

How to Be an Eavesdropper and Get Paid for It!

ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

MARCH 1969 • 50¢

ABCs of the VTVM ★ **CB on a Motorbike**
Consumer Report on Hi-Fi Tape Cassettes
Death of a Color TV Picture Tube

6 Most Useful
New Ham
Accessories



*74
ec Jan 12-69*

- ★ Build a Big Λ Antenna
- ★ Build a \$1.59 Transistor Checker
- ★ Build a Magnetic Stirrer for Liquids
- ★ Build a Blockbuster Broadcast Bo

47166
HUBER BENNING
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You can pay \$600 and still not get professionally approved TV training. Get it now for \$99.

Before you put out money for a home study course in TV Servicing and Repair, take a look at what's new.

National Electronic Associations did. They checked out the new TV training package being offered by ICS. Inspected the six self-teaching texts. Followed the step-by-step diagrams and instructions. Evaluated the material's practicality, its fitness for learning modern troubleshooting (including UHF and Color).

Then they approved the new course for use in their own national apprenticeship program.

They went even further and endorsed this new training as an important step for anyone working toward recognition as a Certified Electronic Technician (CET).

This is the first time a self-taught training program has been approved by NEA.

The surprising thing is that this is not a course that costs hundreds of dollars and takes several years to complete. It includes no kits, requires no experience, no elaborate shop setup.

All you need is normal intelligence and a willingness to learn. Plus an old TV set to work

on and some tools and equipment (you'll find helpful what-to-buy and where-to-buy-it information in the texts).

Learning by doing, you should be able to complete your basic training in six months. You then take a final examination to win your ICS diploma and membership in the ICS TV Servicing Academy.

Actually, when you complete the first two texts, you'll be able to locate and repair 70% of common TV troubles. You can begin taking jobs for money or start work as a valued apprentice technician in electronic service businesses.

Which leads to the fact that this new course is far below the cost you would expect to pay for a complete training course. Comparable courses with their Color TV kits cost as much as six times more than the \$99 you'll pay for this one.

But don't stop here. Compare its up-to-dateness and thoroughness. Find out about the bonus features—a dictionary of TV terms and a portfolio of 24 late-model schematics.

Get all the facts. Free. Fast. Mail the reply card on the attached flap.

ICS

TV ghosts beware! We've got a full line of ghost-fighting antennas and we're out to get you. With all our experience in the TV business, you've got plenty of reason to be scared.

Wait till you try to creep through our 1/2" seamless tubing. You'll never make it. Or just try to cross our double booms. They'll set you straight.

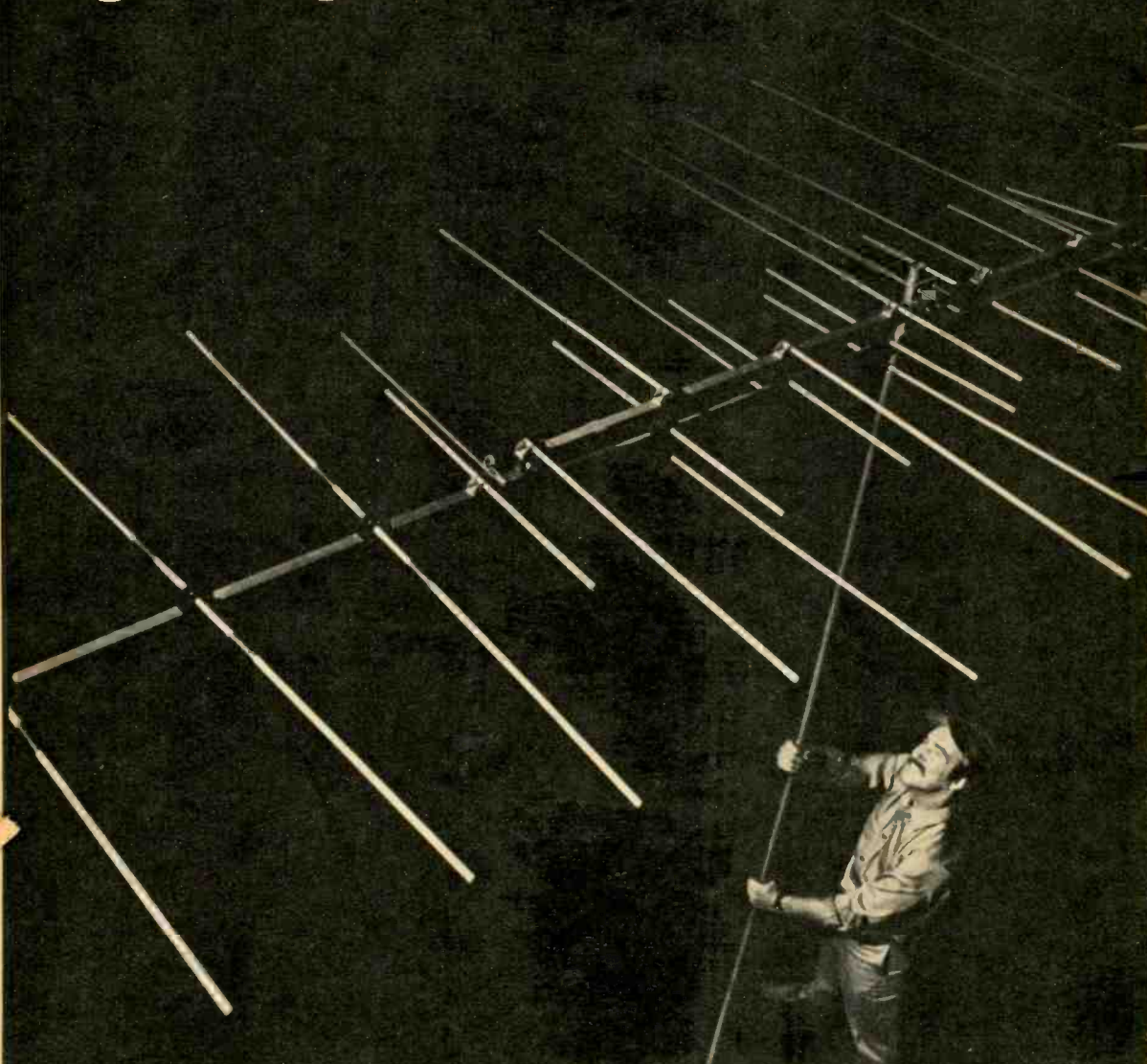
And to make your life even more difficult, we've

dipped our antennas in anti-corrosive material inside and out. So there'll be no rusty morsels for you to thrive on.

Take a word of warning. Before you choose another living room to haunt, check the roof. Make sure a Sylvania antenna isn't installed. Because if it is, you don't stand

SYLVANIA
A DIVISION OF
GENERAL TELEPHONE & ELECTRONICS

Sylvania goes into the ghost-fighting business.



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ELECTRONICS ILLUSTRATED

A Fawcett Publication

March 1969

Vol. 12 No. 2

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ELECTRONICS ILLUSTRATED is published bi-monthly by Fawcett Publications, Inc., Fawcett Bldg., Greenwich, Conn. 06830. Second-class postage paid at Greenwich, Conn., and at additional mailing offices.

EDITORIAL OFFICES: 67 W. 44th St., New York, N.Y. 10036 (phone 212-661-4000). Contributions must be accompanied by sufficient postage and will be handled with care, though the publishers assume no responsibility for return thereof.

ADVERTISING OFFICES: 67 W. 44th St., New York, N.Y. 10036 (phone 212-661-4000); 101 E. Ontario St., Chicago, Ill. 60611 (phone 312-DE 7-4680); 1532 Guardian Bldg., Detroit, Mich. 48226 (phone 313-WO 2-4860); 2978 Wilshire Bld., Los Angeles, Calif. 90005 (phone 213-DU 7-8258); 681 Market St., San Francisco, Calif. 94105 (phone 415-EX 7-3441); 1430 W. Peachtree St., N.W., Atlanta, Ga. 30309 (phone 404-TR 5-0373); James B. Boynton, 370 Tesquesta Dr., Jupiter, Fla. 33458 (phone 305-746-4847); 123 S. Broad St., Philadelphia, Pa. 19109 (phone 215-PE 5-3636).

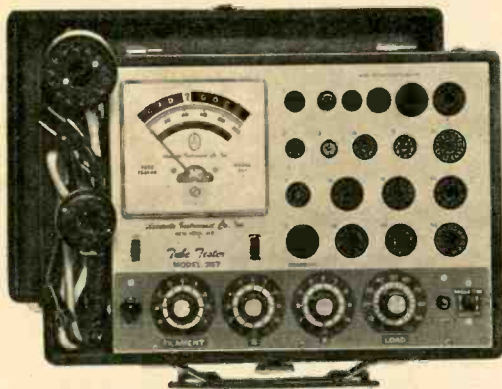
SUBSCRIPTIONS: \$3 per year (6 Issues) in U.S. and possessions and Canada. All other countries \$4 for 6 issues. All subscription correspondence, including changes of address (Form 3579), should be addressed to **ELECTRONICS ILLUSTRATED**, Subscription Dept., Fawcett Bldg., Greenwich, Conn. 06830. Foreign subscriptions and sales should be remitted by International Money Order in U.S. funds payable at Greenwich, Conn.

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Electronics Illustrated

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**COMPLETE WITH ALL
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- ✓ Complete set of tube straighteners mounted on front panel.

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- ✓ Single cable used for testing all Black and White Picture Tubes with deflection angles 50 to 114 degrees.
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CIRCLE NUMBER 41 ON PAGE 13

Feedback from Our Readers

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

● XYL VFO



It seems to me that your Telephone Remote Control [Jan. '69 EI] is unnecessarily complicated. Why do you need to carry around that silly tone generator? My wife is an opera singer and has perfect pitch, for example. Why couldn't she just sing the tones needed to trip the circuit she wants? And, with a pitch-pipe, I should think anyone could do it.

Louis Walinski
Grand Rapids, Mich.

Some of our readers aren't married.

● NAME SOUNDS FAMILIAR

But WBBH does have everything—including a license! [See WBBH, the Station With Everything—Except a License, Nov. '68 EI.] WBBH-TV, that is! WBBH is the new television station in Fort Myers, Fla., expected to come on the air Nov. 20 [1968]. It will operate on channel 20 with 630,000 watts, not just 50 watts. It will affiliate with the NBC network and broadcast in color.

Richard Black
Fort Myers, Fla.

At the time our story was written we checked to make sure that no legitimate station had laid claim to the WBBH call. If any had, we would have taken pains to dispel possible confusion between it and our junior

short-wave pirates. Since then, while our story was sitting on the sidelines waiting for space in an issue, WBBH-TV seems to have caught up with us. So, for the record, there's no reason to suppose the slightest similarity between the two WBBHs—except the call.

● HARD-UP HEARING

Look, you say that anybody who plays in a rock group [Can Hard Rock Make You Stone Deaf?, Jan. '69 EI] should wear earplugs. Well, let me tell you, my friend, that



you're not going to play so good if you can't tell what the rest of the group is up to! Like how can you make it without the beat? And you can't make a dime if you can't hear that line.

Joel Shrecker
Utica, N.Y.

If you can't hear 130db right through the earplugs it proves you should have been using them all along.

● HELP!

I have two Osborne CB radios, model 300. Both are in need of repair. If any reader has a schematic, a copy would be appreciated

Maj. V. H. Arrell
Box 882
Howard AFB, Canal Zone

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CIRCLE NUMBER 8 ON PAGE 13

March, 1969



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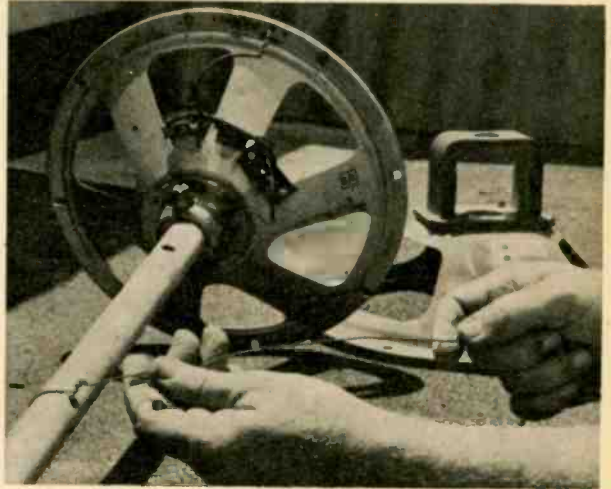
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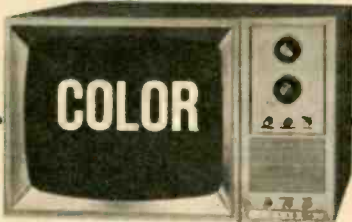
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CIRCLE NUMBER 25 ON PAGE 13

TRY THESE



There's more than scrap value in those old discarded heavy-duty speaker frames. When the cone is torn beyond repair or the voice coil is burned out the frame can be used as a base for an antenna. The frames from smaller speakers can be used for mike desk stands or floor pedestals.



NEW CONAR All-Channel COLOR TV KIT \$366.00

Model 600UK

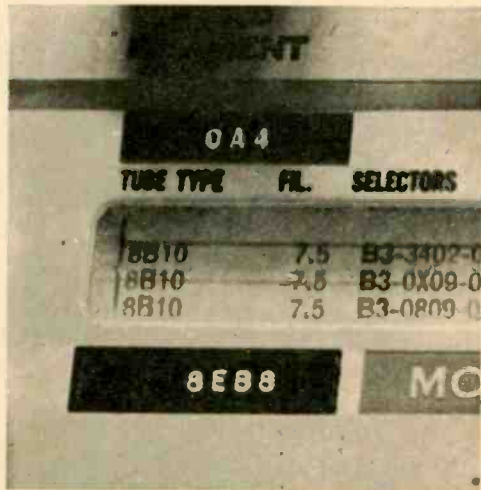
- Easier to build because it's designed for learning
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Tops for quality, simplicity of design, ease of building, the new CONAR 600 gives you the latest advances in the art of color TV receiver construction. In addition to 21 tubes, this all-channel receiver incorporates a transistor UHF tuner, transistor noise cancellation circuit and 16 solid-state diodes. Separate gun killer switches and a cross hatch generator are built in. All hardware is engineered for accessibility. Attractive bronze-tone steel cabinet with durable wood-grained vinyl covering.

For information write Dept. CE9C

CONAR instruments

DIVISION OF NATIONAL RADIO INSTITUTE
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WRITE FOR FREE CONAR CATALOG



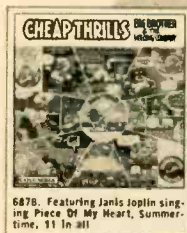
Service-shop owners often come to the end of the roll chart on a tube tester and find that the data are listed in the next column. Mark the highest tube number under the roll window. Now put the lowest tube number on the roll above the window. Do the same thing for the other columns also.

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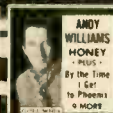
6878. Featuring Janis Joplin singing 'Piece Of My Heart, Summer-time, 11 in all



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6928. Also: Free To Go, Wintertime Love, 11 in all

6930. Program taken from performances at Carnegie Hall

6897. Also: People, The God, The Bed and The Ugly; 11 in all

6936. Plus: Love Is Blue, Windy, Up, Up And Away, etc.



6490. Includes: Honey, The Mighty Quinn, Lady Madonna, etc.



6762. Plus: Do You Know The Way To San Jose, Money, etc.



6313. "L Ma the movie, a hit album!" - Billboard Magazine



6514. Plus: I'll Get By, Love Is Blue, The Look Of Love, etc.



6489. Plus: Up And At It, Geared On My Mind, 15 in all



6340. Also: Like A Lover, The Look Of Love, Roda, etc.



5964. Cry Me A River, People, Second Hand Rose, many more



6797. Also: Here Comes The Judge, The Gallop, etc.



5236. España, On The Trail, Waltz Of The Flowers, etc.



6706. Plus: Poor Cow, Young Girl Blues, Franchin' Love, etc.



6723. Plus: Look In Your Soul, Whiter Shade Of Pale, etc.



5553. Plus: Maria, Moon River, Yesterday, Dominique, etc.



7639. "The best musical score of '65" - Am. Record Guide



6388. Includes: Old Friends, Mrs. Robinson, At The Zoo, etc.



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Terre Haute, Indiana 47808

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(fill in numbers)

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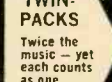
I agree to purchase five selections during the coming year... and I may cancel membership at any time thereafter. If I continue, I am to receive a stereo tape of my choice FREE for every two additional selections I accept.

