is approximately 365 $\mu\mu$f. Either use the low-cost unit specified or the antenna section of a two-gang tuning capacitor salvaged from a transistor radio. Install C5 so that the dial will project above the cabinet so you can easily turn the dial to change the operating frequency.

The terminal strip shown is a miniature type, such as would be found in transistor equipment; a standard-size terminal strip will be too large for the cabinet.





Layout is not terribly critical but note that resistor R1 and capacitors C1,C2,C3 as well as lead from S1 are all grounded at same point. Watch the heat when soldering Q1 or you'll ruin it.



Metal near L2 changes its inductance causing it to shift 1,000 kc oscillator's frequency. This causes tone change in nearby radio set to 1,000 kc.

PARTS LIST

B1—9 V battery
C1,C2,C3—.05 μf, 12 V or higher ceramic disc capacitor
C4—.01 μf, 12 V or higher ceramic disc capacitor
C5—10-365 μμf miniature variable capacitor (Lafayette 99 H 6217)
J1—Miniature phone jack
L1—2.5 mh subminiature iron-core choke (J. W. Miller 70F253A1, Allied 54 E 1869, 84¢ plus postage. Not listed in catalog)
L2—Pickup coil; 8 turns No. 22 enameled wire (see text)
PL1—Miniature phone plug to match J1
Q1—2N3860 transistor (GE)
R1—33,000 ohm, ½ watt, 10% resistor
R2—20,000 ohm, ½ watt, 10% resistor
R3—1,000 ohm, ½ watt, 10% resistor
S1—SPST slide switch
Misc.—4 x 2⅛ x 1⅝-in. Minibox, terminal strip

Metal Locator

To avoid soldering-heat damage, Q1 must be the last part installed. Do not cut Q1's leads short—use them full length. The wire from Q1's collector to J1 is ordinary shielded wire—you can use thin coax—with the shield connected *only* at J1's ground lug. Tape the shield at the transistor end of the wire to prevent strands from shorting to other components.

Winding the Coil. The search head is a 10½-in. dia. piece of ½ or ¾ in. thick stock; plywood is fine. Drill two holes approximately 1/16 in. dia. spaced about ½ in. apart from the top of the head through to the side as shown in the drawing. Pass about 3 in. of No. 22 enameled wire through one hole so the free end sticks through the top of the search head and wind 8 tight turns.

There's no need to be neat, just 8 tight turns, even a scrambled winding will do. Pass the free end of the wire up through the second hole and then twist the two free ends together twice to secure the coil. Coil rigidity is extremely important, so coat the coil with a thin layer of silicon rubber adhesive such as Silastic Bathtub Caulk. Let the adhesive dry overnight. If you don't have any No. 22 enameled wire you can substitute 9 turns of No. 22 hookup wire or No. 24 enameled wire.

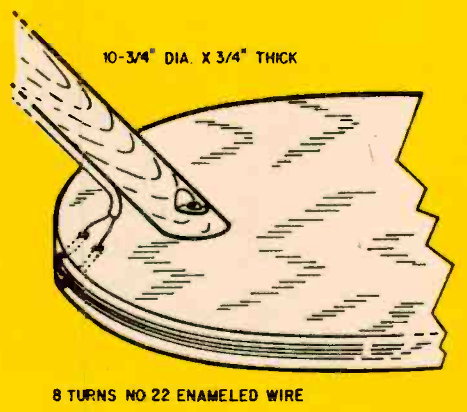
Final Assembly. Salvage the handle from an old broom or mop, cut an angle on the bottom end and attach the handle to the search head. A single wood screw will hold the handle to the head if you also use a good contact cement such as Touch-And-Glue.

Mount the oscillator cabinet on the handle, about 12 in. down from the top. Connect a shielded lead to PL1, plug PL1 into J1 and run the wire to the bottom of the handle, fastening it in place with staples. Cut the free search head wires short and attach them to the braid and hot lead of the shielded wire: it doesn't matter which goes to which.

Checkout. Place a transistor radio near the box; it can be taped on the handle just below the oscillator cabinet as shown. Tune in a reasonably strong station above 1,000 kc—the locator's oscillator does not operate below 1,000 kc. Carefully adjust C5 until you hear a loud beat note in the radio. If you now pass the coil near metal you should hear the beat note change pitch.

If you do not get the beat try tuning to a station well above 1,000 kc; depending on how you made L1 the locator might not tune all the way to 1,000 kc. If you still can't get the beat check for a wiring error. Normal battery current is 2 to 6 ma.

Using the Locator. Tune in your reference station and slip the radio into a pocket or tape it to the finder's handle. Hold the search head a few inches above the ground and adjust C5 for a low-pitched growling beat note in the radio. As you move the search head, keeping it as close to the ground as is possi-



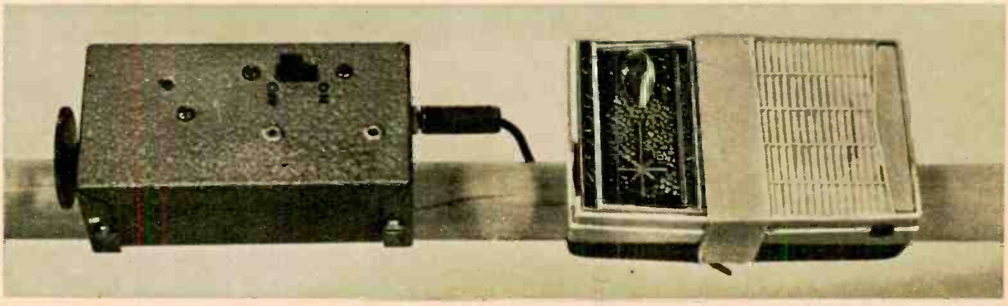
The search-head coil should be wound on a 10½-in. dia. piece of ½ or ¾-in. thick plywood; coil is scramble wound around edge of wood. Because coil must be as rigid as possible, coat it with a thin layer of silicon rubber adhesive. Make certain the adhesive completely covers every bit of the wire.

ble, there should be no change in the beat's pitch until you pass over metal. Then, depending on the type of metal, the note will slide up or down in pitch. Try to use a growl, rather than a high pitched beat, as a very slight change in L1's inductance will cause a large change in pitch when a growl is used as the reference.

The locator's sensitivity will depend on the size of the buried object. Coins can be detected about 1 to 2 in. below the surface, depending on their size. About 25 sq. in. of metal can be detected from 2 to 4 in. As the object gets larger the sensitivity gets better. Very small objects will cause only a barely perceptible change in beat note, so pay attention to those minute changes in frequency.

How it Works. As we said, you simply tune in a strong broadcast station on a transistor portable which can be kept in a pocket or taped to the handle of the locator. Then, you adjust C5 until you hear a loud squeal in the radio. Finally, C5 is trimmed so the radio tone becomes a low growl. When L2 is passed over any metal the growl will either go up or down in pitch, or down to full zero beat. Since the broadcast-station frequency is maintained to ± 20 cps and since the radio's oscillator is not an integral part of the treasure finder, the drift of one oscillator, and the tendency of the oscillators to lock up, is eliminated.

Coil L2 does not need the usual electrostatic shield. When a shield is used all the capacitive effect is eliminated and there is no change in the oscillator frequency as the coil is brought near the ground. However, a shielded coil responds only to ferrous metals, not to aluminum and copper. By leaving off the shield the locator detects all metals.



Radio can be carried in your pocket or taped to the Locator's handle directly below the oscillator. Don't try to pick up more signal by moving the radio closer to oscillator or the radio will jam.

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Advanced Features. Top quality American brand color tube . . . 227 sq. in. rectangular viewing area . . . 24,000 v. regulated picture power . . . improved phosphors for brilliant, livelier colors . . . new improved low voltage power supply with boosted B+ for best operation . . . automatic degaussing . . . exclusive Heath Magna-Shield to protect against stray magnetic fields and maintain color purity . . . ACC and AGC to reduce color fade and insure steady, flutter-free pictures under all conditions . . . preassembled & aligned IF with 3 stages instead of the usual 2 . . . preassembled & aligned 2-speed transistor UHF tuner . . . deluxe VHF turret tuner with "memory" fine tuning . . . 300 & 75 ohm VHF antenna inputs . . . two hi-fi sound outputs . . . 4" x 6" 8 ohm speaker . . . choice of installation — wall, custom or optional Heath factory assembled cabinets. Build in 25 hours.

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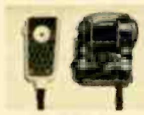

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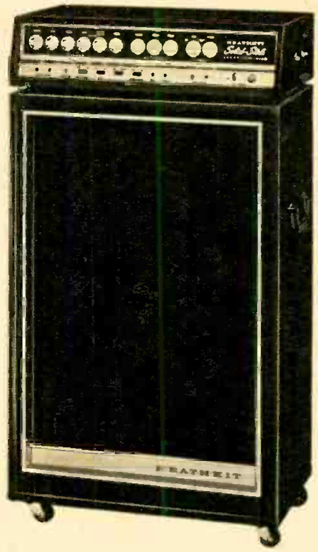

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The Heathkit TA-17 Deluxe Super-Power Amplifier & Speaker has 180 watts peak power into one speaker (240 watts peak into a pair); 3-channels with 2 inputs each; "fuzz", brightness switch; bass boost; tremolo, reverb; complete controls for each channel; foot switch; 2 heavy duty 12" speakers plus horn driver. Also available separately kit or factory assembled (Kit Amplifier TA-17, $175; Assembled $275; Kit Speaker TA-17-1 $120; Assembled $150; Kit TAS-17-2, amp. & two speakers $395; Assembled TAW-17-2, amp. & two speakers $545).

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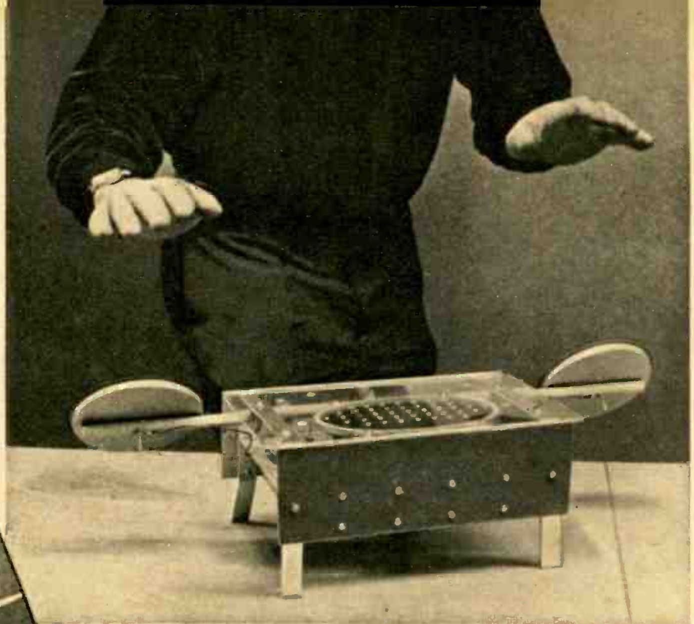
10th ANNIVERSARY
2
SPECIAL

Cover, Jan. 1961 EI



Wide-Range Theremin

By DAVID WALKER

DRIFTING in from outer space, lurking in shadows of intrigue or part of the scoring of a psychedelic musical selection is the spine-chilling sound of the theremin. It's eerie and you probably can recall it if you remember the film Spellbound or are a devotee of science-fiction pictures. The invention of a Russian engineer named Leo Theremin, the device is relatively simple and you can build one easily to produce your own creepy sounds.

Unlike the theremin in our January 1961 issue, this one doesn't have to be operated through a radio or hi-fi amplifier (you could do it that way, though, by taking the signal from J1 in the schematic); it has a built in amplifier and speaker and is battery operated. By moving your left hand near its pitch antenna you'll produce a wide range of tone from a growl up to the shrillest whistles. Volume is controlled by your other hand near the right antenna plate.

Panel and Chassis Preparation. Start construction by assembling the front panel and chassis. The panel, which *must* be metal, measures 12 x 4 in. (aluminum). To the panel are fastened two strips of aluminum to form the framework (Fig. 3). These strips are ¾ in. wide and are available at hardware or metal-supply stores. If you use a 20-in.-long strip you'll be able to bend it to the dimensions shown.

Next, the chassis. Best material is perforated circuit board, though some other non-metallic material (like Masonite) will do. The four corners of the chassis should be fastened to the metal strips with machine screws. Use solder lugs at the four corners for convenient ground connections for

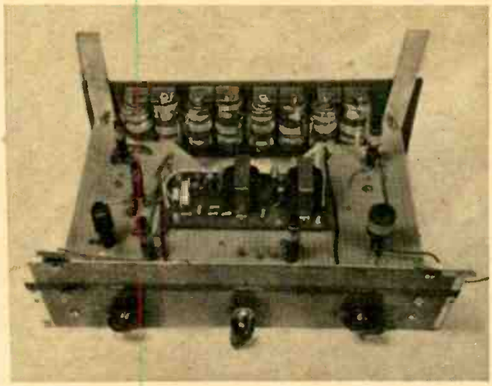


Fig. 1—Underside of theremin. In center is audio-amplifier module. To prevent shorts, space it at least ¼ in. away from perforated-board chassis.

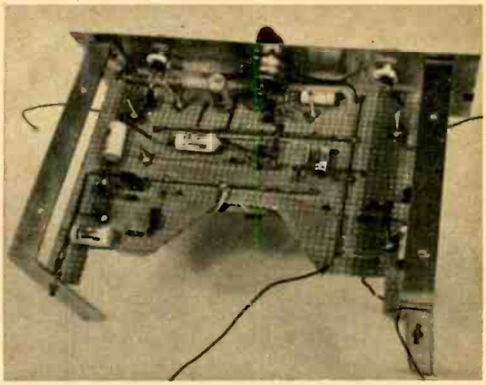


Fig. 2—Top of theremin. Cutout in circuit board (foreground) is for speaker and batteries. Speaker is mounted on plastic panel which sits on top.

the ground buses. The buses are bare copper wires which run along the board and are used for connections of parts to the positive (or ground) side of the circuit. The negative side of the circuit must not connect to ground. Cut out the rear of the board for the speaker and batteries, which are mounted last.

Amplifier Mounting. Mount the amplifier module on the underside of the board (Fig. 1). But mount it so its bottom surface is ¼ in. away from the board. This allows other parts to be installed on the top of board without touching the foil on the underside of the amplifier. Don't follow the wiring instructions supplied with the module. Use our pictorial (Fig. 4) for connecting the colored wires.

Coil Mounting. Unless you have the right-size drill bits for cutting the holes for the coils, drill a small hole where a coil is to be mounted. Then gradually enlarge it with a reamer until the coil's collar just fits through. The coil can then be snapped into place by applying firm pressure from the underside of the chassis. As you press the coil up, rock it slightly from side to side so the two metal tabs on its collar snap out on the top of the chassis. Note that the coil also has a tiny metal indexing tab on its collar. Try to align this tab with one of the board holes before snapping the coil in place. Solder a short piece

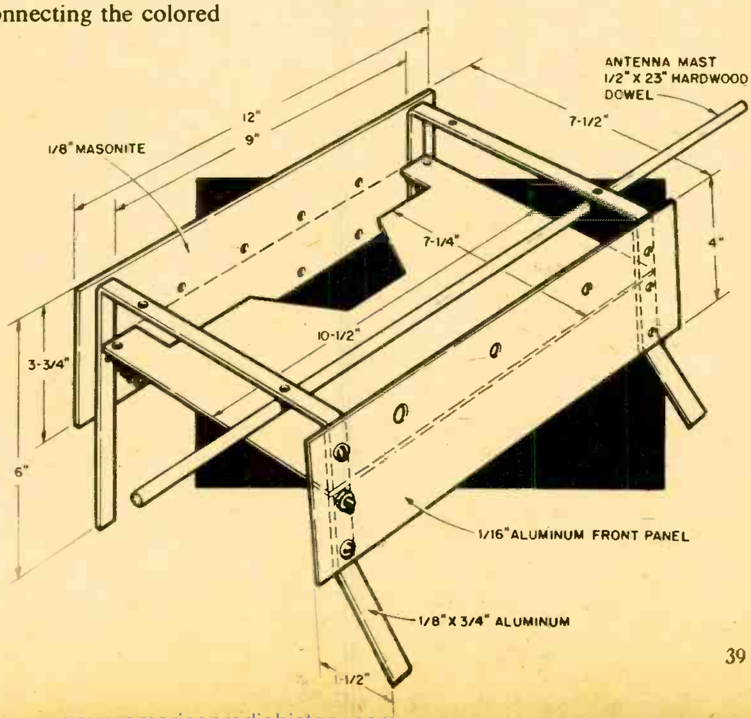


Fig. 3—Should you wish to duplicate our model, use the dimensions in this diagram. The front panel must be metal to eliminate the effects of hand capacitance when you adjust the front-panel controls. We used clear plastic for the top only to make insides visible to the curious. It could just as well be Masonite or a thin piece of plywood.

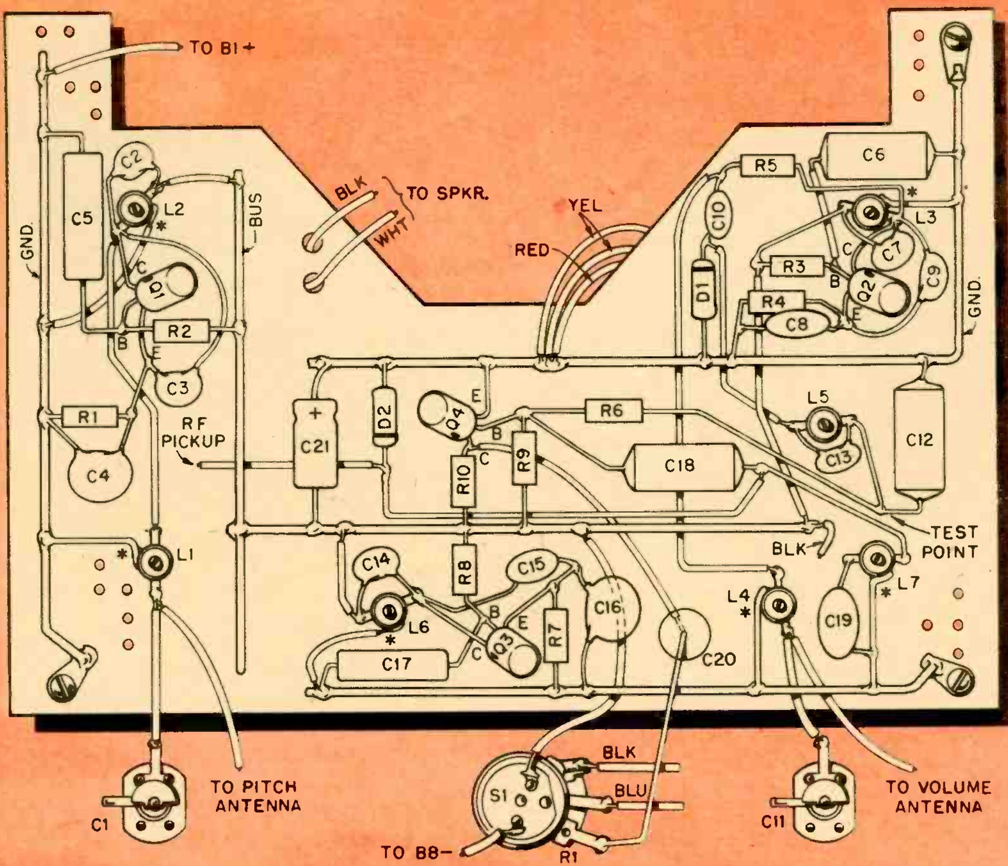


Fig. 4—Mount all parts exactly where shown on 10¼ x 7¼-in. perf.-board chassis. Asterisks (coils L1, L4, L6, L7) indicate wire from coil collar to ground. Color-coded wires (8) come from amplifier underneath.

Wide-Range Theremin

of wire from the collars of coils L1, L2, L3, L4, L6 and L7 to ground.

Circuit Assembly. Almost all parts are installed on the top of the board. Be extremely careful when wiring on the board above the amplifier module. You can use the holes for anchoring and soldering parts, but wires should not protrude down too far or they'll touch the back of the amplifier.

Notice one wire marked *RF Pickup* in the pictorial (Fig. 4)—about 2 in. long from diode D1—that apparently goes nowhere. It acts as a pickup of RF energy radiated by Q1 and Q3 and must go where shown. On R1, solder the top lug (Fig. 4) to the case.

After chassis wiring is completed, prepare the rear and top panels. Since both of these panels might have to be removed at a future time, be sure to leave ample slack in battery and speaker wires. In our model, the top panel is made of ⅛-in. thick polystyrene (available from electronic parts distributors).

There's a cluster of holes above the speaker for the sound. Also, drill a ¼-in.-dia. hole above each coil's slug-adjustment screw to permit alignment with all components and top panel in place.

The antenna plates are mounted at each end of a ¼-in.-dia. wood dowel which is attached to the aluminum strips. (This dowel must not block any coil slugs.) The antennas in our model are covers from pipe-tobacco cans, but any piece of metal with an area about the size of your hand will do. When a nut and bolt are used to mount the antennas on the dowel, be sure to scrape away the paint on the can cover to assure good electrical contact.

Alignment. Although the coil slug screws can be turned by a thin screwdriver, they won't last long under this treatment. Avoid damage by using an alignment tool with a recessed blade especially made for

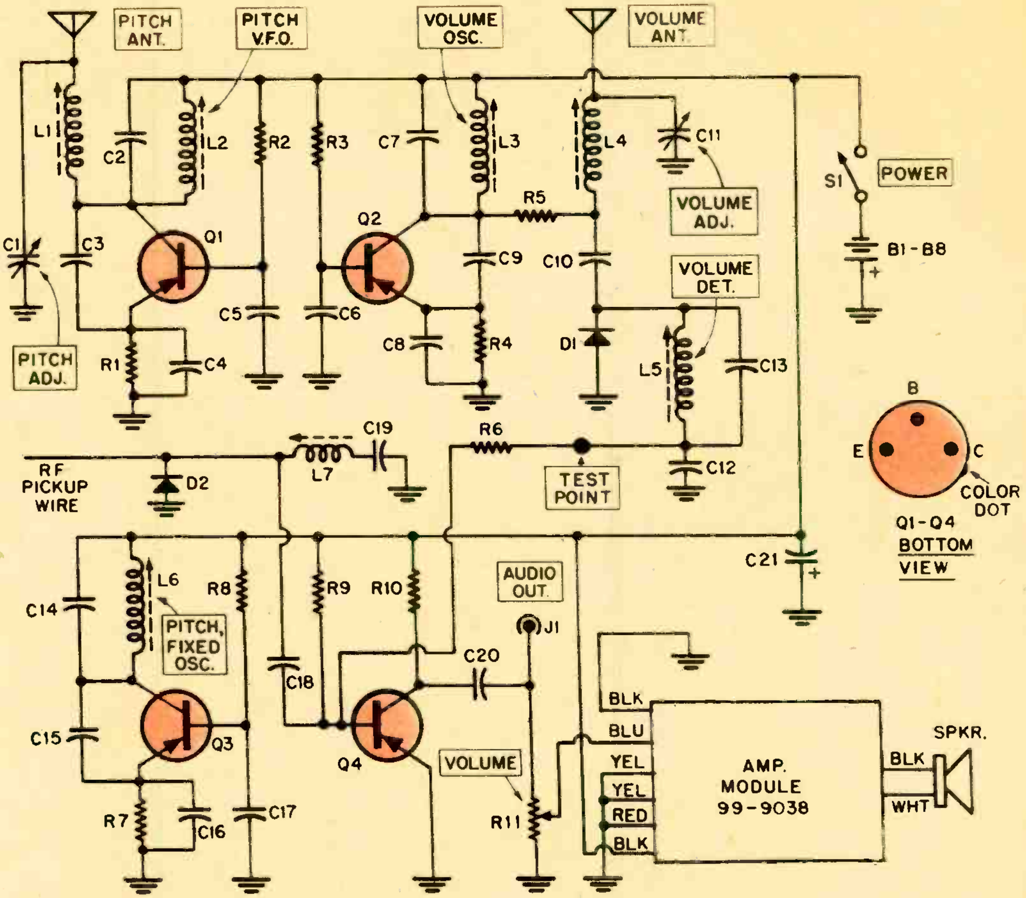


Fig. 5—Detection (D2) of signals from variable- and fixed-frequency oscillators Q1 and Q3 produces tone. Detected (D1) signal of variable-frequency volume oscillator (Q2) changes bias of Q4 and volume.

PARTS LIST

B1 through B8—1.5 V battery (size C)
Capacitors: 50 V or higher unless otherwise indicated
C1,C11—1.5-5 μμf subminiature variable capacitor (E. F. Johnson 160-102, Allied 43 B 3758)
C2,C7,C13,C14—330 μμf ceramic disc
C3,C9,C15—.001 μf ceramic disc
C4,C8,C16—.01 μf ceramic disc
C5,C6,C12,C17,C18,C20—.1 μf tubular
C10—.005 μf ceramic disc
C19—100 μμf ceramic disc
C21—100 μf, 15 V electrolytic
D1,D2—1N34A diode
J1—Phone or phone jack (see text)
Coils: Ferrite RF, all adjustable (Superex Vari-Choke No. in paren.)
L1—30-130 mh (V-60)
L2,L4,L6—.65-6 mh (V-6)
L3,L5—0.15-0.75 mh (V-5)
L7—5-43 mh (V-25)
(A package of the aforementioned seven coils is available from Allied Radio for $6.75 plus postage. Order Stock No. 11-1748. Not listed in catalog.)
Q1-Q4—2N1524 transistor (RCA)
Resistors: ½ watt 10% unless otherwise indicated
R1—1,000 ohms
R2,R3,R5,R8—47,000 ohms
R4,R7—680 ohms
R6—33,000 ohms
R9—2.2 megohms
R10—100,000 ohms
R11—5,000 ohm audio-taper potentiometer with SPST switch
S1—SPST switch on R11
SPKR.—5 x 7-in. 8-ohm speaker
Misc.—1-watt audio amplifier (Lafayette 99 H 9038), knobs, perforated circuit board, ¾-in. wide x ⅛-in. thick aluminum strips, 5-in. dia. metal can covers, holders for size C cells, wood dowel, 12 x 4-in. metal panel, Masonite

Wide-Range Theremin

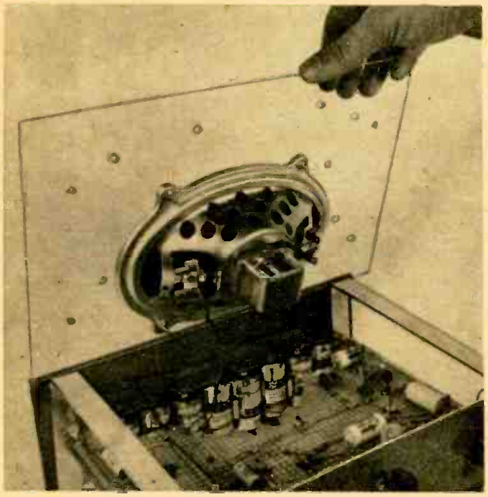


Fig. 6—Only reason for mounting speaker on clear plastic is to permit look at inside. Holes are for access to slug-adjustment screws on the coils.

coil slugs. (General Cement No. 8276). Alignment will be done in two steps; first the pitch section, then the volume circuits. Until you're familiar with the various alignment points, follow this step-by-step procedure the first time. All coils and the test point are shown in Fig. 7.

Refer to Fig. 4. Connect a short clip lead from the *test point* to a circuit ground. Turn the volume control all the way up. Turn L1's slug all the way down so the screw is nearly flush with the top of the collar. Turn L2 until its screw is about half way in, or protruding about 1 in. above the collar. Do the same for L7. Next, align in this order:

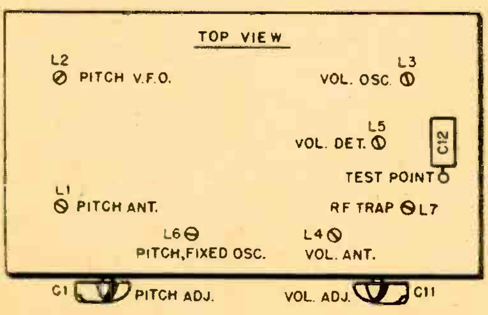


Fig. 7—When aligning and making adjustments, refer to this diagram which shows the location of each of the coils and the front-panel controls.

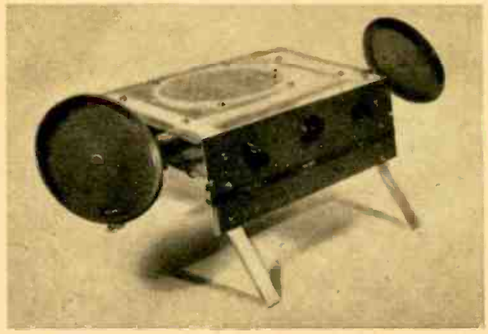


Fig. 8—Completed theremin. Tone plate is at left, volume plate at right. Both are tops of tobacco cans. You must touch left plate before each use.

1) Tune L6 through its complete range. You should hear several faint zero beats where the tone starts at a high pitch, falls to zero and then rises in pitch. Find the loudest range and then tune that one for a zero beat.

2) Turn capacitor C1 (*Pitch Adj.* knob on the front panel) until its plates are half meshed.

3) Start turning L1's slug counterclockwise. As the slug rises it will begin to affect the pitch of the sound. Continue turning L1 until the tone rises to the highest pitch you can still hear.

4) Tune L6 to bring the pitch of the tone *down* until it disappears at the zero beat.

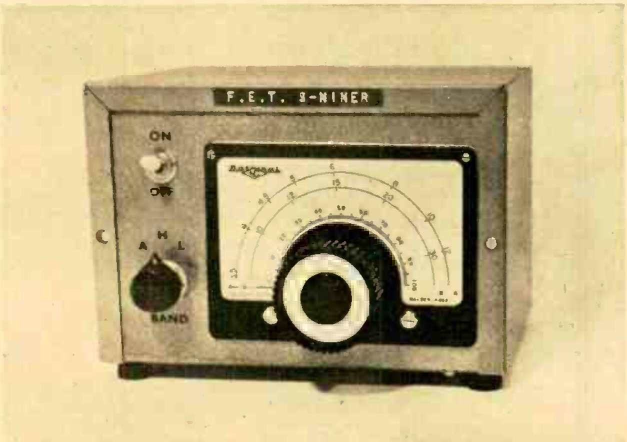
This completes alignment of the pitch section. You can check the job in two ways: Rock C1 back and forth to see if you can control the zero-beat point. Always adjust C1 so you hear a very low-pitched tone. Then, as you bring your hand toward the pitch antenna, the tone should rise in pitch.

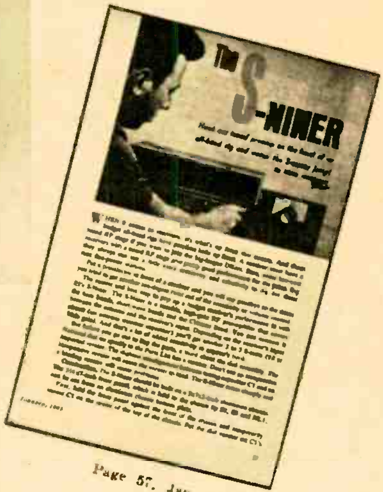
Note: If you turn off the theremin and turn it on again, you must always *touch* the pitch antenna momentarily to trigger the oscillator. This allows the pitch oscillator to be aligned very critically and to operate with extremely high sensitivity to hand capacitance.

Volume Alignment. Remove the jumper between the *test point* and ground. Connect a VTVM to the *test point* and to a ground bus. Set the meter so it can measure approximately 3 VDC, then turn the meter's zero knob so the needle rests at mid-scale; this allows positive or negative indications. Throughout the following steps you must

[*Continued on page* 110]

10th ANNIVERSARY 3 SPECIAL





Page 57, Jan. 1965 EI

The FET S-Niner

By VICTOR KELL

THE DX game is funny that way. You could have the hottest short-wave receiver or the cheapest budget job but there always is that one signal—just below the sensitivity threshold—that is the one you've got to hear.

To the SWL the lost signal might be a flea-power transmitter from a two-bit country trying to make the big time around 7 mc. To the ham with a pair of tight cans on his head it could be the signal worth waiting hours for. It might be the whisper from a DXpedition to the Tsooris Islands. Whatever it is, there is always a time when you need a smidgen more receiver sensitivity.

Put our updated solid-state S-Niner ahead of your receiver and you'll hear signals you never knew existed. Big thing about this S-Niner, compared to the one in our January 1965 issue, is that it uses a field-effect transistor instead of a tube. The S-Niner will give you a 12db to 18db (2 to 3 S-unit) kick in the antenna. Put another way, if you've got a budget receiver with a 5-μv sensitivity the S-Niner will give you a sensitivity of at least 1.2 μv. And if you've got one of those de luxe receivers with less than 1 μv sensitivity the S-Niner will put you below the measurement range of lab-grade instruments.