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Electronic Marketplace

Mariner. . . The 130-A is a multi-channel transceiver with BCB reception in addition to crystal-controlled two-way operation on six marine channels. Among its features are Posi-dent channel identification markers, gate squelch and automatic noise limiter. It is one of a new line of marine transceivers. \$399.95. (Model 130-B with remote channel switch and 20-ft. interconnect, \$474.95.) Simpson Electronics, Inc., 2295 NW 14th St., Miami, Fla. 33125.



Para-Meter. . . The Guardohm is designed for in-circuit measurement of component parameters from resistance to a semiconductor's back voltage, gain and forward drop. It is a volt-ohm-milliammeter and it also will deliver constant-current outputs from 1 μ a to 100 ma. Its matrix-type switching yields a total of 39 function-range combinations at 1 per cent accuracy. It is AC-powered and housed in a console-style case. \$335. f.o.b. Schenectady. Systemation Inc., 140 Erie Blvd., Schenectady, N.Y. 12305.

Electronics Illustrated

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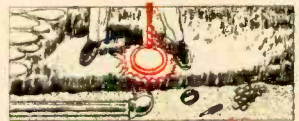
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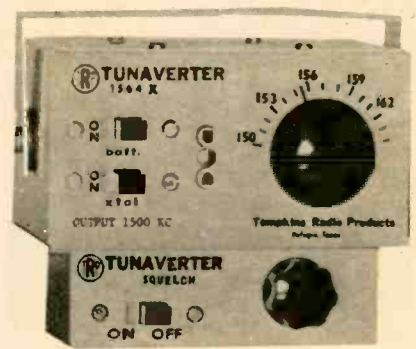
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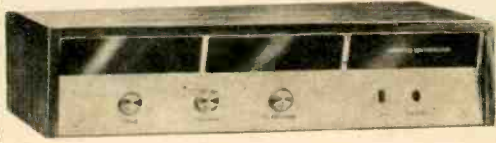
Electronic Marketplace

Silencer. . . . Newest in the Tunaverter line is an outboard squelch—an outboard outboard, in fact, since it is designed to be used with the RF converters in the Tunaverter line. The ac-



cessory attaches to the underside of the RF converter and connects in the circuit between converter and radio by means of standard jacks and cables. It can be powered from the 9-V source in a Tunaverter or directly by a 12-V auto battery. Model ST, \$17.50 (model SU with its own mounting bracket, \$18.50). Herbert Salch & Co., Marketing Div. of Tompkins Radio Products, Woodsboro, Tex. 78393.

Reverbbbbb. . . . The solid-state R-777 is designed to operate with a stereo receiver or amplifier that has a speaker selector switch capable of feeding two sets of speakers both individually and simultaneously (usually marked *Main*, *Remote*, *Main & Remote*). The reverb can be used to power a third channel by attaching it to the remote-speaker connections on amplifier or re-

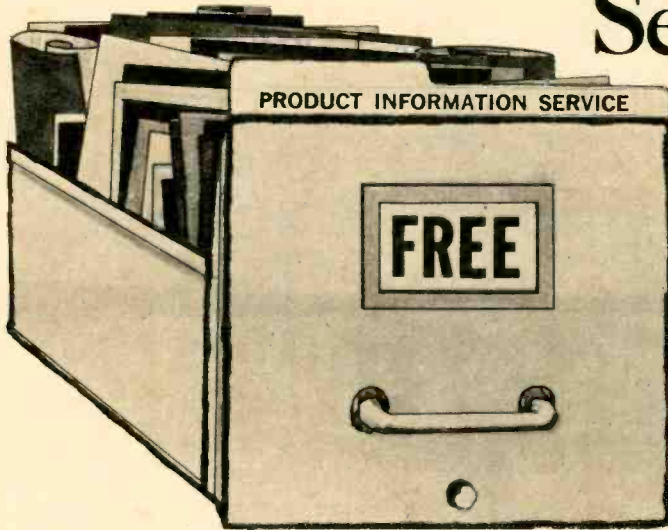


ceiver. The R-777 has four controls: percentage of reverberation, volume, tone and on/off switch (plus a pilot light). It is listed for 10 watts output (rms) at 8 ohms. It is made under license by Hammond Organ. \$59.95. Lafayette Radio Electronics Corp., 111 Jericho Tpk., Syosset, N.Y. 11791.

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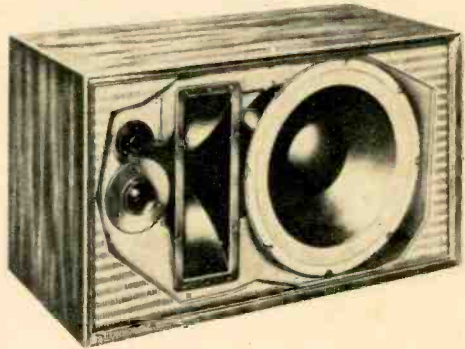
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tweeter. Power rating is put at 10 watts (IHF) minimum, 30 watts maximum. Frequency response is listed at 25-20,000 cps with crossovers at 1 and 5 kc. It measures 14 x 25 x 13½ in. \$79.95 (\$99.95 assembled and finished). Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680.

Featherweight. . . The XLS series of soldering pencils is available with heating elements in ratings of 11, 15, 20, 25, 33, 40, 50, 60 and 75 watts. The handle is molded of blue polycarbonate and is available with either a two-wire or three-wire cord. Heating elements, which screw directly into the handle, are stainless-clad and are available with a variety of tips that can be replaced by removing the heating element from the handle and loosening a single screw. Irons cost \$7.40-\$8.81 with an ⅛-in. copper tip, depending on wattage. Replacement tips come in several configurations for different types of work, in copper or iron-plated. They cost \$.26-\$1.76, depending on configuration and metal content. Wall Mfg. Co., Box 3349, Kinston, N.C. 28501.



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A new catalogue of the 200 series of miniature strip-chart recorders describes the complete line of more than 30 models for recording current, voltage, power, events, pressure, temperature, etc. It also includes information on chart paper, drive motor specifications, accessories, dimensions, weights and so on. Free from Rustrak Instrument Div., Gulton Industries Inc., Municipal Airport, Manchester, N.H. 03103.

Professional Methods for Record Care and Use by Cecil E. Watts is a somewhat technical, detailed treatment of its subject. Predictably, a good deal of space is devoted to the products of the booklet's publisher. But whether considered as information or as advertising, it contains much of interest to fastidious record buyers. Copy, 50¢ at hi-fi dealers or direct from Elpa Marketing Industries, Inc., Thorens Bldg., New Hyde Park, N.Y. 11040.

A new guide is designed to acquaint both professionals and amateurs with the techniques of television tape production. Titled The Producer, it covers all stages of TV tape production in easy-to-follow sequence. Free from 3M Co., Magnetic Products Div., Marketing Services Dept., 3M Center, St. Paul, Minn. 55101.

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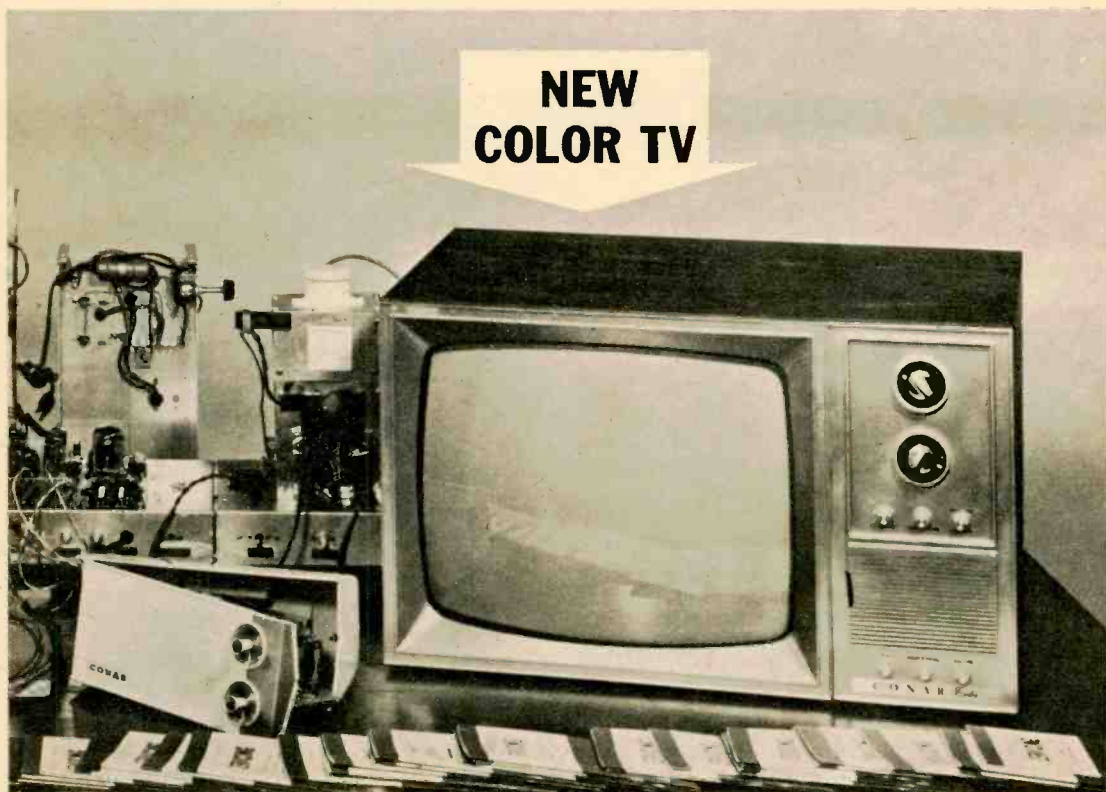


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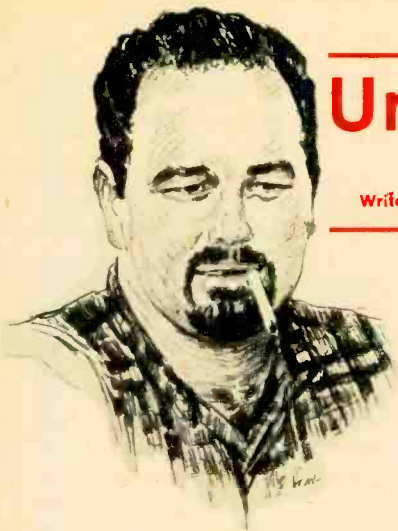
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NEW COLOR TV



March, 1969

19



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.

★ *I came across an ancient name-brand radio from the '30s and was amazed to find an input socket on the rear panel marked for a TV receiver. Tracing out the wiring, I found that it was simply a connection into the audio section of the set. What's this all about?*

*Martin Bernard
Pascagoula, Miss.*

Back when video was supposed to be just around the corner many ads were claiming TV receiving equipment would consist of a converter-type gizmo that would hook into the radio receiver. Which just goes to prove that shrewd merchandisers today have nothing on their daddies.

★ *In your September column you told a Mitchell Wagner about getting a radiosonde transmitter from the manufacturer. I have a less expensive way. You can tell Mitchell that military surplus AMT-6 radiosonde sets are being offered around for only \$6 each. They weigh 7 lbs. and are made with parachutes for being dropped from planes.*

*John Brennan
Shenorock, N.Y.*

Maybe Mitchell doesn't want to be dropped from a plane.

★ *In tuning the short-wave bands I frequently have come across point-to-point stations announcing that they are owned by Cable and Wireless, Ltd. Where can I address letters to some of these stations, especially the ones in Barbados, Jamaica and Gambia?*

*Patrick Hector
Canoga Park, Calif.*

Either directly to the station or to Cable & Wireless, Ltd. Mercury House, 110/124 Theobalds R., London WC 1, England. They're not famous in the QSL department.

★ **Wasted Money Dept.** With TV rotor installation costs what they are today, I've been wondering why those viewers who want to receive from two directions and won't need the in-between positions bother with all of this engineering and cash outlay. By simply installing two fixed antennas on the roof and a cheap little switch at the receiver the whole problem is solved.

★ *What frequency is used by the San Mateo Police Department?*

*Roger Diaz
San Mateo, Calif.*

They're on 154.77, 155.07 and 155.67 mc. Take your pick.

★ *Some time back you said that the best way not to get caught in a radar speed trap was to buy either a radar-detecting gadget to hear 'em or a Jaguar to out-run 'em. I presume you use the Jag method. How is the kitten?*

*Herbert D. Doremus
Imperial Beach, Calif.*

Sorry to report that the old Jag XK-150 sputtered its final breath during a blizzard last winter. It was replaced with a 1968 Corvette 427 which, by comparison, makes the Jag look like Aunt Hilda's Hupmobile. Since I'm the kind of guy who wears both a belt and suspenders, I also have a radar detector.

★ **Big Broadcast Dept.** It appears that the next mystery broadcaster in the anti-Castro network will be an existing commercial station in Costa Rica. The station now is rounding up programs and sponsors from militant groups formerly associated with Radio Americas and is expected to hit the airways shortly (they're on the lower end of the broadcast band, by the way) with a new signal running in the megawatt range. Guess whose favorite

uncle is bankrolling the venture?

★ **Mean Hombre Dept.** When I heard the FBI wanted to talk to me I figured they mistakenly were back on that old mistaken-identity caper I mentioned last year. Maybe you remember. They thought I was an escaped wife-killer, that's all. Friendly bunch, like. Anyway, this time J. Edgar's chaps merely wanted my help (now there's one for you) in rounding up a guy who may be one of my readers. And that's just what I need. Fewer readers. The chap is one Frederick Laraway Jones. The FBI wants to ask him about a little Navy AWOL matter of



a few years back. Yes, his former employer would like to know how he has adjusted to civilian life. Seems Freddy was an avid reader of radio magazines and even became an electronic hobbyist (among his other sins). Just call your nearest FBI office and tell them your Uncle Tommy sent you. To shake them up a little and make life interesting at the rookery, you might add, "You know, Uncle Tommy, the dreaded wife killer. Hahaha. Hohoho." The G-men say Jones, who is 26, stands 5 ft. 5½ in. But then they sent me my own personal snapshot that shows him about 5 ft. 10½ in. That's a little inside joke, see. The FBI figures he's been shrinking since the picture and they're in a hurry to catch him before he disappears altogether. Freddy sometimes is known as Robert Alden or Robert Allen or Robert Laraway. Whozis has hazel eyes and a birthmark on the left mid-

[Continued on page 22]

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Handy "Tray Bien" sets lie flat or sit up on a bench, hang securely on a wall, pack neatly in a tool caddy.

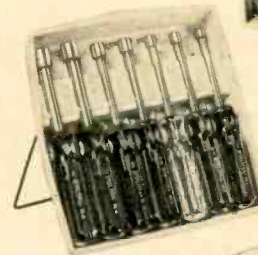
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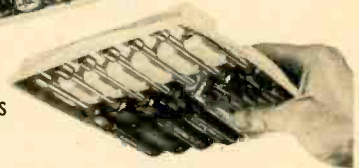
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CIRCLE NUMBER 50 ON PAGE 13

Uncle Tom's Corner

Continued from page 21

forehead. Lastly, say my stooles at the fed fen (look *that* up in your Fink & Wagnall's), Bobby has an evil eye—his left one. If you want to know what that is, just call up your friendly local feds and ask them to send one over for inspection.

★ *Every evening I tune in several short-wave spy stations using coded series of numbers or letters. The strongest is on about 5800 kc and transmits in a voice code consisting of letters (pronounced individually in Spanish) in groups of five. Each broadcast commences with something like Kodigo Bay, Kodigo Elay or Kodigo Efoy. Can you give me any information on these?*

Roger Quincy
Galveston, Tex.

Looks like you've stumbled onto a station operated by an anti-Castro action group calling itself Movimiento de Recuperacion Revolucionaria. For what it's worth, a copy of part of their code list appears below. Your Kodigo Bay, etc. actually is Codigo Bé—meaning Code B—and is the decoding key for the agent receiving the message inside Cuba.

MOVIMIENTO DE RECUPERACION REVOLUCIONARIA	
A	ABCDEF GHIJ KLMNOP QRSTUVW XYZ
B	ZYXWVUTSRQP ONMLKJIHG FEDCBA
C	ABCDEF GHIJ KLMNOP QRSTUVW XYZ
D	YXWVUTSRQP ONMLKJIHG FEDCBAZ
E	ABCDEF GHIJ KLMNOP QRSTUVW XYZ
F	VUTSRQP ONMLKJIHG FEDCBAZYXW
G	ABCDEF GHIJ KLMNOP QRSTUVW XYZ
H	TSRQP ONMLKJIHG FEDCBAZYXWVU
I	ABCDEF GHIJ KLMNOP QRSTUVW XYZ
J	RQP ONMLKJIHG FEDCBAZYXWVUTS
K	ABCDEF GHIJ KLMNOP QRSTUVW XYZ
L	QP ONMLKJIHG FEDCBAZYXWVUTSR
M	ABCDEF GHIJ KLMNOP QRSTUVW XYZ
N	PONMLKJIHG FEDCBAZYXWVUTSRQP

*"I have not yet,
indeed,
thought of a remedy
for luxury..."* BENJAMIN FRANKLIN

"I am not sure that in a great state it is *capable of a remedy*; nor that the evil is in itself always so great as it is represented.

"Suppose we include in the definition of luxury all *unnecessary expense*, and then let us consider whether laws to prevent such expense are possible to be executed in a great country, and whether, if they could be executed, our people generally would be happier, or *even richer*.

"Is not the hope of being one day able to purchase and enjoy luxuries, a great spur to labour and industry?"

"May not luxury, therefore, produce more than it consumes, if, without such a spur, people would be, as they are naturally enough inclined to be, lazy and indolent? *To this purpose I remember a circumstance.*

"The skipper of a shallop, employed between Cape May and Philadelphia, had done us some small service, for which he refused to be paid. My wife, understanding that he had a daughter, sent her a present of a new-fashioned cap.

"*Three years after*, this skipper being at my house with an old farmer of Cape May, his passenger, he mentioned the cap, and how much his daughter had been pleased with it.

"'But' (said he) 'it proved a dear cap to our congregation.'

"How so?"

"'When my daughter appeared with it at meeting, it was so much admired, that all the girls resolved to get such caps from Philadelphia, and my wife and I computed that the whole could not have cost *less than a hundred pounds*.'

"'True', (said the farmer) 'but you do not tell all the story. I think the cap was nevertheless an advantage to us; for it was the first thing that put our girls upon knitting worsted mittens for sale at Philadelphia, that they might have wherewithal to buy caps and ribbons there; and you know that the industry has continued, and is likely to con-



Original wood engraving by Bernard Brussel-Smith

tinue and increase to a much greater value, and answer better purposes."

"Upon the whole, I was more reconciled to this little piece of luxury, since not only the girls were made happier by having fine caps, but the Philadelphians by the supply of warm mittens."

"Poor Richard" put his finger on this simple key to an expanding economy over 200 years ago. So, isn't it strange to find people—well-meaning people—in this country today who still frown on the luxuries most of us work to enjoy? They want the government to restrict the broad range of products and services in the marketplace. And to cut back on advertising because it makes people want things they don't need.

Don't need? Well, of course, no little girl *needs* a bow in her hair. Yet, Mary Murphy will forever top off the apple of her eye with a ribbon. And where would the ribbon factories be without her? And the ribbon clerks?

It is just this very human desire to add the little frills to our living that has created our jobs and our prosperity... the ribbon factories and automobile factories and television factories... and the most dynamic economy in man's history. Shouldn't we be careful about how we tinker with the forces that have created all this? Because the simple, troubling truth is, nobody knows for sure how far you can regulate our economy without damaging it.

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Use Swami for inside your car, too . . . it's harmless and greaseless . . . will never scratch or smear. Use it on paint, chrome, plastic, rubber, leather, and especially glass . . . it dry cleans windows beautifully. Swami is also recommended for use on boats, bicycles, scooters, motorcycles, guns, golf clubs . . . even wood paneling. You can save hundreds of dollars a year with the amazing Swami Polishing Cloth.

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House cleaning chores need be done only half as often. Swami is absolutely greaseless and will not leave a sticky residue on any surface. It can never scratch or mar any surface. It can be used on wood, metal, tile, linoleum, venetian blinds, and glass . . . even dry cleans windows. Swami Home Cloth can be used over and over again . . . just shake and wash . . . it will last for months.

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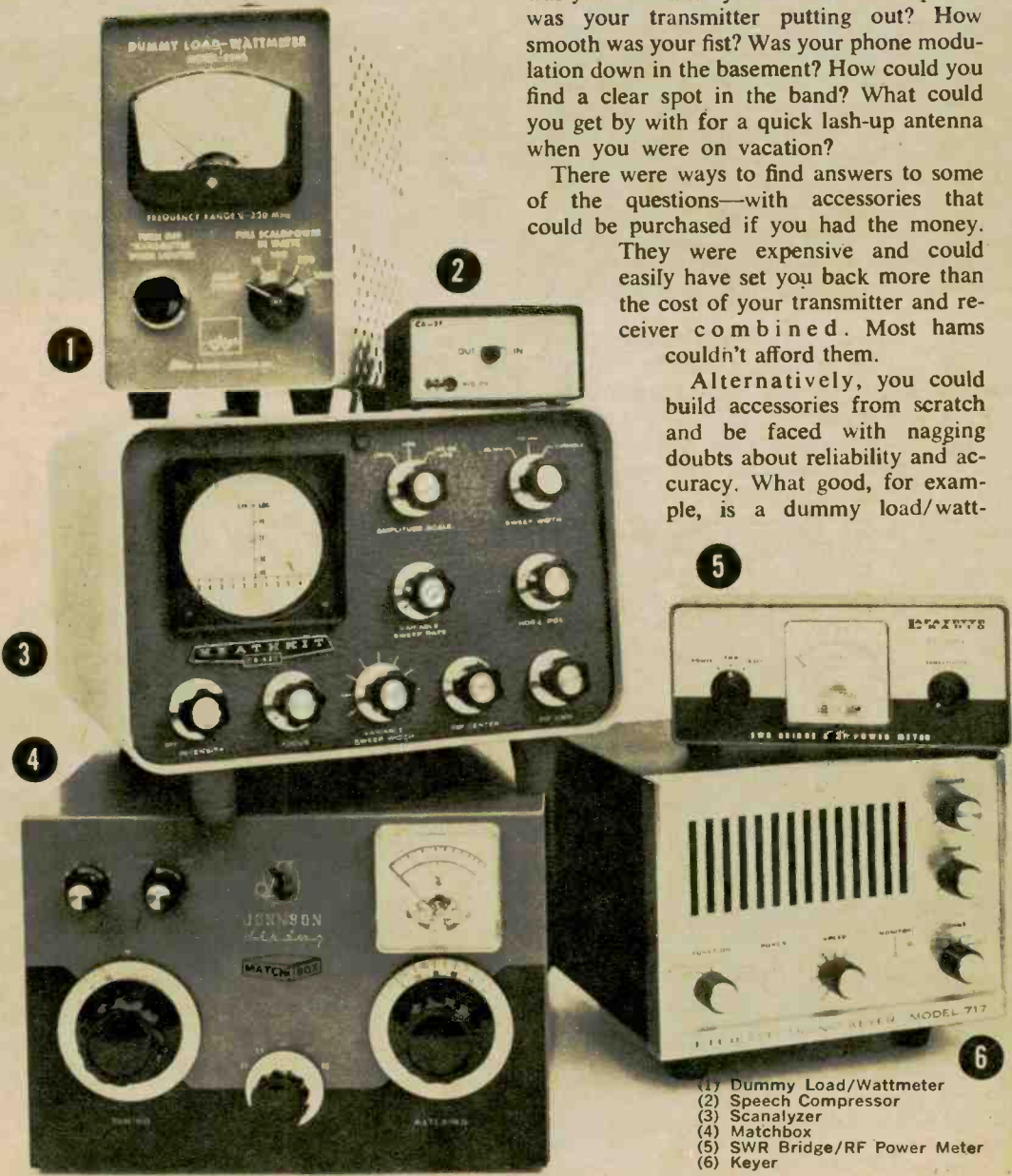
6 Most Useful New Ham Accessories

By HERB FRIEDMAN, W2ZLF BACK in the early days of ham radio you turned on the shack's power, tuned up the transmitter and went on the air. How much signal got out and its quality remained mysteries.

Then there were questions that haunted you when you were on the air: how efficient was your antenna system? How much power was your transmitter putting out? How smooth was your fist? Was your phone modulation down in the basement? How could you find a clear spot in the band? What could you get by with for a quick lash-up antenna when you were on vacation?

There were ways to find answers to some of the questions—with accessories that could be purchased if you had the money. They were expensive and could easily have set you back more than the cost of your transmitter and receiver combined. Most hams couldn't afford them.

Alternatively, you could build accessories from scratch and be faced with nagging doubts about reliability and accuracy. What good, for example, is a dummy load/watt-



(1) Dummy Load/Wattmeter
 (2) Speech Compressor
 (3) Scanalyzer
 (4) Matchbox
 (5) SWR Bridge/RF Power Meter
 (6) Keyer

6 Most Useful New Ham Accessories

meter if you don't know whether its indications are 5 or 50 per cent off?

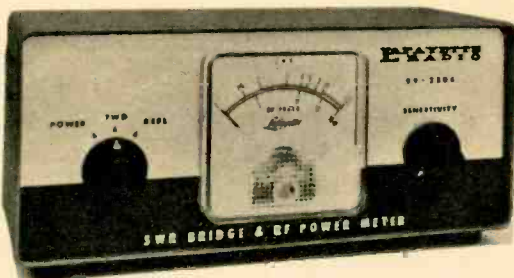
Those days are history. Now there are new accessories for the shack that are within the budget of almost every amateur. Not only are they cheaper than their predecessors—they're better, too, thanks to semiconductors and big advances in the state of the art.

The new accessories can improve your station's performance considerably. Enough, in fact, to make the difference between being a stateside operator or a DX hound. You may not be able to use all the accessories, but at least one or two can give new dimensions to your QSOs. We've picked out what we think are the six most useful of the new breed of accessories for coverage in our article.

(1) SWR Bridge/RF Power Meter. Heading the list is the SWR meter (or bridge). Although most modern transmitters are designed to work into a 25- to 100-ohm antenna system, many things can put your antenna's radiation resistance out of this range. Moisture in the transmission line or antenna loading coils, a TV mast or antenna that's too close, operating too far from the cut frequency of a loaded antenna can all cause a serious mismatch between the antenna system and the transmitter. Though the transmitter's pi-net output circuit may show proper loading, the RF output might not be



(2) Matchbox (E. F. Johnson, Viking) matches transmitter's output into almost any kind of antenna. This model (250-23-3) handles up to 275 watts.



(1) SWR bridge/RF power meter (Lafayette 99-2508) indicates antenna system's SWR (in-line, 1 kw maximum). Also measures RF to 15 watts to 50 mc.

going farther than the pi-net coil or the transmission line. You'll never know it without an SWR meter such as Lafayette Radio's 99-2508—a combination SWR and 15-w (maximum RF) output meter.

The meter has an in-line rating of 1 kw and it can be permanently connected in series with the transmission line to monitor the antenna system's SWR. The meter indicates SWR in terms of the RF energy sent into the antenna vs. the RF that is reflected back from the antenna.

In an ideal system where the antenna's radiation resistance is equal to the transmission line's impedance, all the energy delivered by the transmitter into the line is absorbed by the antenna system (less normal line loss) and there is no reflected energy. Hence, the meter will indicate a 1:1 SWR.

But assume for a moment that moisture entered an antenna loading coil (trap) and changed the antenna's resonant frequency. The radiation resistance could now be 150 ohms. If the transmission line's impedance is 50 ohms (a 3:1 mismatch or 3:1 SWR) not all the RF output will be absorbed by the antenna. Twenty-five per cent will be reflected back down the line and dissipated as heat in the transmitter's output tank and the transmission line. The SWR meter will show this condition, indicating 25 per cent of the total power is being reflected back from the antenna. The meter will indicate a 3:1 SWR.

The SWR meter, therefore, heads our list of accessories because it gives a continuous indication of the antenna-system's efficiency. Without it, you might have a full gallon rig that can't get down the block.

Since the output-power function is limited by the 52-ohm, 15-watt internal dummy-load resistor, the meter can serve as a combina-



(3) Dummy Load/Wattmeter (Waters Model 334A) measures transmitter's output into 52-ohm dummy load up to 1 kw. Its frequency range is 2-230 mc.

tion dummy load and power meter only for low-power transmitters with RF outputs no higher than 15 watts. Such would be the output from small 10 and 6-meter transceivers (not 2 meters as the meter's upper frequency limit is 50 mc).

(2) **Matchbox.** A matchbox is an easy-to-use matching system which you connect between a coax transmission line and just about anything you want to use for an antenna. Available in two basic models, for either 275 watts (the \$94.95 Model 250-23-3 unit shown) or 1 kw, the Johnson Matchbox is available with or without a built-in directional coupler—an SWR meter. The Matchbox also provides, by means of an internal relay, TR antenna switching and receiver control.

The Matchbox provides the impedance transformation between the transmitter's output and the antenna system. The antenna system can be either coax fed, have balanced feeders, or be direct coupled to a long wire. Four terminals on the back automatically provide the correct feed method. An RF pick-off probe terminal is also provided to feed an oscilloscope, modulation indicator or signal monitor.

Do modern antenna systems need the Matchbox? It all depends on the installation, but it's surprising how often the answer is yes. For example, a straight dipole antenna can easily be fed with coax transmission line,

but you get a better radiation pattern by using a balanced line (like 72- or 300-ohm twinlead). The Matchbox makes the transformation. Another example is the vacation rig, which works into a hank of wire strung to a tree branch. Now a modern transmitter might appear to be loading into the wire but you can be sure little RF is getting out of the cabinet. Connect the Matchbox between the transmitter and the wire and you'll get most of the soup into the skyhook.

Using the Matchbox is just one more simple step to improve transmitter tuning. You set the band switch to the appropriate band (80 through 10 meters) and adjust a tuning and a matching control for minimum SWR indication on the SWR meter (which is connected between the transmitter and the Matchbox). At minimum SWR the transmitter is matched into the antenna system. If there is a severe mismatch between the antenna and transmission line (which it normally prevents the transmitter from loading into the system, the Matchbox will match the transmitter to the system. Remember however, that there will still be a mismatch *after the Matchbox*—between the transmission line from the Matchbox and the antenna. RF losses due to this mismatch will still be present; the Matchbox will only insure that the transmitter loads into the entire system.

To insure maximum antenna system performance, whether using the Matchbox to transform into a balanced transmission line or to match into a high-SWR coax, many operators employ an SWR indicator both between the transmitter and Matchbox and between Matchbox and antenna line.

(3) **Dummy Load/Wattmeter.** Both by law and just plain common sense, a transmitter under test should always be operated



(4) Compressor (World Radio Labs. Model CA-27) boosts low-level modulating signals, attenuates high-level signals. Effect is boost in modulation.

6 Most Useful New Ham Accessories

in to a dummy load to: A) prevent interfering radiation, B) to provide a known matched load for the transmitter output. And since the purpose of performance tests or adjustments is to check or restore like-new performance, or to observe the effects of transmitter modifications, some means should be available to check RF output power. Reason is that RF output is generally the best transmitter test. The \$135 Waters Model 334A Dummy Load/Wattmeter provides in a single instrument both the required dummy load and an output-power meter.

The 334A contains an oil-cooled, 52-ohm, non-inductive load resistor and a safety lamp that lights when the coolant's temperature is excessive. The output power meter, with full scales of 10, 100, 300 watts and 1 kw has a frequency range of 2 to 230 mc; accuracy of indications is from 5 per cent to 20 per cent of full scale depending on the frequency. The meter is so designed that it can safely measure peak power (cw) levels to 1 kw. The maximum 100 per cent AM modulated carrier that can be applied is 375 watts. For SSB the peak power rating is 1 kw.

Though a dummy load/wattmeter is generally employed as a transmitter termination, the 52-ohm load can also be used to check SWR meters. With the 52-ohm dummy load terminating a 52-ohm transmission line, a



(6) Keyer (Eico Model 717) produces perfect dot-dash-space ratios at 3-75 wpm speed. Built-in speaker lets you hear your fist while you send.