The S-Niner is an RF preselector (or pre-amplifier if you prefer) tunable from 3.5 to 30 mc in two bands. Gain is provided by a combination of antenna matching and a field-effect transistor (FET). The high input impedance of the FET insures that the Q of the antenna coils (L1, L2) remains high while low internal noise insures a high signal-to-noise ratio.

Take a look at the schematic (Fig. 1). The S-Niner has separate low- and high-band antenna coils. The FET's output is broadband—not tuned—to prevent oscillation. This eliminates the need for complex shielding

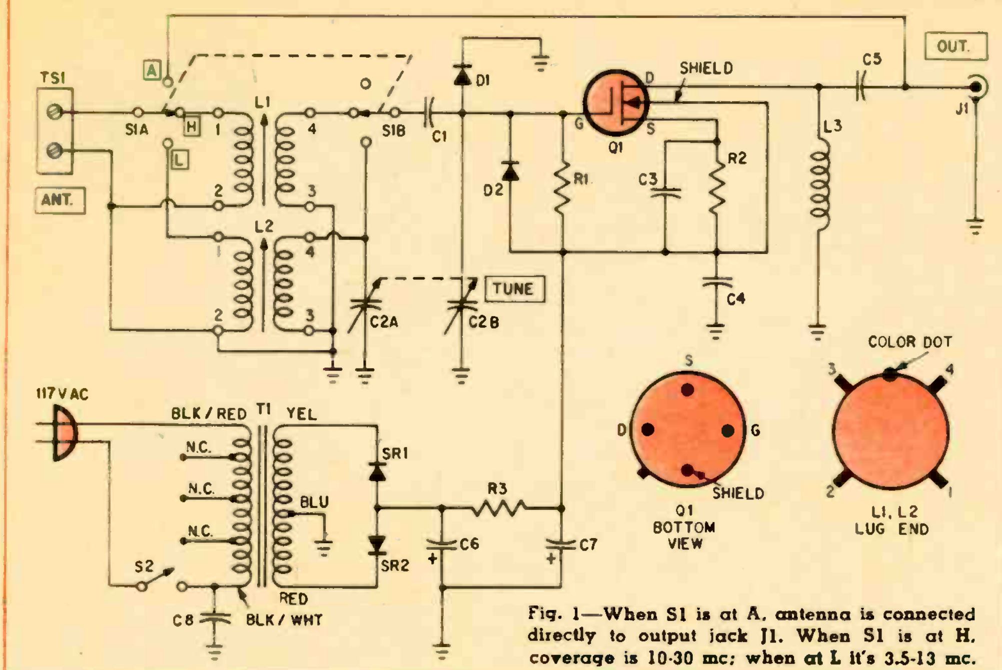


Fig. 1—When S1 is at A, antenna is connected directly to output jack J1. When S1 is at H, coverage is 10-30 mc; when at L it's 3.5-13 mc.

The FET S-Niner

PARTS LIST

Capacitors: 15V or higher unless otherwise indicated
C1—470 μμf ceramic disc
C2A,C2B—10.3-365.7 μμf 2-gang variable capacitor (Lafayette 32 H 1102 or equiv.)
C3,C4—.05 μf ceramic disc
C5—.005 μf ceramic disc
C6—1,000 μf electrolytic
C7—500 μf electrolytic
C8—.01 μf, 500 V ceramic disc
D1,D2—1N912 diode
J1—Phono jack
L1—12-36 mc antenna coil (J. W. Miller D-5495-A, Lafayette 34 H 8720)
L2—5-18 mc antenna coil (J. W. Miller C-5495-A, Lafayette 34 H 8751)
L3—2.5 mh subminiature RF choke (J. W. Miller 70F253A1, Allied 54 E 1869. 84¢ plus postage; not listed in catalog)
Q1—40468 field-effect transistor (RCA)
R1—220,000 ohm, ½ watt 10% resistor
R2—330 ohm, ½ watt, 10% resistor
R3—1,200 ohm, ½ watt, 10% resistor
S1—2-pole, 3-position non-shorting rotary switch (Mallory 3223J, Allied 56 B 4353)
S2—SPST toggle or slide switch
SR1, SR2—Silicon rectifier; minimum ratings: 50 ma, 100 PIV (Allied 24 B 9692 or equiv.)
T1—Multi-voltage transformer (Allied 54 B 4731)
TS1—Screw-type terminal strip
Misc.—Vernier dial (National MCN, Allied 47 B 2171 or equiv.) 4 x 5 x 6-in. Minibox.
A kit containing L1, L2, L3 and Q1 is available from Tridac Electronics Corp., Box 313 Aldon Manor Branch, Elmont, N.Y. 11003. Price of $6.35 includes postage. N.Y. State residents add appropriate sales tax.

and component layout.

Note also diodes D1 and D2 connected to the FET's input. Their purpose is to prevent high-level RF surges from damaging the FET. The diodes must be used if you intend to operate near a ham transmitter. Since, to some degree, D1 and D2 reduce sensitivity, we suggest they be eliminated in a unit intended for SWLing only. An S-Niner used without the diodes should be grounded to prevent random RF pulses from breaking down the FET.

Construction

The S-Niner is built in the U-section of a 4 x 5 x 6-in. Minibox. First step is to cut the hole for the National Co. MCN vernier dial; a mounting template is supplied with the dial. Temporarily mount tuning capacitor C2 so the center of the tuning shaft is 2⅜ in. from the right edge of the cabinet. Then mark the front panel with the location of C2's tuning shaft. Remove C2, tape the dial's template to the panel, then drill and cut the holes for the dial.

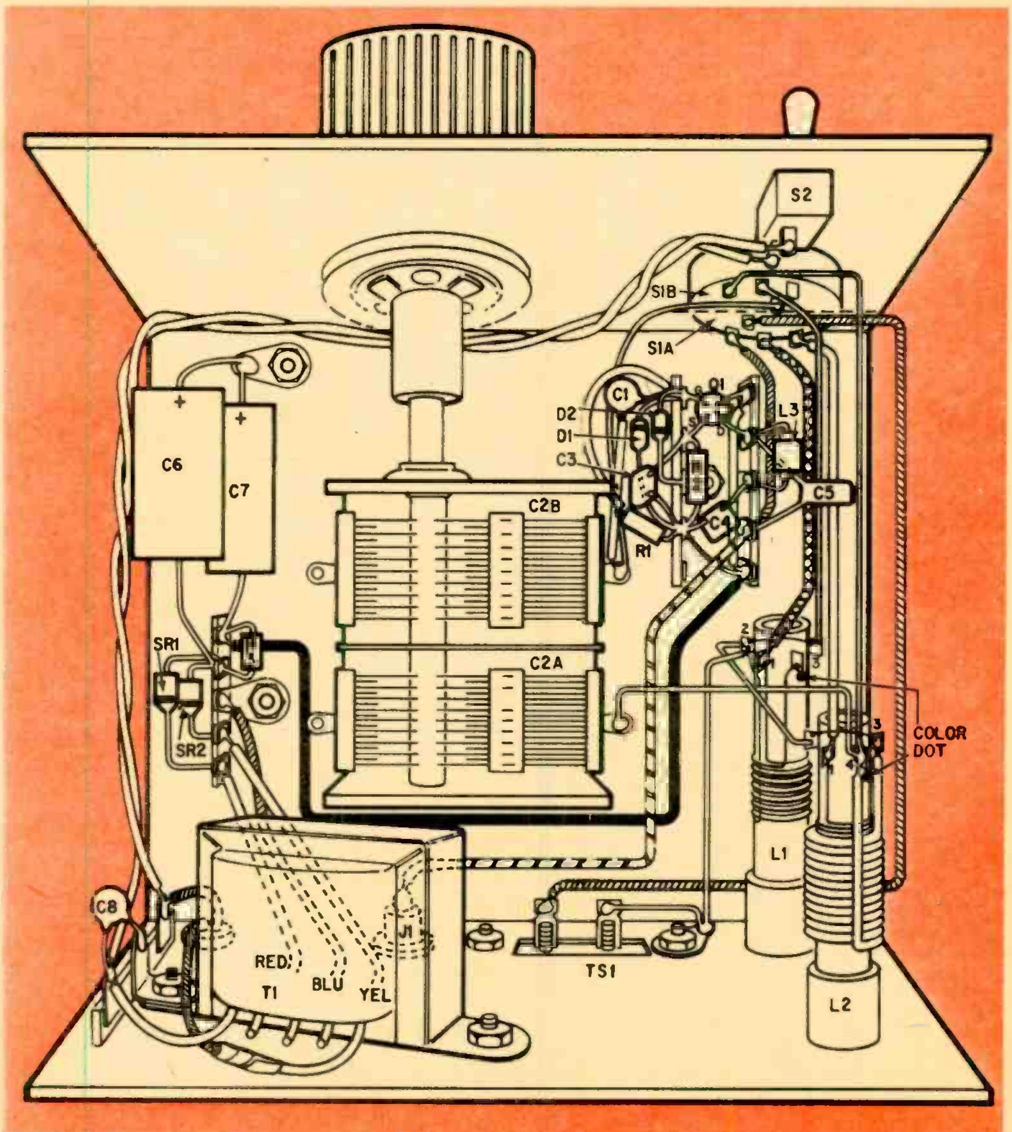
Temporarily mount the dial to the front panel and mount S1 and S2 on a line ⅝ in. from the left edge of the dial—1 in. from the left edge of the cabinet. Coil L2 is mounted on the rear apron directly behind S1 and 1⅜ in. above L1 (behind S2).

Drill the chassis holes for all other components except power transformer T1. Temporarily re-install C2, then hold T1 on the left corner of the rear apron and rotate C2 through its entire range. If T1 interferes with C2's plates, reposition it. There should be at least ¼ in. between C2's plates and T1. Mark T1's position, remove C2 and drill T1's mounting holes.

Mount all chassis components first, then complete the power supply. T1 is a special multi-tapped transformer which provides several voltages. Use only the color-coded leads indicated in the schematic and pictorial. Cut off all other wires close to T1 making certain no loose strands from the cut wires touch the chassis.

Check the power supply before proceeding with the FET wiring. The voltage at the junction of R3 and C7 with no circuit connection at the junction should be between −9 and −11 V. If it is lower or higher check that you have used the correct transformer wires.

Fig. 2—Inside view. Mount and connect coil L1 before coil L2. On power transformer T1, red, blu and yel leads are secondary. Primary leads are black/red and black/white. Be sure C2 does not touch T1.



The FET S-Niner

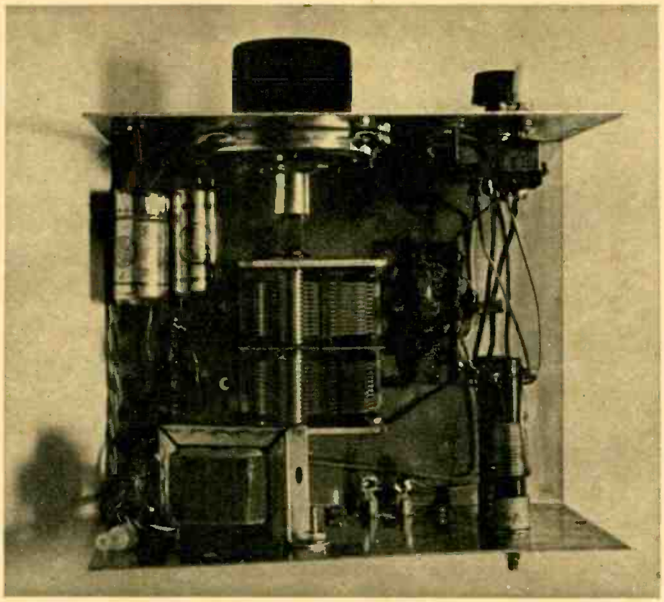


Fig. 3—Install coils and components at right of variable capacitor before installing capacitor and transformer. Before permanently installing transformer (lower left), temporarily position variable capacitor, open its plates fully and make sure they don't touch transformer. And do not force-fit dial coupling on variable's shaft or the dial will bind and will not turn.

If the power supply checks out, proceed to the FET wiring in the following order: Install R1, R2 and C1, then D1 and D2, if used. Then install Q1. Note that Q1 is oriented so its leads face *up*. Make certain Q1's leads do not touch and that Q1's case does not touch the cabinet. Next, install choke L3 and capacitor C5. To avoid instability do not substitute another choke for the specified L3, a subminiature 2.5-mh choke. Now install capacitors C3 and C4.

Finally, complete the wiring of antenna coils L1 and L2 and connect the B−. Coils L1 and L2 should be wired with No. 18 or No. 16 solid wire to insure rigidity. Note in the schematic and pictorial that L1 is connected first when S1 is moved from the *A* or direct-from-antenna-to-receiver position. Also note that C2's rear section is connected only when S1 is set to the low band (L2). When L1 is used, only C2B, the front section, is in the tuning circuit.

Checkout and Alignment

First thing to do is to insert one of the blank dial cards in the dial's frame. Connect J1 to a receiver through a very short length of coax such as RG58A/U. Set S1 to the *A* position, so the S-Niner's antenna input (TS1) is directly connected to J1. Connect a signal generator set to 3.5 mc to TS1 and tune in the generator's signal on the receiver. (Use the lowest possible signal generator output level.) If you don't have a signal generator connect an antenna to TS1 and tune in a moderate to weak signal at approximately 3.5 mc—on the high side of 3.5 mc, not on the low side.

Switch S1 to the low band (*L*) position, set C2 so its plates are fully meshed (maximum capacitance) and adjust L2's slug for maximum signal into the receiver. Mark the dial 3.5. Tune in a 4-mc signal and tune C2 for peak gain; mark the dial 4. In the same manner calibrate the entire dial to 10 or 12 mc.

Set S1 to the high band (*H*) position and set C2 for minimum capacitance (plates open). Tune in a 30-mc signal and adjust L1 for peak signal. We recommend alignment of L1 at 30 mc, but if your receiver doesn't go up that high, set C2 to maximum capacity (plates fully meshed) and tune and peak a 10-mc signal. Calibrate the high-band dial the same way as the low-band dial.

Operation

The S-Niner requires no warm-up time; therefore, it can be left off until needed. In normal operation S1 is kept in the *A* position with S2 off. If a particular signal is too weak for normal reception, simply flip S2 to *on*, set S1 to the desired band and peak the signal with C2.

Pages 46-47, July 1961 EI

Two-Way Power Pack

PORTABILITY—that big feature of electronic equipment which permits operation on self-contained batteries—has become commonplace in many tape recorders and TVs.

But what of other equipment which will operate only on 117 VAC? When you're out fishing how could you watch a tube TV if the only available power is 12 VDC from the boat's battery? The solution is simple. You'd use a solid-state inverter to change 12 VDC to 117 VAC—or thereabouts.

In our July 1961 issue we published plans for an inverter which would supply up to 115 watts at 115 VAC for a TV, sewing machine or electric razor. As is the case with all inverters, ours pulled a lot of juice out

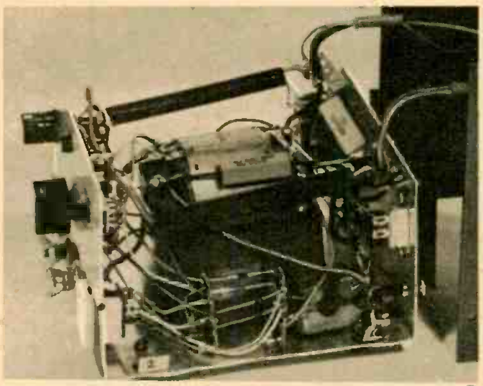


Fig. 1—Inside of power pack. As transformer (large object, center) is installed last, there's plenty of space in which to work when mounting parts.

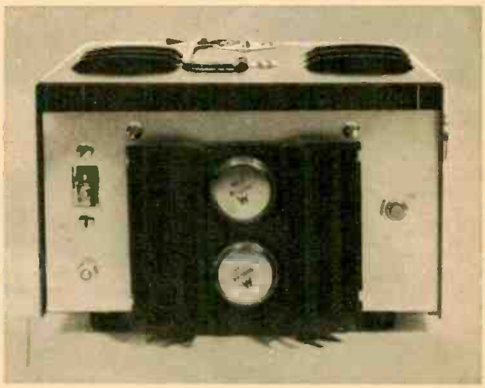


Fig. 2—Rear of power pack. Outlet at left is for 117-VAC power cord; button at right is circuit breaker. Transistors are on heat sink in center.

Fig. 3—Photo at right is of TV set operated on 117 VAC. Photo at left is of TV set operated from power pack. Note that picture is smaller in height and width (studio camera change further reduced size of men). Loss is due to lower B+ voltages caused by square-wave input power.

Two-Way Power Pack

of the car's battery, which could make starting the car difficult. Ideally, you'd think, an inverter should somehow be able to put back into a battery what it has taken out.

This can be done and rather easily, too. However, after attempting to modernize our previous circuit we concluded that at the present state of the art, it makes better sense, in terms of cost and performance, to assemble a kit rather than build an inverter/charger from scratch.

Such a kit is Allied Radio's Knight-Kit KG-666 Power Inverter/Charger (two-way power pack). The price of the kit is $44.95. (A 125-watt inverter/charger, the Model KG-662 costs $34.95.) The KG-666 will deliver up to 200 watts at 110-130 V with a square-wave output of 55-65 cps. Thus, our 1968 project becomes a kit report rather than a start-from-scratch project.

The exact output frequency is slightly dependent on the load. An unusual though useful feature is another socket at which is available 120 VDC. This DC output is particularly valuable when powering equipment with a universal motor, such as a hand drill or power saw. Universal motors when powered by square-wave AC lack torque and run slowly. But when powered by DC they run as fast or slightly faster than they would if powered with 60-cps sine-wave AC, and they have almost full torque.

In the charge mode the KG-666 delivers a maximum charging current of 6 A, which tapers off as the battery is charged.

Take a look at the KG-666's front panel in the photo at the top of the first page of this article. A single rotary switch selects the mode of operation and turns the whole thing off. The AC power cord—for the charge mode—plugs into the back of the unit. The AC and DC power-output sockets and the battery-power lugs also are on the front panel.

Assembly is one of the those one-evening projects (if you work fast). All components except the power transistors are inside the cabinet. The transistors mount on the outside of the cabinet cover in the 125-watt version, the KG-662. The KG-666 has a larger power transformer and two additional transistors

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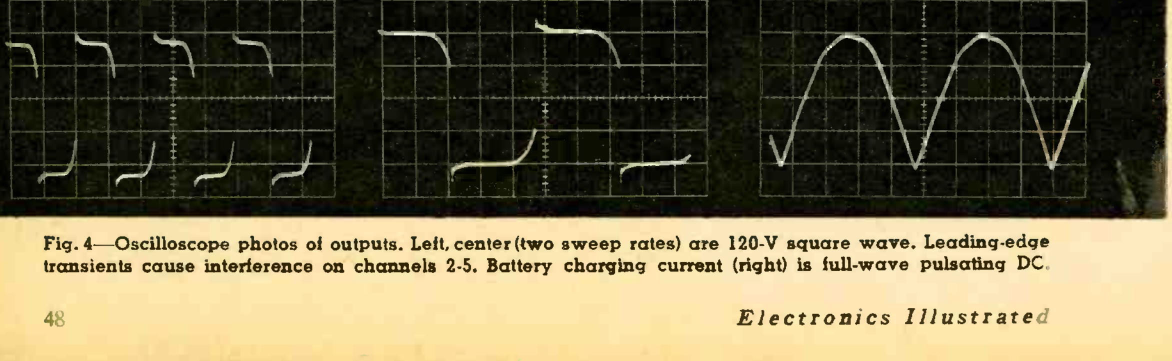


Fig. 4—Oscilloscope photos of outputs. Left, center (two sweep rates) are 120-V square wave. Leading-edge transients cause interference on channels 2-5. Battery charging current (right) is full-wave pulsating DC.

By JOHN SMITH RICHARDS

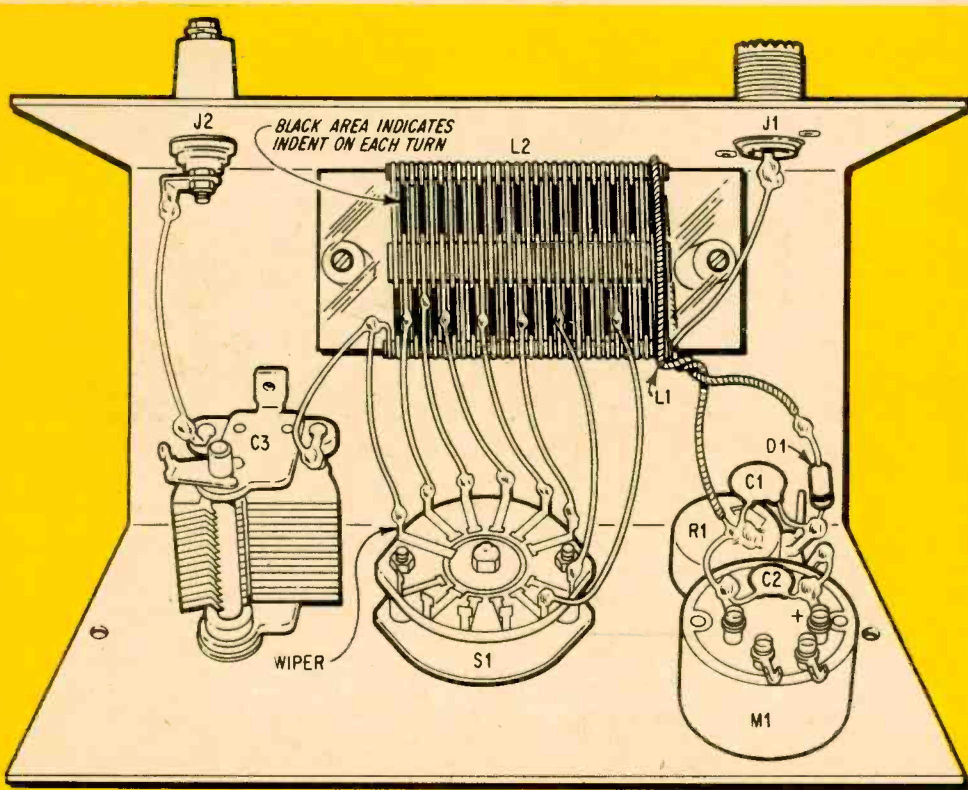
Compact Antenna Tuner

TIME was when taking the ham rig on vacation meant dragging along a couple of heavy cases of gear. Because of this ordeal, portable operation ended up being simply a long stay at only one resort. Now that sideband rigs are just a little bit larger than a weekend size suitcase—and just about as light—there's no reason any longer to leave a rig at home. Even an overnight trip to the mountains or seashore is a good opportunity for a few quick contacts.

But what do you use for an antenna? Stringing even a simple dipole can take up half a day, providing you find the space. Here's the solution. Just tie a rubber ball to the end of a thin copper wire and you've got a long-wire antenna you can toss into the branches of a tree, drop off the side of a hill or throw up to the roof of the house or cottage next door. Add the Compact Antenna Tuner and you're on the air in minutes instead of hours. This tuner has it over the one in our Sept. 1963 issue because it is smaller and includes an RF indicator.

The antenna tuner will match a long-wire antenna, which must be a long wire—40 ft. or more, to any 10- through 80-meter transmitter. If you don't plan to operate on 75 or 80 meters, the antenna can be a minimum-length 20 ft., though the longer the wire the better the results. The tuner incorporates an RF meter. We feel, though, that for optimum results the tuner should be used with an SWR meter.

Construction. Our model is built in a 3 x 8 x 6-in. cowl-type Minibox but any metal cabinet can be used. The specified tuning capacitor (C3) will handle SSB transmitters rated to 250 watts. For higher power use

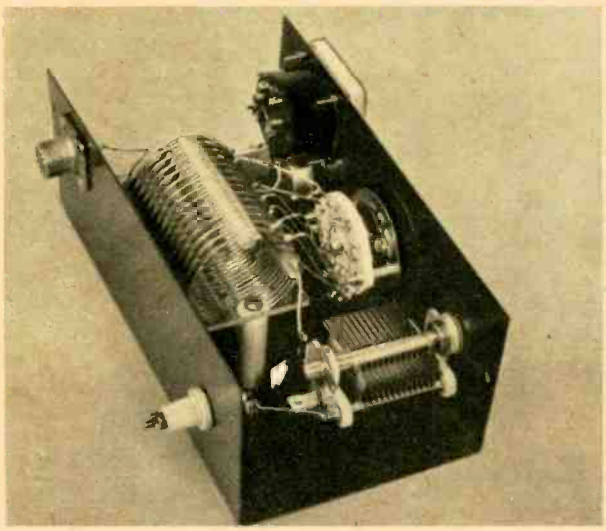


Front panel has been bent down to show connections to M1, R1 and S1 more clearly. Lug on S1 referred to in text as 1 is to right of wiper. Note location of one-turn coil, L1, at right end of L2.

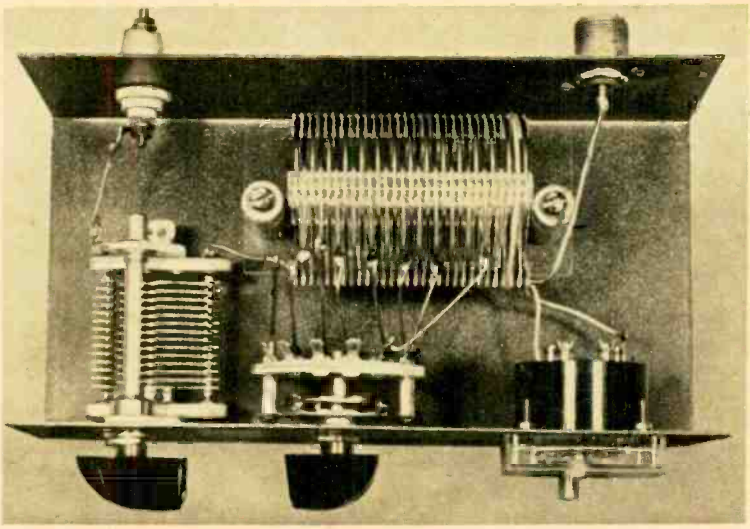
Compact Antenna Tuner

PARTS LIST

C1—.01 µf. 500 V ceramic disc capacitor
C2—.001 µf. 500 V ceramic disc capacitor
C3—10.3-300 µµf variable capacitor (Hammarlund MC-200 M, Allied 43 E 3676. Not listed in catalog; $3.40 plus postage)
D1—1N34A (or equivalent) diode
J1—Coax connector to match existing cable connector
J2—Porcelain feed-thru insulator or coax connector
L1—Meter coil; 1 turn No. 20 or 22 solid plastic-insulated hookup wire (see text)
L2—RF coil, Inside diameter: 1¾ in. No. 14 wire, 2⅝-in. long (Air Dux No. 1411. Available for $2.82 plus postage from World Radio Labs, 3415 West Broadway, Council Bluffs, Iowa. Catalog No. 20-050)
M1—S-meter (Allied 24 B 9333)
R1—25,000 ohm, linear-taper potentiometer
S1—1 pole, 11-position ceramic rotary switch (Mallory 172 C, Allied 56 E 4327. Not listed in catalog; $2.37 plus postage)
Misc.—Minibox, knobs, standoff insulators



Mount coil L2 by attaching plastic support strip through its center to the tops of two porcelain standoff insulators (arrow behind C2 points to one).



Fold L2's right lead back to panel and mark position for J1. Make certain that when J1 is installed, wire from L2 will fit into solder lug. You should not have to splice to L2's lead for connection to J1. We used porcelain feed-thru insulator for J2. Note that in the pictorial a connection is not shown to 28th turn of L2 (extreme right). While this connection will not usually be needed, we suggest you make it if you can route the lead to the next lug on S1 without touching other leads.

a capacitor with proportionately greater spacing between plates.

The capacitor specified for C3 has a linear characteristic and when the plates are open fully the rotor overhangs the stator by a good ½ in. Make certain C3 is positioned as far to the left side of the front panel as possible, but not so far that the rotor plates will touch the cabinet when open fully.

Install coil-tap selector switch S1 so its left edge is at least ½ in. from C3. Position S1 so its wiper contact is at the left, near C3.

Tuning coil L2 is supplied with indented turns and with a plastic mounting strip running through its center. Mount it rigidly in the cabinet with two 1¼-in. high porcelain or steatite standoff insulators. Position L2 so the right edge of the plastic mounting strip is in line with the center of M1 and so that the plastic coil supports (there are two) are at the top and bottom.

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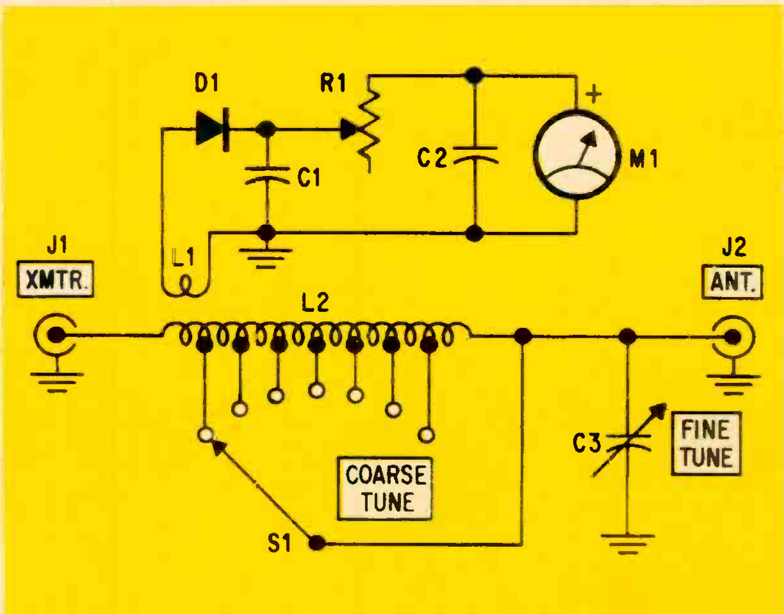

As S1 is turned clockwise it progressively increases inductance in circuit. One-turn coil L1 picks up small amount of RF which is detected by D1,C1 and fed via calibration pot R1 to meter M1. M1 indicates transmitter's relative RF output. Symbol for J2 suggests coax connector; however, we used a porcelain feed-thru.

Gene Frost was "stuck" in low-pay TV repair work. Then two co-workers suggested he take a CIE home study course in electronics. Today he's living in a new house, owns two good cars and a color TV set, and holds an important technical job at North American Aviation. If you'd like to get ahead the way he did, read his inspiring story here.

IF YOU LIKE ELECTRONICS—and are trapped in a dull, low-paying job—the story of Eugene Frost's success can open your eyes to a good way to get ahead.

Back in 1957, Gene Frost was stalled in a low-pay TV repair job. Before that, he'd driven a cab, repaired washers, rebuilt electric motors, and been a furnace salesman. He'd turned to TV service work in hopes of a better future—but soon found he was stymied there too.

"I'd had lots of TV training," Frost recalls today, "including numerous factory schools and a semester of advanced TV at a college in Dayton. But even so, I was stuck at $1.50 an hour."

Gene Frost's wife recalls those days all too well. "We were living in a rented double," she says, "at $25 a month. And there were no modern conveniences."

"We were driving a six-year-old car," adds Mr. Frost, "but we had no choice. No matter what I did, there seemed to be no way to get ahead."

Learns of CIE

Then one day at the shop, Frost got to talking with two fellow workers who were taking CIE courses... preparing for better jobs by studying electronics at home in their spare time. "They were so well satisfied," Mr. Frost relates, "that I decided to try the course myself."

He was not disappointed. "The lessons," he declares, "were wonderful—well presented and easy to understand. And I liked the relationship with my instructor. He made notes on the work I sent in, giving me a clear explanation of the areas where I had problems. It was even better than taking a course in person because I had plenty of time to read over his comments."

Studies at Night

"While taking the course from CIE," Mr. Frost continues, "I kept right on with my regular job and studied at night. After graduating, I went on with my TV repair work while looking for an opening where I could put my new training to use."

His opportunity wasn't long in coming. With his CIE training, he qualified for his 2nd Class FCC License, and soon afterward passed the entrance examination at North American Aviation. "You can imagine how I felt," says Mr. Frost. "My new job paid $228 a month more!"

"CIE training helped pay for my new house,"

says Eugene Frost
of Columbus, Ohio

Currently, Mr. Frost reports, he's an inspector of major electronic systems, checking the work of as many as 18 men. "I don't lift anything heavier than a pencil," he says. "It's pleasant work and work that I feel is important."

Changes Standard of Living

Gene Frost's wife shares his enthusiasm. "CIE training has changed our standard of living completely," she says.

"Our new house is just one example," chimes in Mr. Frost. "We also have a color TV and two good cars instead of one old one. Now we can get out and enjoy life. Last summer we took a 5,000 mile trip through the West in our new air-conditioned Pontiac."

"No doubt about it," Gene Frost concludes. "My CIE electronics course has really paid off. Every minute and every dollar I spent on it was worth it."

Why Training is Important

Gene Frost has discovered what many others never learn until it is too late: that to get ahead in electronics today, you need to know more than soldering connections, testing circuits, and replacing components. You need to really know the fundamentals.