(5) Scanalyzer (Heathkit Model SB-620) is panoramic adaptor that displays a 150-500 kc segment of a band. It also displays transmitter's output.

proper functioning SWR meter should indicate zero reflected power—a 1:1 SWR.

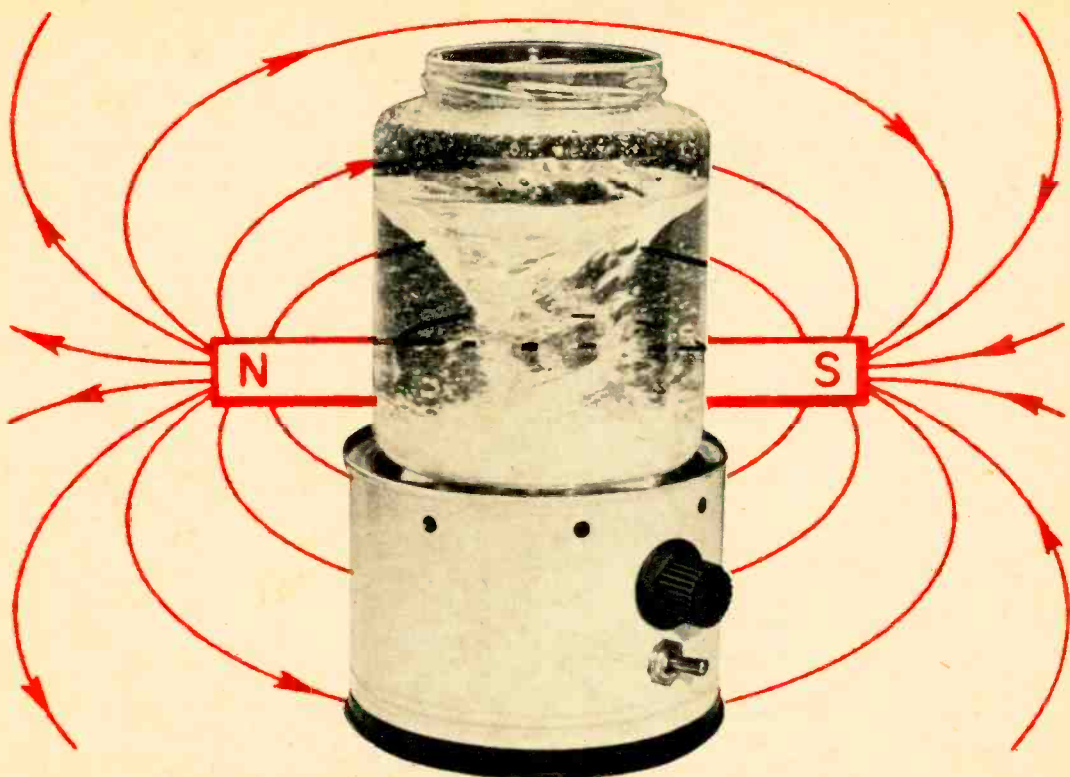
The dummy load/wattmeter combination can also be used to check coax cable loss. Suspect that old coil of coax is shot or the losses are excessive? Just use the meter to measure the transmitter output. Then connect the coax transmission line between the transmitter and the meter and note the reduced power indication. The difference between the two indications is the cable loss.

While it is true that many hams go through a lifetime of contacts without a dummy load or output meter, they do make tests and measurements a lot easier for the ham who insists on getting every watt of RF he paid for.

(4) **Speech Compressor.** While it is modulation peaks that determine 100 per cent modulation, the average voice has dynamic range and the average modulation level is about 10 per cent to 20 per cent, with only occasional peaks reaching to 100 per cent. In addition, the average power is some 6db to 10db less than the peak power, so that much of the time the modulation level is well under 20 per cent.

The \$14.95 WRL (World Radio Labs., 3415 W. Bway., Council Bluffs, Iowa 51505) CA-27 speech compressor compensates for the modulation losses due to both the dynamic range and average-power effects by boosting the low-level modulation signal and reducing the level of high-level signals. The effect to the receiving operator when the compressor is properly used is four times or better. That is, for the same carrier level, the modulation appears to be four times louder (that's

[Continued on page 117]



Magnetic Stirrer

By HARRY KOLBE

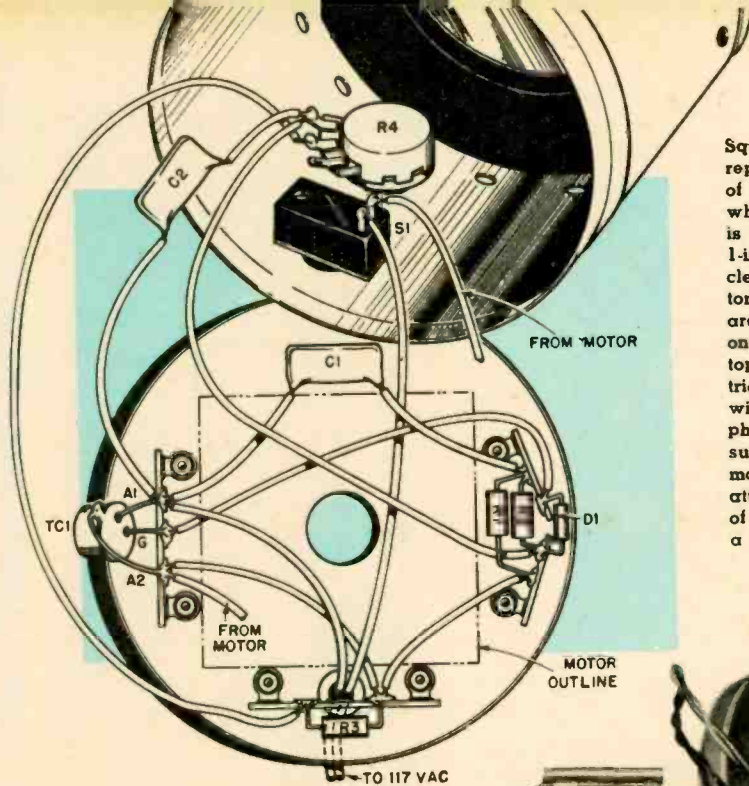
IT takes a fast egg beater to make a good omelet, and for whipping up a really smooth whiskey sour a blender has few peers.

But in a chemical or medical laboratory such home appliances would seldom be used for mixing. The professionals use a magnetic stirrer—an unusual device which, among other things, can mix liquids in a *closed* container. Because they cost \$40 or more, such lab-grade stirrers are out of the question for home applications. With a little mechanical skill and about \$15, you, too, can own one of these useful and interesting devices.

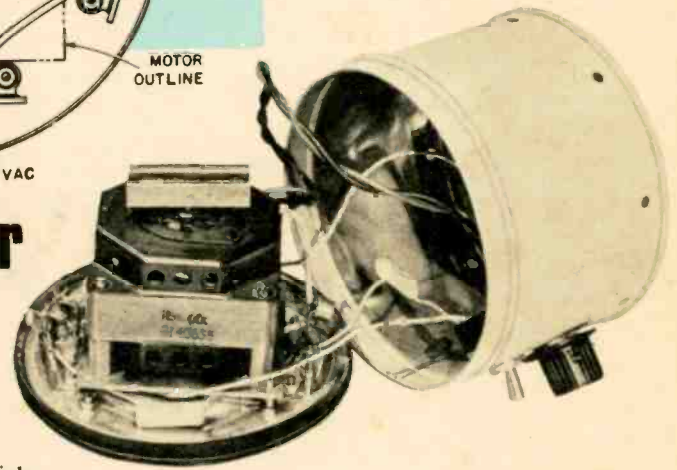
How does a magnetic stirrer work? Simple! Into a glass or non-magnetic container in which there's a liquid to be stirred, you place a small cylindrical magnet (covered with a protective coating of a chemically-inert material). You then maneuver the magnet so it lines up with and is held in the field of another cylindrical (or bar) magnet mounted on the shaft of a motor in the base on which the jar sits. Flip a switch and the motor-driven magnet in the base starts to spin. Its magnetic field causes the magnet in the jar to turn with it and stirring action starts.

You are not limited to one speed with our stirrer. Our stirrer has a solid-state control circuit using a triac which permits you to vary the stirring speed to suit the liquid and the degree of mixing required.

Construction. A good housing for the stirrer is a coffee can—the short fat kind that is about 5 in. in dia. and 3½ in. high. As you can see in the photo-



Square marked motor outline represents 3-in.-square piece of 1/16-in.-thick aluminum on which the magnet drive motor is mounted. Hole in center is 1-in. in dia. and provides clearance for shaft on bottom of motor. Other parts are mounted on terminal strips on three sides of coffee can's top. Connection to A2 on triac TC1 is made by soldering wire to TC1's case. Note in photo construction of magnet support assembly on top of motor. Cylindrical magnet is attached to the top of a piece of square aluminum bar with a small bit of epoxy cement.



Magnetic Stirrer

graph, the motor and electronics are built on the can's top. The bottom of the can itself becomes the base on which you place the jar.

Centered in the top of the can (which we'll refer to from now on as the base) layout 2 11/16-in. square. At each corner of the square drill a 1/8-in.-dia. hole.

Next thing to do is cut out the bottom of the can (which we'll now call the top). In the center of the top, cut, drill or punch a 2 1/4-in.-dia. hole. Around the side of the top of the can drill eight 1/4-in.-dia. holes for ventilation. Then on the side of the can drill a 1/2-in.-dia. hole 1 1/8 in. up from the bottom for power switch S1. Drill a 3/8-in.-dia. hole 2 1/8 in. up from the bottom for speed-control potentiometer R4.

The motor does not get mounted directly on the base. Instead, you mount it on a 1/16-in. thick piece of 3-in.-square aluminum plate to correspond with the holes in the base. Next, drill four more holes in the aluminum plate to mount the motor. These should be 1/8-in.-dia. holes at the corners of a 2 3/8-in. square, centered on the plate.

Mount the motor on the plate using the spacers furnished with it. The motor mounting plate should be mounted on the base with spacers to keep the plate 3/8 in. above the base.

The next bit of mechanical work is the rotating magnet assembly. The assembly consists of a piece of aluminum bar stock on which is cemented a cylindrical magnet. The aluminum bar is 1 3/4-in. long x 3/8-in. square. In the center of one side of the bar drill a 3/16-in.-dia. hole to fit on the motor's shaft. On another side at right angles to this hole, drill and tap a hole to accommodate a 6-32 set screw.

Using epoxy cement, attach the 1/4-in.-dia. x 1 3/4-in. long cylinder magnet on the side opposite the motor-shaft hole. Center the magnet to balance the assembly then set this

part aside overnight to allow the epoxy to harden.

Cut 1/4-in. off each of the motor's shafts. Use a vise to hold the motor so you don't bend the shaft or damage the bearings. Paint the can before you install anything else in it.

After the paint has dried, cement a 3 1/2-in.-square piece of 1/16-in.-thick plexiglass on the top of the can over the 2 1/4-in.-dia. hole. When mounting the motor plate and rotating magnet assembly, adjust both so that the top of the rotating magnet is about 1/32-in. below the underside of the plastic top. This dimension is critical. The strength of the magnetic field decreases rapidly as the magnets are separated and if they're too far apart, the magnetic force of the rotating magnet may not turn the jar magnet.

Refer to the pictorial. On the base install a four-lug terminal strip on each of three sides. Install all parts where shown being careful that leads are covered with spaghetti insulation so they do not touch the can. Also be sure that wires going from one side of the base to the other do not rub against the motor shaft.

When installing diode D1, hold its leads next to its body with a pair of needle-nose pliers when bending the leads and when soldering. This will prevent them from breaking off and from being damaged by heat when soldering.


Note in the pictorial that a connection is made to TC1's case. In order not to overheat TC1, you'll have to work quickly. To accomplish this, clean TC1's case thoroughly with fine steel wool at the point to which you will solder. Using a tiny speck of soldering paste, tin the surface with a drop of solder.

Tin the end of a piece of stranded hookup wire and quickly solder it to the case. Then cover TC1's case with electrical tape. This is absolutely necessary as the case is hot with AC line voltage and if it touches the can you could get quite a shock.

Install the switch and potentiometer in the side of the can with long leads and put the top on the base. You are now ready to mix your first magnetic martini.

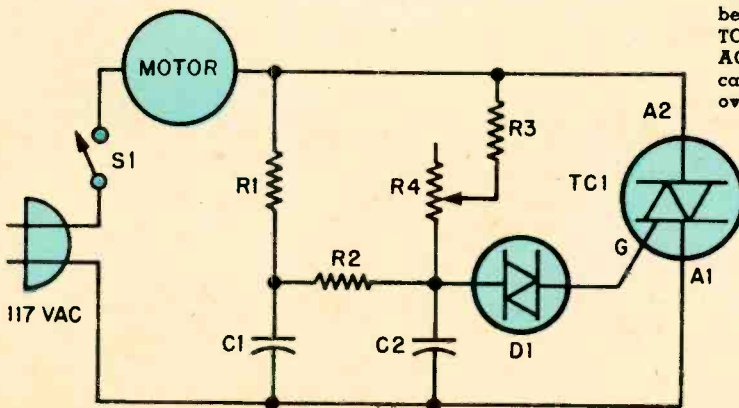
Operation. Set S1 to off and plug in the line cord. Place the cylindrical magnet (covered evenly with GE silicone sealer) in the bottom of a flat-bottom glass jar. Hold the jar over the top of the stirrer (close to it) and move the jar around until the magnet snaps into position over the rotating magnet.

Pour in the ingredients, flip the switch and adjust the speed-control for best mixing action.

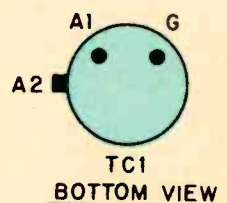
Bottoms up! 

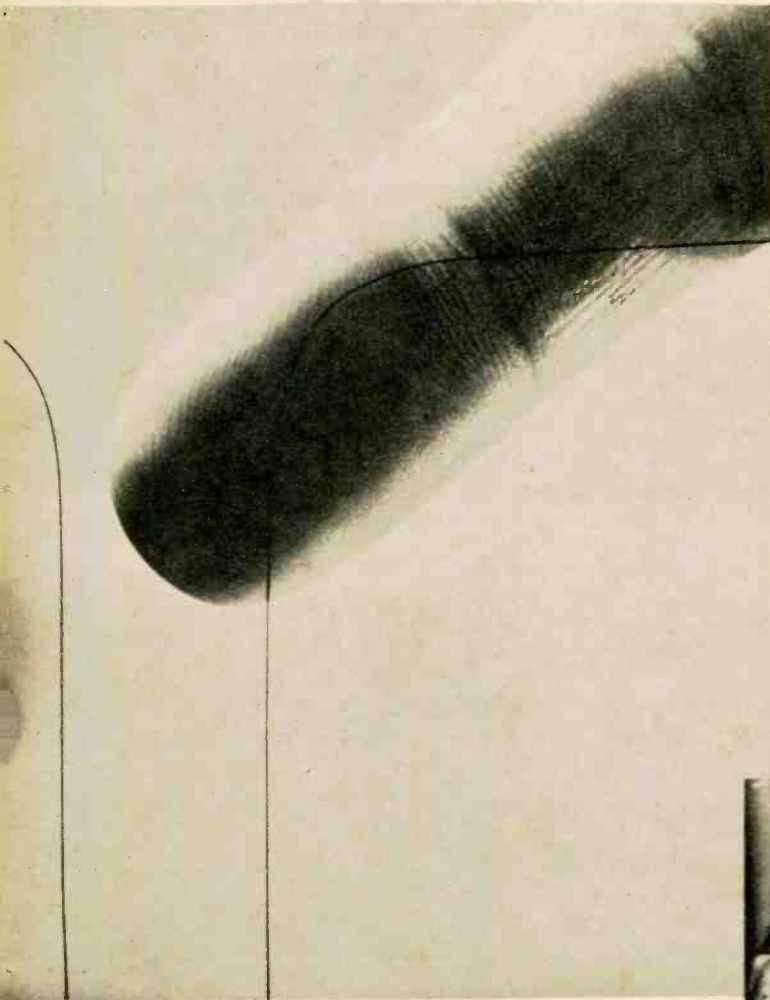
PARTS LIST

- C1,C2—1 μ f, 200 V mylar capacitor
- D1—Bilateral trigger diode (Motorola HEP-311, Allied 22 C 3846 or equiv.)
- Motor—Four-pole motor (Olson Electronics MO-184)
- R1—68,000 ohm, 1/2 watt, 10% resistor
- R2—39,000 ohm, 1/2 watt, 10% resistor
- R3—120,000 ohm, 1/2 watt, 10% resistor
- R4—30,000 ohm, linear-taper potentiometer
- S1—SPST switch
- TC1—40529 triac (RCA, Allied 49 C 1 40529-RCA \$1.62 plus postage)
- Misc.—Alnico cylinder magnets, 1/4-in. dia. x 1 3/4-in. long (Edmund Scientific Co., 300 Edscorp Bldg., Barrington, N.J. 08007. Stock No. P-40,418; \$1.20 plus postage for two), coffee can, AC line cord



Induction motor's speed can be controlled because triac TC1 (full-wave device) applies AC to motor. Motor slows because lowered current can't overcome drag of moving parts.

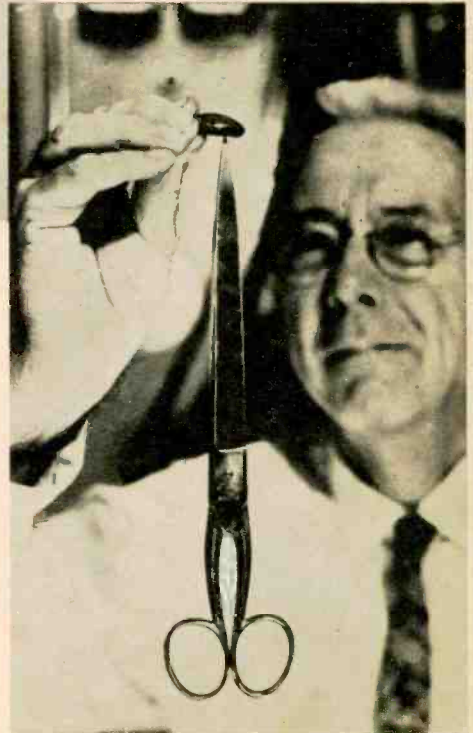




RABBIT HAIRS. . . They're only about twice the thickness of human hairs but they're actually copper wires embedded in the vinyl interlayer of a laminated auto windshield to form a permanent rabbit-ears type of antenna for car radios. The idea, worked out jointly by Pittsburgh Plate Glass and Pontiac, is an attempt to eliminate standard auto whips, with their open invitation to accident and vandalism.

Electronics in the News

Get the point? . . . the point being that the scissors will stay up only because what looks like a button in the scientist's hand actually is a uniquely powerful magnet. It is made by Bell Telephone Laboratories, using rare earths that can be molded in a magnetic field, yielding a magnet of just about any configuration with almost any field orientation. In this case, the poles are at top and bottom of the button shape—extremely close by conventional magnet standards.



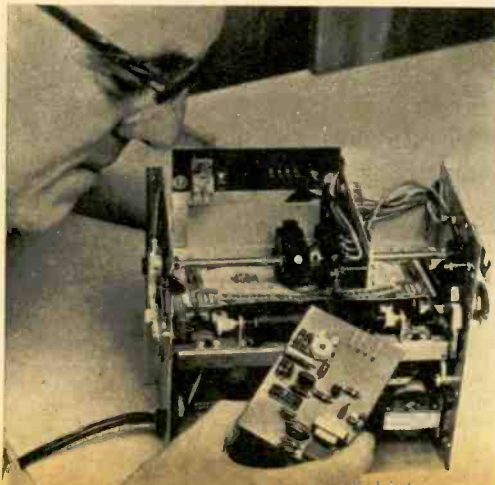


Chitty-Chitty-Hush-Hush. . . Only a few years ago, electric autos were thought of as freaky antiques. No more! Among the most active agitators in the sprouting new wave of electrics has been Gulton Industries. The hood peered under by this Gulton engineer and friend belongs to a jointly-developed Rambler electric. One of its innovations: regenerative braking, which converts the motor to a generator. Instead of simply dissipating the car's kinetic energy in the form of heat (as in conventional braking) it uses the generator's drag on the drive system to reconvert momentum into electricity, partially recharging the battery.

Lost Vegas. . . All the pleasures of a gambling palace, served up Horn & Hardart style, are offered by something called the Slot-Tronic-803, a product of K&M Electronics Co., Baltimore. Care for a drink? It can serve up any one of 23 specialties in 4 seconds. Want to try your luck? There's a one-arm bandit built in. Need change before you can do either? That's taken care of, too, with an automatic change-maker. So put 'er there, podner—right in the slot. This is a recording.



The ICs see. . . Integrated circuits are responsible for improving the reliability of this Transmarine automatic bill-changer, according to Texas Instruments. A sensing assembly passes infrared radiation through the bill and the output is compared to the standard for which it is programmed—in this case, a U.S. \$10-bill. With a change in programming it can be used to validate (and change) almost any type of paper currency, from just about any country.



"Performance-Plus" Kits For Home And



NEW
kit AD-27

\$169⁹⁵



NEW
kit AD-17

\$109⁹⁵

HEATHKIT AD-27 FM Stereo Compact

The new Heathkit "27" Component Compact was designed to change your mind about stereo compact performance. How? By sounding as if it were made of top quality stereo components . . . which in fact it is. Heath engineers took their highly rated AR-14 solid-state Stereo Receiver, modified it physically to fit the cabinet, and matched it with the precision BSR McDonald 500A Automatic Turntable. Performance? Here's the AD-27 in detail. The amplifier delivers 30 watts music power . . . 15 honest watts per channel — enough to drive any reasonably efficient speaker system. Response is virtually flat from 12 Hz to 60 kHz, and Harmonic & IM distortion are both less than 1% at full output. Tandem Volume, Balance, Bass & Treble controls give you full range command of all the sound. Select the FM stereo mode with a flick of the rocker-type switch and tune smoothly across the dial, thanks to inertia flywheel tuning. You'll hear stations you didn't know existed in your area, and the clarity and separation of the sound will amaze you. The adjustable phasing control insures best stereo separation at all times. And the automatic stereo indicator light tells you if the program is in stereo. AFC puts an end to drift too. The BSR Automatic Turntable has features normally found only in very expensive units, like cueing and pause control, variable anti-skating device, stylus pressure adjustment and automatic system power too. Comes complete with a famous Shure diamond stylus magnetic cartridge. The handsome walnut cabinet with sliding tambour door will look sharp in any surroundings, and the AD-27 performs as well as it looks. For the finest stereo compact you can buy, order your "27" Component Compact now. 41 lbs.

HEATHKIT AD-17 Stereo Compact

Using the component approach of the AD-27, Heath engineers took the solid-state stereo amplifier section of the AD-27, matched it with the high quality BSR-400 Automatic Turntable and put both of these fine components in a handsomely styled walnut finish cabinet. The result is the "17" — featuring 30 watts music power, 12 Hz to 60 kHz response, auxiliary & tuner inputs, less than 1% Harmonic & IM distortion, adjustable stylus pressure & anti-skate control and much more. Order your "17" now. 27 lbs.



NEW
kit TA-38

\$225⁰⁰

HEATHKIT TA-38 Solid-State Bass Amplifier

The new Heathkit TA-38 is the hottest performing bass amp on the market, for quite a few reasons. First, there's all solid-state circuitry for reliability. Then there's the tremendous power — the TA-38 puts out 120 watts of EIA music power, 240 watts peak, or 100 watts continuous. Extremely low harmonic & IM distortion too. Many amps suffer from "blow-out" problems, but not the new TA-38 — *YOU CAN'T BLOW IT* . . . it boasts two 12" heavy duty special design speakers with giant 3 pound 6 ounce magnet assemblies mounted in a completely sealed, heavily damped 3/4" pressed wood cabinet — those speakers will take every watt the amp will put out, and still not blow. Sound? The TA-38 is tailored to reproduce the full range of bass frequencies delivered by bass guitars and its sound with combo organs and other instruments is remarkable. Easy 15 hour assembly to the wildest bass amp on the market. Order one now and surprise the guys with the high-priced gear. 130 lbs.

HEATHKIT GR-58 Solid-State AM/FM Clock Radio

The easy way to get up in the morning. Choose the morning news & weather on AM or the bright sound of FM music. AFC makes FM tuning easy. The "Auto" position on the Telechron® clock turns only the radio on, or use the "Alarm" setting for both the radio and the alarm. You can even enjoy fresh coffee when you awake in the morning, thanks to the clock-controlled accessory AC socket on the back of the new GR-58. The handy "snooze" alarm feature lets you wake up gradually for ten minutes to the sound of the radio, then the alarm goes on . . . push the "snooze" button to silence the alarm for ten minutes more of music or news — the alarm sounds automatically every ten minutes and the "snooze" button turns it off, cycling continuously until the selector switch is moved to another position. Fast, easy circuit board construction, smart blue hi-impact plastic cabinet and top reliability make this GR-58 the clock radio for you. 8 lbs.

NEW
kit GR-58

\$47⁹⁵



HEATHKIT IG-18 Solid-State Sine-Square Wave Generator

A precision source of sine or square waves at a low kit price . . . that's the new solid-state IG-18 from Heath. Delivers 5% accuracy thru the wide range of 1 Hz to 100 kHz. The sine wave section features less than 0.1% distortion thru the audio range, 8 output voltage ranges from 0.003 to 10V, switch-selected internal 600 ohm load or external load and metered output of both voltage & dB. The square wave section has a 50 nS rise time and three output voltage ranges from 0.1 to 10 V P-P. Both sine & square waves are available simultaneously and the frequency is switch-selected for constant repeatability and fast operation. Circuit board construction makes the new IG-18 easy to build . . . new Heathkit styling and engineering excellence make it easy to use. Put the new IG-18 on your bench now. 10 lbs.



NEW
kit IG-18

\$67⁵⁰

Wired IGW-18

\$99⁵⁰

CIRCLE NUMBER 3 ON PAGE 13

Hobby... From The Leader



Now There are 4 Heathkit Color TV's...
All With 2-Year Picture Tube Warranty

NEW Deluxe "681" Color TV With Automatic Fine Tuning

The new Heathkit GR-681 is the most advanced color TV on the market. A strong claim, but easy to prove. Compare the "681" against every other TV — there isn't one available for any price that has all these features. Automatic Fine Tuning on all 83 channels... just push a button and the factory assembled solid-state circuit takes over to automatically tune the best color picture in the industry. Push another front-panel button and the VHF channel selector rotates until you reach the desired station, automatically. Built-in cable-type remote control that allows you to turn the "681" on and off and change VHF channels without moving from your chair. Or add the optional GRA-681-6 Wireless Remote Control described below. A bridge-type low voltage power supply for superior regulation; high & low AC taps are provided to insure that the picture transmitted exactly fits the "681" screen. Automatic degaussing, 2-speed transistor UHF tuner, hi-fi sound output, two VHF antenna inputs... plus the built-in self-servicing aids that are standard on all Heathkit color TV's but can't be bought on any other set for any price... plus all the features of the famous "295" below. Compare the "681" against the others... and be convinced.

GRA-295-4, Mediterranean cabinet shown... **\$119.50**
Other cabinets from \$62.95

Deluxe "295" Color TV... Model GR-295

Big, Bold, Beautiful... and packed with features. Top quality American brand color tube with 295 sq. in. viewing area... new improved phosphors and low voltage supply with boosted B+ for brighter, livelier color... automatic degaussing... exclusive Heath Magna-Shield... Automatic Color Control & Automatic Gain Control for color purity, and flutter-free pictures under all conditions... preassembled IF strip with 3 stages instead of the usual two... deluxe VHF tuner with "memory" fine tuning... three-way installation — wall, custom or any of the beautiful Heath factory assembled cabinets. Add to that the unique Heathkit self-servicing features like the built-in dot generator and full color photos in the comprehensive manual that let you set-up, converge and maintain the best color picture at all times, and can save you up to \$200 over the life of your set in service calls. For the best color picture around, order your "295" now.

GRA-295-1, Walnut cabinet shown... **\$62.95**
Other cabinets from \$99.95

Deluxe "227" Color TV... Model GR-227

Has same high performance features and built-in servicing facilities as the GR-295, except for 227 sq. inch viewing area. The vertical swing-out chassis makes for fast, easy servicing and installation. The dynamic convergence control board can be placed so that it is easily accessible anytime you wish to "touch-up" the picture.

GRA-227-1, Walnut cabinet shown... **\$59.95**
Mediterranean style also available at \$99.50

Deluxe "180" Color TV... Model GR-180

Same high performance features and exclusive self-servicing facilities as the GR-295 except for 180 sq. inch viewing area. Feature for feature the Heathkit "180" is your best buy in deluxe color TV viewing... tubes alone list for over \$245. For extra savings, extra beauty and convenience, add the table model cabinet and mobile cart.

GRS-180-5, table model cabinet and cart... **\$39.95**
Other cabinets from \$24.95

Now, Wireless Remote Control For Heathkit Color TV's

Control your Heathkit Color TV from your easy chair, turn it on and off, change VHF channels, volume, color and tint, all by sonic remote control. No cables cluttering the room... the handheld transmitter is all electronic, powered by a small 9 v. battery, housed in a small, smartly styled beige plastic case. The receiver contains an integrated circuit and a meter for adjustment ease. Installation is easy even in older Heathkit color TV's thanks to circuit board wiring harness construction. For greater TV enjoyment, order yours now.

kit GRA-681-6, 7 lbs., for Heathkit GR-681 Color TV's... **\$59.95**
kit GRA-295-6, 9 lbs., for Heathkit GR-295 & GR-25 TV's... **\$69.95**
kit GRA-227-6, 9 lbs., for Heathkit GR-227 & GR-180 TV's... **\$69.95**

kit GR-681

\$499.95

(less cabinet)



kit GR-295

now only

\$449.95

(less cabinet)

kit GR-227

now only

\$399.95

(less cabinet)



kit GR-180

now only

\$349.95

(less cabinet)



New Wireless
TV Remote Control
For GR-295, GR-227
& GR-180
\$69.95

New Wireless
TV Remote Control
For GR-681
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NEW

FREE 1969 CATALOG!

Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, electric guitar & amplifier, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

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CL-350

MEET THE



VTVM

By JOHN S. RICHARDS WHEN it comes to making critical voltage measurements in electronic circuits a vacuum-tube voltmeter (VTVM) is a must. That old standby, the VOM (see *The Versatile VOM*, Nov. '66 EI), just won't cut the mustard when sensitivity is important. Although it's the general workhorse on the electronics bench, the VOM actually can cause more problems than it solves.

Biggest disadvantage of the VOM is that it is a relatively low-resistance load (that changes according to the range selected) on the circuit to which it is connected. This causes voltages in the circuit—and the accuracy of the readings—to go haywire.

In addition, the VOM responds meaningfully only to sine-wave AC signals. This limits its usefulness since most electronic equipment is filled with complex non-sinusoidal signals.

Enter the VTVM—the test instrument that can put the VOM on the shelf again and again. The VTVM has four important advantages over the VOM: 1) high input impedance; 2) high sensitivity; 3) protection against overload, and 4) wide frequency response—valuable when making AC measurements.

The general-purpose, service-grade VTVM, most frequently used by hobbyists and servicemen, has a high input impedance that remains the same regardless of the range to which the instrument is set. And it may be 10 to 25 megohms, depending on the model, although 10 megohms is more common. In addition, the DC probe contains a 1-megohm resistor to provide isolation between the probe tip and the capacitance of the connecting cable. This 1-megohm resistor enables the VTVM to measure DC voltages in RF circuits without loading and detuning.

These service-grade VTVMs have an AC input impedance lower than the DC input impedance. The nominal minimum AC input impedance is 1 megohm. However, the newer and higher-price VTVMs have an AC input impedance about as high as the DC impedance. The instrument's AC probe does not have a built-in isolating resistor.

All service-grade VTVMs have AC and DC voltage ranges which start at 1.5 V to 5 V and extend to 1,000 or 2,000 V. Supplementary probes are available to extend the instrument's range up to 30,000 V. Some of the latest models also include a 0.5 VDC range—a valuable feature when you have to

make measurements in transistor equipment.