Without such knowledge, you're limited to "thinking with your hands" ...learning by taking things apart and putting them back together. You can never hope to be anything more than a serviceman. And in this kind of work, your pay will stay low because you're competing with every home handyman and part-time basement tinkerer.

But for men with training in the fundamentals of electronics, there are no such limitations. They think with their heads, not their hands. They're qualified for assignments that are far beyond the capacity of the "screw-driver and pliers" repairman.

The future for trained technicians is bright indeed. Thousands of men are desperately needed in virtually every field of electronics, from 2-way mobile radio to computer testing and troubleshooting. And with demands like this, salaries have skyrocketed. Many technicians earn $8,000, $10,000, $12,000 or more a year.

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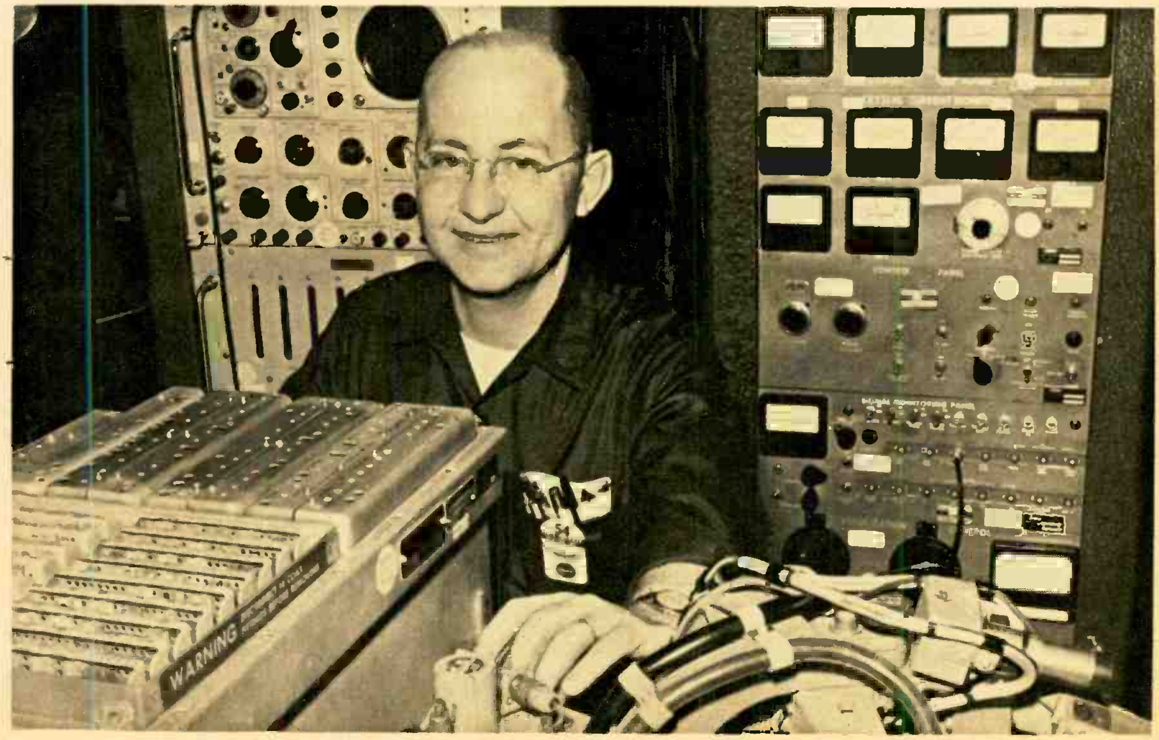


Pages 108-09, Nov. 1963 EI

Super Stereo Balancer

By LAWRENCE GLENN

LAST night when you listened to stereo—were you really hearing what the artists and recording engineer put on the tape or disc or were you getting a counterfeit stereo effect?

You've got it made if your stereo speakers are identical and the tone controls on your amplifier track perfectly. But if the controls don't track, the speakers are different and the balance control's dial markings are not accurate, it's more than likely you're not getting good stereo.

Best stereo occurs only when the volume, bass and treble *from each speaker* are in perfect balance. To achieve this you need our Super Stereo Balancer—a test set that enables you to set up your amplifier for optimum balance. The design is based on a Balancer which appeared in EI in November 1963.

If you're using dissimilar speakers the Balancer will assist you in making them sound more like a matched pair.

The Balancer consists of two independent sections. One is a three-frequency audio oscillator whose output goes to your amplifier's *auxiliary* or *tuner* inputs. The oscillator provides a 1 kc cps signal for volume balance of the two channels, 100 cps for balancing the low end and 10 kc for balancing the high end.

The other section is a high-gain amplifier that drives a VU meter. You place your tape recorder's—or other identical—microphones in front of the speakers and connect them to the Balancer's input. The VU meter then indicates the relative *acoustic output* of the speakers. To balance the system you simply adjust the amplifier's volume and tone controls until the VU meter indicates that the sound levels from the speakers are equal at the *same* frequency—that is, 100 cps left must equal 100 cps right.

Construction

The Balancer can be built in the U-section of a 7 x 5 x 3-in. Minibox. While the circuit has been designed for outputs of 100 cps 1 kc and 10 kc the actual output frequencies will depend on the tolerance of the oscillator components: C5 through C13 and R10 and R11, and to a minor extent on transistor Q4. However, there is no need to use anything but standard-grade components. A typical oscillator with standard components produced frequencies of 150, 1,100 and 9,000 cps—more than suitable for most applications.

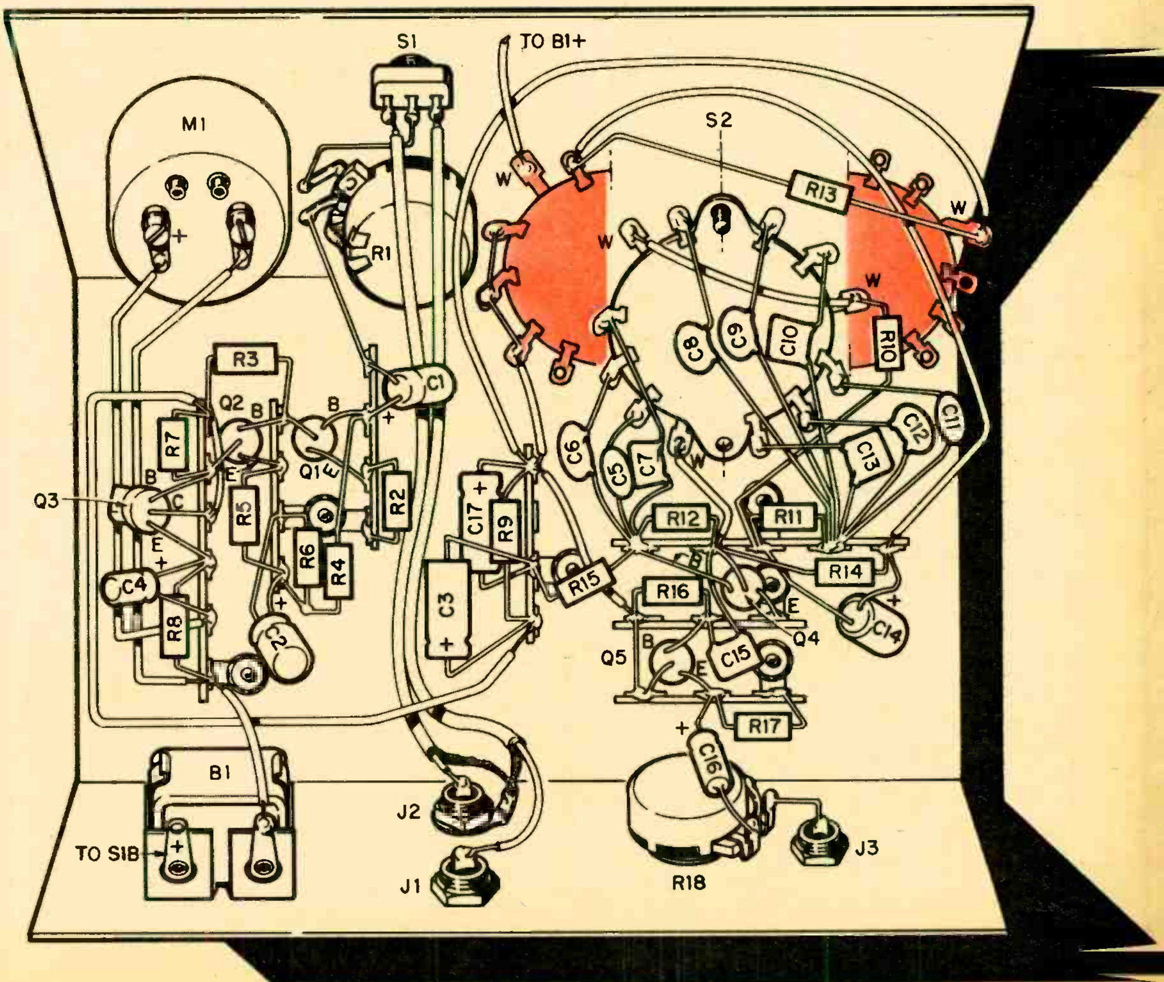
Start construction by mounting all the front- and rear-panel components. Leave as much room as possible for frequency-selector switch S2 as wiring gets tight around it. The hole for meter M1 can be cut with a standard 1½-in. chassis punch.

Note carefully the installation of R13 across S2's front deck. Make certain it does not short to any other switch contacts. And do not eliminate R13 in an attempt to get more oscillator output voltage as R13 not only equalizes the three output-frequency levels it also insures low-distortion output at 100 cps.

The leads of all the transistors should be used full length as they are short to begin with; shortening them may result in soldering-heat damage. Complete all the wiring for the oscillator first, as its output will be used to check out the meter circuit.

When the oscillator is complete, connect output jack J3 to your amplifier's *tuner* or *auxiliary* inputs using a *Y* connector. Turn output-level control R18 full counterclockwise (off) and then turn the oscillator on by advancing S2 to the 100-cps position. Set the amplifier's volume control to its normal lis-

Fig. 1—If mikes have phone plugs, use phone jacks for J1 and for J2. To simplify wiring to S2's front deck, the deck is shown in color, split in half, and the halves are shown pulled out to the right and to the left.



Super Stereo Balancer

tening-level position and then advance R18 until you hear the oscillator's output from your speakers. Then switch to the 1,000- and 10,000-cps positions. In all three positions the distortion should be low (it measures less than 1 per cent) and the volume levels should be reasonably equal.

After the oscillator is checked out complete the meter-circuit's wiring. The connections between J1 and J2 and switch S1 must be shielded, with the shields connected to the chassis (ground) *at the jacks only*. The lead from S1's wiper to R1 is short and need not be shielded. Double check to be sure that C16's polarity is correct.

The overload point of the meter will depend to some degree on the characteristics of the transistors you use. At the very least the meter will indicate the 0 VU (100 per cent) mark correctly but the circuit may go into clipping—giving false level indications—immediately above 0.

With different transistors of the same type, clipping might not occur until after the pointer is driven off-scale. To insure accurate meter indications always adjust meter-sensitivity control R1 so that the pointer stays below 0. For most convenience and accuracy adjust R1 so the pointer falls between the meter scale's −3 and −1 marks.

To check the meter circuit connect a patch cord between the oscillator output (J3) and either J1 or J2. Set S1 to the matching input position and set R1 full counterclockwise (off). Apply power by advancing S2 to 1 kc. Set R18 to mid-position and then advance R1 until the meter indicates approximately −2. If you cannot obtain a meter indication check for a wiring error in the meter circuit, particularly the B+ connection at switch S2B. Adjusting either R1 or R18 should cause the meter indications to vary.

Using The Balancer

Figure 5 shows the best connections for the Balancer. The oscillator output connects to the amplifier's high-level inputs. Place identical mircrophones as close as possible to the speakers—right up against the grille cloth if possible but not touching any part of the cabinet or the speaker's mounting board. If you don't have identical microphones, you can use one microphone, moving it from speaker to speaker.

Connect the microphones to J1 and J2. Set R1 to about the mid-position and then set S2 at 1 kc. Adjust R18 and the amplifier's volume control for very low speaker output. (You should conduct all tests at the lowest possible speaker volume.) When sound comes

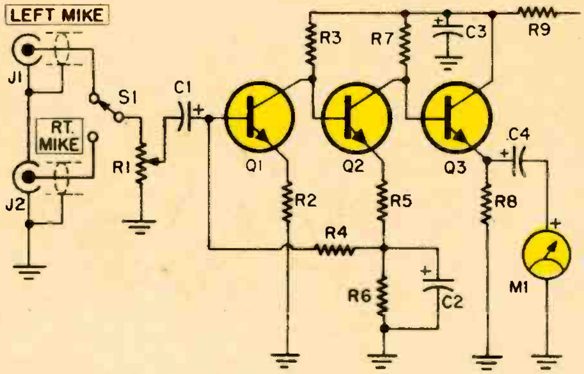
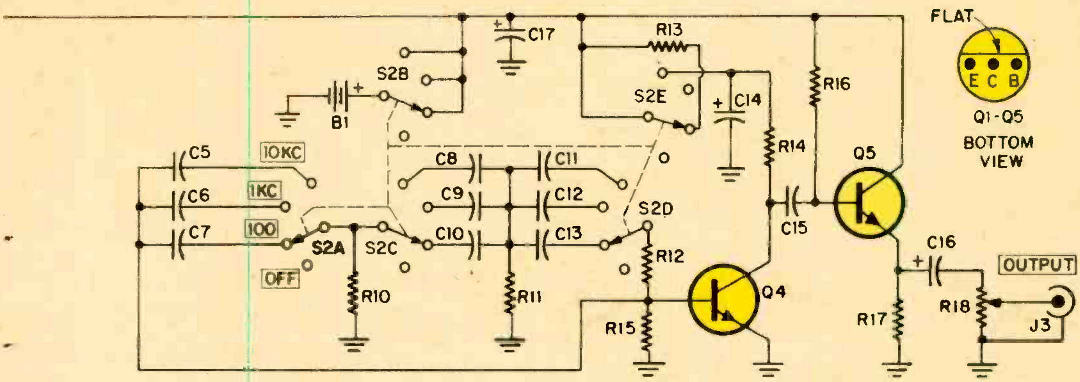


Fig. 2—Balancer's meter-amplifier circuit consists

PARTS LIST

B1—9 V battery
Capacitors: 12 V or higher unless otherwise indicated
C1,C4,C16—2 µf, 6 V electrolytic
C2—100 µf 3 V electrolytic
C3,C17—100 µf electrolytic
C5,C8,C11—.001 µf ceramic disc
C6,C9,C12—.01 µf ceramic disc
C7,C10,C13—.1 µf ceramic disc
C14—50 µf, electrolytic
C15—.05 µf ceramic disc
J1,J2,J3—Phono jack
M1—VU meter, Lafayette 99 H 5024
Q1—2N3391 transistor (GE)
Q2,Q3,Q4,Q5—2N3392 transistor (GE)
Resistors: ½ watt, 10% unless otherwise indicated
R1—50,000 ohm audio taper potentiometer
R2—150 ohms
R3—18,000 ohms
R4,R12,R16—220,000 ohms
R5—330 ohms
R6—680 ohms
R7,R8—4,700 ohms
R9—470 ohms
R10,R11—6,800 ohms
R13—22,000 ohms
R14—3,300 ohms
R15—82,000 ohms
R17—1,000 ohms
R18—10,000 ohm audio-taper poteniometer
S1—SPDT switch
S2—6-pole, 3-position non-shorting rotary switch (Mallory 3263J, Allied 56 B 4361 or equiv.)
Misc.—7 x 5 x 3-in. Minibox, terminal strips, battery holder



of transistors Q1,Q2 and Q3. Three-frequency oscillator (100 cps, 1 kc, 10 kc) is shown directly above.

out of the speaker the meter should give some indication that a microphone is picking up sound. Set S1 to the position that corresponds to the microphone in front of the left speaker and set R18 for a −2 meter indication. (If you are using only one mike place it in front of the left speaker and note on paper the −2 indication.)

Now switch to the right-channel mike and note the meter indication. If it is not −2 adjust the amplifier's right-channel volume control or the balance control so the right-speaker output produces an indication which is the same as the left channel.

Next, switch to 100 cps and adjust the amplifier's bass control in the same manner so that the 100 cps outputs from both speakers are equal. Note that the VU meter at 100 cps will probably not indicate the same as for 1 kc. This is of no importance because you are only interested in matched speaker outputs at a specific frequency.

Finally, set the Balancer's output to 10 kc and once again balance the speakers by adjusting the treble tone control.

Once the speakers are balanced at all three frequencies the system is balanced and what you hear out of the speakers will be the effective program balance, originally determined at the time the recording was made. Of course, it is true that the system is balanced for one setting of the tone controls.

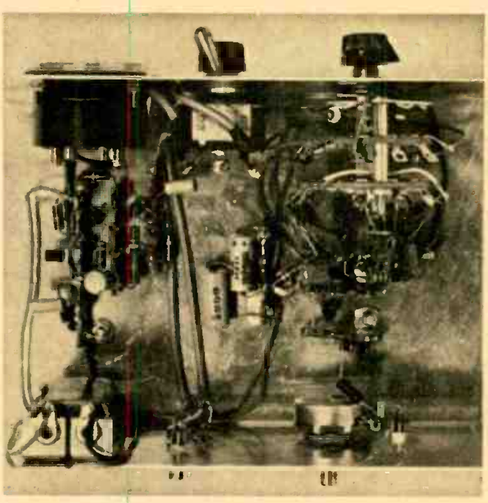


Fig. 3—Looking down into Balancer. Meter amplifier circuit is directly behind meter at left. Oscillator components are behind switch at right.

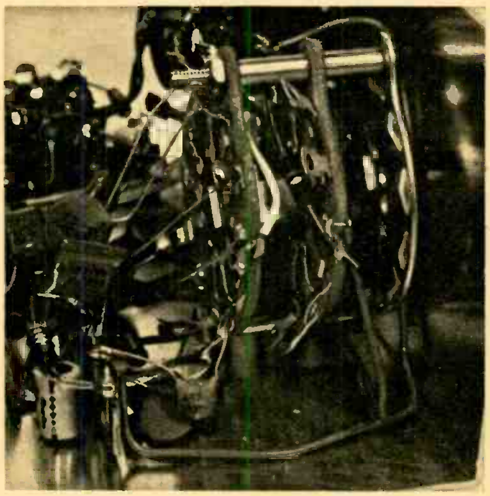


Fig. 4—Closeup of frequency-selector switch S2. Wire components to S2 before installing other parts. Leads to switch should have a little slack.

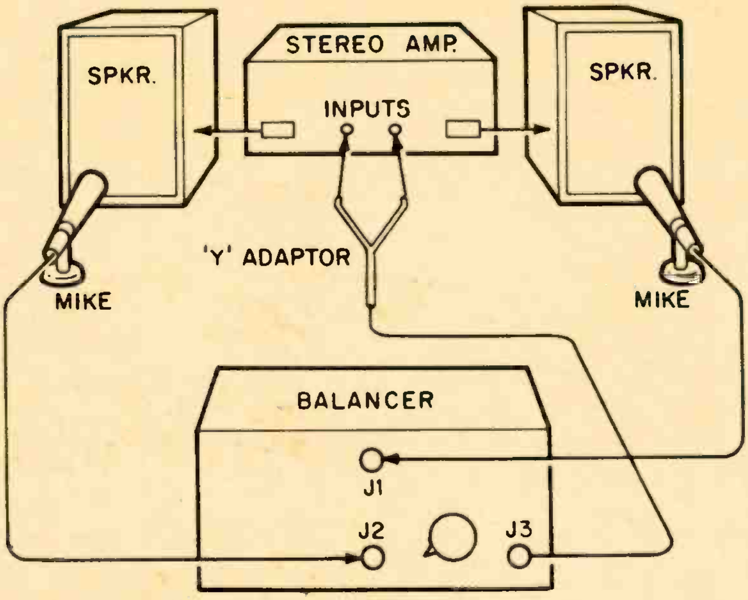


Fig. 5—Typical test setup helps explain theory of operation. Balancer's output at J3 is fed via Y connector to amplifier's left and right tuner or auxiliary inputs. Signals are amplified, picked up by mikes and fed back to balancer, where they are amplified and fed to VU meter. You then adjust controls on amplifier for equal outputs from both the speakers.

Super Stereo Balancer

Theoretically, an amplifier's tone controls should track if they are ganged so that adjusting one adjusts the other. Unfortunately, controls do wear and after some time the controls do not track together. Once again, use the Balancer to insure proper tracking. Here's how it's done.

Feed in a 100-cps signal to the right and left channel, set the bass control to the flat position and adjust R1 so the meter indicates approximately −5 from the left and right speakers. Now advance the left and right bass controls any given amount; the meter should give the same indication for each channel. If it doesn't, correct one tone control until the meter indications are equal and then mark the control accordingly. This procedure can be used through the tone control's entire range. When adjustment of the tone controls produce a meter indication which is above 0 or too low to be usable, simply adjust R1 for a convenient indication, say about −5.

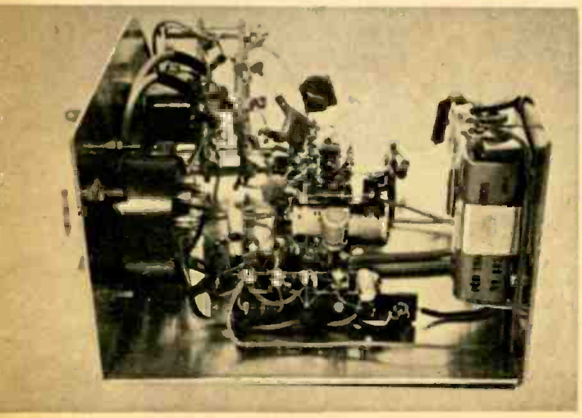


Fig. 6—Closeup of right side of Balancer shows meter-amplifier components mounted on terminal strip. Mount 9-V battery on back panel (right).

The same technique is used to insure proper tracking of the treble control and, if desired, the volume and loudness controls.

When the speakers are exactly balanced for identical output level, there is only one optimum position for stereo listening—directly between the two speakers. To obtain good stereo balance when the seating position is not between the speakers have someone adjust the amplifier's tone and volume controls while you are seated.

When you feel the sound has been balanced for your preferred listening position set up the balancer and note the difference between left and right VU indication. For example, at 100 cps, the reading might be −6 from the left speaker and 0 from the right. Do the same for 1,000 and 10,000 cps. Put marks on your amplifier so you can easily reset it for best balance.


The COM-VOX

Page 33, Nov. 1963 EI

The FET VOX

By LESLIE POWELL

BIG feature of modern SSB transmitters is VOX—a device which automatically switches the rig to the transmit mode when you start speaking. Thus, it does away with pushing the PTT switch on the mike or reaching to the rack or receiver to get to the transmit/receive switch.

But don't feel that this hands-free operation is limited to only SSB equipment. You can add VOX to existing equipment (CB transceiver or phone ham transmitter) with very little effort or expense by building the FET VOX.

The FET VOX is a big cut above the Com-Vox in our Nov. 1963 issue because it is solid state. And it has an advantage over most other solid-state VOXs in that its input impedance is very high—2 megohms at least. This allows you to use a crystal or ceramic mike without worrying about a loss of low-frequency response or reduced output level.

Reason for the high input impedance is Q1—a field-effect transistor (FET) whose input impedance is on the order of several megohms. Therefore, the VOX's input impedance is determined by the 2.2-megohm input load resistor, R1. Another feature is anti-trip which reduces the possibility of sound from your receiver's speaker from tripping the VOX.

How it Works. With the mike connected to J1 (you connect J2 to the mike input on the transmitter), Q1 samples the signal without affecting its frequency characteristics or level. The signal is amplified by Q1 and passed through *sensitivity* control R4 to Q2. Transistor Q2 is normally

The FET VOX

PARTS LIST

Capacitors
C1,C10—.01 μf, 12 V or higher ceramic disc
C2.C6—100 μf, 3 V electrolytic
C3—100 μf, 6 V electrolytic
C4—2 μf, 6 V electrolytic
C5—.25 μf, 12 V or higher ceramic disc
C7—1 μf, 3 V disc (Allied 43 B 1295)
C8—.01 μf, 500 V ceramic disc
C9—1,000 μf, 15 V electrolytic
D1,D2—1N456, or equiv., diode (silicon, general purpose) D3—1N34A diode
J1,J2,J3—Jacks to match existing connectors (see text)
J4—Phone jack (see text)
Q1—40468 field-effect transistor (RCA)
Q2—2N3391 transistor (GE)
Q3—2N3393 transistor (GE)
Q4—2N3394 transistor (GE)
Resistors: ½ watt, 5% unless otherwise indicated
R1—2.2 megohms R2,R3,R6—3,300 ohms
R4—100,000 ohm audio-taper potentiometer
R5—470,000 ohms (see text)
R7—39 ohms R8—470,000 ohms
R9,R12—50,000 ohm linear-taper potentiometer
R10—2,000 ohms R11—27 ohms
RY1—SPST (normally open), 12 VDC, 250-ohm coil miniature reed relay (Magnecraft W101MX-2, Allied 41 B 4441)
S1—SPST switch
SR1,SR2—Silicon rectifier; minimum ratings: 100 ma, 50 PIV
T1—Universal output transformer (Lafayette 33 H 7503)
T2—Low-voltage rectifier transformer (Allied 54 B 4737)
Misc.—7 x 5 x 3-in. Minibox, perforated board, flea clips.
A kit of four transistors is available for $3.75 (includes postage and handling) from Tridac Electronics Corp., Box 313, Alden Manor Branch, Elmont, N.Y. 11003. N.Y. State residents add sales tax.

biased on. Its relatively heavy collector current causes a large voltage drop across R6 and a low voltage at its collector. Because the collector voltage is considerably less than D2's breakover voltage, D2 does not conduct.

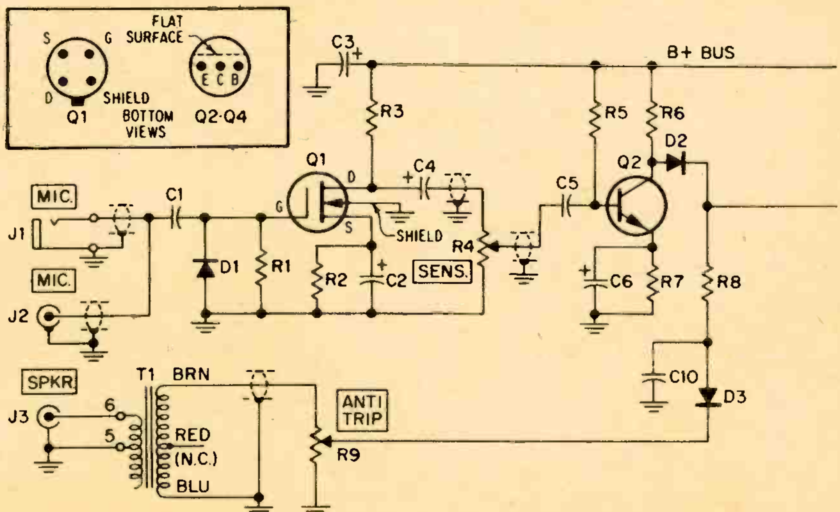
When a signal is applied to Q2's base the negative part of the signal reduces the positive bias on Q2's base, the collector current decreases and the voltage at the collector increases. Diode D2 is forward biased and it applies a positive voltage to Q3's base. The positive voltage on Q3 causes it to conduct which in turn causes Q4 to conduct; Q4's collector current energizes relay RY1, closing its contacts.

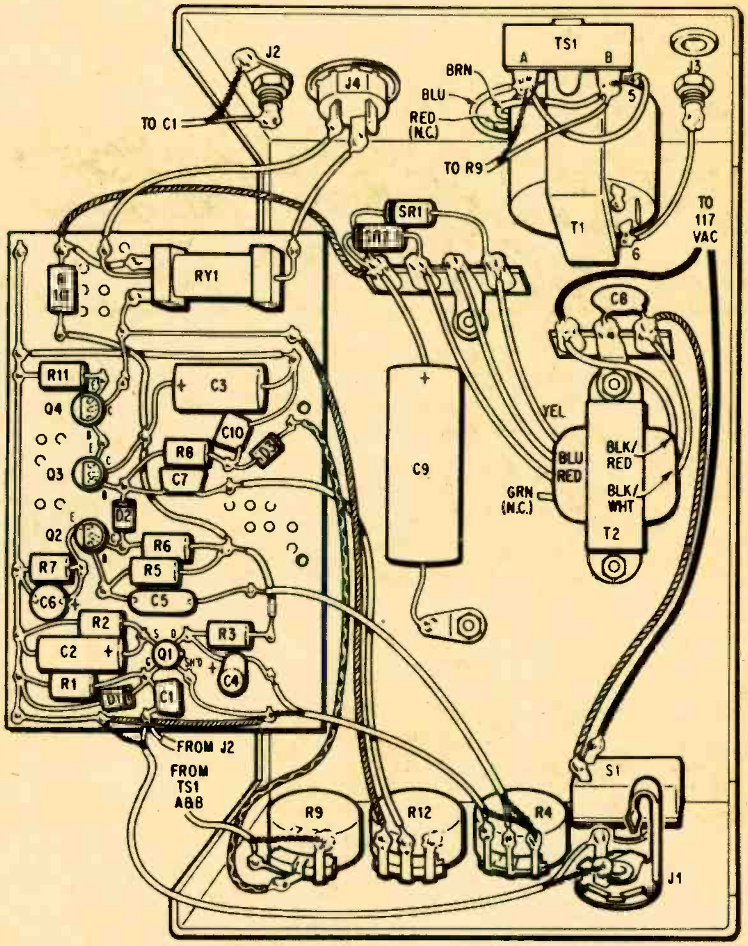
Capacitor C7 and potentiometer R12 form a time-delay network that maintains a positive voltage on Q3's base to hold in RY1 between speech syllables. If the delay network was not used, the positive-going part of the input-signal waveform would cut off D2 and RY1 would open and close in step with the speech.

To insure that a time-delay does not result in the loss of part of the first word, we've used a fast-acting reed relay for RY1. Transformer T1, which is connected across the receiver's speaker, *anti-trip* control R9 and D3 reduce the possibility of the VOX being tripped by sounds from the speaker which are picked up by the mike.

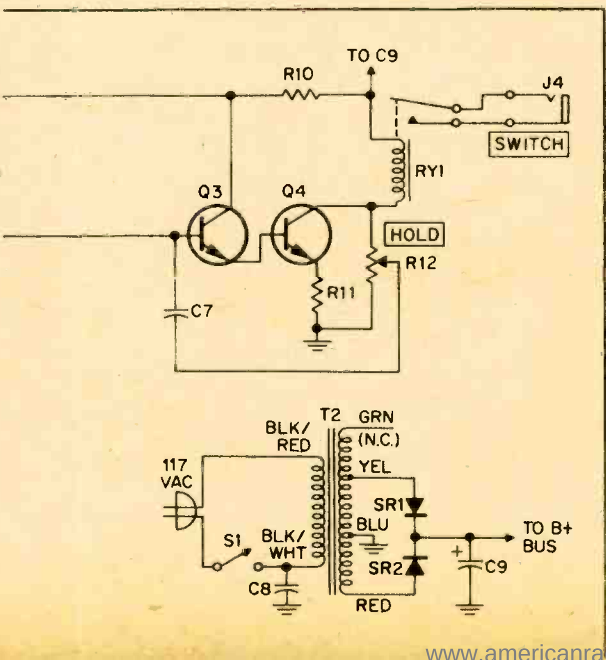
Construction. The unit shown is built in the main section of a 7 x 5 x 3-in. Minibox. To insure proper operation we suggest you do not make substitutions for the parts specified.

VOX schematic. Signal from mike at J1 is fed directly to J2 where it goes to transmitter mike input. Signal also goes to FET Q1 where it is amplified and fed to Q2. Negative-going peaks of signal cause increase in Q2's collector voltage. D2 is then forward biased and signal continues to relay amplifiers Q3 and Q4. These trip RY1 which puts transmitter in transmit mode. R12 and C7 cause RY1 to remain closed between your speech syllables.





Inside of VOX. Circuit board (2¾ x 4½ in.) has been pulled up and turned 90° to the left to show all parts on it clearly. Note on all shielded wires where braid is grounded and where it is cut off. Black bands on rectifier diodes SR1 and SR2 indicate cathode end. Relay RY1 is held to circuit board with pieces of hookup wire which go through threaded holes.



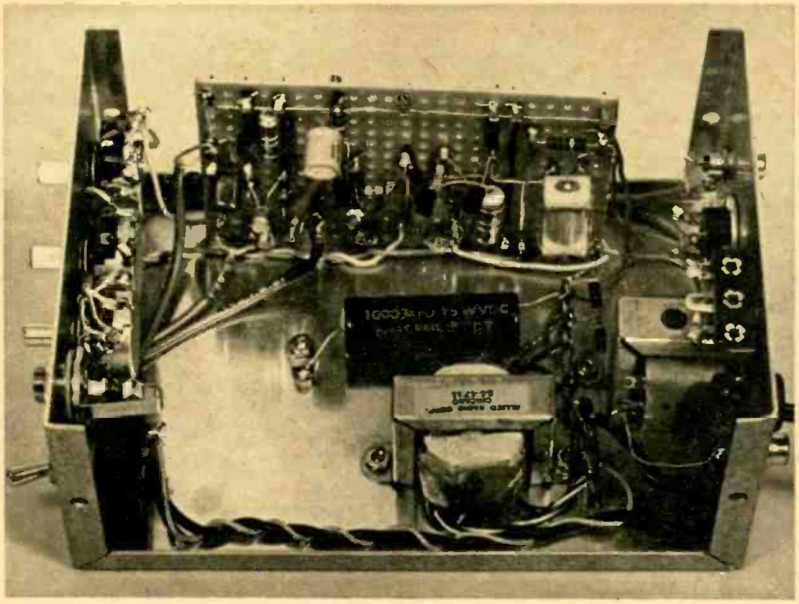
Start construction by building the 2¾ x 4½-in. circuit board. Use flea clips or Vector T28 terminals for tie points. From scrap aluminum make a small L-bracket to attach the board to the cabinet.

The bracket should be no longer than 1¾ in. and should cover no more than two rows of terminal holes on the board. Center it along the bottom edge of the board. Attach the bracket to the board first to insure that it won't interfere with or short the wiring.

Use a heat sink on all transistor leads and in particular on Q1 (the FET) when soldering. Do not cut the transistor leads short; use them full length. The leads on D1, D2 and D3 should be no shorter than ½ in.

Reed relay RY1 is held in place with two loops of wire. Note that the plastic block on each end of RY1 has corner notches. Place

Inside of VOX. Circuit board (top) is held to side of Minibox with bracket (not visible as it's on other side of board) made of scrap aluminum. In foreground is power transformer T2 (far away from board). At right on rear panel is anti-trip transformer T1. Twisted wires in foreground carry AC to power switch on front panel (left).



The FET VOX

RY1 on the board, insert a length of No. 20 or No. 22 bare solid wire up through a hole in the board and bend the wire across the corner notches and back down to the underside of the board. Twist the ends of the wire and place a drop of solder on the twist. Do the same to the other end. To avoid breaking RY1's delicate switch leads, use as much lead length as is possible and don't make any sharp bends; bring the leads to the tie points in a wide arc. Complete the board and then set it aside until the cabinet components are mounted.

Keep power transformer T2 away from the circuit board by mounting it close to the bottom edge of the cabinet. Transformer T2 is a special multi-voltage transformer. Make certain you use only the *blk/red* and *blk/wht* primary leads; cut the remaining primary leads off right at the transformer and be sure strands don't touch the cabinet. The *grn* secondary lead is not used and should also be cut short. Mount transformer T1 on the rear of the cabinet.

Jacks J1 and J2 should match your existing microphone connectors. J3 can be any type jack and J4's terminals should be *insulated* from the cabinet.

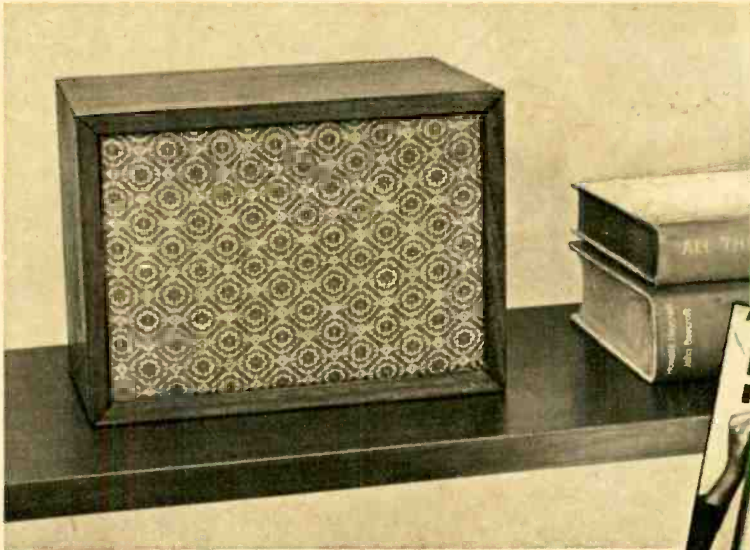
Mount the circuit board after all cabinet components are in place and the power supply is wired, then wire the cabinet components to the board using shielded wire where indicated.

To prevent the transmitter's RF energy from jamming the VOX, wire the shielded leads in this manner: The wire from J1 to the circuit board has its shield grounded at J1 and the circuit board's ground bus. The wire from C4 to R4 has its shield connected to the board's ground bus *and* R4's ground lug (the ground lug must not be soldered to R4's case). The lead from R4's wiper to C5 has its shield connected to R4's ground lug and no shield connection at the C5 end. The lead from J2 to C1 has the shield connected only at J2. The lead from T1 to R9 has the shield connected to the cabinet through R9's ground lug which is soldered to R9's case.

Checkout. Connect a microphone to J1, set *sensitivity* control R4 to maximum gain (full clockwise) and connect an ohmmeter to RY1's switch contacts. Turn power switch S1 on; the relay might close. This will be indicated on the ohmmeter by a brief zero-resistance indication. Avoid making any noise—which will cause the VOX to trip—and speak into the mike; the instant you speak RY1 should close, as indicated by zero resistance.

If speaking into the mike fails to trip the VOX, set *hold* control R12 full counterclock-

[*Continued on page* 116]



Cover, Nov. 1965 EI

Mini Mini Speaker

By HARRY KOLBE

IT starts off quietly and slowly yet gives you the feeling of restrained power. Finally when the Mini Mini winds up, the volume of the sound it puts out is likely to set you back on your heels. This 10x7x4-in. (260 cu. in. inside volume) box can roar like a lion. What's more, the sound is extraordinary clean, free from break-up and the frequency-response curve (Fig. 5) looks pretty good, too.

One of the most popular speaker projects published in EI was the Sub-Mini Speaker in our Nov. '65 issue. In those days its small size was truly startling. In fact it was so small that it was reproduced life-size on a page of the magazine. And its sound was amazingly good, considering cost and dimensions. But the Mini Mini will outdo it easily in terms of both response and power-handling ability.

Small speakers have become commonplace over the last two or three years. They're a fixture of budget stereo systems even though, in many cases, the sound contradicts claims to high fidelity. But in spite of vast improvement in the design of small speaker systems, you still can't make a silk purse out of a sow's ear (would you believe silky pigskin?). But the Mini Mini can out-perform speakers of comparable price and size.

How come? One of the reasons speaker systems this small cannot come close to delivering hi-fi sound is that their frequency-response curve looks like a mountain with a peak somewhere between 1,000 and 4,000 cps. There are few systems of this size that can boast a fairly flat response.

Unfortunately, good sound is produced in these systems only at relatively

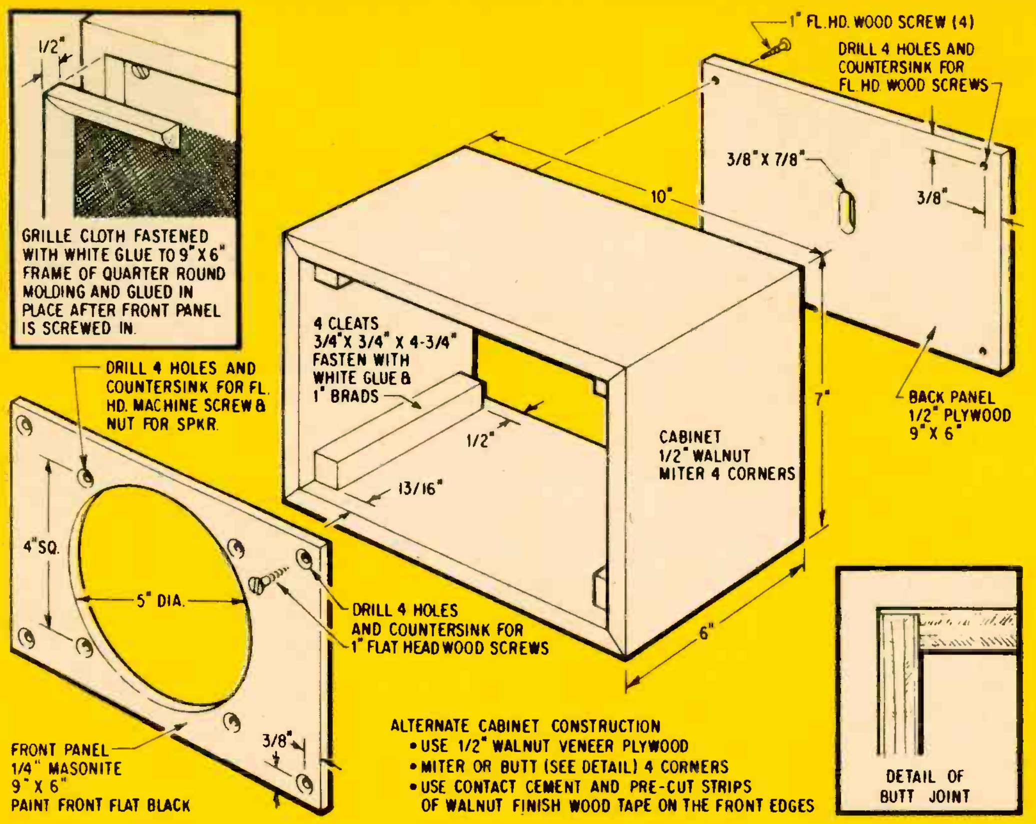


Fig. 1—To make sure the cabinet is airtight, use Mortite or putty around inside edges of front panel and make sure the rear panel fits tightly. The oval hole in the rear panel is for the terminal strip.

Mini Mini Speaker

low volume levels. Try to push out power and they break up. Not so with the Mini Mini. It is capable of operating at the high levels you would expect from systems many times larger. And, as a bonus, it does not suffer from the low-efficiency characteristic of the weak-on-power but good-on-response class of small systems.

The Mini Mini owes its startling performance to one big feature and two medium-size ones. The big one is the speaker. It's a special 5¼-in. job which is designed along different lines from most speakers used in small systems. Unlike its cousins, this speaker has a 10-oz. magnet. The strong magnetic field it produces around the voice coil goes a long way toward increasing speaker efficiency.

But there's something else in the Mini Mini which you may have noticed. It is a contour network made of a capacitor, inductor and resistor connected in parallel and in series with one of the speaker leads. The purpose of the contour network is to give the speaker a smooth response.

In a speaker this size it generally is impossible to expect a flat response. Most small speakers have a response peak somewhere between 1,000 and 4,000 cps. What the contour network does is pull down the mid-range, thus flattening overall response.

Now consider these two characteristics of speakers in general. Efficiency is proportionate to the size of the magnet and inversely proportionate to the mass of the cone. The other important characteristic is the free-air resonant frequency. This is significant because a speaker's low-end response drops off rapidly below the resonant frequency. Therefore, if all other things are equal, you improve the low-end response by lowering the resonant frequency.

In many small speakers the resonant frequency is lowered by increasing the mass of the cone. But this decreases efficiency. And many speakers have a small magnet which even further lowers efficiency.

The Mini Mini has a 10-oz. magnet (large for a speaker this size) a low-mass cone and

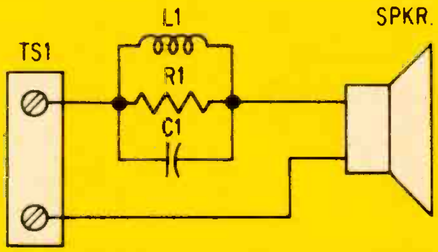


Fig. 2—This contour network, which attenuates mid-range frequencies, must be used with speaker to flatten the response curve.

PARTS LIST

C1—1 μf, 100 V Mylar paper capacitor (not electrolytic)
L1—Inductor, wound with No. 16 enameled wire (see text)
R1—20 ohm, 10 watt wirewound resistor
SPKR—CTS-5¼C1077. Available for $12.95 (postage included) from Tridac Electronics Corp., Box 313, Aldon Manor Branch, Elmont, N.Y. 11003
TS1—Two-screw terminal strip
¼-in. Masonite, 9 x 6 in.
½-in. quarter round, 3 ft.
½ x 6-in. walnut, 36 in.
½-in. plywood, 6 x 9 in.
¾ x ¾-in. cleats, 20 in.
120 cu. in. fiberglass wool
Wood screws, nails, grille cloth, finishing nails, walnut wood tape

a free-air resonance of around 75 cps. In other speakers which have a low resonant frequency, a small magnet and a high-mass cone, the low-end response may not be bad, but only at low volume levels. Crank up the amplifier's gain and the low end breaks up.

As we said, the Mini Mini's resonance is 75 cps, its magnet is 10 oz. and it has a low-mass cone. At first you might think the low end will be pretty poor because of that 75-cps resonance. But because of the large magnet and low-mass cone, the low end is extremely efficient. This means you can crank up your amplifier's bass control and the speaker's low end will really come through—and at high volume levels—without breaking up.

For its size the Mini Mini does an excellent job and even makes a superior extension speaker. It has a 1-in.-dia. long-throw voice coil whose wire is heavy.

The contour network is a must. You can't leave it out. Although the speaker's high end may sound slightly weak to some ears, it is because of the deliberate attenuation of response around 4,000 cps, which brings the high end down a bit, too. But this can be compensated for with the treble control on your amplifier.

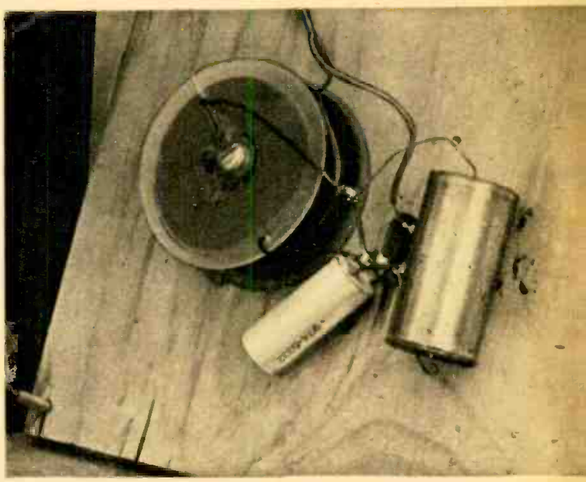


Fig. 3—Contour network parts should be attached to back panel with epoxy cement so they won't rattle. Do not use an iron screw to hold the coil.

Cabinet construction is not difficult. Cut four pieces of ½-in. walnut plywood to the sizes indicated and miter them at 45°. These will be the sides, top and bottom. For the front and rear panels ordinary fir plywood can be used. To aid in assembly, cleats are used at the inside corners. These are cut from ¾-in or 1-in. pine and they're nailed into place to close the mitered joint. They also serve to support the front and rear panels.

The cleats must be cut and positioned accurately so the rear and front panels will be flush when installed. Wood tape can be used to cover the exposed plywood edge; apply as directed by the manufacturer. Make the speaker hole with a saber saw. Sand the board smooth, then mount the grille cloth with staples and glue. The coil, resistor and capacitor can be mounted to the inside of the rear panel with glue.

Finish the wood in whatever way you want. For walnut, the recommended procedure is an application of paste wood filler followed by several coats of thinned shellac rubbed between coats with fine steel wool. Follow with a coat of paste wax.

It's quite simple to wind inductor L1. Take a look at Fig 3. At the upper left is the coil, which happens to be wound on a custom-made form. But don't let this throw you. You can make up a form with a short piece of broomstick (for the hub) and two thin

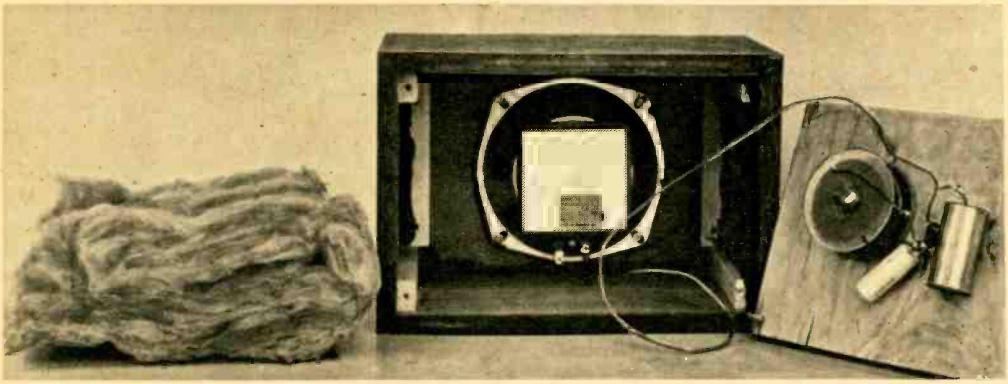


Fig. 4—The inside fiberglass-wool stuffing should be 120 cu. in. Our piece was 2 in. thick, 24 in. long and 5 in. wide. Cleats must be used because of mitered corners and to hold the front panel in position.

Mini Mini Speaker

pieces of plywood or Masonite. The hub should have a diameter of ¾ in. The diameter of the end pieces should be 2¼ in. and the space between the insides of the end pieces should be ⅞ in.

After you make the form, wind on fairly evenly No. 16 enameled wire until the diameter of the coil is 2 in. One pound of wire should see you through this.

The coil, capacitor and resistor must be attached firmly to the back of the cabinet. If they are not, they will produce annoying rattles. Epoxy is perfect for cementing them in place. In Fig. 3 you notice we used a screw to hold the inductor. This is permissible as long as the screw is not iron or steel since this would change the inductance. Don't use a nail, either, unless it is brass or aluminum.

So much for the carpentry and winding the coil. You may think you're ready to close the box, but you're not. You still must cut a hole in the back panel for the terminal strip.

By the way, it's important to make a tight seal between the front panel and the cabinet with Mortite or sealing compound. The box must be airtight.

Final thing to do is stuff the cabinet with 120 cu. in. of fiberglass wool. One hundred and twenty cubic inches is a piece 12 x 10 x 1-in. thick. But these dimensions don't matter so long as the volume is correct. Take a look at Fig. 4 to see how our stuffing looked.

Well, that just about winds it up. We hope if you have a stereo system you're about to start on your second speaker. By the way, the speakers are not available from the usual mail-order distributors or, for that matter, from any distributor other than the one mentioned in the Parts List. And don't go and use some other 5- or 5¼- or 6-in. speaker. You won't get the same performance. The Mini Mini is a total design in which cabinet, speaker and contour network are all closely related for best sound.

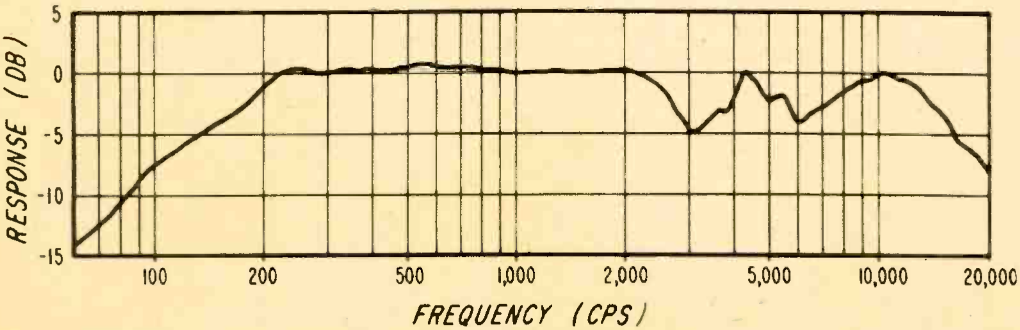


Fig. 5—Speaker's response curve. Response is quite flat from around 200 to 10,000 cps. To boost low and high ends, simply turn up the bass and treble controls on your amplifier. Speaker will take the power.

SPECIAL CB SECTION

Once again, our May issue contains a special section devoted to Citizens Band radio and to CBers. The contents of this year's edition are listed below:

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CB: A Reappraisal

By ALAN LEVESQUE

NINE years back—in 1958—when someone in Washington cooked up the idea of the Class D segment of the CB service the proposal was to "provide low-cost communications over short distances for personal and business use." It was to be, in a manner of speaking, a no-wires telephone that could be used when land lines couldn't. But, in spite of the tidy dike the FCC built against seepage of CB into fields already claimed by other services, the flood of response quickly spilled over and began seeking its own course like the Mississippi in March.

And CB still is seeking its level. Is it a fad? A hobby? Is it a vital communications tool? Or a toy? After nine years of trials and triumphs, fantasies and fizzles, where is it? And what is it?

Within months after the band was opened in late 1959 several thousand stations were licensed and the electronics industry was feeling the surge as CB transceiver manufacturers clawed and elbowed each other in a frantic effort to seize a slice of what obviously was going to be a juicy pie. Today there are some 3 million CB sets at large and the industry turns over about $50 million a year.

But, for commercial use, CB has proved itself a dud. One of the drawbacks was that there was no protection of frequencies for any particular user. A business hoping to dispatch a delivery truck sometimes had to hunt high and low for a clear channel and then hope that the mobile unit did the same. Sometimes pranksters would jam commercial communications deliberately or, even worse, send delivery trucks and taxis off to the boondocks on a fool's errand. The base-station rig would chatter away with the minute-to-minute activity on the channel—annoying to anyone attempting to work within 50 ft. of the dispatch desk. Mobile units frequently were turned into miniature ham stations by drivers during leisure moments—often earning stern FCC violation notices for the boss.

With one thing and another, many of the small businesses that started out on CB dropped by the wayside. Some, however, de-

CB: A Reappraisal

cided to spend thousands of dollars on high-powered FM gear that had been turned down before the dry run on CB. It is ironic that manufacturers of two-way radio gear, having condemned CB as a serious threat to their incomes, found CB an excellent salesman.

True, there are business users on CB today—but hardly in the expected abundance. Basically, the majority of users fit into the other of the FCC's categories—personal operation.

Among the foremost exponents of the better-living-through-CB school are hundreds of emergency-service and rescue teams that seem to be on 24-hour standby to lend a hand to any fellow CB operator who signals for help. All deeds of derring-do are performed not only voluntarily and without any charge but are accomplished with considerable pride. Frankly, if CB had done nothing more than prove its ability as an emergency aid it would have been worthwhile. Surprisingly enough, this aspect of CB was given only minimum prominence in early FCC statements on advantages of the service.

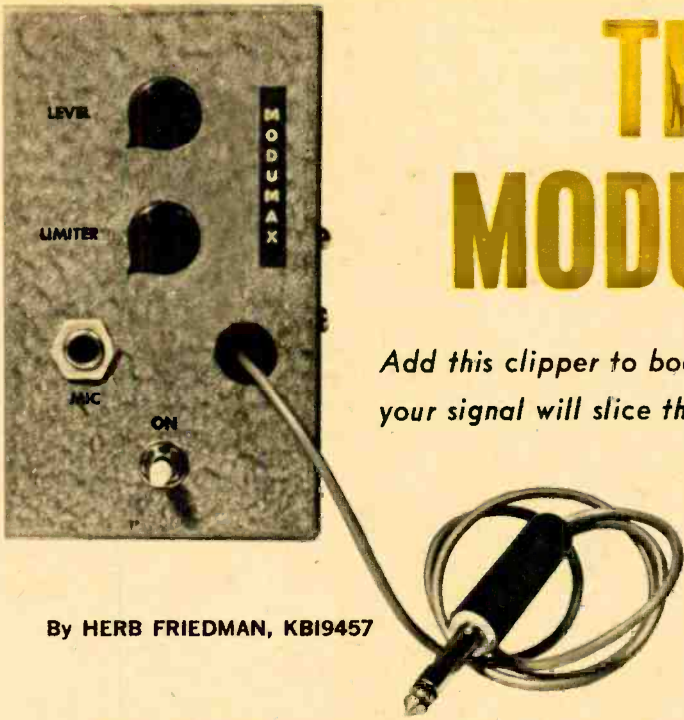
The Civil Defense people have been made aware of the countless times CB has been first on the scene and established basic communications links. While local CD agencies frequently have worked closely with CB groups the national CD people view CB with misgivings. Who would train CB's 3 million operators and how would they be disciplined and controlled? The crackpot fringe alone could deal a crushing blow to even a reasonably well-run net.

Crackpot fringe? Oh, my, yes! Every aspect of life today has its own brand of hangers-on who delight in hysteria and CB is no exception. The main difference is that a CB crackpot can jam transmissions and be a general pain in the antenna while hiding behind a cloak of anonymity. There must be more than 50 four-syllable Freudian disorders that describe the motivation of this small segment of CB operators. Suffice it to say that the FCC weeds them out as soon as possible but sometimes only after months of disruption to communications. They are the prime cause of most of CB's bad publicity.

CB has found its primary place in the hearts and minds of the public as a means of personal communication. This means, in many instances, being used to call your wife from your car to say you're stuck in traffic. Most often, however, it means that in filing an application and the $8 license fee the operator has bought himself a peanut-whistle ham station.

Much to the dismay of the FCC, the term personal communications generally has come to mean little more than using CB as a nationwide party line. Even casual tuning of the channels in any state will confirm this. It's a homey, folksy group of cronies that's found yakking away. And when skip opens up the band it's always pleasant to sit back and listen to the many regional accents. Some operators aren't adverse to giving the distant station a holler to say howdy, even though this is a clear violation of regulations. And familiarity with this sort of operation seems to breed contempt for the regulations, no matter how the FCC tries to tighten them up.

But that's where it is. And to our way of seeing, nothing appears on the immediate horizon that will alter its present course substantially. Of the 17,000 CB license applications that flood into the FCC offices each month it's reasonable to assume at least 16,000 are from people with intentions of using CB exclusively for socializing. And remember—for each CB license issued, an average of three transceivers take to the air.



THE MODUMAX

Add this clipper to boost your talk power and your signal will slice through a crowded band.

By HERB FRIEDMAN, KBI9457

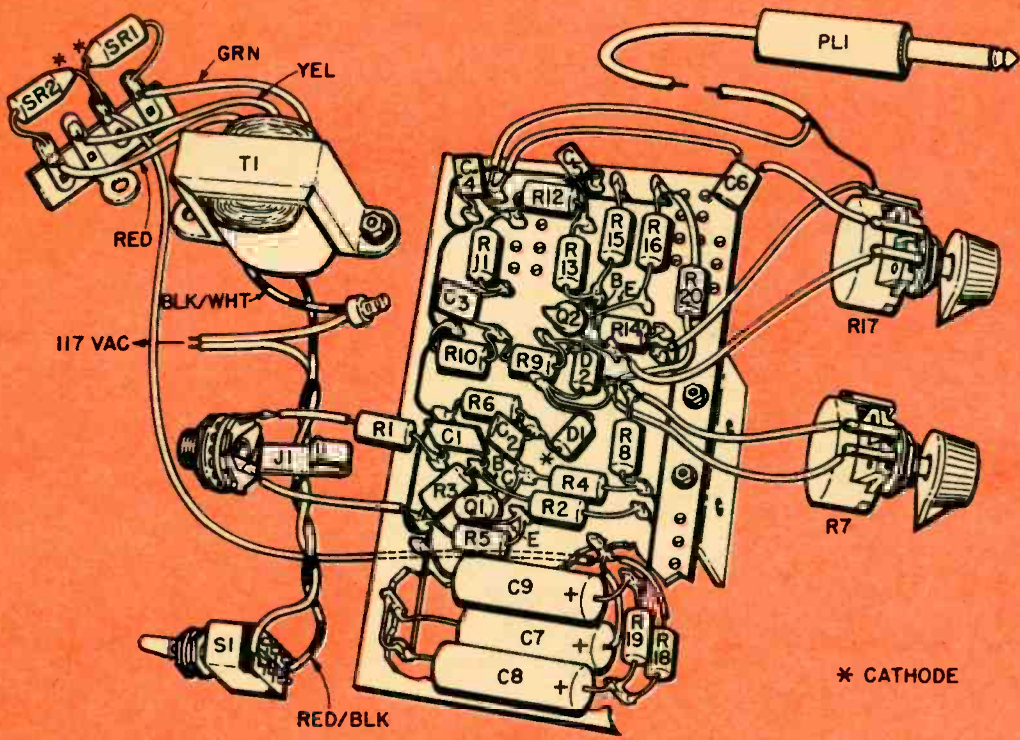
EVER notice how much louder radio and TV commercials are than the sound of the program itself? It's no accident. Sponsors know how to get their messages across and they do it by really burying you under a ton of sound. The solid wall of talk power is produced by using commercially-made devices, such as the *Level-Devel* and *Audiomax*, to automatically soup-up the sound to produce greater intelligibility.

You can get the same tremendous increase in talk power on the Citizens Band and Amateur bands with EI's Modumax, a device that does the following: amplifies the signal from your mike and compresses the normal dynamic range, clips speech peaks sharply to prevent overmodulation and filters all frequencies above 3 kc to prevent sideband splatter.

The Modumax is a fully-adjustable speech clipper that has a user-selected clipping range from almost full off to 30db of clipping. In plain language, this means that if you suddenly lower your voice from a full shout to a whisper there will be no change in the transmitter's modulation level.

Take a look at the schematic. Transistor Q1 functions as a straight preamp. The output of Q1 is passed on to diodes D1 and D2, which are normally forward biased into conduction. For the sake of discussion assume that the voltage at the junction of D1, D2 and R20 is 1 V. As long as the positive peak of the diode's input signal is less than 1 V, the signal will be passed by D1. But should the signal peak exceed 1 V, D1 becomes reversed biased and is cut off, thereby limiting the maximum positive peak to 1 V. Since D1 is forward biased the negative signal peak will always pass through D1 to D2. Note that when the negative signal voltage exceeds −1 V, D2 is cut off, thereby limiting the negative peak to 1 V.

The signal clipping level is determined by the voltage at the junction of D1, D2 and R20. If the junction voltage is set by *limiter* potentiometer R7 to 0.5 V, the clipping level will then be 0.5 V. The voltage range provided by R7 allows the



In order to show all connections clearly, parts not on board are not shown in true positions. Transformer T1 and rectifier diodes SR1, SR2 mount on back panel. Jack J1, S1, R7 and R17 mount on front panel.

THE MODUMAX

limiting to be adjusted from almost full off to about 30db with normal microphone signal levels.

Resistors R11 and R12 and capacitors C4 and C5 form a sharp roll-off filter that attenuates the harmonics generated in the clipper. The possibility of sideband interference is sharply reduced since the filter rolls-off at about 3 kc.

The Modumax's input impedance will match that of almost any dynamic microphone. For microphones of less than 1,000 ohms (recommended) impedance, resistor R1 should be eliminated. The use of crystal and ceramic microphones is not recommended, as the Modumax's relatively low input impedance will produce severe low-frequency attenuation, and there will be a chance of RF pick-up in the microphone input.

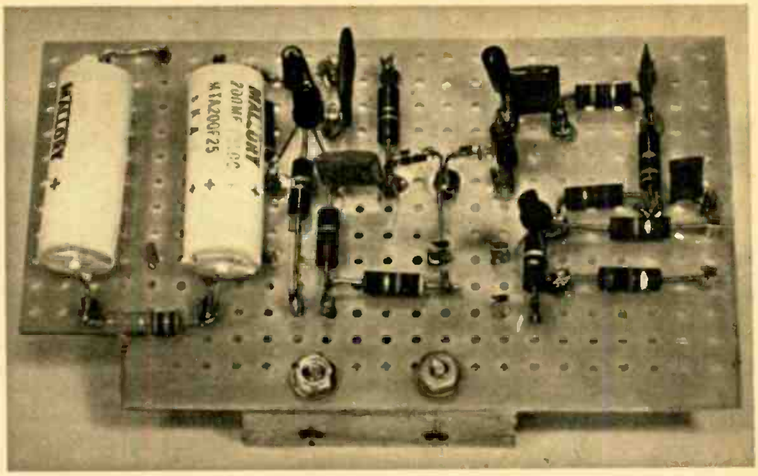
Construction. Our Modumax is built in the main section of a 3 x 7 x 5-in. Minibox. Although it could fit in a much smaller cabinet the larger cabinet was used so that power transformer T1 can be kept away from the circuit.

Except for T1, panel controls R7, R17 and jack J1, the entire circuit is assembled on a 2¾ x 4½-in. piece of perforated board. Vector T28 terminals or flea clips can be used for tie points.

The perforated board is slightly smaller than the cabinet's 3 x 5-in. dimension to make certain it does not prevent the cabinet cover from fitting properly. Cut a ½-in. square notch in one corner of the board so the AC power cord can be routed to power switch S1 on the front panel.

Mount all components in the main section of the cabinet before assembling the circuit board. Switch S1 should be mounted as close as possible to the bottom of the cabinet. Potentiometers R7, R17 and jack J1 can be centered between S1 and the top of the cabinet. If desired, substitute a panel-mounted jack for the shielded output cable and plug (PL1).