On all modern VTVMs, the meter needle can be zeroed at the center of the scale on DC ranges. That is, instead of the pointer being set at the normal zero mark, it can be set dead center. This permits instant determination of whether a voltage is positive or negative. While rarely used for conventional voltage measurements, this feature is valuable when aligning FM detectors, where you are interested in seeing easily how much a voltage is above and below zero.

Unfortunately, general-purpose VTVMs cannot measure current. VTVMs generally provide six resistance ranges, enabling you to measure resistance up to 1,000 megohms.

How the VTVM Works

Figure 1, a simplified schematic of a VTVM, shows its secret of success. R1, R2, V1 and V2 form a bridge. We'll assume the resistances of R1 and R2 are equal and the impedances of V1 and V2 are the same. In this condition the bridge is balanced and the voltages at points X and Y are equal with respect to ground. The voltage from X to Y is zero; therefore, current will not flow through M1, which indicates zero.

When a positive voltage is applied to V1's grid, current flow through the tube increases, impedance drops, the voltage at point X falls and the bridge is unbalanced. Since there's a difference in voltage between points X and

Y, current flows through M1. With proper calibration, M1 will indicate directly the positive voltage applied to V1, which is proportionate to the voltage being measured.

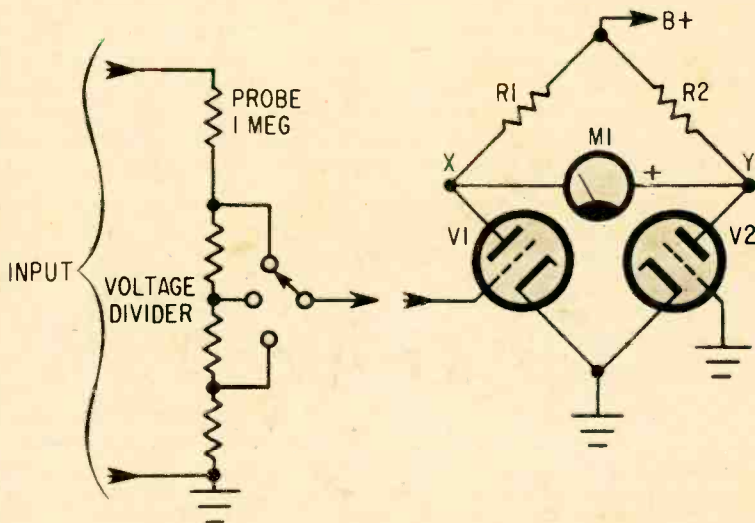
For negative-voltage measurements the VTVM's internal switching grounds V1's grid and applies the negative voltage to be measured to V2's grid. When this happens, less current flows through V2, V2's impedance increases and the voltage at point Y rises. (Note that point Y again is positive with respect to X.) Current flows through M1, causing it to deflect upscale.

Usually only 1 V on either tube's grid produces a full-scale deflection. For this reason, a voltage divider is located ahead of the tube to enable the instrument to measure up to 1,000 V.

Note from Fig. 1 that regardless of which divider tap is used, the divider always appears as a fixed impedance across the input. On one popular VTVM, the input voltage divider is made up of seven resistors since the instrument has seven ranges from 1.5 to 1,500 V. The values of the resistors are 7 megohms, 2 megohms, 700,000 ohms, 200,000 ohms, 70,000 ohms, 20,000 ohms and 10,000 ohms. Added up, these give an input impedance of 10 megohms.

Although Fig. 1 is greatly simplified, it is the basic circuit that is used in practically every VTVM. The complete circuit differs only in tube biasing, balancing, calibra-

Fig. 1—Simplified circuit of input and bridge portion of VTVM. Normally bridge is balanced, voltages at X and Y are equal and M1 indicates zero. Positive input voltage to grid of V1 causes V1 to conduct and voltage at X to drop. This causes M1 to deflect upscale. When switched to measure negative DC, voltage is applied to V2's grid (V1's grid is grounded) causing voltage at Y to rise. M1 also deflects upscale. Impedance looking at input is constant.



MEET THE VTVM

tion controls and other components.

AC Measurements

Though DC operation basically is the same from VTVM to VTVM, AC operation differs. Old VTVMs usually have a simple rectifier circuit, such as the half-wave shunt rectifier shown in Fig. 2, for making AC measurements. When the VTVM is set to measure AC the rectifier is connected between another input voltage divider and the range switch.

Depending on the rectifier's design, its output can be either the peak or the average value of a half cycle of the input signal. Since the peak or average value of a sine-wave signal is of little interest, the meter scale is *calibrated* to indicate rms voltage.

While this circuit is satisfactory for sine-wave voltage measurements, it will produce a meaningless output when you try to measure complex non-sinusoidal waveforms, such as square waves. And if a complex waveform is not symmetrical about the zero axis, what may be a significant half cycle will be eliminated by the circuit and will not be reflected in the rectifier's output.

Take a look at the top diagram in Fig. 3. To begin with, the rectifier circuit eliminates the lower half of the waveform. Of the remaining waveform, the voltage exists, or is on, exactly half the cycle and off the other half. Averaged over one cycle, the voltage is only half the peak voltage.

Now, suppose the square wave is changed to a narrow pulse, as in the lower diagram in Fig. 3 (the peak voltage level remains the same). This means that over a full cycle, the average voltage will be only about one quar-

ter of peak voltage. The meter indication, therefore, will be considerably less than the peak value of the pulse.

While it is possible to calibrate the meter for a square-wave signal, it would not be possible to calibrate it for a non-symmetrical (about the zero axis) waveform such as would be found in a TV set.

In other words, an average-value meter, even if calibrated for peak voltage, would produce incorrect indications because average voltage depends on both peak voltage and width of the pulse.

Some older or low-cost VTVMs are touted as having a peak-to-peak (P-P) calibration. But if you read the fine print you'll discover the P-P calibration holds true only for a sine wave. Since you can *calculate* the P-P value of the sine wave ($2.828 \times \text{rms}$) from the rms calibration on a meter scale, this feature is of little value.

For true P-P measurements of complex waveforms the VTVM must include a special AC rectifier input circuit such as is shown in Fig. 4. Capacitor Cb is a blocking capacitor that keeps DC out of the circuit and allows AC to be measured in the presence of DC.

On the positive half-cycle V1A conducts (charge path is through V1A, C1 and Cb), charging C1 to a peak positive voltage. (C1's charge is negative at the junction of V1A and V1B.) On the negative half-cycle, V1B conducts (charge path is via C2 and V1B), and the applied negative peak voltage *and* the voltage on C1 combine to charge C2 to the P-P voltage. The voltage appearing across C2 is passed on to the meter, which indicates true P-P voltage.

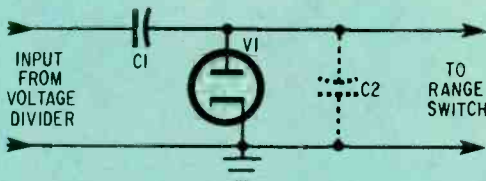


Fig. 2—AC input circuit of early-design VTVMs is peak-responding, half-wave shunt rectifier whose average output is negative DC. Diode V1 shunts positive half of input signal to ground.

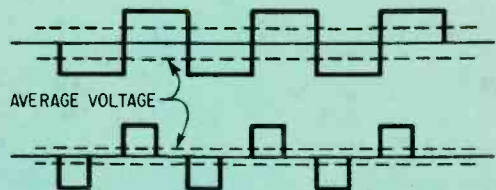


Fig. 3—Average value of a complex waveform is function of pulse height, width. Though heights are same, average voltage is less if positive pulse width is less than the interval between pulses.

The Audio Problem

While VTVMs can be used for audio service you often have to measure extremely low AC voltages, as found in amplifiers and tuners. Since a VTVM cannot measure accurately below 0.1 V, it is useless for measuring, say, a 4-millivolt (0.004 V) signal from a phono cartridge. What's needed for audio work is a specialized VTVM—called an AC VTVM.

The experimenter-grade AC VTVM is simply a high-gain audio amplifier with a voltage-divider input and a meter connected to the output. A basic circuit is shown in Fig. 5. Full-scale indication starts at 0.001 V (1 millivolt) with 300 or 500 V at the top. In addition, AC VTVMs are calibrated directly in decibels so gain measurements can be made without the need for computations to convert voltage change to db gain or loss.

One AC VTVM on the market has built into it a wattmeter circuit. The meter is calibrated directly in watts. The wattmeter/voltmeter contains load resistors of 4, 8, 16 and 600 ohms. The calibration is adjusted so the meter indicates automatically the amplifier's output power regardless of selected load resistor. Calibration also is made automatic to indicate output power when the amplifier under test is connected to a separate load resistor (or any other load).

Keep in mind, however, that AC VTVMs respond accurately only to sine-wave signals. Not only do they indicate incorrectly when measuring a complex waveform but they give erroneous indications if the sine-wave signal contains a modest amount of distortion.

Which One For You?

As a general rule, the standard AC/DC, ohmmeter VTVM should be your first choice

because it can be used for most of the experimental and service work you're likely to get involved with. However, it is practically useless for *extensive* tests on audio equipment because it does not measure down into the millivolt-AC region. Probably the greatest problem you'll have with a standard VTVM is deciding on whether to get one with or without true P-P measurement capability.

Since most electronic equipment handles complex signals it is best to bypass those models without *true* P-P calibration. And remember, P-P calibration of sine-wave signals only is not useful P-P calibration. The difference in price between a VTVM with P-P and one without is a few dollars at most. Extreme difference in price usually represents a larger meter scale, more accurate calibration, degrading accuracy and better long-term stability (in short, better components).

If you're interested primarily in audio work the AC VTVM is the choice, though you will have to back it up with a standard VTVM if you'll be making DC measurements. While you could get by with a VOM for most DC measurements in audio equipment, a VTVM is necessary for measurements in tube and solid-state circuits.

While AC VTVMs generally are in the same price range, the modest extra cost of one with a built-in wattmeter is justified if you intend to make output-power measurements. If you're just going to test your own amplifier occasionally you *could* purchase the required load resistor(s) and calculate the power output from a standard AC VTVM voltage reading. However, remember that when selecting the resistors, they must be able to handle the amplifier's output power without overheating. And the resistors should be the non-inductive type.

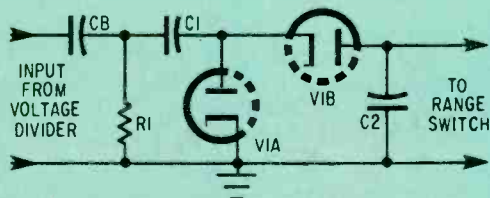


Fig. 4—Rectifier circuit used in VTVMs that respond to and indicate peak-to-peak voltage of complex wave is full-wave doubler. Voltage to range switch equals signal's peak-to-peak voltage.

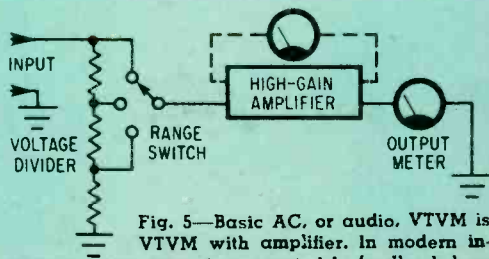


Fig. 5—Basic AC, or audio, VTVM is VTVM with amplifier. In modern instruments the meter is connected in feedback loop (dotted line) to insure good frequency response.

CB Corner Unsafe at Any Frequency?

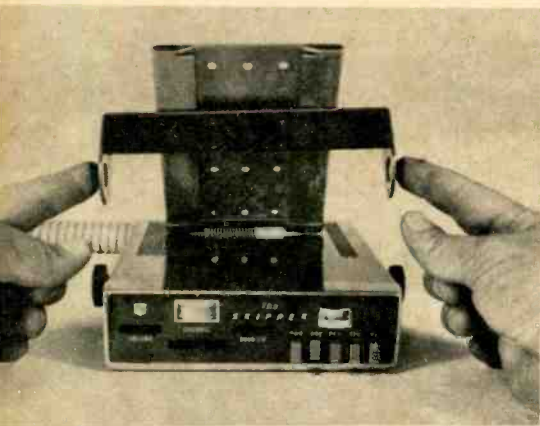
By Len Buckwalter, KQA5012

LOOK inside a '69 car and you'll see signs of recent federal specs on auto safety. The padded dash, breakaway mirror and flattened knobs reduce injury to passengers in a sudden, unscheduled stop.

But what happens when you add a CB rig? Toothy knobs, pointy corners and sharp edges hardly would please the likes of Ralph Nader. Although there's no controversy yet over the safe CB rig, at least one manufacturer (Squires-Sanders) decided to do something about it. Certain fillips on its Skipper transceiver could save some barked knees or possibly more serious injury.

As our photo shows, the front panel is shorn of hostile projections. Instead of jutting controls, there are roller knobs for volume, squelch and channel. Other switches are push buttons which recede easily. And the front-panel frame is rounded to reduce possible cutting edges.

But the most notable feature is the mounting bracket. Unlike others, this novel arrangement doesn't lock the rig tightly into place but yields under moderate pressure. Note the two slots that form a friction fit. If a passenger is jammed against the set the cabinet slides back on impact, out of harm's way.



Skipper auto CB rig is supplied with a safety mounting bracket that will slide in channels of mounting plate on impact if a passenger hits it.

Beyond the Blue Horizon . . . One of CB's tricky variables is operating range. When sunspots are numerous (as they are now) signals skip around the globe. Otherwise, when buildings block the wave you could do better by shouting. And one signal-tripper that never changes is the curvy contour of Mother Earth. Normal line-of-sight CB fails to hold the turn of the horizon so it slides off into space.

To eke out greater range, don't lower the horizon—raise the antenna. In fact, you could raise it until the wave reached the maximum legal limit of 150 mi. Since antenna height would have to be nearly 20,000 ft. for that range you'd need Mt. McKinley for a base. What, then, is the down-to-earth effect of antenna height?

A look at theoretical range figures will give you an idea what to expect. There'll be differences at your location because of obstacles, terrain and other local features, of course. But, as a rule of thumb, you can expect that an antenna only 10 ft. above the surrounding ground level will reach out a little over 6 mi. (This would apply to the common CB situation where a base station communicates with a mobile having a whip antenna about 4 ft. above ground.)

As you raise the base antenna to 20 ft. it should increase coverage to about 20 mi. And as you continue to raise it 10 ft. at a time, coverage should go up by about 1 mi. for each position. Above 70 ft. or so, however, gains in extra coverage begin to drop off fairly rapidly.

Raising the antenna from 90 to 100 ft., for example, will produce only about a half-mile of extra coverage—or a gain of only a few per cent, even though the rise from 10 to 20 ft. netted about a 30 per cent gain. This will give you an idea where raising the antenna will pay off and where it simply will be a waste of time. So put most effort into raising the low-lying antenna. Besides overlooking more of the horizon, the signal probably will clear more local obstructions.

How do you improve the height of a mobile antenna? That's often much easier than for a base; just drive up the nearest hill and start talking. 📻

BY FRED B. MAYNARD UNRELENTING as the familiar rock beat is these days, it doesn't totally dominate the musical scene. (Thank God for that!) Still sharing the limelight are the exciting rhythms of the Latin style—mambo, bossa nova and cha-cha. And almost always this music includes the mellow sound of the marimba—a percussion instrument whose keyboard consists of wood bars which are struck with mallets. Hanging from below the bars are hollow resonators (metal tubes) which reinforce the sound.

Now a $4\frac{1}{3}$ -octave marimba can set you back up to \$1,000 if you want a good one. And it's no easy task to move it from one place to another. Typically, a marimba with this range is almost 7 ft. long, about 3 ft. high and weighs around 150 lbs.