If your transmitter has a microphone with a push-to-talk (PTT) circuit, either make provision for the extra PTT wires or substitute connectors for J1 and PL1 which match



Top of circuit board before leads to front and back panels have been connected. Only two parts, R19 and C7 (see pictorial at left) mount on back of the board. Ground bus on our board was on bottom but it could be put on the top as on pictorial. Note notch in left corner for wires to switch S1.

the existing microphone and transmitter connectors.

Before assembling the circuit board, attach an *L*-bracket mounting foot to the bottom of the board. The foot will hold the circuit board to the cabinet. Do not try to support the board with the leads from the panel components.

The circuit board layout is not critical, but try to follow the pictorial so the board-to-panel connecting leads are as short and as straight as possible. To avoid heat damage to the transistors, do not cut their leads short. Use the full length as supplied. Similarly, do not cut the leads of D1 and D2 shorter than ¾ in. A heat sink is also recommended when soldering.

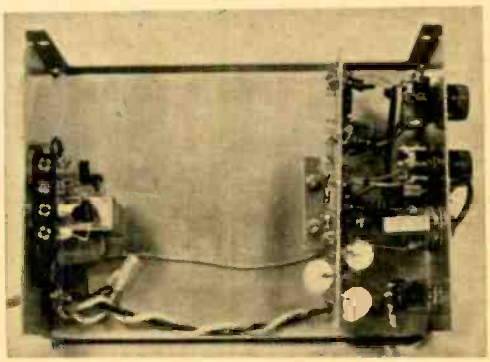
While run-of-the-mill 1N34A diodes can be used for D1 and D2, best results, in terms of symmetrical modulation, will be obtained if D1 and D2 are a matched pair—it's worth the extra few cents.

When the circuit board is completed, set it aside until T1 is installed and connected. Note that T1 has both primary and secondary taps to provide a wide range of secondary output voltages. Use only the leads indicated in the schematic—blk/wht and blk/red primary leads and grn and red secondary leads; ground the yel lead.

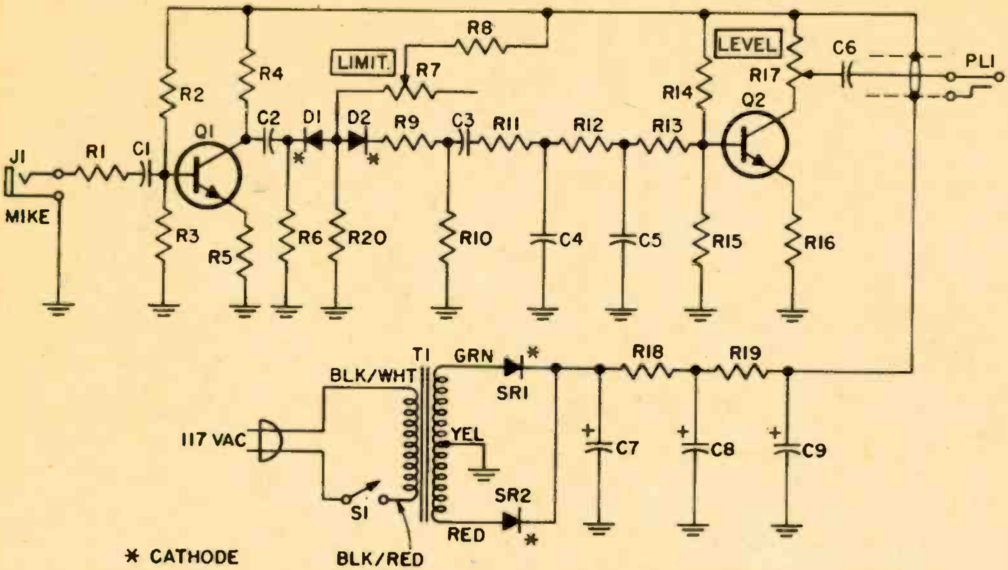
Completely install and wire T1 and then install the circuit board. Position the board just behind the panel controls, allowing enough space so the wires from the board to the controls can be connected easily. Make certain the board is not mounted so close to the controls that some components get shorted by the tip of the mike plug.

Using the Modumax. The Modumax is designed to be connected to the transmitter's mike input. Its output level for a normal mike input signal (with R17 full open) is nominally 1 V. This allows the Modumax to be connected to the transmitter's modulator *after* the existing mike preamp. While this might be difficult to do on a CB rig, it can generally be done on an amateur transmitter. The reduction in noise and distortion obtained by eliminating the microphone preamp will generally be worth the effort.

Connect your mike to J1, and plug PL1 into the transmitter's mike jack. Set *level* control R17 to *off*—full counterclockwise. *Limiter* control R7 should be set for no limiting—full clockwise if you've connected R7 as shown in the pictorial. Set the transmitter's mike-level control to the normal position if



Inside view of project. Mount circuit board far to right to keep it away from power supply (left); but don't short parts to front-panel controls.



Transistor Q1 is a straight preamp whose output is fed to normally-forward-based diodes D1, D2. Diode D1 clips positive speech peaks, D2 clips negative speech peaks. R11, R12, C4, C5 form sharp cut-off filter.

THE MODUMAX

PARTS LIST

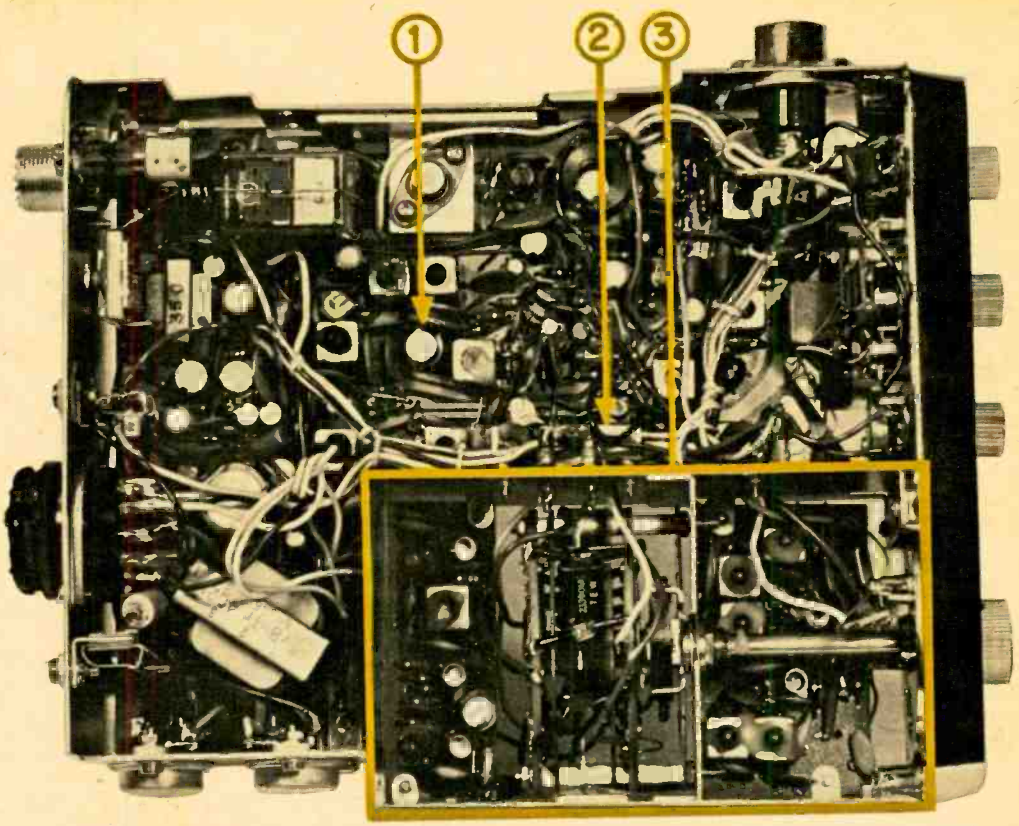
Capacitors: Ceramic disc or tubular, 25 V or higher
C1—.1 μf
C2,C3—.05 μf
C4,C5,C6—.01 μf
C7,C8,C9—200 μf electrolytic
D1,D2—1N34A diode (see text)
J1—Phone jack
PL1—Phone plug (see text)
Q1—2N3391 transistor (GE)
Q2—2N3393 transistor (GE)
Resistors: ½ watt, 10% unless otherwise indicated
R1—22,000 ohms
R2,R14—220,000 ohms
R3,R6,R15—10,000 ohms
R4—6,800 ohms
R5—47 ohms
R7—1 megohm linear-taper potentiometer
R8—47,000 ohms
R9,R10—4,700 ohms
R11—2,700 ohms R12—3,300 ohms
R13—5,600 ohms
R16—100 ohms
R17—10,000 ohm audio-taper potentiometer
R18,R19—1,500 ohms
R20—39,000 ohms
S1—SPST toggle or slide switch
SR1,SR2—Silicon rectifier; minimum ratings: 50 PIV, 100 ma
T1—Low-voltage Rectifier transformer (Allied 54 A 4731)
Misc.—Perforated board, 3 x 5 x 7-in. Mini-box, shielded wire

the transmitter is so equipped. Key the transmitter and modulate. As you modulate, advance R17 until the transmitter's modulation monitor indicates 85 to 100 per cent.

While modulating, turn R7 counter-clockwise. The peak modulation level (which determines the per cent modulation) will fall, indicating the speech peaks are being chopped off. Set R7 to the desired degree of limiting and then advance R17 until the transmitter is again being modulated from 85 to 100 per cent. Normal limiting is obtained by close-miking—talking close to the mike. If you place the mike a foot or more away and then talk in a low voice, the signal level will be below the limiting threshold, and while the transmitter might show it to 100 per cent modulation you won't get any limiting.

To avoid dissatisfaction with the Modumax it is important to keep in mind the effect known as *anything sounds good when it's strong*. When your signal is pounding in at the S6 to S9 and over level, almost any modulation will sound good.

It is when your signal is buried in noise, or under a mess of heterodynes, that the Modumax performs best. At low signal levels it will create an effect equivalent to raising the input signal level some 10 to 12 db—almost two S-units.



The guts of a state-of-the-art CB transceiver reveal several clues to what makes it that way: 1—an IC (integrated circuit); 2—a mechanical filter (partially hidden); 3—the frequency-synthesis section.

The State of the CB Art

By PRICE DANIELS

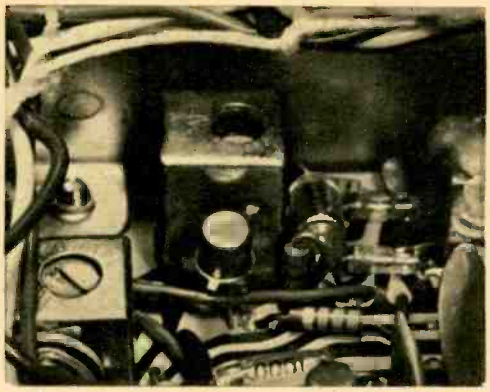
A LOOK under the hood of a really modern CB transceiver proves it to be amazingly sophisticated for a 9-year-old. Packed in a space not much larger than a cigar box are circuit features that were either prohibitively expensive or not yet developed when the CB service first opened, less than a decade ago.

We have the popularity of the service itself to thank for these things, of course. Without its attractively large market, manufacturers would have had little reason to try to outdo themselves in improving equipment and little prospect of mass-production economics. As it is, CB can sport ICs, low-cost mechanical filters, RF noise silencers, frequency synthesis circuits—the works.

Let's examine the state of the CB art feature by feature to see just how they improve your on-the-air communications.

First, because it's the most obvious, we'll start with the magic words solid state. To be frank, early attempts at solid-state CB rigs left a lot to be desired. Though a few were well designed and constructed from the very introduction of the transistor into CB sets, most rigs simply were attempts to capitalize on the trouble-free and low battery-drain features of transistors. Unfortunately, manufacturers had neither the design information nor the equipment to produce good solid-state gear at competitive prices. While these rigs did pull but a few hundred milliamperes from the battery, they had a tendency to blow the RF output transistor if the transmitter was keyed with no antenna connected. Noise limiters were strictly second rate vis-à-vis tube rigs. (Some still are.) And, of course, solid-state receiving sections were

Several integrated circuits may be used in a modern CB transceiver—in IF strip, as AF amplifier or (as in the case of the IC at the center of this photo) as RF amplifier in noise-silencer circuit.



Mechanical filter (top, center) looks like IF transformer at first glance. Similar filters were introduced into ham gear years ago but were relatively costly. Crystal filters pose alignment problems.

subject to overload with resultant cross-modulation and desensitization.

But look at the vast improvements in just two or three years. The general availability (drop in price) of silicon transistors allowed design of transmitters that were relatively unaffected by heat and were not prone to blow-out if the antenna was disconnected. And some transceivers now incorporate FETs (field-effect transistors) which are effectively immune from overload when used in the receiver's front end.

Regardless of the improvements in transistorization, itself, solid-state circuits once tended to duplicate the features found in tube models—only they were smaller and cheaper to build. But as the price of transistors and associated components was reduced manufacturers added extra-feature circuits while maintaining a reasonable price tag on the transceiver.

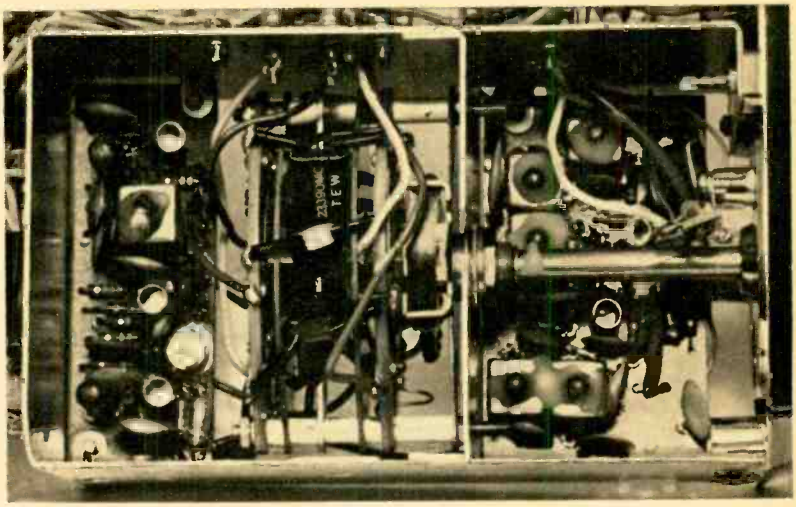
The RF Noise Silencer (or Noise Silencer) was one of these extra features. It literally punched a hole in mobile noise. Perhaps without exception, previous noise limiters in CB rigs had been simply updated versions of noise clippers used 30 years ago. They clipped noise peaks off the detector's AF output. If the clipping was light the sharp impulses of mobile noise would come through. If the clipping was heavy the pulses were reduced to a low-pitch roar with some distortion of the desired signal. RF noise silencers, on the other hand, do not clip the noise pulses. Rather, they mute the receiver for the duration of the pulse.

The silencer works this way. The antenna input is fed to two RF amplifiers. One feeds the rest of the receiver in the usual way. The second feeds additional RF amplifiers. The output of the second amplifier string is rectified and the resultant DC is used to bias the receiver's normal IF amplifier to cut-off during the noise pulse, making a hole in the signal rather than clipping its peaks. The holes are so narrow they go unnoticed.

While it is true that RF noise silencers were used many years ago in ham and communications equipment, they never really became popular because of the cost. It was the transistor that put the silencer in consumer equipment.

Another advanced receiver circuit feature is frequency synthesis. Full 23-channel coverage with drift-free frequency stability used to require full crystal control in both transmitter and receiver. This took 46 crystals (23 for transmit and 23 for receive). With crystals priced approximately $2 and up, the minimum investment for full coverage was $92 (sometimes less if the manufacturer provided a full-coverage package deal). Frequency synthesis allows full coverage with about ¼ the usual number of crystals.

Some early CB frequency synthesizers tried to follow the military technique of using a minimum number of crystals with several oscillators beating together to produce the desired output (or receiver-conversion) frequency. Unfortunately, when you have a lot of oscillators in the same cabinet the possiblity of producing spurious signals



Circuitry for frequency synthesis (this entire section of transceiver chassis) reduces the number of crystals needed for full 23-channel operation by beating crystal-controlled signals with each other to provide the required frequency.

The State of the CB Art

is very high and circuit tuning is critical.

Synthesizers used in most modern transceivers, both tube and transistor, generally reflect a compromise design. About 12 crystals are used to obtain full-channel coverage. At $2 per crystal this represents a saving of at least $68 (less the cost of the extra oscillators—but oscillators cost considerably less than crystals).

An alternative to full frequency synthesis uses a single transmitter crystal for both transmit and receive on each channel. Receiver frequency is derived from the transmit crystal by beating its frequency with a crystal built into the set for that purpose.

What happened to spurious frequencies in frequency synthesis? They were stripped off, in many instances, by bandpass filters. Some transceivers also use bandpass filters to provide very high adjacent-channel rejection with a minimum number of IF amplifiers. It's cheaper to use a three-stage filter than two or three extra stages of amplification.

But for super-selectivity there are crystal and mechanical filters. While crystal filters still are used in some fine equipment they require precision, lab-grade alignment equipment—and you won't find that at your local service shop. Mechanical filters, once running around $50 and therefore infrequently used, are now low in cost thanks to Japan. They are used in several rigs because—while selectivity is better than that of crystal filters that are poorly designed or aligned and approaching that of even a good crystal job—they require less special circuitry and permit alignment with service-grade equipment. The selectivity of the higher-cost U.S.-made mechanical filters generally is greater than that of the units used in CB gear but they cost $20 to $30 more.

The really big thing this year in CB receivers is the IC. Looking at one transceiver we find three ICs serving three different functions. One replaces a three-stage RF amplifier in an RF noise silencer. The advantages here are that the overall circuit Q is high and the noise pulses do not spread —muting only for the width of the noise pulse—and the IC reduces total cost. The second IC is used in the IF amplifier, providing the gain of two IF stages. The third is the entire AF amplifier (less microphone preamp and power output/modulator transistors). It replaces at least two stages of amplification.

So much for receiver circuitry. It's sort of difficult to improve on the transmitter because the 5-watt limitation forced manufacturers, early in the game, to get the most out of what little they had to work with. Much effort the past few years has gone into what best can be called super-modulation. Multi-stage speech clippers and their required harmonic filters were in use years ago. Compressors, using fewer components, originally were able to produce only about

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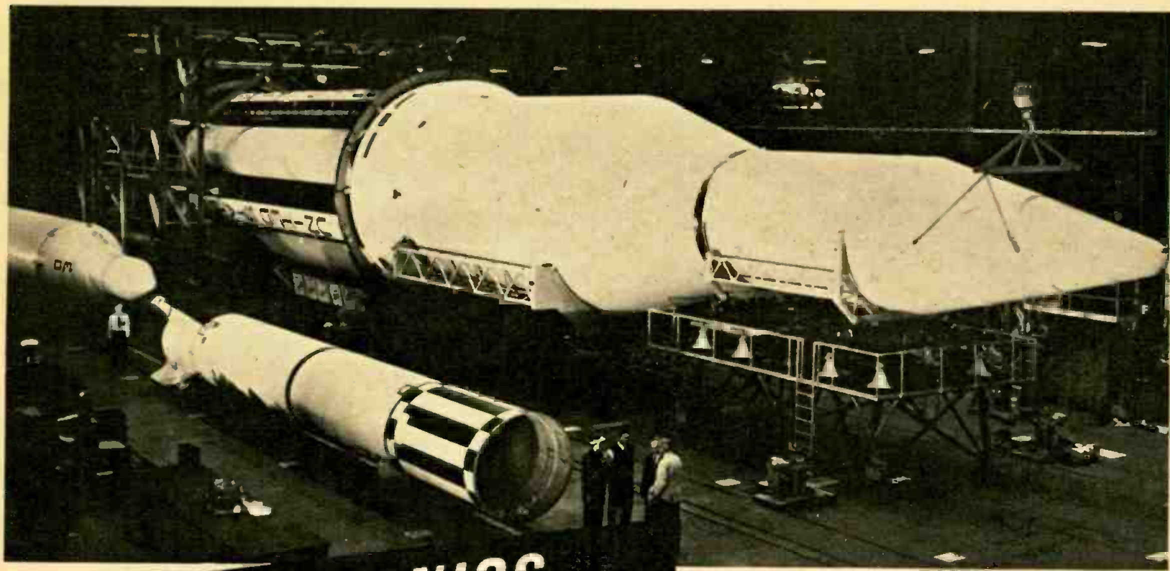
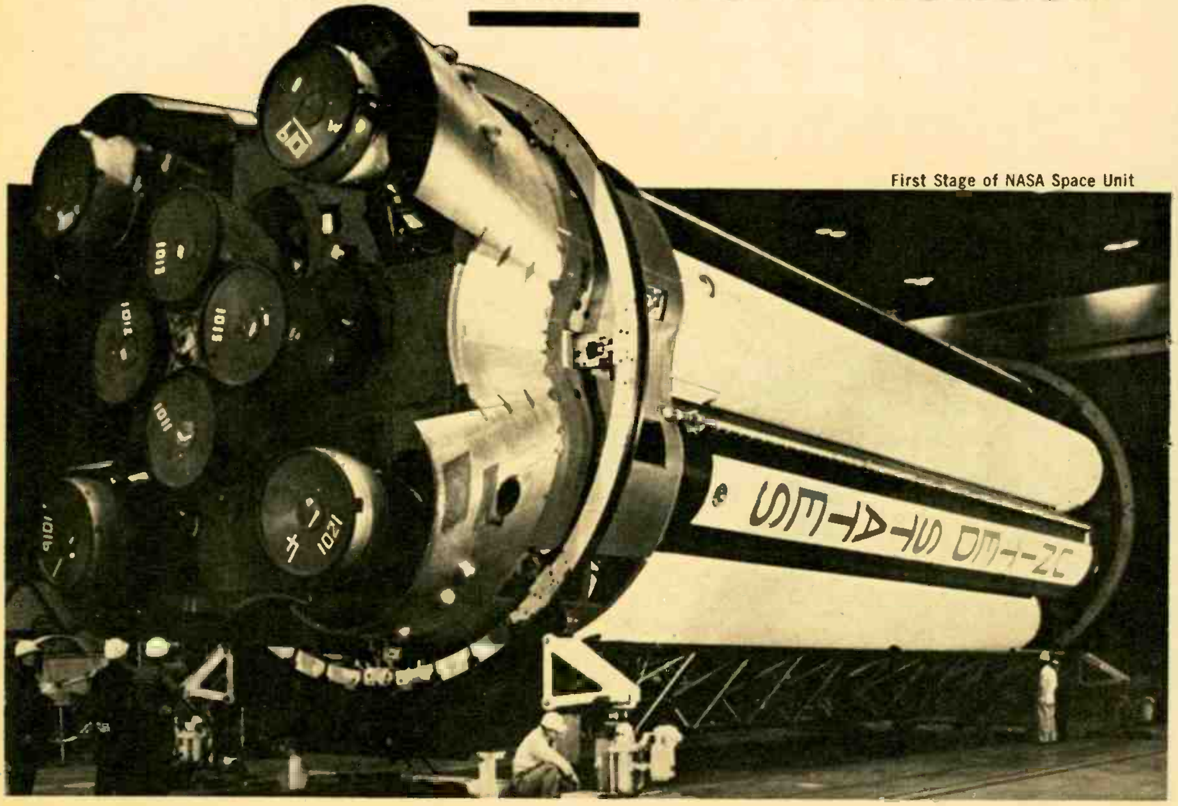


NASA Outer Space Vehicle

IN ELECTRONICS...

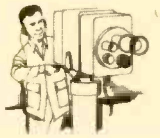
There must be a Reason

First Stage of NASA Space Unit



SPACE & MISSILE ELECTRONICS

INDUSTRIAL ELECTRONICS



TV - RADIO

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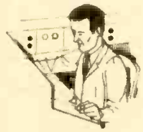

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BELL & HOWELL

Pages 34-35, Nov. 1960 EI

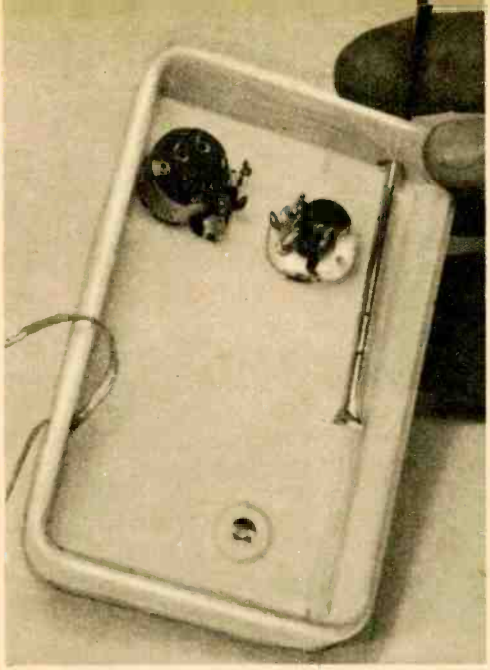
Pocket CB Receiver

By LEN BUCKWALTER, KQA5012

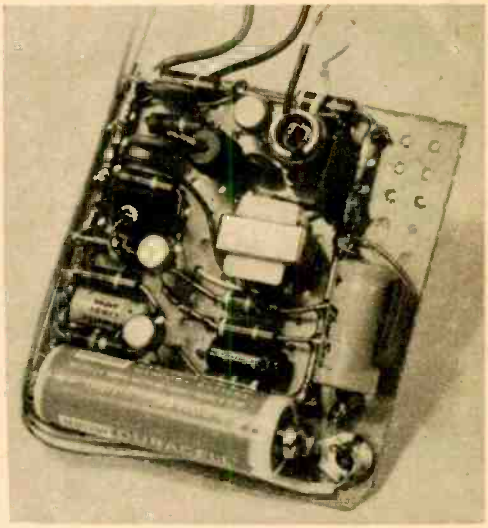
IT'S incredible how Citizens Band has made two-way radio available to so many people in such a short time. But there are situations when one-way radio will do the job. For example, someone on the roof installing a TV antenna need only receive instructions. He doesn't have to talk back. Or if you just want to page someone it is sufficient for them to hear you. Such applications for one-way communications need merely a simple receiver rather than an expensive walkie-talkie or transceiver, only half of whose functions are used.

With our take-along Pocket CB Receiver you can eavesdrop on the Citizens Band anywhere. Its sensitive three-transistor circuit pulls in all 23 channels on a continuous-tuning dial. Though the set is small, you won't need the talents of a jeweler to assemble it.

The circuit is a superregenerative design. If you've never worked with one, here's what to expect: first, you can't buy more sensitivity with so few parts as with a superregen. It pulls in stations with nearly the same proficiency as a big receiver. On the other hand, a superregen won't have the same degree of selectivity. When you tune a strong station it tends to to spread out over the dial. Don't expect the crystal-control accuracy you get with a conventional superhet. Another good feature of the superregen is its resistance to impulse-type noise (car ignition) without using elaborate



View inside case without board. At top are gain, tuning controls and whip antenna. Whip bottom is cemented to case. Earphone lead comes in at left.



View of wired board before mounting in case. Note how leads protrude near top of board. They connect to parts on top of case after board is installed.

limiter circuits.

Building the Board. After you've selected a small plastic case (ours was 4⅛ x 2¾ x 1⅛ in. thick), cut a piece of perforated board to fit it. As shown in the illustrations, the board should occupy about three quarters of the case to allow room for the gain and tuning controls. Start by installing two lengths of heavy bare wire along the board's sides to act as + and − buses. If you need other tie points for small parts, simply press the leads through board holes and put a dab of solder at the underside to retain them.

The two coils used in the circuit are modified slightly. Before mounting L1, the tuning coil, examine it closely and you'll see three separate windings. Only the large winding at the middle is used so cut through the top and bottom windings only and carefully remove the cut wires. Be sure you don't tear the main winding. The cut wires connect to lugs 1 and 3 (marked on the bottom of the coil form). Those lugs are bent out from the form so you can attach wires to them from the top of the board. Snip off the unused coil lugs.

Coil L2 is a home-brew RF choke. The one in our model was made by taking a 1-watt carbon resistor (over 200,000 ohms) and covering it with 100 turns of No. 32 enameled wire. Scrape clean the ends of the wire then solder them to the resistor leads.

Note that the battery can be soldered into the circuit. Since the receiver only draws about 3 ma, the mercury battery will last a very long time. The battery is installed by soldering its negative clip to the negative bus. On the positive end solder a solder lug directly to the terminal. Watch the heat!

Next, attach the following wires to the board before mounting the board in the case: the leads to *gain* control R4; the wires that will go to *tuning* capacitor C4 and the earphone leads. Note that the earphone leads must first go through a hole in the side of the case before soldering. Also, tie a knot in the leads on the inside of the case.

Preparing the Case. Mount both R4 and C4 near the top of the case and slip the whip antenna through a hole in the case. Only the top three sections of the whip are needed. The whip length should be reduced to about 20 in. by cutting off the two lower sections. Be sure to cut about 1 in. below the joint so the remaining top three sections telescope properly. Shortening the whip in this manner makes it easier to handle. After the bottom of the whip is inserted through the case hole, melt a bit of solder at the point where capacitor C3 will be soldered. Then attach the whip directly to the case with epoxy cement. Cover the whip inside the case with cement, leaving a clear spot only where you've melted the solder for C3.

Pocket CB Receiver

PARTS LIST

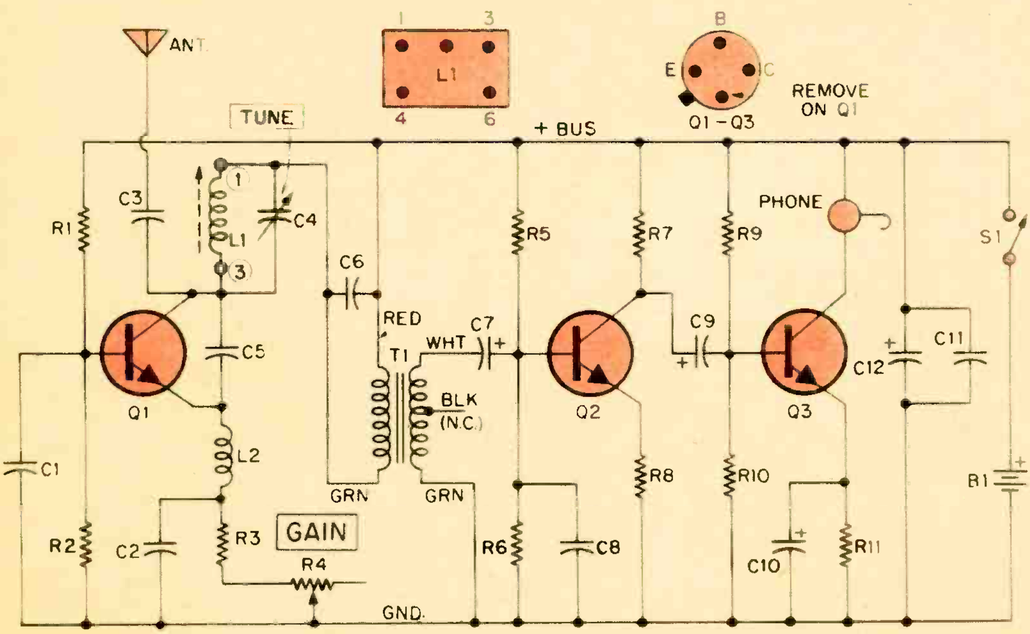
B1—9.8 V mercury battery (Mallory TR-177 or equiv.)
Capacitors: ceramic disc, 50 V or higher unless otherwise indicated
C1—.002 µf
C2—.005 µf
C3—5 µµf
C4—1.5-5.0 µµf miniature variable capacitor (E. F. Johnson 160-102, Allied 43 B 3758)
C5—27 µµf
C6,C8,C11—.05 µf
C7,C9—2 µf, 15 V electrolytic
C10—10 µf, 15 V electrolytic
C12—100 µf, 15 V electrolytic
L1—CB RF antenna coil (Lafayette 99 H 6200)
L2—50-75 µh RF choke (see text)
PHONE—3,000 ohm earphone (Lafayette 99 H 2540 or equiv.)
Q1—SK3018 transistor (RCA)
Q2,Q3—SK3020 transistor (RCA)
Resistors: ½ watt, 10% unless otherwise indicated
R1,R7—4,700 ohms
R2,R3,R8,R11—1,000 ohms
R4—5,000 ohm miniature audio-taper potentiometer with SPST switch
R5,R9—47,000 ohms
R6,R10—10,000 ohms
S1—SPST switch on R4
T1—Interstage driver transformer; primary: 10,000 ohms, secondary: 2,000 ohms (Lafayette 99 H 6131)
Misc.—Whip antenna (Lafayette 99 H 3005), perforated board, plastic case, knobs

Install the board in the plastic case. To complete the job solder the leads from the board to S1, R4 and C4. Install C3 from the whip to the lug on C4.

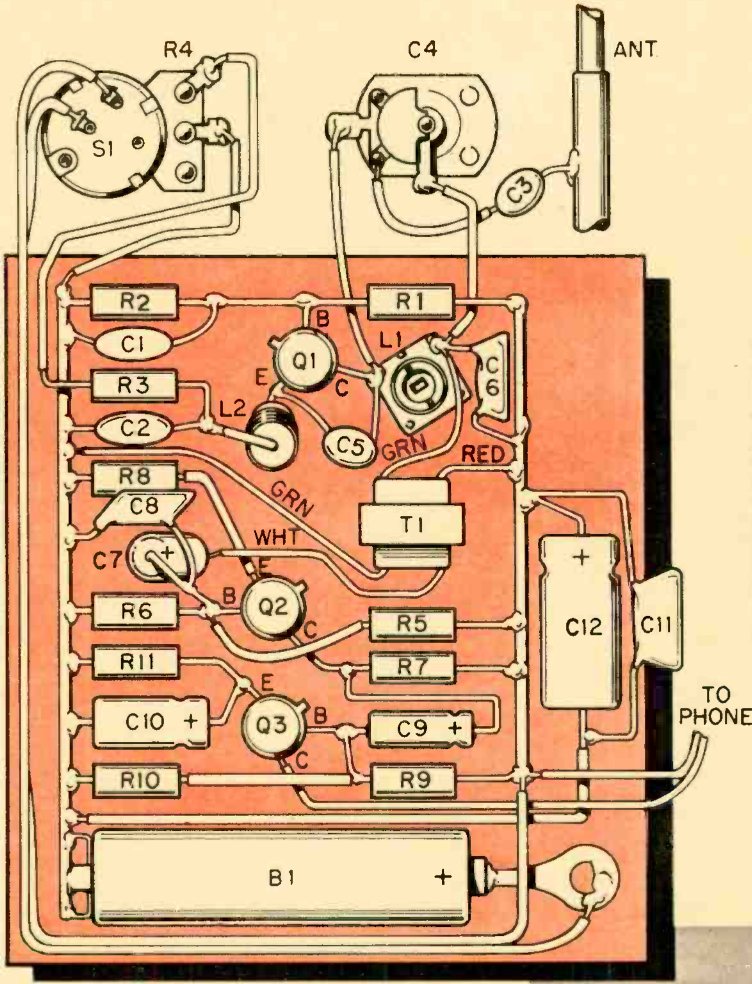
Adjustments. Before attaching the tuning knob, rotate C4 until its plates are fully meshed. Tighten the knob so the pointer is at the left—the low end of the band. The complete range of the C4 is a half turn—until it points to the right. Actually, frequency coverage of the receiver is several hundred kc above and below the CB band.

To test the receiver, turn R4 clockwise. At first there should be silence in the earphone until the knob is about halfway up. Then you should hear a distinct pop as the receiver breaks into oscillation. Rotate R4 a bit more and you'll hear a steady hiss. The correct setting for R4 is just past the pop and slightly into the hiss region.

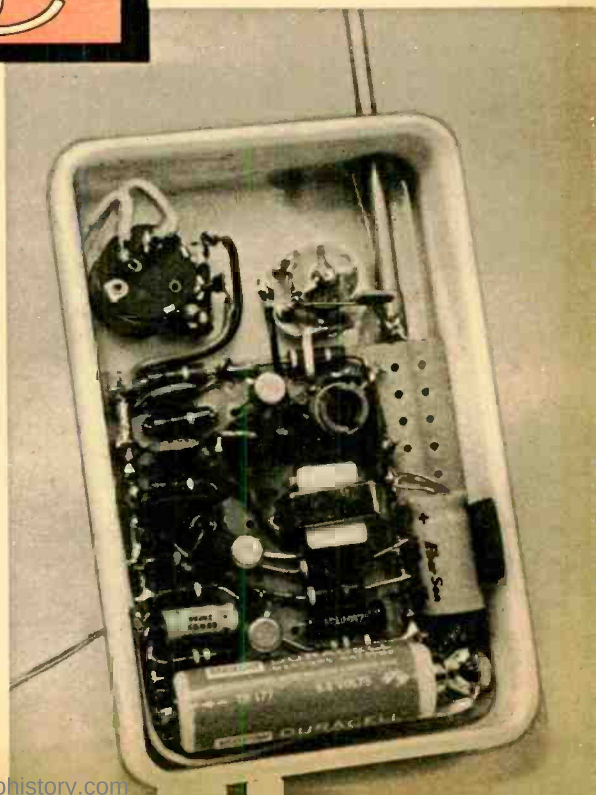
When you get this action the next step is to adjust the tuning range. If there are CB stations on the air, adjust L1's slug with a plastic alignment tool until you hear them. The final touch-up of L1 should be made on a very weak station on a channel in the center of the band. First turn C4 until its plates are half meshed, then adjust L1 until you hear a station. If the signal is strong, it will spread over the dial and make alignment difficult.



Receiver schematic. Q1 is superregenerative detector whose 27-mc oscillation frequency is determined by C4/L1. C5 sustains oscillation; C1 and R2 determine quench frequency. Q2,Q3 amplify audio signal.



Perforated board in our model is 2½ in. wide and 2⅝ in. high. Although we show all wiring on top, some can go on underside depending on placement and size of your parts. Wire going from top to bottom at left is ground bus. Wire going from top to bottom at right is B+ bus. Below is photo of board mounted in case. Battery at bottom can be changed without removing board.

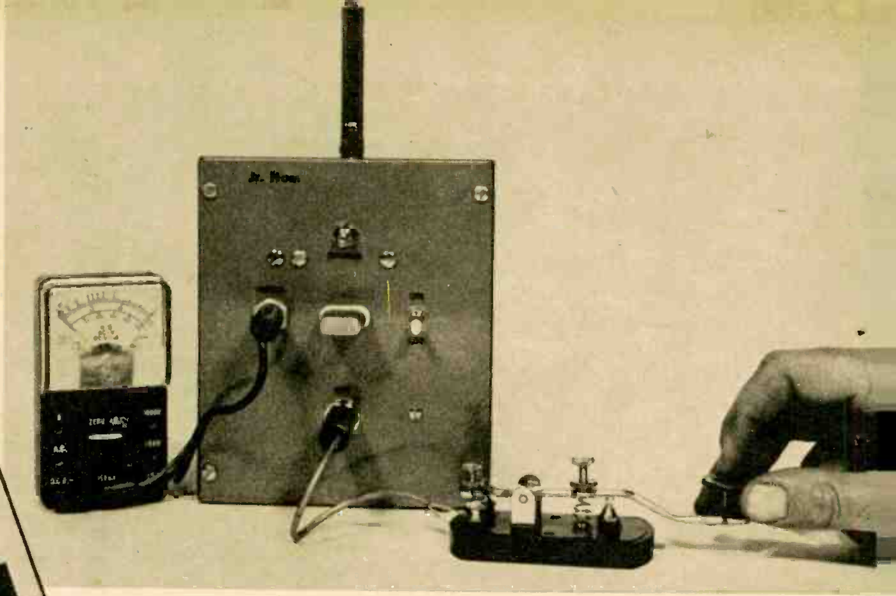


Another alignment method is to place a dummy load on your regular CB transceiver and turn it on transmit. Walk away with the receiver until the signal is weak, then tune L1.

If you have any trouble, you can use your CB transceiver for troubleshooting. Let's say you turn up R4 but don't hear the pop and hiss sound. Set the CB rig to receive and listen for sudden rushing noise in its speaker or watch for an increase in the S-meter indication. If you get this response it means the detector stage (Q1) in the receiver is operating and the trouble is in audio stages, Q2 or Q3.

Assume you get the pop and hiss in the receiver's earphone, but you can't receive stations you know are on the air. This probably means the wiring layout in your model is not the same as ours and L1 isn't covering the band. Chances are that stray capacitance is lowering the tuning range. This can be cured by removing one turn from L1.

10th ANNIVERSARY 10 SPECIAL




Want to be a 'JUNIOR HAM'?

Page 55, March 1964 EI

Junior Ham Transmitter

By JOSEPH RITCHIE

AFTER a while the CB rag-chewing routine (it's illegal, of course) gets to be a bore. And because of the restricted nature of CB compared to amateur radio, many CBers feel a strong urge to move on to the ham bands for greater adventure. However, to get a ham ticket you must know code.

One of the best ways to get your speed up to pass the Novice or General exam is with our Junior Ham Transmitter. It is a modulated-CW rig which operates in the 27-mc License-Free Band. You can work one or more other operators and use the CW contacts to increase your code proficiency . . . or you can just shoot the breeze.

This rig is an improvement over the Junior Ham Station in our March 1964 issue because it does not require you to use an external BFO at the receiver. This set transmits a carrier which is tone modulated.

Since input power is limited to 100 mw and the oscillator is crystal controlled, you do not need a license to put the transmitter on the air. Use your existing walkie-talkie or CB transceiver for a receiver and you've got a complete station.

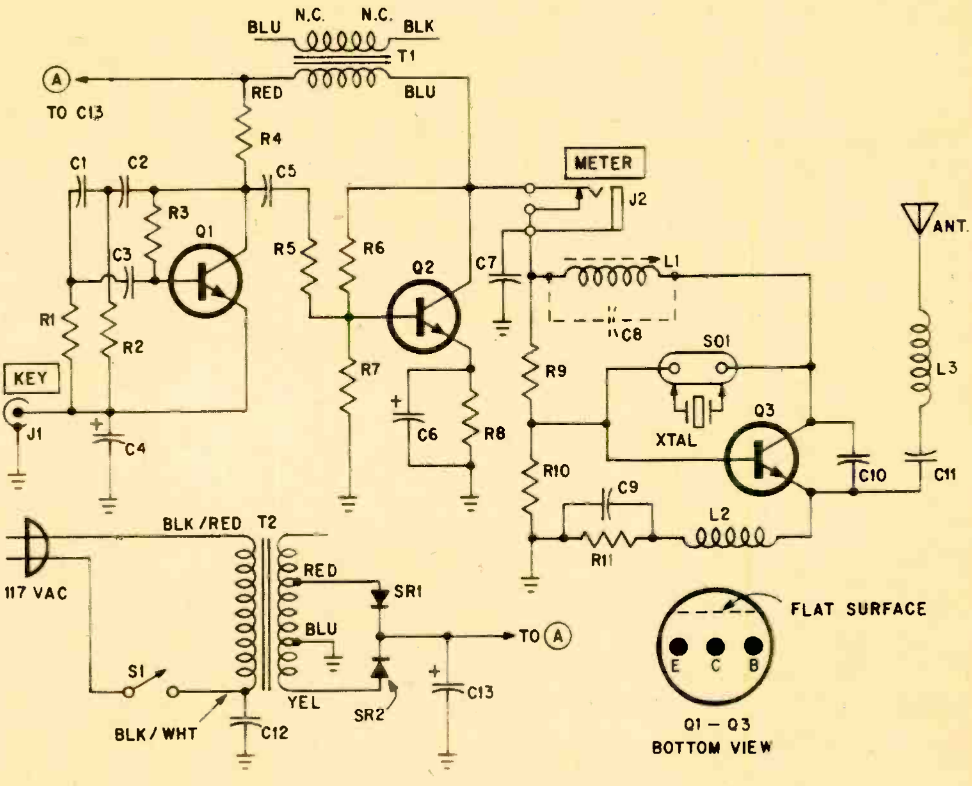
The Circuit. The transmitter uses three transistors and produces a tone-modulated carrier. Transistor Q3 is a crystal-controlled oscillator which is tone modulated whenever the key plugged in jack J1 is closed. Transistor Q1 is a phase-shift oscillator with an output frequency between 500 and 1,000 cps—depending on the values of C1, C2, C3, R1 and R2. You can juggle the values of these parts to change the frequency of the modulating tone. The output of Q1 is fed through C5 and R5 to Q2, the amplifier modulator. Note that the modulated B+ at Q2's collector is the DC supply for Q3. Hence, modulated B+ is fed to Q3 where it modulates the RF carrier at an audio-frequency rate.

Normally Q3 is always on. The key controls the tone modulation only. The reason we did it this way instead of having the AF oscillator always on while the RF oscillator is keyed (as is more common), is that an overtone oscillator requires a fraction of time to start. If the oscillator were keyed, part of the first code character would be lost.

Jack J2 allows you to measure Q3's input

PARTS LIST

Capacitors: 15 V or higher unless otherwise indicated
C1,C2,C3—.01 μf ceramic disc
C4—2 μf electrolytic
C5,C7,C9—.05 μf ceramic disc
C6—10 μf, 3 V electrolytic
C8—5 μμf (see text)
C10—20 μμf ceramic disc
C11—100 μμf ceramic disc
C12—.01 μf, 500 V ceramic disc
C13—1,000 μf electrolytic
J1—Open-circuit phone jack
J2—Closed-circuit phone jack
L1—1.0-1.87 μh adjustable RF coil (J. W. Miller 42A156CB1. Newark Electronics Corp., 500 N. Pulaski Rd., Chicago, Ill. 60624. Stock No. 59F182; $2.10 plus postage. $2.50 minimum order)
L2—24 μh iron-core RF choke (J. W. Miller 4625, Allied 54 B 3839)
L3—Choke (see text)
Q1,Q2—2N3394 transistor (GE)
Q3—2N3662 transistor (GE)
Resistors: 1/10 watt, 10% unless otherwise indicated
R1,R2,R7—4,700 ohms
R3—220,000 ohms
R4—3,300 ohms
R5,R6—22,000 ohms
R8—56 ohms
R9—33,000 ohms, ½ watt
R10—15,000 ohms
R11—120 ohms
S1—SPST toggle or slide switch
SO1—Socket for type HC6/U crystal
SR1,SR2—Silicon rectifier; minimum ratings: 25 PIV, 50 ma
T1—Transistor output transformer; primary: 2,000 ohms, secondary: 10 ohms (Lafayette 99 H 6101)
T2—Low-voltage rectifier transformer (Allied 54 B 4731)
XTAL—Third-overtone CB transmit crystal
Misc.—52-in. telescoping antenna (Lafayette 99 H 3008), perforated circuit board, 5 x 6 x 4-in. aluminum utility cabinet, flea clips



Transmitter schematic. When power is turned on by S1, RF oscillator (Q3) transmits carrier constantly. Pressing key (J1) starts phase-shift tone oscillator (Q1) whose output goes to modulator Q2.

Junior Ham Transmitter

power. Using a built-in 10-V power supply, a meter indication of 10 ma means Q3's input power is a legal 100 mw.

Construction. The transmitter will fit in a 5 x 6 x 4-in. aluminum utility cabinet. The RF oscillator is built on the front panel. The tone modulator is built on a 1⅝ x 2½-in. piece of perforated board (flea clips are used for tie points) which is also mounted on the front panel.

First, build the power supply then set it aside. Next, lay out and drill the front panel except for the circuit-board's single mounting hole. Install L1 centered on the front panel 1¼ in. down from the top. Install the RF oscillator terminal strips close to L1. Mount crystal socket SO1 ¾ in. below the terminal strip. Wire the complete RF oscillator up to meter jack J2. Jack J2 is a closed-circuit phone jack which *must* be insulated from the chassis with fiber shoulder washers.

Drill a single mounting hole in the center of the board, then wire the modulator. When it's finished mount it on the front panel using a spacer to prevent the flea clips from shorting to the panel. Then make the connections between the board and J1 and J2.

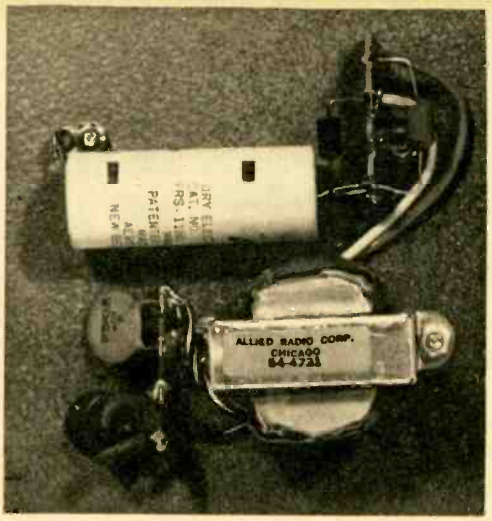
Using a ½-in. drill or a ½-in. dia. rod for a coil form, wind L3, which consists of 10 tight-wound turns of No. 18 enameled wire. Bend the leads out at right angles to the coil and cut them ½ in. from each end of the coil.

Attach the front panel to the cabinet, check that the antenna isn't shorted to the cabinet and solder one end of L3 to the antenna's solder lug. Then solder C11 from L3 to L2.

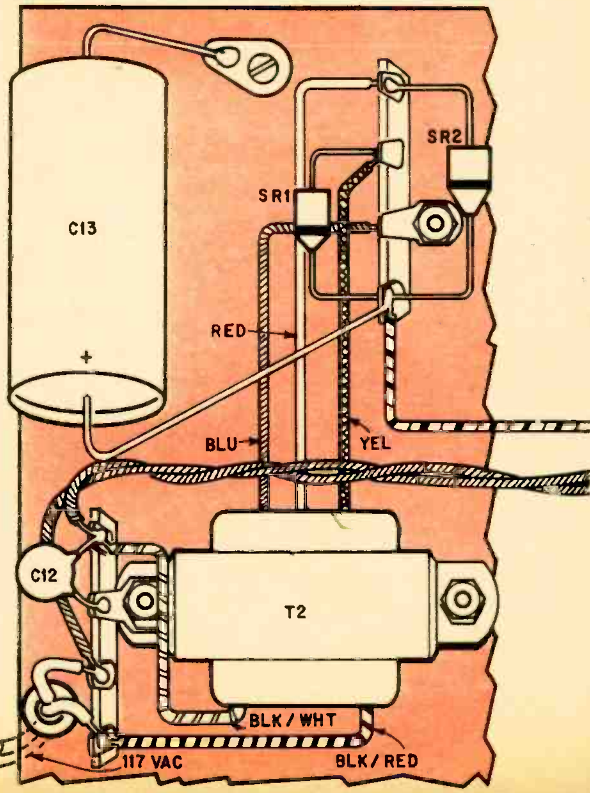
Checkout. Insert a phone plug in J2 and connect the negative lead of an 0-20 ma (or higher) DC milliammeter to the plug's frame terminal (commonly called the sleeve terminal). Connect the meter's positive lead to the plugs' tip terminal.

Plug a crystal in SO1 and place a walkie-talkie or CB transceiver, tuned to the crystal's frequency, approximately 10 ft. away. Plug a key in J1 and extend the whip antenna fully.

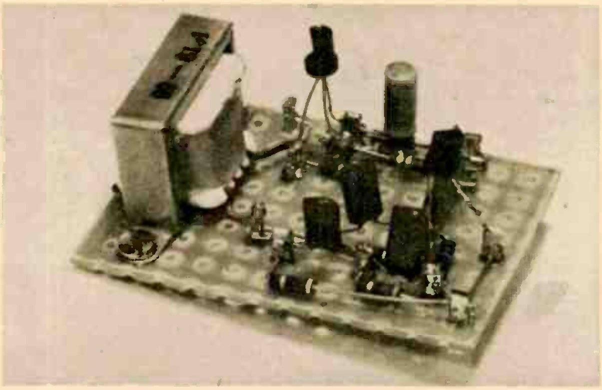
With your eye on the meter turn S1 on. If the meter fails to indicate above zero or indicates more than 15 ma, quickly turn off power and check for a wiring error. If the meter indicates 15 ma or less—it should be close to 8 ma—turn L1's slug full counterclockwise so it is all the way out of the coil. Then turn the slug clockwise until the meter indicates a slight peak. To be sure the oscillator will always start, turn the slug clockwise one full turn after the meter indicates a rise in current. If the meter fails to rise as L1's



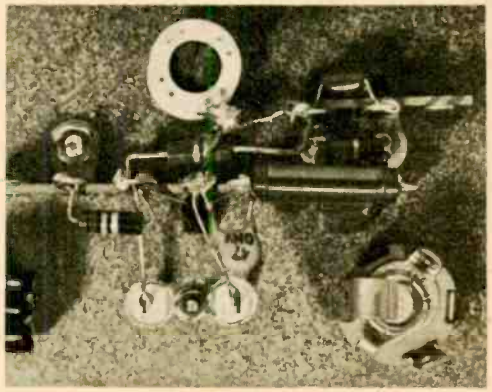
Power supply should be built on rear cabinet cover. Transmitter will operate on 9-V battery but it must be at least the size of an Eveready No. 276.



Build power supply (T2, C13, etc.) on rear panel of utility box. Other circuitry (right page) is built on box's front panel. L3's lug goes to whip antenna on top.



Oscillator/modulator is built on circuit board. Note stand-up electrolytic (C6) and 1/10-watt resistors which were used to minimize crowding.



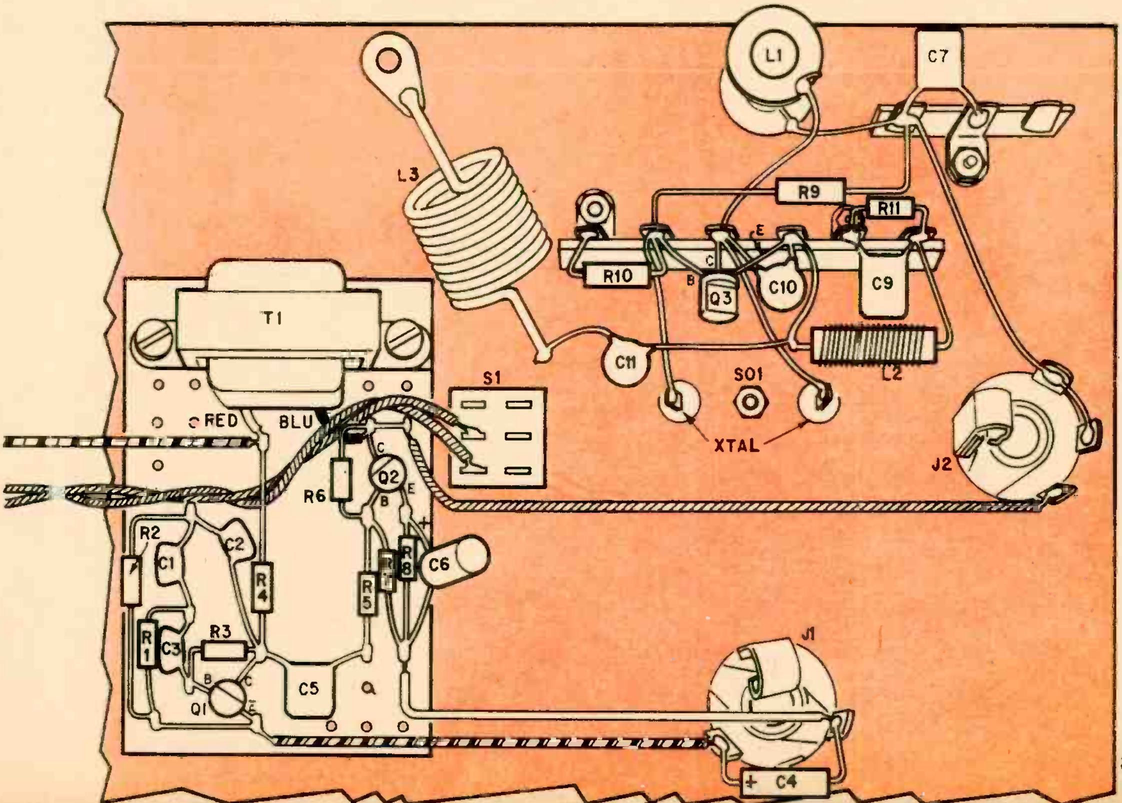
The RF oscillator is built directly on the front panel. Terminal strips are placed close to slug-tuned coil (L1) to keep lead lengths to minimum.

slug is adjusted, or if the meter indicates a peak with the slug full-in, connect a 5- or 10-$\mu\mu$f capacitor (C8) across L1.

When the transmitter is tuned and radiating RF you will hear a quieting in the nearby walkie-talkie or transceiver. Close the key and you'll hear a tone.

If the meter indicates a current greater than 10 ma the transmitter is illegal—its input power is in excess of 100 mw. Reduce the current by increasing the value of R9. If the meter indicates less than 10 ma, increase the current by reducing R9's value.

Note that L1's tuning will have some effect on the frequency. Parallel-type crystals, which are usually connected between a CB transceiver's oscillator grid and ground, will be slightly off frequency when used in this transmitter. Series type crystals will generally be on-frequency.



CB Corner

By Len Buckwalter, KQA5012

Washington Report

READERS of electronic trade papers were startled recently by a quotation from FCC Chairman Rosel Hyde. In what appeared to be off-the-cuff remarks, he had said it might be a good idea to up the present $8 CB license fee and add an examination for prospective licensees that would test their technical competence to operate a station. Sound bad? Well, don't lose heart—yet.

To check out this latest kettle of fish and see what else might be on the fire I journeyed to FCC headquarters in Washington and queried three of its leading lights: Everett Henry, Chief of the CB division; William Grenfell, head of rules and legal branch, and Richard Everett, CB's general attorney. Being aware that FCC action is anything but unilateral (there are too many minds at work on overlapping problems within the Commission—to say nothing of the external groups, federal and otherwise, with whom their plans must be dovetailed) its officials generally point out that what they say represents their own evaluations at a particular moment and decline direct quotation. (The Chairman may be an exception.) But in spite of the understandable reserve a number of interesting observations emerged. Let's take them one at a time.

• If a technical examination ever materializes, you won't need a slide rule to pass it. It would be more like a driver's test (which doesn't ask how the car's ignition system works). A taste of the test may be a booklet now being mailed to all new licensees. Called How to Use CB Radio, it employs a self-teaching approach. One example: in this CB conversation is Allan committing an offense?

Allan: Hi, Janet. Glad to find you at home. Can you go swimming with me today?
Janet: I'd love to. When can you get me?
Allan: In about 15 minutes—it isn't too far from your house to mine.

Sorry, Allan! Official FCC answer: "He should use the phone instead." (Like many such tests it may penalize the imaginative, who may reason that Janet is riding in her Jag and Allan is in his Alfa.)

• Setting aside certain channels for stranded motorists is one of CB's oldest chestnuts. It raises a touchy issue among FCC men. They've been petitioned to reserve channels 1 and 9 for emergency calling and there's the powerful voice of auto manufacturers plumping for the HELP plan (two new channels especially for the motoring public). These proposals seem to be stalled in Washington and officials offer several reasons for the delay.

First, the Commission always has shied away from special channels—too few frequencies and too many parties with special interests. And even if a channel were reserved for some special use it could flop on the protection issue. The FCC declares that it is not now equipped to put the necessary teeth of enforcement into any special channel to keep it free of interference.

Also, highway safety is becoming a problem that could prove too big for CB to handle. Along with HELP, the Commission is considering other plans. One system under observation uses push-button transmitters posted along Washington's Beltway. It's having equipment and people problems. Stranded motorists press a mute button and wait. There's no reassuring voice saying help is on the way and some motorists become confused. With 90 million cars on the road a mistake in selecting a system (CB or otherwise) could prove disastrous.

• Talk about a national CB organization and you're apt to get a snicker around Washington. One FCC man believes that, because of diversity of activities and interests, CB never can weld itself into a cohesive national group.

Mention local clubs and official response is varied. The FCC believes clubs could make a contribution, especially in self-policing. But some noble aims often fail. Applications are received to license HELP-type operations, for example. Yet experience suggests that voluntary 24-hour monitoring has a low survival rate. It's those middle-of-the-night calls that dampen enthusiasm.

• Despite CB's problems it is enjoying a growth rate roughly equivalent to that of a

Among those interviewed for this report was William Grenfell, FCC's Chief of CB rules.

Richard Everett, also on the panel of interviewees, is attorney for FCC's CB division.

healthy adolescent. From birth, in 1958, it has shot up at a dizzying rate. Near the end of 1967, total number of licenses stood at over 845,000. There are portents, though, that CB is reaching numerical maturity. FCC men suspect that the one-million mark could be the plateau that had to come.

The number of CBers licensed each month is not significantly lower than before. Applications still pour in at a monthly rate that swings between about 15,000 and 20,000. Outstanding licenses still fail to reach the million mark in spite of the continued high issue rate because of the large number of licenses now expiring.

• The Commission has received several petitions to raise antenna height above the 20-ft. limit. One argues that new antennas need 25 ft. for mounting; another wants more height for clearing obstacles. It's agreed that inequities exist between heights of neighboring antennas but changes seem unlikely. To meet FAA requirements the Commission would have to check each application for hazard to aircraft. It could delay licenses as much as six months.

• Single sideband still is too rare to have any impact. But if everyone did go sideband (and thus create more channels) it might not make a dent in the overcrowding problem. More people, goes the argument, would get on the air.

• Population of the older CB bands—A and B—remains miniscule compared to sprawling Class D. Only some 6,000 licenses are on costly Class A. And CB's first band (B, on 465 mc) seems doomed. It's used mostly for garage-door openers, with about 6,250 licenses.

• Type acceptance, which holds the CB manufacturer responsible for equipment performance, will probably become law in 1968. Hopefully, it will cure some technical violations and assure better equipment.

• Now you're issued a new call-sign when your license is renewed or modified. Though the Commission is aiming toward re-issuing the same call, the system for doing so has not yet materialized.

• There'll probably be no upswing in FCC law enforcement in the near future. Problem is budget. The Commission has asked Congress for more money but the hope is dim. Like other non-military agencies, the FCC will probably receive a reduction, not an increase.

• Brightest possibility on the official horizon: The FCC is casting around (budget willing) for an outside professional organization to make the first in-depth study of CB. It will close the yawning knowledge gap on just how many people use the service and for what purposes. Today there are only guesses on how well CB meets people' s needs and the source of its problems. Once these questions are answered with some accuracy CB may start aiming for its second million licenses.

Mobile Beam for CB

Quickly set up, beam boosts effective radiated power almost three times.

By H. B. MORRIS

YOU'RE driving 10, maybe 15, miles from home and trying to get a message back to the base station. No luck; only hash and static because your 5-watt signal is lost in the fringe area. So you stop the car, open the trunk and take out something about the size of a skinny golf bag.

Less than five minutes later—voila! Perched on the car roof is a huge 2-element beam that nearly triples your effective radiated power. Now your base hears you loud and clear. And it's done without touching a screwdriver.

The beam outperforms a regular whip for several reasons: First, it focuses your signal in a specific direction. Second, it uses full-length elements that mount at the highest point on the car so signals clear obstacles. The beam, too, uses the complete car roof as a ground plane. No holes are drilled in the car and the antenna can be put on another vehicle in minutes.

The beam's longest knocked-down dimension is four feet and its width is only a few inches. Although intended for stationary operation, it can also be used temporarily while you're in motion.

Main parts of the beam are shown in Fig 1. There are two vertical elements which rise about 8 ft. above the car roof. The forward element is a *director;* the rear element is the *driven* element. The beam always fires the strongest signal along a line from driven to director elements.

We have a novel system for getting a good electrical ground for the verticals. There are two large metal *ground plates* under the elements which act as plates of capacitors. They transfer RF energy right through the paint on the car roof; therefore, you won't have to sandpaper your car's roof down to the

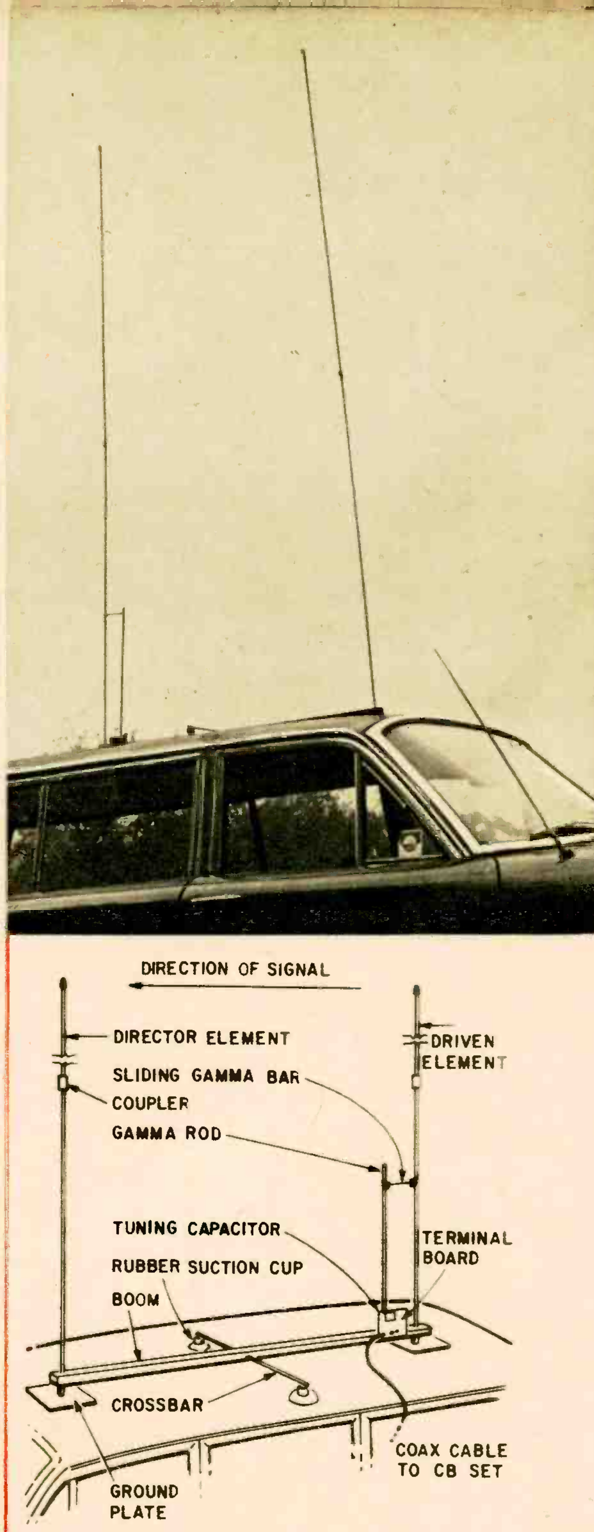


Fig. 1—Photo at top shows beam installed on top of station wagon. Elements are parallel although they don't appear so here because of angle at which photograph was taken. The diagram above shows the major parts of the beam.

bare metal. If you own a convertible, the beam's not for you. It'll work on anything from a VW to a hearse, so long as the roof is metal.