A marimba doesn't have to be this large. Build one with transistors and the weight drops by about 75 per cent and the length can be cut in half. For example, the marimba shown on the first page of this article

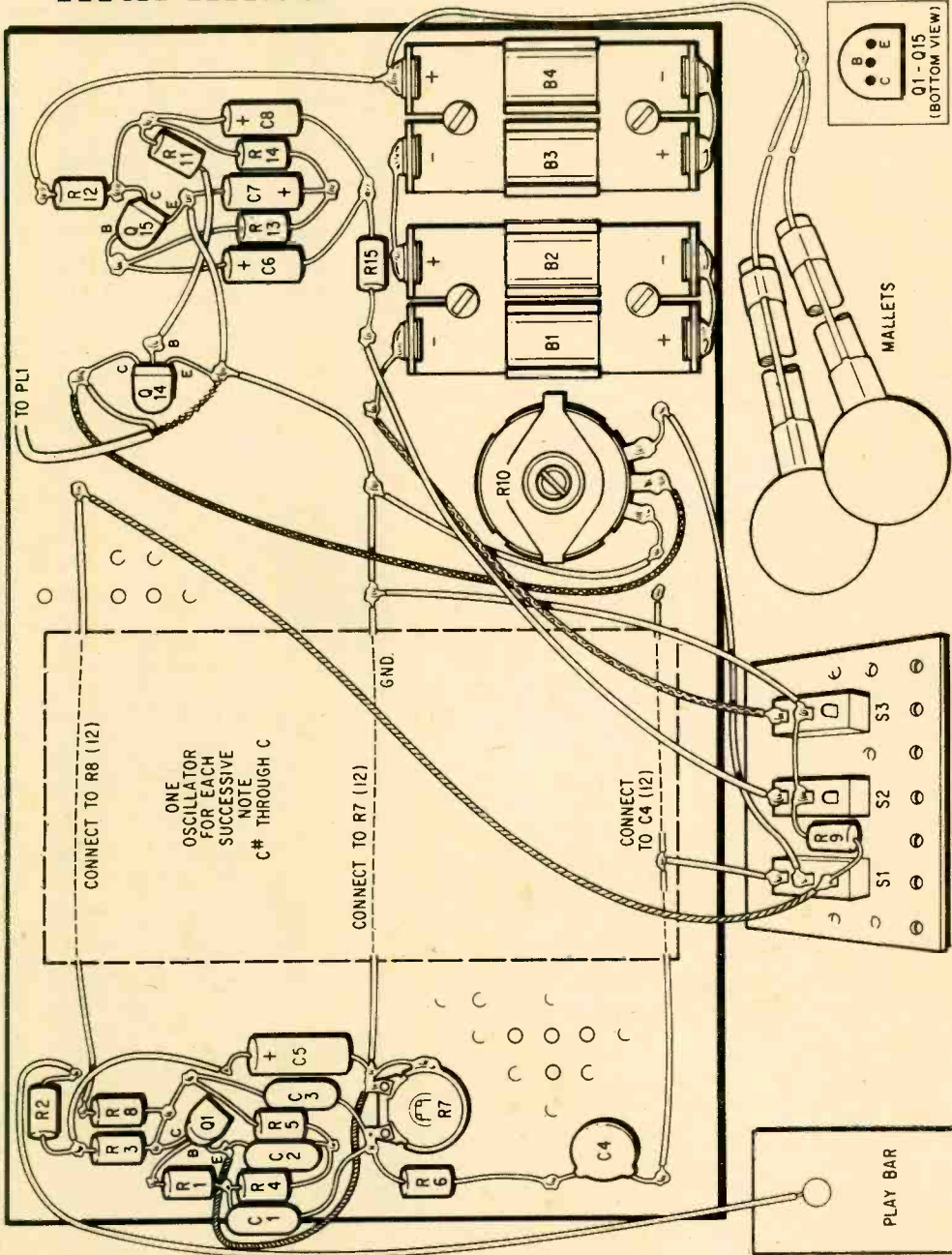
Solid-State Marimba



March, 1969

Solid-State Marimba

Fig. 1—Circuit board is 5 x 17 in. Only one tone oscillator is shown because others (which connect to three buses) are identical. Tremolo circuit is at the upper right.



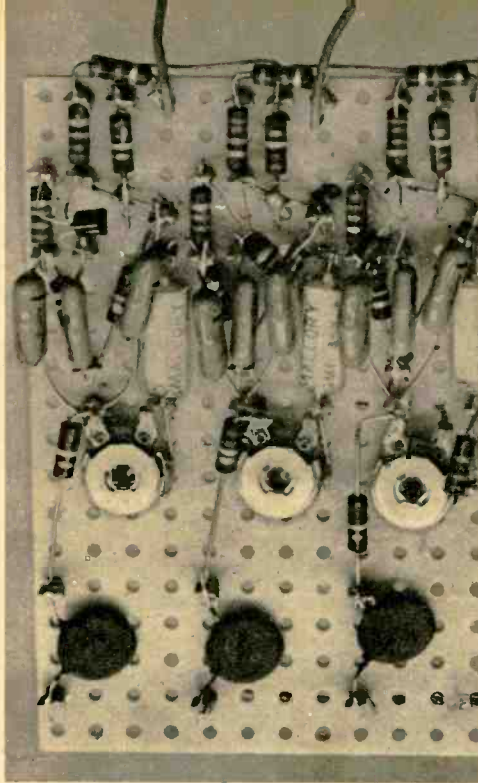


Fig. 2—Tone oscillators for C, C# and D notes. Wires going out of photo at top go to play bars. Run three bus wires (in Fig. 1) on back of board.

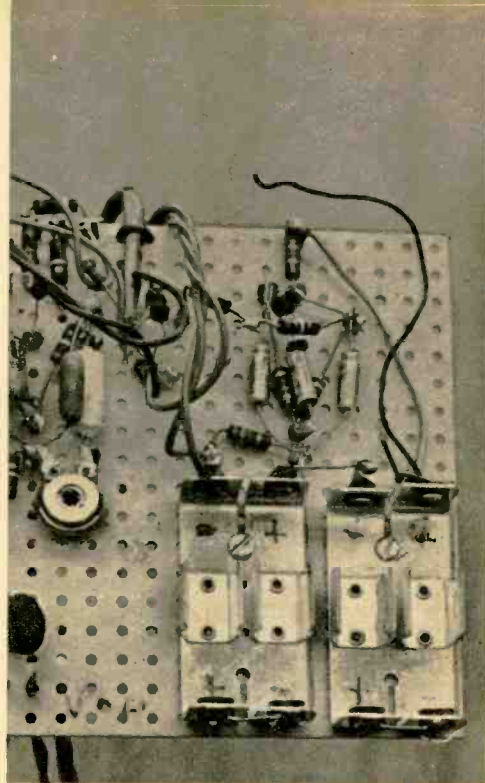


Fig. 3—At right side of board are tremolo parts and battery holders. Floating wire from right battery holder supplies voltage to the two mallets.

has a range of one octave. It is 19 in. wide and without the stand is $2\frac{3}{8}$ in. thick; it weighs about 4 lbs. Make it into a four-octave instrument, reduce the width of the play bars and you could have a marimba about 4 ft. long weighing about 15 lbs.

Our marimba is a simple, reasonably low cost and really interesting electronic musical instrument. You can build it with simulated play bars just like a real marimba and it can include as many notes as you want. You can, for example, build only a few notes, such as an eight-note white-key scale. Later, without changing a thing, you can add the five sharps and flats and even expand it to a three or four-octave range.

Each note will cost \$3.00. This figure is based on distributor prices for the parts for one oscillator. If you buy parts for several notes you can often get a price break.

How it Works

Each note is generated by the tone oscillator (Q1) shown in Fig. 4; this is a very stable twin-tee oscillator. The circuit configuration of all the oscillators is the same; however, some part values are different. The parts whose values change and whose values

are the same are listed separately in the Parts List.

The tuning of each oscillator is accomplished with potentiometer R7. Note also, that the table in the Parts List gives the approximate resistance setting of R7 to tune each oscillator. These values will hold to within about ± 10 per cent if the capacitor values specified are used. The potentiometers specified for R7 are low-cost Mallory MTC trimmer controls; however, ordinary pots can be used.

The frequencies for which the oscillator part values apply are for the octave which begins at middle C and goes to C an octave above. If you would like to go another octave higher or lower, it is easy to do so. Simply double the values of the capacitors C1, C2 and C3 to go one octave lower. Use capacitors of half the value to go up an octave. It is not necessary to exactly double or halve a capacitor value—come as close as you can. Any differences can be compensated for with R7.

Notice in the schematic in Fig. 4 that collector voltage is not normally applied to the oscillators. Each transistor's collector is connected via resistor R2 to a play bar; the col-

lector voltage is applied to the playing mallet. Both mallets have metallic heads so that when they are touched to the bars they apply voltage to start the oscillator. Because a charge is stored in C5, the oscillator keeps going with a decaying intensity after the mallet is removed from the bar. This effect, called sustain, is common to a marimba and many other instruments.

Using a 10- μ f capacitor for C5, this sustain is fairly short. It can be made longer by using a 15- or 20- μ f capacitor. You can try different values to establish the sustain time you like best, since this is a matter of personal preference.

The collectors of all the oscillators are coupled to a deep-tone output bus through 220,000-ohm resistors (R8). A bright-tone output is fed to a bus through C4 and R6. These outputs go to S1 where either may be switched to the output circuit. The deep-tone voice through R8 is nearly pure sine wave. The bright-tone voice is richer in harmonics

and has a sound much like string instruments.

The circuit consisting of Q14 and Q15 is the tremolo oscillator and control gate. Transistor Q15 is a twin-tee oscillator similar to the tone oscillators, but it operates at a lower frequency—around 6 cps. The signal on Q15's collector modulates Q14's gate. Signals from the tone oscillators, at R10's wiper and Q14's collector (and then at the output) are periodically attenuated by being shunted to ground as the conductivity of Q14 changes. The value of R11 should be adjusted until the depth of the tremolo sounds pleasant and smooth. A value of 470,000 ohms should be about right. If you wish to have an adjustable tremolo depth, substitute a 1-megohm pot for R11. Resistor R15 controls the tremolo speed. If desired you can substitute 2,500-ohm linear-taper pot here to provide an adjustable speed.

Because this is amplitude modulation, it is called tremolo, as contrasted with vibrato, which is frequency modulation. Both are used in electronic musical instruments.

Three switches are included in our model: switch S2 is the power switch and S3 is tremolo on-off. Switch S1 is SPDT, and switches either to deep tone (collector output) or bright tone. With separate SPST

Solid-State Marimba

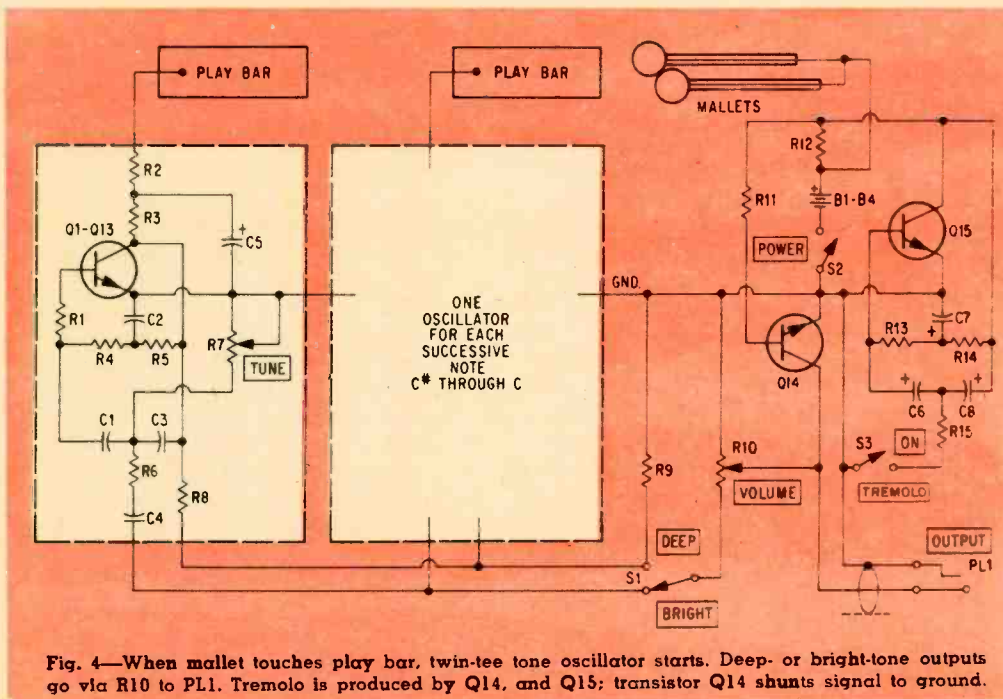


Fig. 4—When mallet touches play bar, twin-tee tone oscillator starts. Deep- or bright-tone outputs go via R10 to PL1. Tremolo is produced by Q14, and Q15; transistor Q14 shunts signal to ground.

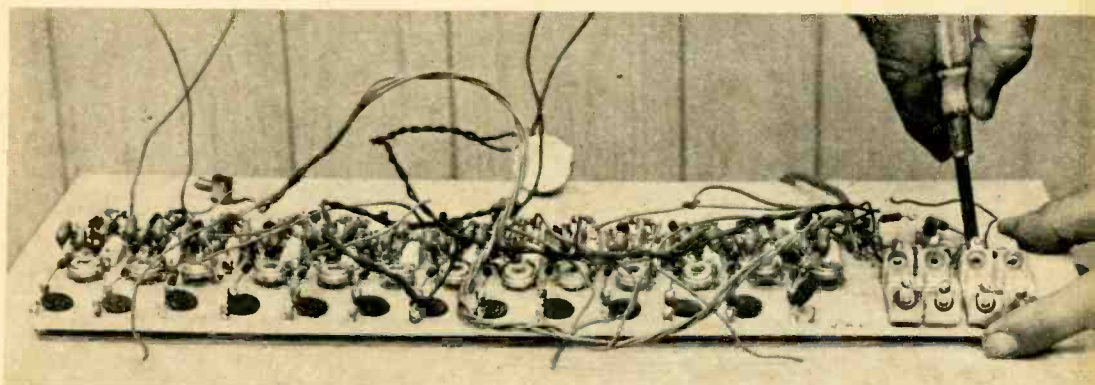


Fig. 5—Completely wired circuit board being installed on base shown in Fig. 6. Wires going out of photo go to volume control and three switches.

PARTS LIST

All oscillators:

- C2—.022 μ f, 100 V mylar capacitor
 C4—.005 μ f, 500 V ceramic disc capacitor
 C5—10 μ f, 15 V electrolytic capacitor
 Q1 through Q13—MPS6521 transistor
 (Motorola, Allied 49 F 26 MPS6521-MOT.
 90¢ plus postage. Not listed in catalog)
 R1—68,000 ohm, 1/2 watt, 10% resistor
 R2—100 ohm, 1/2 watt, 10% resistor
 R3—15,000 ohm, 1/2 watt, 10% resistor
 R6—100,000 ohm, 1/2 watt, 10% resistor
 R8—220,000 ohm, 1/2 watt, 10% resistor
C, C#, D, D#, E, F oscillators:
 C1,C3—.0068 μ f, 100 V mylar capacitor
 R4,R5—120,000 ohm, 1/2 watt, 10% resistor
F#, G, G#, A, A#, B, C oscillators:
 C1,C3—.0047 μ f, 100 V mylar capacitor
 R4,R5—100,000 ohm, 1/2 watt, 10% resistor

Potentiometer R7

Note	Resistance (ohms)	Approx. Setting (ohms)	Mallory (MTC-)	Lafayette (33 T-)
C	20,000	15,000	24L4	1680
C#	20,000	12,500	24L4	1680
D	15,000	10,500	153L4	1679
D#	15,000	9,000	153L4	1679
E	10,000	7,500	14L4	1678
F	10,000	6,000	14L4	1678
F#	20,000	15,000	24L4	1680
G	20,000	13,000	24L4	1680
G#	15,000	11,000	153L4	1679
A	15,000	9,000	153L4	1679
A#	10,000	7,500	14L4	1678
B	10,000	6,500	14L4	1678
C	10,000	5,500	14L4	1678

Tremolo and other parts:

- B1-B4—1.5 V penlite cell
 C6,C8—1 μ f, 12 V electrolytic capacitor
 C7—2 μ f, 12 V electrolytic capacitor
 PL1—Phone plug
 Q14,Q15—MPS6521 transistor (see Q1-Q13)
 R9—4,700 ohm, 1/2 watt, 10% resistor
 R10—20,000 ohm linear-taper potentiometer
 R11—470,000 ohm, 1/2 watt, 10% resistor
 R12—6,800 ohm, 1/2 watt, 10% resistor
 R13,R14—47,000 ohm, 1/2 watt, 10% resistor
 R15—1,800 ohm, 1/2 watt, 10% resistor
 S1—SPDT switch
 S2,S3—SPST switch
 Misc.—Perforated board, flea clips, battery holders, shielded wire

switches. the deep and bright can be switched to the output either separately or together to provide three distinctly different voices. Potentiometer R10 is a volume control. The marimba may be patched into any amplifier with a medium- to high-gain input.