The *boom* of the antenna, which separates the verticals is made of wood. Metal can't be used here as it would ruin tuning of the elements by acting like part of the antenna. The *crossbar* provides most of the lateral support for the whole beam and large rubber suction cups provide a good grip on the roof.

Last major component is the *gamma* section. Consisting of two rods, the gamma section acts like a transformer to boost the antenna's impedance from about 17 to 50 ohms. The *gamma bar* is a sliding element that matches the antenna's impedance to that of the CB rig. A tuning capacitor resonates the system.

Most beam hardware is available from electronic parts distributors. Big stuff, like aluminum tubing and wood, is not. And it's good idea to use the same materials shown here. They were carefully selected so the beam can be electrically tuned to 27 mc and easily erected or knocked down. If aluminum tubing isn't available at a local hardware store, you'll have to try a metal supply house. There are many kinds of ⅜-in. aluminum tubing and some are too soft for the job. The type we used was listed in a metal-supplier's catalog as 6061-T6, which describes wall thickness and hardness. That tubing struck many a tree branch and survived well. The metal for the ground plates is common brass *shim stock*.

The small plastic tips on the top of the verticals are used on chair legs. Large rubber suction cups are sold for cartop carriers and are also easy to obtain. For the terminal board, on which you mount the coaxial cable and tuning capacitor, use bakelite or plastic.

Construction. The details needed to build the beam are in Figs. 2 and 3. Note that shaft couplers are mounted on each of the two top-element sections. To install them, slide half a coupler on a top element. Then tighten the coupler screw. Remove the other coupler screw and substitute a spade bolt which you can loosen or tighten with your fingers. Two other shaft couplers are used at the bottom of each element under the boom. They are for a tension adjustment which is made when the beam is mounted

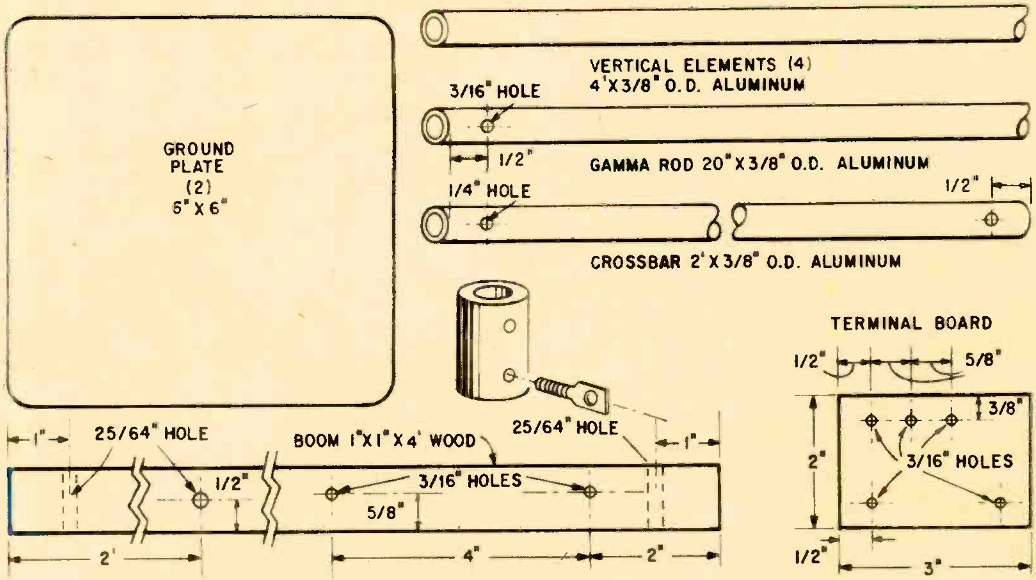
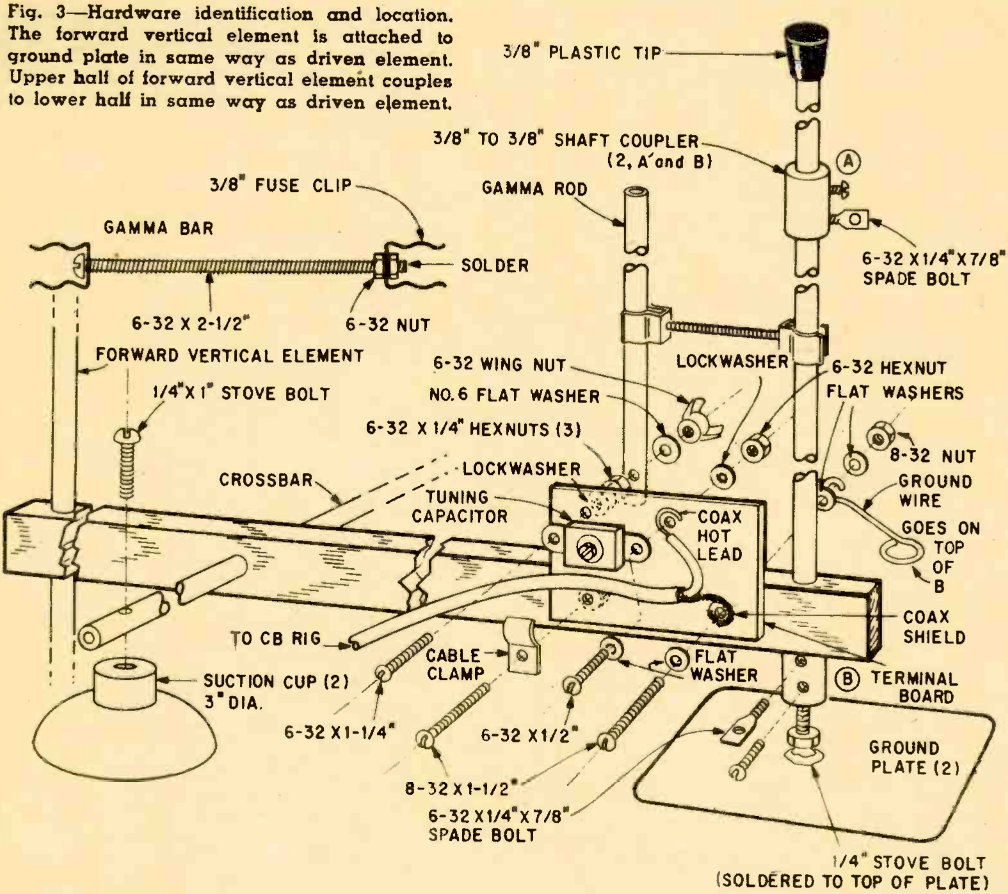


Fig. 2—Cutting and drilling dimensions. The two ground plates are made of common brass shim stock. The holes at each end of the 2 ft. x ⅜-in. outside-diameter aluminum crossbar have a diameter of ¼ in.

Fig. 3—Hardware identification and location. The forward vertical element is attached to ground plate in same way as driven element. Upper half of forward vertical element couples to lower half in same way as driven element.



Mobile Beam for CB

on the roof of the car.

To keep the two ground plates smooth so they don't scratch the car top, solder the bolt on one side of the plate. If you worry about scratching your car top with ground plates, put contact paper on their undersides.

Mount the hardware on the small terminal board but don't do any final tightening yet. Install the tuning capacitor by spreading its mounting tabs so screws can be inserted through the holes. One thing that's not obvious is a ground wire from the terminal board to the bottom of the boom. It's installed after the terminal board is mounted according to the detail in Fig. 4. First, fasten the ground wire as shown under the right nut (between two flat washers). Temporarily slide a piece

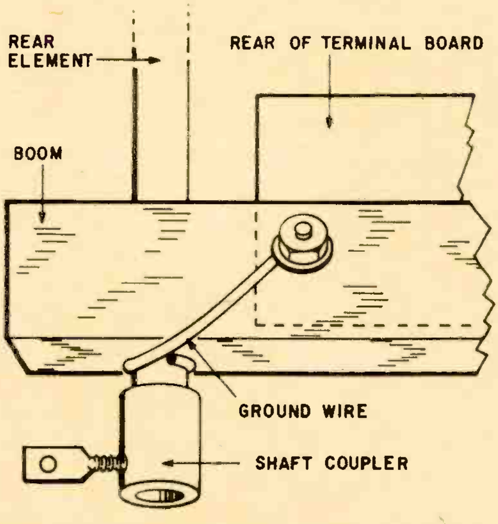


Fig. 4—Ground wire detail. Sandwich wire between washers before installing on screw. Screw comes through coax braid, board and boom.

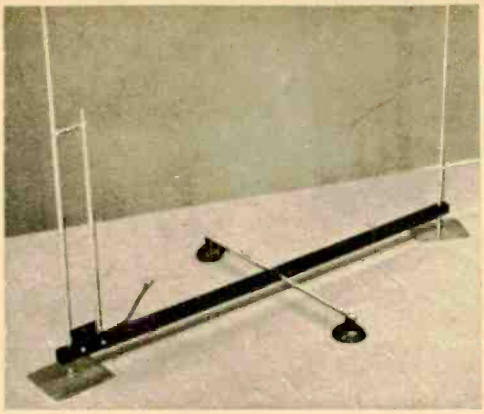


Fig. 5—Finished antenna. Dark bar is wood boom. Suction cups hold cross-bar to roof. Metal plates capacitively ground beam through paint to roof.

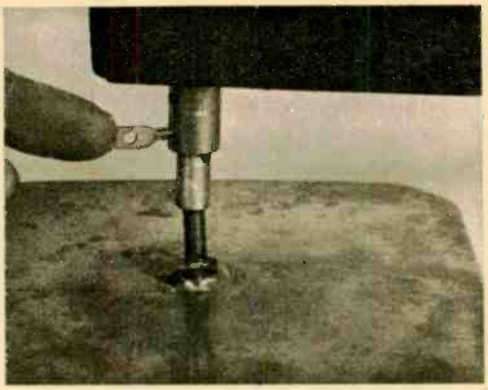


Fig. 6—Shaft coupler is used below boom on both elements. Spade bolt allows hand adjustment of coupler to compensate for different roof curves.

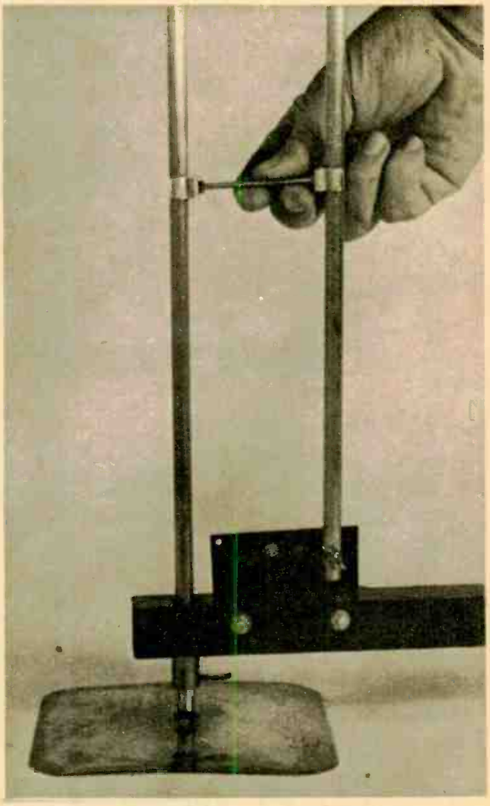


Fig. 7—Gamma rod (right) is clipped to rear vertical element by long bolt fitted with fuse clips. Bar must be slid up or down for the lowest SWR.

BILL OF MATERIALS

Quantity	Item
1	Boom: 1 x 1 x 48-in. pine, baluster stock
1	Terminal board: 2 x 3 in. bakelite or plastic
1	Crossbar: 2 ft. x ⅜-in. O.D. aluminum tubing (all tubing type 6061-T6)
4	Vertical elements: 4 ft. x ⅜-in. O.D. aluminum tubing
1	Gamma rod: 20 in. x ⅜-in. O.D. aluminum tubing
2	Plastic tips: ⅜-in. I.D.
1	Tuning capacitor: 25-280 $\mu\mu$f trimmer (Lafayette 34 H 6832 or equiv.)
2	Rubber suction cups: 3-in. dia.
1	Cable clamp
2	Fuse clips (for gamma bar) ⅜ in. (Littlefuse 120002)
4	Shaft couplers: ⅜ in. to ⅜ in.
2	Stove bolts: ¼ x 1 in. (for mounting suction cups)
4	Spade bolts 6-32 x ¼-in., ⅞-in. long
2	Ground plates: 6 x 6 x 0.025-in. thick brass shim stock
1	Ground wire: No. 14 solid copper, approx. 4 in.
Misc.	No. 6 and No. 8 machine screws, nuts and washers; sizes given in Fig. 3

of aluminum tubing through the rear boom hole. Then bend the ground wire under the boom and around the tubing. You should be able to move the tubing out of the hole without disturbing the wire loop. The shaft coupler will be forced against the ground wire for electrical contact. It grounds the element to the coaxial cable shield.

Erecting the Beam. Begin by laying out all parts on the ground:

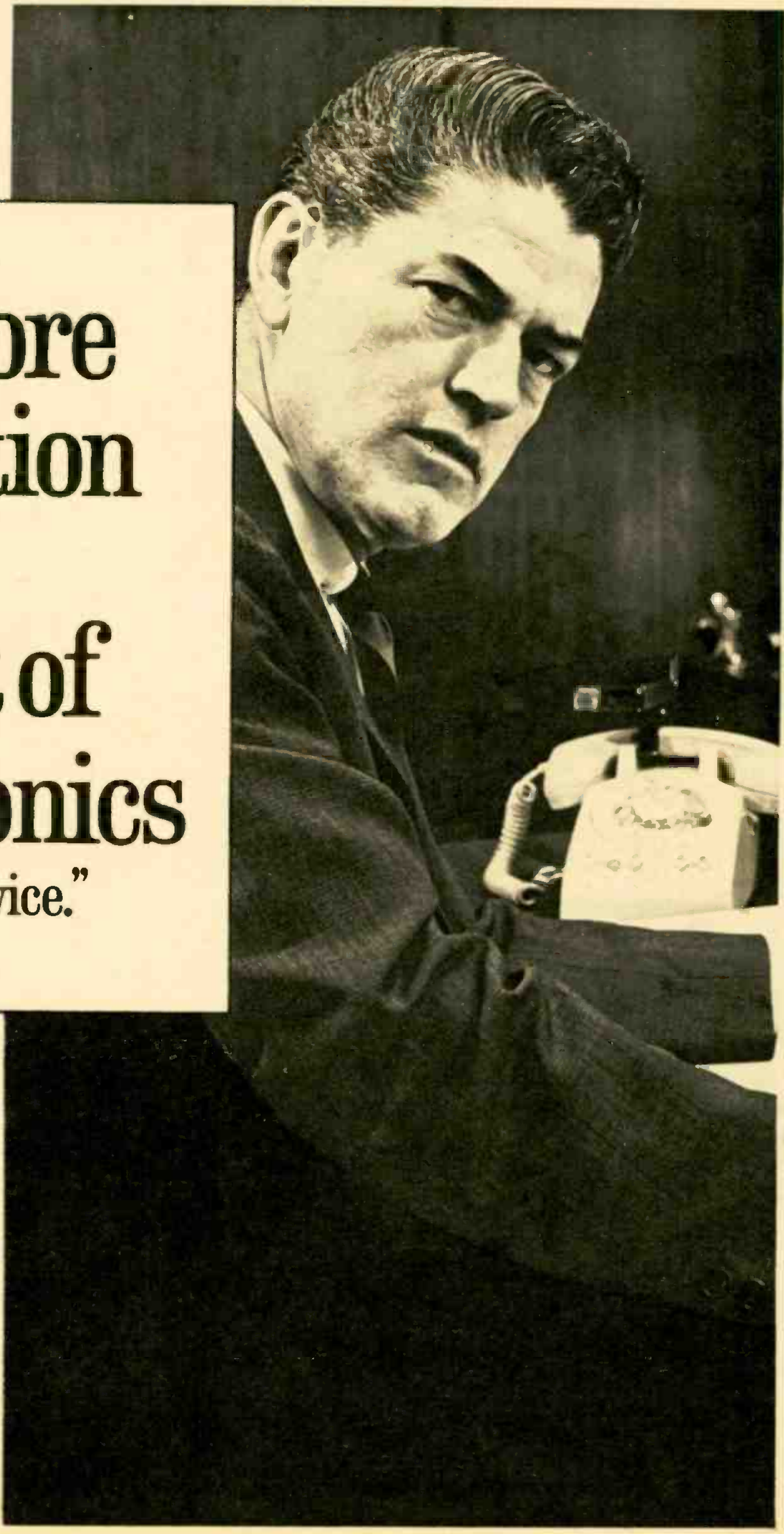
1) Remove one of the suction cups from the crossbar and slide the bar through the boom. Replace the suction cup.

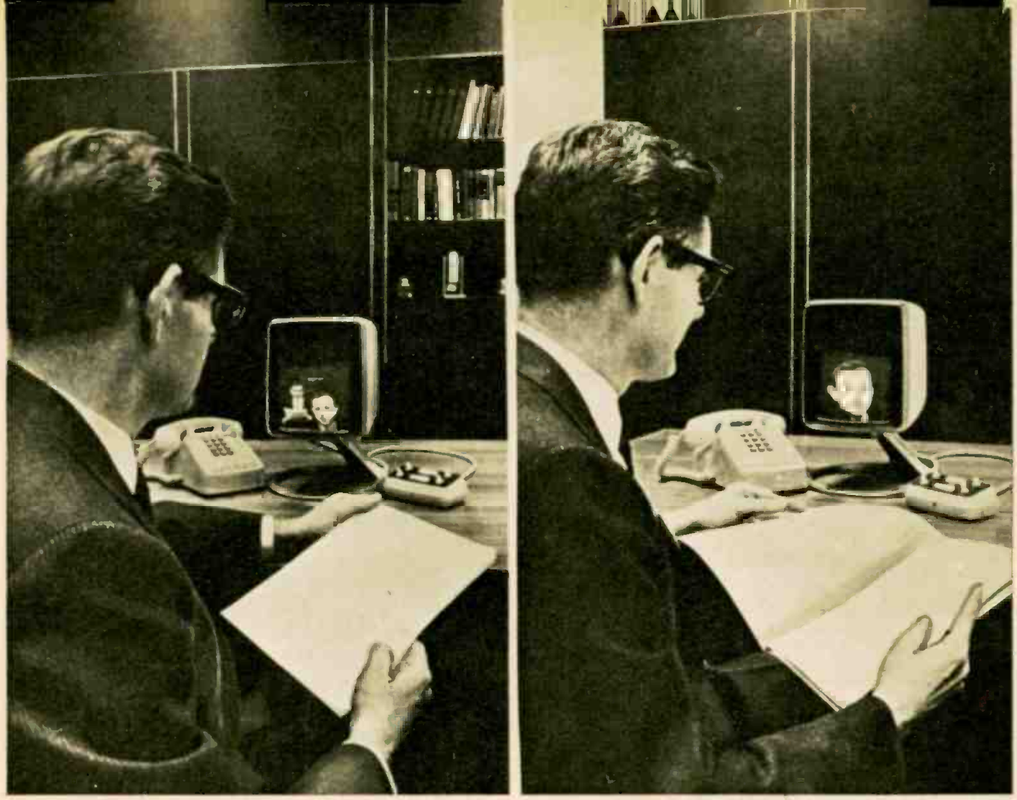
2) Insert the two lower vertical elements up through the *bottom* of the boom. Push them in until their shaft couplers touch the underside of the boom.

3) Clip the gamma bar onto the gamma rod and raise the rod to the vertical position. Then clip the free end of the gamma bar onto the rear vertical element. Gently tighten the wing nut at the bottom of the gamma rod. [*Continued on page* 115]

"Get more education or get out of electronics

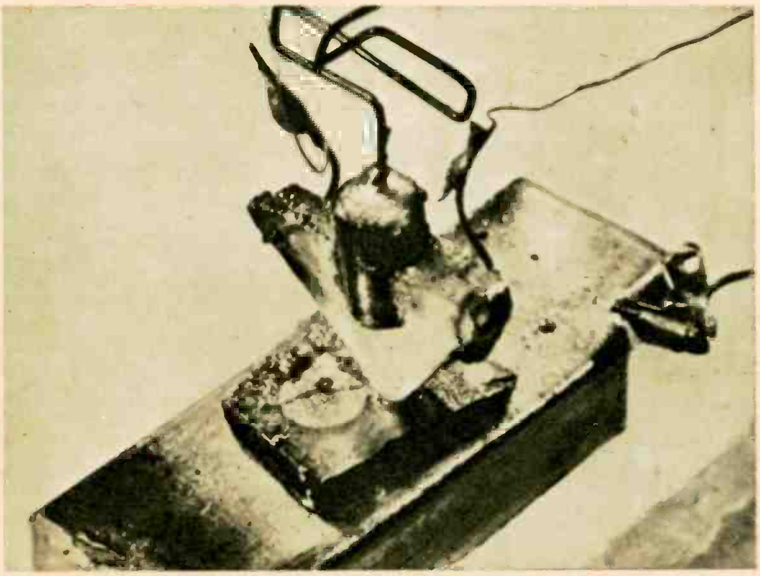
...that's my advice."





ZOOM-A-PHONE. . . A second-generation Picturephone is being shown by Bell Telephone these days. The most obvious advantage of the new model is its zoom capability—the viewer may enlarge part of the picture for a clear view of fine detail. Three operating distances are provided for—1 ft. for closeup of documents or small objects, 3 ft. for face-to-face conversation, 20 ft. for groups or transmission of large objects such as a blackboard.

Electronics in the News



Happy Birthday. . . No, that's not a home-brew SIA antenna. It's its great granddaddy—the original transistor, first successfully used in December, 1947. Bell Labs released the picture as part of the 20th birthday celebration of an event that was, in 1956, to net Nobel prizes for three Bell scientists.

Noise Organ. . . Don't try to play Melancholy Baby on this one, Henry. You could get anything from the patter of raindrops to the roar of a Sherman tank. It plays only sound effects, each recorded on ⅜-in. magnetic tape and played by pressing the right combination of switches and a key on the keyboard. A total of 1,260 effects can be stored on tape, related sounds being cued by adjacent keys for easy sequencing. Sounds can last up to 8 sec. and can be repeated immediately after releasing the key. Faders and variable speed controls (for altering pitch of the effects) are built in. The unit comes from Mellotronics Ltd. in London, England.

Late Flash. . . TV news without sound for men who need the news at their desks is available in New York through the combined efforts of Television Presentations, Inc., United Press International and Manhattan Cable Television. UP bulletins are converted into video by an RCA character generator and fed by cable to an unused channel on subscribers' sets. They can glance at the news from time to time or (unlike news coverage on radio or standard TV broadcasts) ignore it.

Hi-Fi Today

By John Milder

* *Light Up and Listen*
* *Wring Out the (Deci)Bells*
* *From Disc to Tape*

NO doubt about it: the hot news this year is about a flaming loudspeaker. I mean a speaker that actually uses a modulated flame to produce sound.

It seems that some engineers at the United Technology Center in Sunnyvale, Calif., were working on (of all things) underwater speakers when someone got the idea of coupling the output of an audio amplifier to the flame of an acetylene torch through a pair of electrodes. Lo and behold, sound came out. And it was pretty good sound above 3 kc or so. In fact, with no diaphragm to worry about, output can be truly omni-directional.

Will the United Technology (don't confuse the UTC initials with those of the New York purveyor of transformers and speakers) flame speaker make it to market? I tend to wonder. For one thing, it falls off rapidly (6db per octave) below 3 kc since its small-area flame just won't couple well to the air around it. That doesn't matter, of course, if you use it only as a tweeter. But the flame itself is not the easiest thing to build into the average living room.

Still, if a way can be found to keep the new speaker from setting the world on fire, perhaps it will.

Having made it three times last year to San Francisco's hallowed Fillmore Auditorium (the home, sort of, of the Jefferson Airplane, the Grateful Dead, and lots of others), I can report that those alarmist doctors may be right. As practiced at the Fillmore and elsewhere, rock music may easily destroy a healthy gob of hearing acuity pretty quickly. I have walked out of the Fillmore with my ears feeling like they do after a sudden drop aboard a jet. And I've seen rock musicians have a tough time identifying speech sibilants at way above normal talking volume.

So, an appeal. Bring it down by 10db or so, gentlemen. After the first week it will seem just as soul-satisfyingly loud and you can get all the distortion effects you want. Honest. And please do it before I'm drawn (I can't help myself) to the Fillmore again.

As we noted a while back, hi-fi manufacturers keep branching out into new component categories. One of the most interesting expansions in a while has been that of the U.S. arm of BSR (British makers of record changers) into tape. BSR has produced a nice little tape deck for a total tab of $129.95, including walnut base. The machine in question, the BSR TD-1020, isn't pretentious in appearance (for that price, what do you expect?) but its initial performance makes BSR's entry into tape well worth applauding.

In the United Technology Center Physical Sciences Laboratory, researchers K. L. Baker, W. R. Babcock (Chief Scientist) and Dr. A. G. Cattaneo listen to their flame loudspeaker. Electrodes (the upper one is in front of Mr. Babcock's left shoulder) feed audio signal to flame, modulating it to produce sound output.

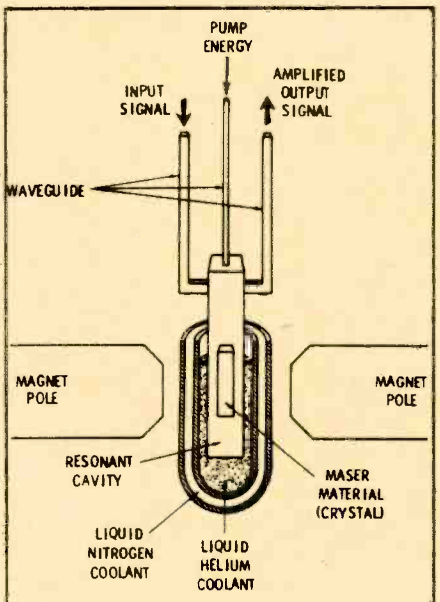
Good Reading

By Tim Cartwright

LASERS AND MASERS. By Charles A. Pike. Howard Sams & Bobbs-Merrill, New York & Indianapolis. 176 pages. $4.95

Back in my Army days I used to squirm when some sergeant got up on a training platform and said, "In the next hour we're going to learn. . ." So my palms went a bit clammy when I saw the first sub-heading in this book: What You Will Learn. But I was pleasantly surprised to find this a well-written short course on lasers and masers. It's a programmed course with a slight twist. Instead of asking questions after each point or at the end of every chapter, this book lets a major thought or two develop for a few paragraphs before posing questions. Sometimes you fill in blanks, write out answers or match columns of characteristics. And there are summary questions and answers at the end of each chapter.

This method is worth investigating. In addition, you'll find good illustrations. So if you don't know what lasers and masers are and would like a really good short course on the subject, get the book.



Solid-state ruby maser diagram is typical of clear illustrations in Lasers and Masers. Many use second color for strong visual explanation of subject.

ELEMENTS OF RADIO SERVICING. By William Marcus and Alex Levy. McGraw-Hill Book Co., New York. 426 pages. $6.95

The approach of this text is to give a service technician (present or potential) something more than the usual bits of information on various techniques, problems and components. The idea is to develop a learning background that permits a serviceman to develop not only functional skills but also a way of looking at or for service problems.

But I'm not convinced that everything is as it should be. The book is well written and produced but the information is of limited value since it's almost entirely about tube equipment. Transistors are covered for 30 or 40 pages and only in specialty applications like portable and car radios. There's no mention whatever of their role in relatively sophisticated products like stereo-FM receivers. So, while I think this text is important enough to bring to your attention, you'll really have to judge it for yourself.

RADAR FUNDAMENTALS. By Gershon J. Wheeler. Prentice-Hall, Englewood Cliffs, N. J. 105 pages. $5.95

A good fundamental text, this falls nicely between the formula-loaded mathematical treatises and popular treatments that offer nothing but glittering generalities. Don't get the idea there aren't any equations. There are plenty—all necessary. But they shouldn't throw anyone with some background in algebra.

SINGLE SIDEBAND. By Harry D. Hooton. Editors & Engineers, New Augusta, Ind. 352 pages. $6.95

The author says the book was intended to be "a modern, one-source reference" on the subject of SSB, which continues to grow in importance and interest to hams. He has succeeded with a text that really offers comprehensive coverage.

And Make Note Of. . .

101 WAYS TO USE YOUR SQUARE-WAVE PULSE GENERATORS. By Robert G. Middleton. Howard Sams, New York & Indianapolis. 160 pages. $2.95

DIODE CIRCUITS. By Rufus P. Turner. Howard Sams, New York & Indianapolis. 160 pages. $3.25

Notes from EI's DX Club

BY the time you read this R. Canada's International Service may be cut back. Like the BBC, they have budget troubles.

BBC on Ascension Island is being flooded with bum reports and requests for picture postcards, stamps, etc., from greedy SWLs. When you write be sure your report is good and don't ask for anything but a QSL. They have a new frequency: 7105 kc (40 meters) from 2300 EST.

The international transmission of Radiodiffusion Nationale Malagache (Malagasy Republic) on 15265 kc at 1100-1200 EST (0800-0900 PST) is aired only *irregularly*, according to Maurice Garrick (California). That makes things a little rough.

Bob LaRose (New York) tells us that R. Lebanon's 1800-2000 EST transmission to Latin America is now on 17710 kc. Meanwhile, their 2130 English to North America, now on 11925, is widely heard.

According to the National Radio Club, a marine just back from Vietnam says the VOA station at Hue (760 kc) uses only a single-tower antenna. This lack of directional punch (along with R. Peking QRM) probably explains why the station is almost never heard outside Asia. A real challenge for West Coast BCBers and *now* is the best time to look for it—around 0600 PST.

AC4NC is said to be operating from Tibet (which, of course, is under Chinese Communist control) and has been worked on 15-meter CW.

R. Kuwait is being logged on the West Coast on 9530 kc around 0600 PST. They seem to QSL reports promptly.

You may want to try the Swedish coast station, Goteborg (pronounced Yotabore) R., with tests on 11120 kc at 1500 EST.

Mike Russell (Missouri) reminds us that the Voice of the West, R. Portugal's English-language service, continues to QSL reports promptly—a marked contrast to its original policies on the subject.

So far no one has logged R. Afghanistan on that famous 6000-kc spot. William Sparks (California) did bag them way down on 4770 at 0600 PST.

A timely utility catch is NORAD San Diego which sometimes shows up with a test tape on about 8775 kc around 2200 EST. Juris Burkevics (Washington) reports reception of NORAD San Francisco on approximately 3350 at 0015 EST (2115 PST).

The Sudanese Broadcasting Service has extended its schedule and is now on until 1700 EST. East Coast DXers should watch for this one on 4994 kc.

ETLF, R. Voice of the Gospel (Ethiopia), has appeared with powerful signals on a new frequency—7125 kc—from 2230 EST in African languages but with English IDs.

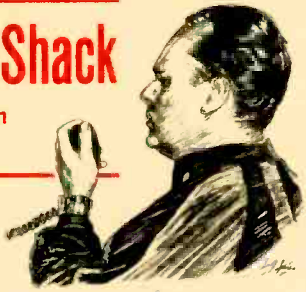
The long-awaited SE Asia Radio Voice is on the air from the Philippines. It has been heard testing on 15420 kc at 1830-2030 and 0600-0800 EST. This station definitely wants reports.

The utility station of the Telecommunications Dept. of the Bahamian government, Nassau, has been logged by William Sparks on 4825 kc (60-meter tropical broadcast territory) at 9145 EST (2245 PST).

Propagation: Openings on 10 and 11 meters, at a high level during the winter and spring months, will decrease during May and June because of seasonal propagation changes. Some 10-meter openings will occur over circuits into the Southern Hemisphere during the late afternoon and evening hours, however. The 13- and 16-meter bands will be excellent for DX much of the time and 19 meters will be open around the clock for DX. At night, DX in all bands between 19 and 49 meters will be possible. Because of high noise levels, broadcast-band DX will be restricted to relatively short distances.

The Ham Shack

By Wayne Green
W2NSD/1



TEN meters has been fantastic the last few months. It's getting back to its old self. Signals are coming in from all over the world and you don't need big power or a long antenna to work them. When 10 is hot you can work farther with less signal than on any other DX band.

To give you an idea of what you can do, a friend of mine near Boston has been having a ball with a converted CB walkie-talkie. He operates it with crystal control and works Europeans one after the other. Not bad for about a watt into a little whip antenna, eh?

Right after the war, in 1946, the first DX band open was 10 meters. That was back in the old AM days. After about a year it got so crowded you either had to run a smoking kilowatt and a good beam or else move out of Kilowatt Alley, the little band from 28.5 to 28.6 mc. DX stations all operated below 28.5 in the DX band and, almost without exception, tuned from 28.5 up the band for calls. This meant the closer you were to the edge of the band the more DX you worked. But it cost more in equipment and beams to get through the incredible QRM.

Then, around 1950, sunspot activity began declining until 10 essentially became a ground-wave band. The 10-meter beams were taken down or else corroded away and by the time 10 started opening up again, around 1956, everyone had moved to the lower bands. These were still AM days, though, and hams returned as soon as 10 improved.

In 1958, while operating from KC4AF on Navassa Island, I tried 10 meters one Saturday morning. I'd never heard anything like it before. I called a short CQ from the low end of the band, announcing I would be tuning above my frequency. As I tuned from 28.6 on up the band to about 29.5 it was absolutely solid with stations calling me. There were hundreds. I worked three or four a minute for six hours straight.

Today, with most amateurs using SSB, there's nowhere near the crowding we had in the old days. You can work 10 with relatively low power through most of the band. The frequencies above 29 mc are vacant most of the time.

A few magazine articles have told how simple it is to convert CB transceivers for use on 10 meters. Almost all of them will convert. Those with tunable receivers may be a little handier for AM use, where contacts don't always zero right in on one channel. But most stations will zero your signal.

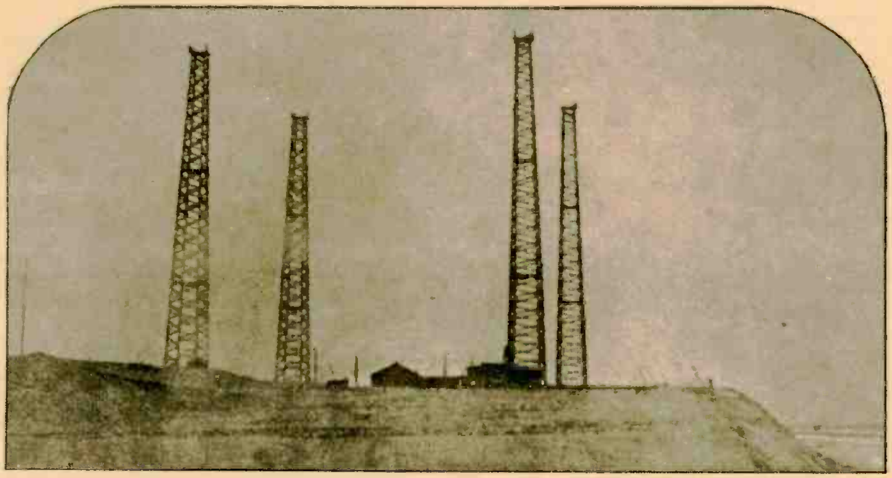
A dipole will work but a beam will work better. You can buy a nice three-element beam for under $30. Or you can whip one up out of bamboo and aluminum foil for less. Quads are simple to make for 10. And if you have a good supply of back-issue magazines or a good handbook you can make a twin-three beam which is very effective during peak sunspot years.

Do get in on the fun on 10. Skip may raise hob with the 11-meter CB band but it is a blessing for 10. . . . And it's legal!

Driven by the ARRL Incentive Licensing disaster, the amateur manufacturers have banded together. They are concerned over the drop in interest in amateur radio which the Incentive Licensing hassle has brought about and have suggested an intermediate license be made available for beginners—a sort of advanced CB ticket. It would permit crystal-controlled phone operation on the high end of 10 meters. This would allow ham-type operation and might well be a stepping stone toward a regular amateur license. Newcomers could get right on the air and participate in international contacts with simple and relatively inexpensive equipment (even converted CB gear).

As an amateur for almost 30 years I can understand why old-timers oppose any reduction in the entrance exam. But, on the other hand, as an amateur intensely interested in the survival of our hobby I am inclined to agree with the manufacturers' idea.

I know every one of them personally and I will testify that to the best of my knowledge they put the welfare of amateur radio above their own interests. (If they had any practical sense they would steer clear of the ham business entirely.) Most amateurs I've spoken to seem to feel that their gear comes from big companies out to squeeze every dollar they can from hams. If that's what you think, just compare ham prices with those for commercial gear!



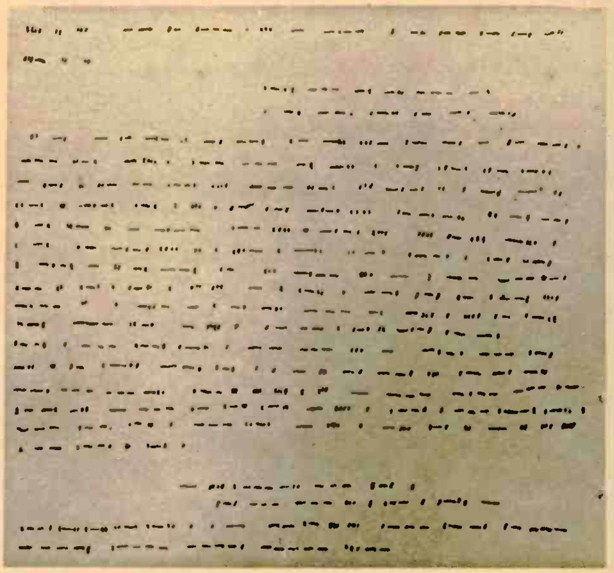
FIRST SPARKS TO EUROPE

FROM a lonely sand dune overlooking the sea came a deafening roar—not the sound of surf pounding at the sheer cliff but the ear-shattering din of huge generators, audible 3 mi. away. Protected by a small building, a wireless operator addressed a message to the King of England.

That transmission—an official greeting from Teddy Roosevelt to Edward VII—was the first to bridge the ocean between the U.S. and England. The date: Jan. 19, 1903. This new station, built by the Marconi Wireless Telegraph Co. (later to become RCA) was a substantial, imposing structure, even by modern standards.

In 1917, after 15 years of faithful service, it finally fell victim to a combination of forces. Big factor was censorship imposed by World War I. Another compelling reason was the vacuum tube. The racket-raising generators and inefficient spark transmitter simply couldn't compete. The final blow came from the relentless pounding of the sea, devouring the sandy cliff beneath the massive tower foundations.

Though little remains of the station, the site is worth a side trip if you're in the area of Wellfleet, Mass. And maybe, if you pick up the right sea shell, you will even hear the sound and fury kicked up by the old spark transmitter.



First Message (shown above in code) read:
His Majesty, Edward VII,
London, England

In taking advantage of the wonderful triumph of scientific research and ingenuity which has been achieved in perfecting a system of wireless telegraphy, I extend on behalf of the American people most cordial greetings and good wishes to you and to all the people of the British Empire.

Theodore Roosevelt
Wellfleet, Mass., Jan. 19, 1903

The Listener

By C. M. Stanbury II

Nigeria or Not?

THE value of short-wave listening as a means of keeping up with the political changes throughout the world was dramatized last May when the region around Enugu in eastern Nigeria declared its independence as the Republic of Biafra. Besides the political puzzle, DXers were confronted with the question of whether Biafra counted as a separate country or was still to be considered part of Nigeria. This situation was further complicated in August, when the region around Benin City, farther west, also declared its independence. It took the name Benin and aligned itself with Biafra.

At that point, was Nigeria one, two or three countries? The answer wouldn't really affect QSL collectors because, so far as we know, none of the secessionist stations ever verified. But for SWLs keeping track of countries logged, Nigeria posed a dilemma.

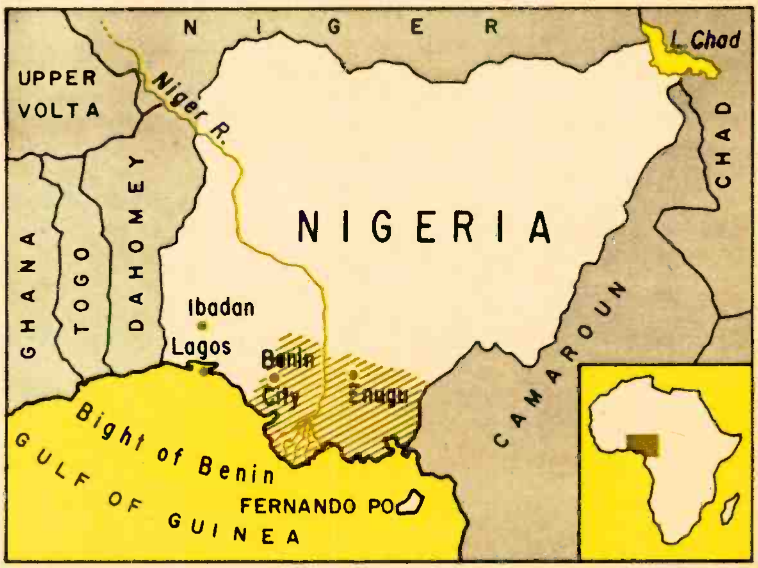
DXers were faced with a similar situation in Africa when Katanga operated as an independent country (July 1, 1960 to Jan. 15, 1963). But there was an important difference. While Katanga's borders were more or less constant during its lifetime, the boundaries of Biafra (and Benin) changed almost daily.

The Biafran government inherited two 10-kw SW transmitters at its capital. Enugu. One of these, called Radio Biafra (3980 kc), was heard in North America infrequently around 2400 EST. The other was the Voice of Biafra on 4855, primarily aimed at neighboring countries. It often was received by North American DXers around 2400 EST. At the same time, a 10-kw transmitter in Benin City could be heard on 4932.

V. Biafra was heard Oct. 8 in California with powerful signals on 6145, a new frequency. But by then Enugu already had fallen into federal hands, as had Benin City. One theory, advanced by the New York Times correspondent in Lagos, was that an attack on Enugu was anticipated well in advance and this new station already had been built at a safer location within the Eastern Region. But the 6145-kc station obviously was no shoestring affair. Construction must have begun early in August, which would indicate that the Biafrans had been pessimistic about their capital's future.

An alternate possibility that cannot be ignored is that a foreign station masqueraded as Biafra after Enugu's fall—possibly on the nearby Portuguese island of Sao Tome, which

[*Continued on page* 108]



Secessionist areas of Nigeria, indicated by hatching, include Biafra, east of the Niger, and Benin, to the west. Entire area is also referred to as Biafra. Lagos government, of course, has refused to recognize existence of either. Insert at lower right shows the relationship of main map area to the rest of Africa.

CIRCLE NUMBER 14 ON PAGE 11

The Listener

Continued from page 107

the Portuguese are reported to have used to supply the needs of the Biafran rebels.

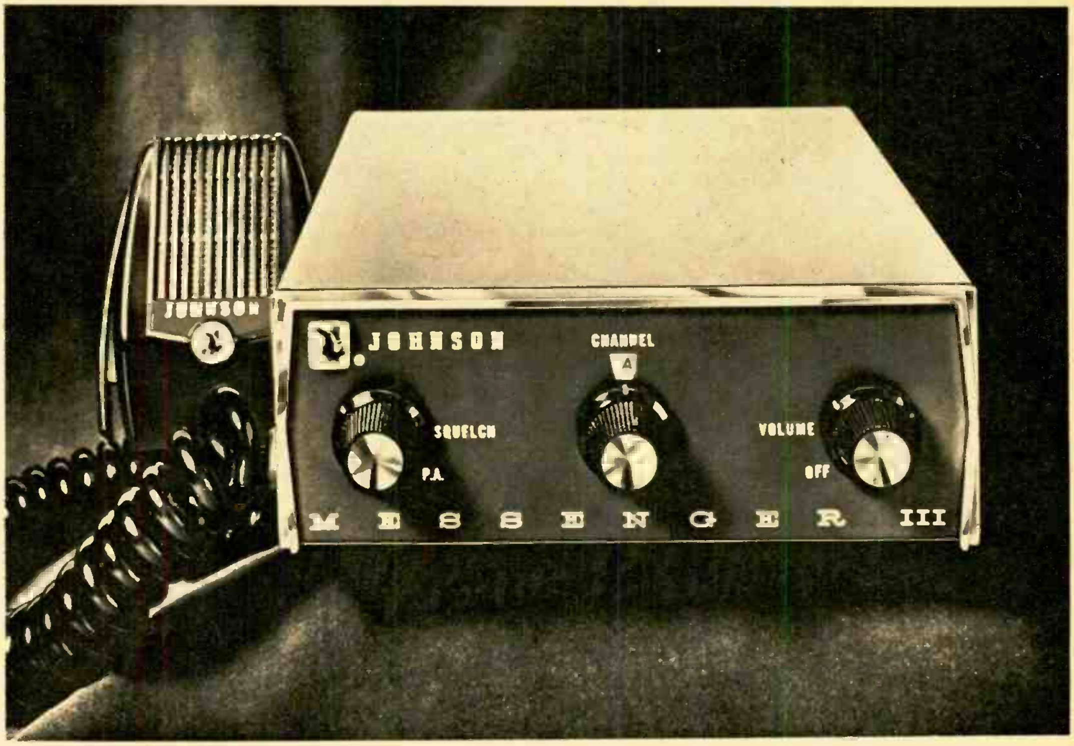
Meanwhile, the Lagos government continued to broadcast as R. Nigeria on 4990 (1700-2400 EST) and V. Nigeria, on 11900 and 15120 (1600-1705). How should you count these Nigerian loggings? For the moment, at least, that's up to you.

BBC Long Wave . . . On August 14th the British government successfully silenced most pirate broadcasters around the United Kingdom—except the two R. Carolines which, reports said, were still on the air. Then in September the BBC reshuffled its own networks to fill the gap. Transmitters on 1214 kc and on FM were assigned to the new Radio One whose programming is modeled after R. Caroline.

But a new BBC service that, potentially, should draw the largest audience is Radio Two with a format halfway between Radio One and the BBC's old Light Program. Where does this one operate? Well, not on the broadcast band, as you would expect, but on 200 kc (long wave) with a single 400-kw transmitter formerly used to back up various BCB and short-wave transmissions.

Despite a rising sunspot count and the coming of spring. North American DXers still have a shot at this almost incredible operation. 200 kc is right at the bottom of our beacon band so their lower sideband should be more or less in the clear. Radio Two doesn't sign off until 2100 EST, to return at 0030 (except Sundays when sign-on is at 0155). Prior to 0030 the frequency is still used to back up the BBC's European Service.

R. Americas again . . . With a SW transmitter once again operating on 6000 kc it now seems as though R. Americas is trying to create the impression that this is not only a new operation but that it is a separate entity from its BCB station. A brand new address in Caracas, Venezuela (Apartado 1156, Correo Bedacao) is announced on SW *only*, the phrase "Transmitting from the center of the Americas" has been deleted from the SW ID *only*, and the modulation differs noticeably from both the BCB and old SW outlet. It is much more bassy and slightly distorted—a little like R. Libertad.



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CIRCLE NUMBER 34 ON PAGE 11

Wide-Range Theremin

Continued from page 42

hear audio, so turn C1 until a tone is heard;

1) Turn the slugs of L3, L4 and L5 all the way in so they're nearly flush with the collars.

2) Place an AM radio near the theremin and tune it to the lowest point on the dial (about 510 kc). Tune L3 until you hear the signal in the radio (a rushing sound which quiets radio noise and static). This sets the approximate frequency of the volume oscillator. To prevent interference to radio reception, turn L3 clockwise four turns. (The AM radio is no longer needed.)

3) Start tuning L5 for highest *positive* voltage.

4) Set capacitor C11 (*Vol. Adj.*) so its plates are half-meshed.

5) Tune L4 so the VTVM needle drops back to zero or slightly negative. Continue turning L4 until the voltage returns to the original positive indication obtained in Step 3.

6) There's some interaction between L5 and L4 so find the best control action this way: move your hand repeatedly toward and away from the volume antenna while making *slight* adjustments to these two coils. Obtain the maximum change in loudness with your hand. Watch the meter, too, for greatest voltage change.

If you notice any false whistles as volume is varied, it's probably due to harmonics from the pitch oscillators. This can be cured by slight readjustment of L3 until the birdies disappear. Then repeat the adjustments for L4 and L5.

7) Adjust the tone for a zero beat with C1 and place your hand close to the volume antenna. While listening with your ear close to the speaker, tune L7 for least hiss and noise. If this reduces the audio volume when the theremin is played, find some compromise setting for L7 that quiets noise while keeping audio at a satisfactory level.

Alignment will probably take a few trials. There'll be interaction when you bring a tuning tool or hand near the circuit simply because that's the way it's supposed to work.

Playing it. Turn on the power and touch a finger to the pitch antenna. Then turn the volume control up about halfway. Slowly move your left hand back and forth near the

pitch antenna. At the same time, make volume changes with your right hand. The musical quality is greatly enhanced by vibrating your pitch hand slightly to impart a vibrato-like quality to the sound. Similarly, if your volume hand is moved in time with rhythm, the tone will improve in musical quality. These and other variations should become apparent with experience.

Finally, use the front-panel controls to touch up pitch and volume if these functions drift. Each time the instrument is used, turn the *Pitch Adj.* control for a very low tone; bringing your hand in to the antenna should raise it. Touch up the *Vol. Adj.* control occasionally to insure that your right hand causes maximum loudness swing.

The State of The CB Art

Continued from page 77

6db of compression. With the switch to transistors, which lend themselves to heavy compression, the figure could be increased to perhaps 12db or more. It is not unlikely that ICs (some of which make very fine 20- and 30-db compressors without pumping) are next on the horizon.

Most other advancements in the CB field were primarily adaptations or upgrading of existing ideas. The PA (public address) output is merely a switching facility. Protection of power-supply components was simply a question of putting a fuse or circuit breaker at the output of the power supply. Final RF output metering is a simple meter application. And flashing lights and indicators improve nothing.

It's easy to see that many of the features we've been discussing are not, basically, new. But CB has taught some old dogs new tricks. Speech clipping and compression, for instance, was rarely included in ham transmitters until SSB became popular. Yet the technique has been used in CB for several years with simple, inexpensive circuits giving almost the same performance as multi-stage clippers and compressors used in ham and communications transmitters.

Similarly, among the genuinely new features, ICs (several of them) were used in a moderate-price CB transceiver that was in the catalogs when IC-equipped FM receivers were still only talk. That's a pretty good state for the art to be in.

Two-Way Power Pack

Continued from page 48

mounted on a heat sink on the back (Fig. 2). They are connected in parallel with the transistors on the cabinet cover.

The power transformer is the key to the power pack's operation. When used as an inverter, the power transistors (in the 12-V primary) switch the applied 12 VDC battery current through a center-tapped primary, much like an old auto-radio vibrator, to produce a 120-V (rms) square-wave output at the secondary. The secondary output is fed directly to a socket for the 120 VAC output, and another socket via a full-wave bridge rectifier for the 120 VDC output.

In the charge mode 120 VAC from the AC power line is fed to the transformer secondary, the 12-V voltage at the primary is rectified by the transistors and about 13 V full-wave pulsating DC goes to the battery terminals.

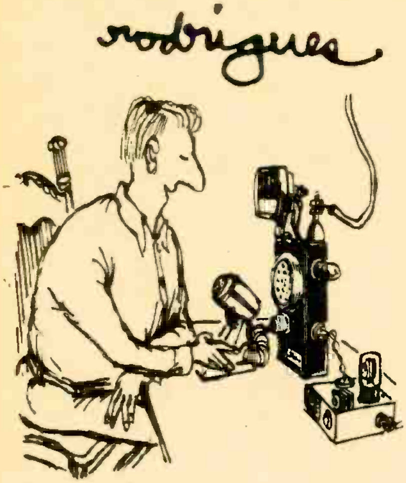
The output waveforms are shown in the photographs. At the left and center in Fig. 4 are the square-wave 120 VAC output (different sweep rates). Note the transient on the leading edge (left edge) of the waveform. The high-frequency energy in the transient resulted in a slight interference pattern on a TV receiver tuned to channels 2 through 5. Transient noise was also noted in tape recorders.

Another problem with a square-wave output is that equipment designed for sine-wave AC ends up with somewhat lower operating voltages. Figure 3 (right) shows the picture obtained on a portable TV when AC powered. At the left in Fig. 3 you see the picture when the TV was inverter powered. Note that the inverter picture is slightly smaller; there are two distinct black bars on the side, top and bottom of the picture.

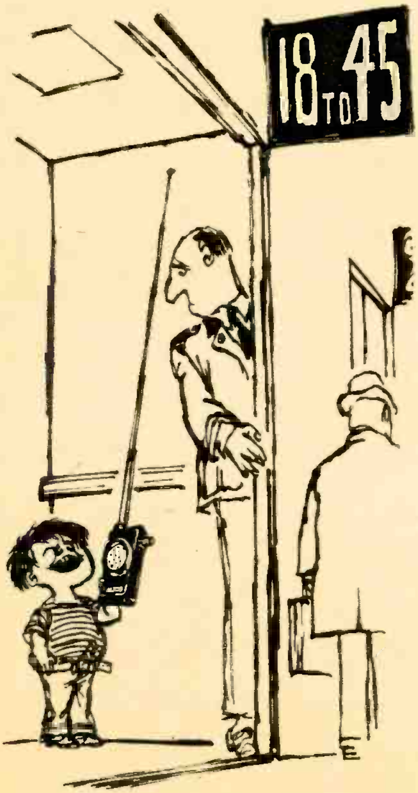
Tape recorders powered by the power pack tend to run slightly off speed. Since the output frequency depends to some extent on the load, and is between 55 and 65 cps, tapes are rarely on-speed. This is because as the speed of the induction motor in such machines is determined by frequency.

However, if you're willing to put up with a slightly shrunk TV picture, or you use your recorder in the car for dictating (record and playback power the same), the KG-666 will be more than adequate.

Over and Out



"The rig here is a modified Tiny-Mite."



"Roof, please!"

"My batteries are about gone, Ralph. I'll get back to you after I've collected my allowance."

"Gee, thanks, Pop! I can really get out now—the knot acts like a base-loader."

"Come in, Wake Island!"

Mobile Beam For CB

Continued from page 95

4) Install the two top vertical elements and tighten the spade bolts.

5) Place the two ground plates on the car roof, about 4 ft. apart.

6) Hold one vertical element in each hand (close to the boom) and raise the complete antenna to the car top. The verticals are slid onto the bolts protruding from the ground plates.

Mechanical Adjustments. With the antenna on the car, loosen the two shaft couplers just below the boom at front and rear. Then press down the suction cups. Go to the forward shaft coupler and push it up gently until you feel resistance. Then do the same for rear coupler. Make some back and forth adjustments until the boom remains horizontal and there is some tension at the crossbar—just enough to keep the antenna firmly in place. (Too much tension will bend the crossbar or loosen the suction cups.) Once you've found the right coupler adjustments, you won't have to change them unless the antenna is transferred to another car.

Electrical Adjustments. To tune up the beam, you should use an SWR meter and field-strength meter. Insert the SWR meter in the transmission line near the antenna's terminal board. (This explains the closeness of the coax connector to the antenna.) Place the field-strength meter in front of the car (the direction in which the beam is pointing) as far away as possible (you must be able to see the meter). Connect the CB rig to the SWR meter and have someone turn on the transmitter. Adjust the tuning capacitor at the base for highest field-strength indication. Then measure SWR and try to get it as low as possible by adjusting the position of the gamma bar. By going back and forth between these two adjustments, you should hit settings where signal strength is *highest* when SWR is *lowest*.

Once you find them, mark the position of the gamma bar on the elements and the setting of the tuning capacitor with a dab of nail polish. They'll need only an occasional check, and not adjustment each time you erect the antenna.

If you have difficulty keeping the SWR below 2:1, chances are your ground plates are not capacitively coupled sufficiently to

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the car roof. More than half the surface of each plate should touch the roof. To improve contact, remove the plates and bend them slightly being careful not to crease the metal. When they are remounted, the downward force of the vertical elements should flatten them out and make good contact.

The FET VOX

Continued from page 64

wise and try again. If you still can't trip the VOX, check the voltage at Q2's collector.

Connect an 0-10 V DC voltmeter from Q2's collector to the cabinet. With no input signal the meter should indicate from 0.1 to 0.4 V—more likely around 0.25 V. (If the voltage is greater than 0.5 to 0.7 V, diode D2 will breakover and trip RY1.)

When you speak into the mike the voltage at Q2's collector should instantly rise above 0.5 V, causing D2 to conduct and trip RY1. If speaking causes Q2's collector voltage to rise but the relay doesn't trip, check to see if D2's polarity is reversed. If the voltage at Q2 fails to rise as you speak, look for a wiring error between J1 and Q2's base.

If the voltage at Q2's collector is normally so high that it causes high D2 to conduct, keeping RY1 closed, Q2's gain is probably less than average. Therefore decrease R5's value about 20 per cent at a time until the voltage at Q2's collector is about 0.25 V.

Using the VOX. Connect your mike to J1 and the transmitter's mike input to J2. Connect the transmitter's T/R relay to J4. Connect J3 across the receiver's speaker terminals. Set R4, R12 and R9 to *off*—full counterclockwise. Turn on the transmitter power supply and turn on the VOX. Speak into the microphone in a normal manner—keep in mind that you cannot whisper as the VOX does not have super gain. As you speak, advance R4 till the transmitter is turned on by the T/R relay; then advance R4 just a little past the trip setting. As you speak adjust R12 until the VOX *holds* between syllables.

When you stop talking the VOX will release and turn on the receiver. Set the speaker level to a moderate volume and adjust R9 till the speaker signal does not cause the VOX to trip; use the lowest amount of anti-trip possible. If the speaker level is too loud or the mike is too close to the speaker, even full anti-trip will not prevent the VOX from tripping on the speaker sound.

Compact Antenna Tuner

Continued from page 51

To avoid a rat's nest of wires make the connections (No. 18 solid, tinned wire) to S1 in the following order: Connect L2's left lead to C3's solder lug. Wrap a short length of wire around the lead at the coil, solder and connect the other end to S1's wiper lug. Connect another piece of wire to the second turn —after the first indented turn—and connect the other end to lug 1 (counting clockwise from the wiper as shown in the pictorial).

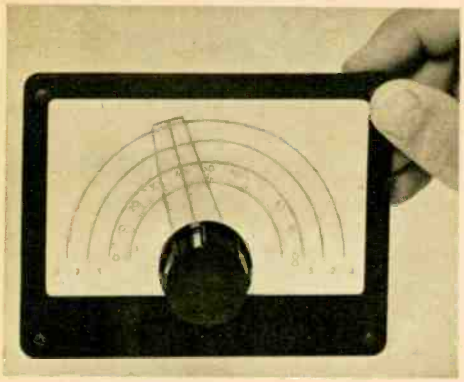
Following the pictorial, connect the 4th, 6th, 10th, 14th, 18th and 24th turns in the same manner. Make certain the wrap around the coil for each connecting wire does not touch an adjacent or indented turn.

The meter loop (L1) is a single turn of No. 22 or No. 20 solid, plastic insulated wire wound over L2's right edge. Twist the loop once or twice to hold it together.

Using the Tuner. Best results are obtained if an SWR bridge is connected between the transmitter and the tuner. Use 52-ohm coax for all connections between the transmitter and tuner (72 ohm can be substituted).

When using an SWR bridge simply set C3 for maximum capacitance and adjust S1 for the minimum reflected-power indication on the SWR bridge. Then trim for lowest indication with C3. After C3 is tuned for minimum SWR switch S1 one position either side to reduce the SWR even further—it might be necessary to trim C3 again. Note that some long-wire antennas cannot be matched closer than 3:1 or sometimes 4:1. If you can't get the SWR lower, don't worry about it.

If you don't feel like taking along an SWR meter you can get reasonably good tuning this way: Set S1 full clockwise. Key the transmitter and adjust R1 for about ¼-scale indication on M1. Peak up M1's indication with C3. Switch S1 to the next position and adjust C3 for peak indication. Then switch S1 to the next position and repeat C3's adjustment. Keep advancing S1 and C3 until there is no more definite upward meter deflection. Then back S1 off one position and adjust C3 for peak. Once adjustment of S1 fails to cause a sharp upward meter deflection and the pointer crawls upscale with each adjustment, further adjustment of S1 will result in an extremely high SWR even though the meter continues to move upscale.



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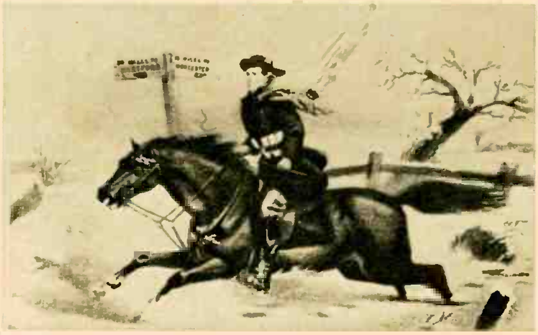

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BLANKLINE: May be placed both above and below the ad, if desired. Each blank line is charged as 5 words.

TO: ELECTRONICS ILLUSTRATED • 67 W. 44th St., New York, N.Y. 10036 • Att.: Classified Advertising Dept.

Gentlemen: Here's our copy for the Classified Section of ELECTRONICS ILLUSTRATED. Remittance of $______ is enclosed to cover ______ insertion(s) in the ______ issue(s).

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

YOUR NAME ______ PHONE ______
(PLEASE PRINT)
FIRM ______
ADDRESS ______
CITY ______ STATE ______ ZIP ______
DATE: ______ YOUR SIGNATURE ______

(PLEASE PRINT OR TYPE COPY • FOR ADDITIONAL WORDS ATTACH SEPARATE SHEET) 5

BUILD 20 RADIO CIRCUITS AT HOME

with the New Improved PROGRESSIVE RADIO "EDU-KIT"®

only **$26.95**

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Training Electronics Technicians Since 1946

A Practical Home Radio Course

Now Includes

- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold in 79 Countries

YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

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

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

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 595AE, Hewlett, N. Y. 11557

FREE EXTRAS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

Please rush my Progressive Radio "Edu-Kit" to me, as indicated below:

Check one box to indicate choice of model.

- ☐ Regular model $26.95.
- ☐ Deluxe model $31.95 (same as regular model, except with superior parts and tools plus Radio & TV Parts Jackpot worth $15.)

Check one box to indicate manner of payment.

- ☐ I enclose full payment. Ship "Edu-Kit" post paid.
- ☐ Ship "Edu-Kit" C.O.D. I will pay postage.
- ☐ Send me FREE additional information describing "Edu-Kit."

Name ______________________

Address ______________________

City & State ______________ Zip ______

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 595AE, Hewlett, N. Y. 11557

PRINTED CIRCUITRY

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

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

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

CIRCLE NUMBER 10 ON PAGE 11

NTS project method:

The sure, simple way to a high-paying, solid career in electronics.

Project-Method training from National Technical Schools: For the man who wants to *move up* fast. It's the sure way to a career that *pays* big. Project-Method builds everything you need to know around practical kit experiments. It's faster, easier to learn. It not only teaches you the *how* and *why* of electronics, you get actual experience using the same equipment you work with on the job. And, NTS sends you this equipment at *no extra cost*. That's the Project-Method. NTS produces the kind of trained men that industry wants and will pay for.

ALL NEW KITS! ALL NEW COURSES!

More big kits than ever offered for training anywhere! A big 25" Color TV, a desk-top computer, solid-state radios. Now for the first time Training kits with integrated circuits. New test equipment, too, including Signal generator, VTVM, and tube checker. They're all you need to begin trouble-shooting work. NTS shows you how to use them early in your training. You earn money repairing TV sets and electronic equipment even before you've completed the course. Brand new color catalog describes in detail all the exciting equipment that comes with each course.

GET THE FULL STORY! SEE ALL THE EXCITING NEW KITS YOU CAN GET FROM NTS!
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You can train at our resident school in Los Angeles. NTS occupies a city block with over a million dollars in facilities devoted to technical training. Check special box in coupon.

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NTS offers accredited high school programs. Take only the subjects you need. Study at your own pace. Everything included at one low tuition. Check special box in coupon for free catalog.

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Please rush new Color Catalog and Sample Lesson plus information on course checked below. No obligation. No salesman will call.

- MASTER COURSE IN COLOR TV SERVICING
- COLOR TV SERVICING
- MASTER COURSE IN TV & RADIO SERVICING
- PRACTICAL TV & RADIO SERVICING
- MASTER COURSE IN ELECTRONIC COMMUNICATIONS
- FCC LICENSE COURSE
- INDUSTRIAL & COMPUTER ELECTRONICS
- STEREO, HI FI & SOUND SYSTEMS
- BASIC ELECTRONICS
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