Construction

Any kind of construction can be used for the oscillator circuits. We used the usual perforated board and push-in terminals but point-to-point wiring is just as good. The circuits can also be built on eight-lug terminal strips. The layout of each oscillator is essentially the same as the schematic.

Once the oscillators are built and tested, the balance of the construction lies in the hardware to make the instrument playable. Here, you use your ingenuity. If you would like to duplicate the model shown on the first page of this article, use the dimensions and construction details shown in Fig. 6.

A standard marimba uses an arrangement of resonant wood bars mounted on two levels. The bottom bars are for the diatonic scale (white keys) the upper bars are sharps and flats.

There are several ways play bars and mallets can be made. In one of our models, the bars were made of 1 x 5-in.-pieces of 1/4-in. plywood covered with aluminum foil cemented on with rubber cement. Each play bar is connected to the 100-ohm resistor (R2) of its corresponding oscillator. You cannot solder to aluminum, so attach the wires with carpet tacks driven through the aluminum-covered bars and into the base-board.

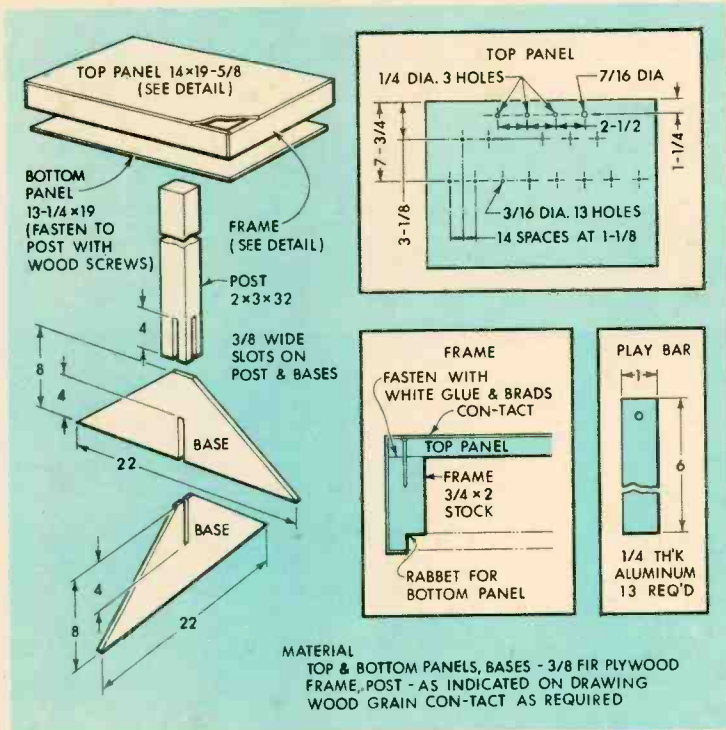


Fig. 6—Details of stand shown in photo on first page of article. Style and dimensions are flexible. You can house marimba in any type and size cabinet you want to make. All dimensions are in inches.

Solid-State Marimba

The mallets are made with 1/4-in.-dia. dowels and 1-in.-dia. rubber balls. Drill a 3/16-in.-dia. hole in the ball and cement the ball to the dowel with rubber cement. Cover the ball with aluminum foil.

The bars are assembled on a base or frame and spaced as suggested in Fig. 6. The eight bars in the bottom row are wired to the diatonic-scale oscillators (C,D,E,F,etc.) and the five upper ones are wired to the C#, D#, F#, G# and A# oscillators.

Tuning and Playing the Marimba

Almost any musical instrument can be used for tuning; for example, a piano, accordion, organ or any of the wind instruments. Chromatic pitch pipes are also available at musical stores for about \$2.00. An oscillator will sound continuously when the B+ is applied to its play bar.

First tune the oscillator approximately to the same pitch as that of the corresponding

note on the instrument you're using for tuning. Then sounding both notes together at approximately the same loudness, tune the oscillator for a zero-beat. If you do not know what zero beat is, here is an explanation: When two tones are *close* to the same pitch, you'll hear beat sounds which sound like a rolling effect in the tone. It is actually a change in the sound produced when the frequencies are first in phase then out of phase. Also, it is the difference frequency between the two tones. As the oscillator frequency is brought closer to the instrument's frequency the beats slow down and finally you will reach a point where there is no beat sound. This is the point you want. To confirm it, continue tuning in the same direction and you will hear the beats again.

It is easy to play the marimba. You can play with one, two, three or four mallets, as some of the real pros do. For the best marimba effect just tap the mallets to the play bars quickly. There is another way of playing our marimba that you cannot duplicate on a real marimba. If the mallet is held to a play bar, the tone sounds continuously. This makes it possible to combine steady tones with a rapid ring sound to produce an interesting musical effect.



By TOM KNEITEL, K2AES

OUR RADIO PIRATE, 1933 VINTAGE

WE Americans like to be the first at everything—and in many instances we have good reason to claim honors. But for a number of years now we have been sitting back and letting Denmark, Holland and England hassle over which first had pirate shipboard broadcasters off their respective coastlines.

Well, once again, it turns out that we can claim a first. Way back in 1933 Uncle Sam had a big, brassy buccaneer right off the California coast. Before that pirate walked the plank he managed to sink two licensed broadcasters and had created an international furor.

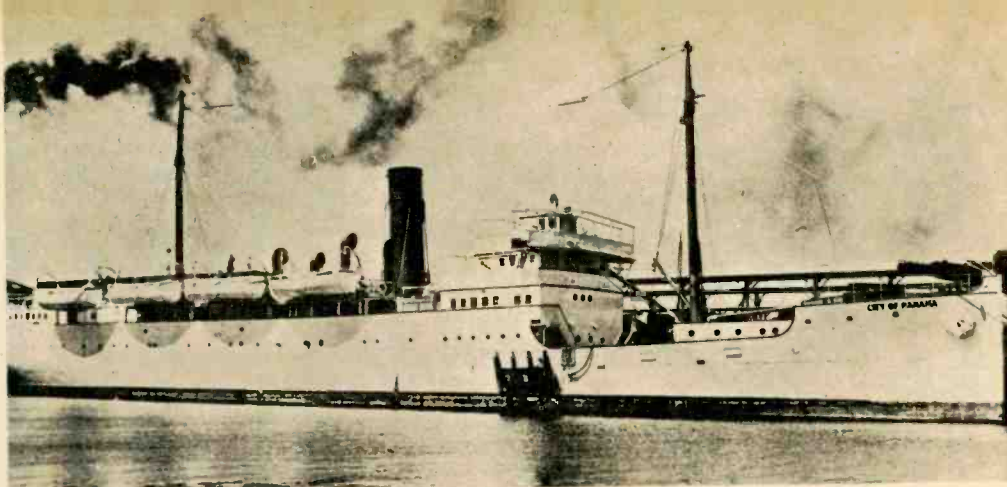
The romantic story took place aboard a convoy sloop (or Q-Boat), the *HMS Mistletoe*. Built by the British Royal Navy to participate in World War I, she was completed in only five months, just in time to be too

late—a piece of government surplus junk the minute she was launched.

After the war the *Mistletoe* was sold to Mexican interests which renamed her *Chiapas* and engaged her in trade sailing from Mazatlan. Later, new owners took over and changed her name first to *Playa Ensenada* and then to *La Playa*.

In 1933 the 15-year-old *La Playa* had been established for some months as a floating saloon (the polite word then was excursion ship) that took passengers from San Pedro, Calif. into international waters for a few hours of immunity from gambling and Prohibition laws. At that time George A. McLoney owned the vessel under a mortgage from one J. Dale Gentry.

McLoney had promised Gentry in December, 1932 that he would sell the ship to new



A pirate ship without a Jolly Roger, the *City of Panama* was speakeasy and casino as well as broadcaster.

OUR RADIO PIRATE, 1933 VINTAGE

owners who would turn her into a floating public-relations showboat plying Pacific coastal waters of the U.S. on behalf of Panamanian export products. The new owners would install a restaurant, bar and dance hall and would establish a radio station to be known as *The Voice of Panama*.

The new manager of the ship, Cecil M. Newcorn, promptly received a temporary ship's registration from Panamanian officials. Then they excitedly granted the ship (now called the *City of Panama* in honor of her new role) a license to conduct experimental non-commercial broadcasts from international waters on 815 kc, using a power of 500 to 1000 watts. The call-sign was to be RXXR.

All of this sounded, on the surface, like a bed of petunias. But it seems that Mr. Newcorn was well known to many Panamanian businessmen. In 1931 he had promoted an outfit proposing to use a new palm nut cracking machine for the commercial production of palm oil. The idea was a flop and those who invested in the scheme, according to the U.S. State Department, were said "to remember Mr. Newcorn with anything but pleasure."

In April, 1933, about three weeks before the station's scheduled opening, a formal protest was made to the Secretary of State by a Washington law firm suggesting that RXXR might be expected to "interfere with and ruin the transmission" of American broadcasting stations. The State Department promptly requested Panama to cancel the registration of

the *City of Panama*.

The Panamanian Consul in Los Angeles just as promptly told us to mind our own business. The vessel, he said, was fully within its legal rights and had promised to operate as a "high class station" that would abide by the standards established by the Federal Radio Commission (forerunner of the FCC).

Amidst all the ruckus the Panama Broadcasting Co. was formed, Cecil M. Newcorn at the helm, with offices at 1646 W. Adams Blvd., Los Angeles. By the end of May, RXXR had commenced broadcasting on 815 kc (or 815.067 kc as measured by FRC monitors).

The *City of Panama* was the same old floating speakeasy she had always been. And far from living up to its announced intentions, RXXR was running an estimated 5,000 watts and accepting advertising from companies in Los Angeles. It was reported that advertisers had contracted for as much as \$1,500 per month. And the FRC was claiming that some of the broadcasts were made while the vessel was "anchored in Santa Monica harbor."

The State Department was looking grim, American broadcasters were in shock, and the listening public was both confused and angry. Since broadcast receivers in those days exhibited poor sensitivity (tuning in about 40 kc at a clip) listeners were in the habit of seeking out a clear-channel, high-power broadcaster, even on the other side of the country.

When RXXR hit the air on 815 kc their signal was nothing less than fantastic. So was the interference they caused. Clear-channel WCCO in Minneapolis (810 kc) was wiped

out in the West. So was WHAS (820 kc) in Louisville, Ky. Listeners from as far away as Hawaii, New York, and even Nova Scotia reported excellent signals from RXKR. As a matter of fact, CNRH (815 kc) in Nova Scotia called it quits and never returned to the air.

In Mexico, station XFI was running 1,000 watts on 818 kc from Mexico City when RXKR arrived. Shortly thereafter XFI, too, went off the air for good. Another station in Mexico City, XETW, had been running 500 watts on 830 kc where interference from American clear-channel powerhouse KOA in Denver had long annoyed them. When XFI quit XETW moved down to 815 kc, bucked RXKR for a few weeks and then ran back to 830 kc in disgust.

Most listeners in the Los Angeles area simply gave up trying to hear any stations operating between 790 and 840 kc while RXKR was transmitting. Complaints poured into the FRC.

The *City of Panama* people were reported "willing to accept \$5,000 or \$10,000 as compensation for their troubles if they are requested to operate on other frequencies." In addition, the RXKR crew were so pleased with its results that they were planning a voyage along the entire Pacific and Atlantic coasts.

The State Department, with a hint of panic, told Panama they feared the development of a gigantic racket with pirate broadcasters "moving from place to place and demanding tribute from broadcast stations under penalty of disrupting their service." Besides, the Mexican government had been considering removing from the air stations that (like Dr. Brinkley's) peddled quackery to U.S. audiences. Now at least one of these broadcasters was threatening to take to the high seas.

Letters were flying thick and fast. On June 7 a cablegram from Washington decried the "serious interference" problem and requested that RXKR's broadcast license be cancelled. On June 16 Panamanian President Arias requested his Secretary of The Treasury to cancel the *City of Panama's* registration. The cancellation was announced in the Panama newspapers on June 28.

But three weeks later the station was still on the air. The Panamanian Consul in Los Angeles claimed that he had received no cancellation of the ship's registration. Through it all the management at RXKR played in-

nocent and even offered to give up their Panamanian registry if they could obtain U.S. registration. This way, they claimed, they might be able to obtain an FRC broadcast license.

Fuming with anger, the State Department suggested that the Los Angeles port authorities "see that the Panamanian flag is removed from the vessel." On August 2, with RXKR still filling the air with music, Washington again telegraphed Panama requesting that they twist the arm of their Los Angeles Consul.

Now there appeared a new complication. There arrived on the desk of Secretary of State Cordell Hull a letter from Sen. Hamilton F. Kean of N.J. He asked for a report on "who is placing the complaint [about RXKR] and the reason and nature of the same" and went on to complain of the loss to the station's owners should they be shut down. Apparently the *City of Panama* folks had sold the senator a bill of goods without mentioning some of the problems involved, and the Senator, without bothering to check further, believed what he was told.

Kean's letter bounced around the State Department for a few weeks until Cordell Hull fired off a strong four pager in reply. Nothing more was heard from the good senator and within a few weeks the *City of Panama*, stripped of her registration and flag, was towed into Los Angeles harbor. In 1934, just after Prohibition was repealed, she was sold to new owners who renamed her the *Star of Hollywood*. In 1939 she was quietly dropped from documentation for reasons which were not disclosed.

➤ Because of the RXKR affair a special section was written into the 1938 Cairo Radio Regulations: "Mobile stations at sea are forbidden to make radiophonic broadcasts intended for direct reception by the general public." The law has been perpetuated and expanded in subsequent international radio conferences at Atlantic City in 1947 and Geneva in 1959. It worked well until 1958 when the Danish pirate Radio Mercur went on the air, bringing with it a whole pack of pirates of varying nationalities.

But it was good old Uncle Sammy who keel-hauled that first radio pirate, way back in 1933 thus giving the U.S. another "first," this time one that caused considerable embarrassment, and one that necessitated a lot of political maneuvering before it was finally dislodged. ♣

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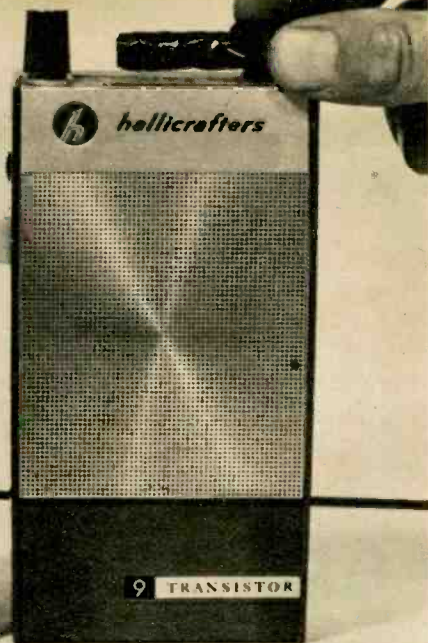
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Preamp for the Broadcast Band

By VICTOR KELL



IN one way the old timers had the right idea. They didn't waste time listening to high-power short-wave stations. When they clamped the cans on their head the other end of the headset cord went to a broadcast receiver. The night's time and effort went into hearing some local programs and color from dinky 100 watters clear across the country. Of course the old BC receiver was a monstrous affair in a large mahogany cabinet, equipped with a big speaker, enough tubes to stock a small store and a flight-control push-button panel with every possible control.

The old console radio has gone the way of the 5¢ beer. Even if you own only a pocket-size transistor radio, you can still enjoy the thrills of BC DXing. Fact is, you can get a mighty wide outlook on things when you hear the stuff rolling in across 1,000 miles in the wee hours of the morning.

Think your local station plays the top 40 records? Nonsense; Sandusky, Ohio probably has a different top 40. Like country music in Chicago, Dallas or L.A.? That's not country music; try digging the Bluegrass from Tennessee or Kentucky.

And all it takes for a new outlook on BC listening is any BC radio and our preamp—a preselector which gives a radio a 20 to 40db kick in the front-end. Connected to a radio which has antenna and ground terminals, such as a budget communications receiver, the preamp will pull in signals you

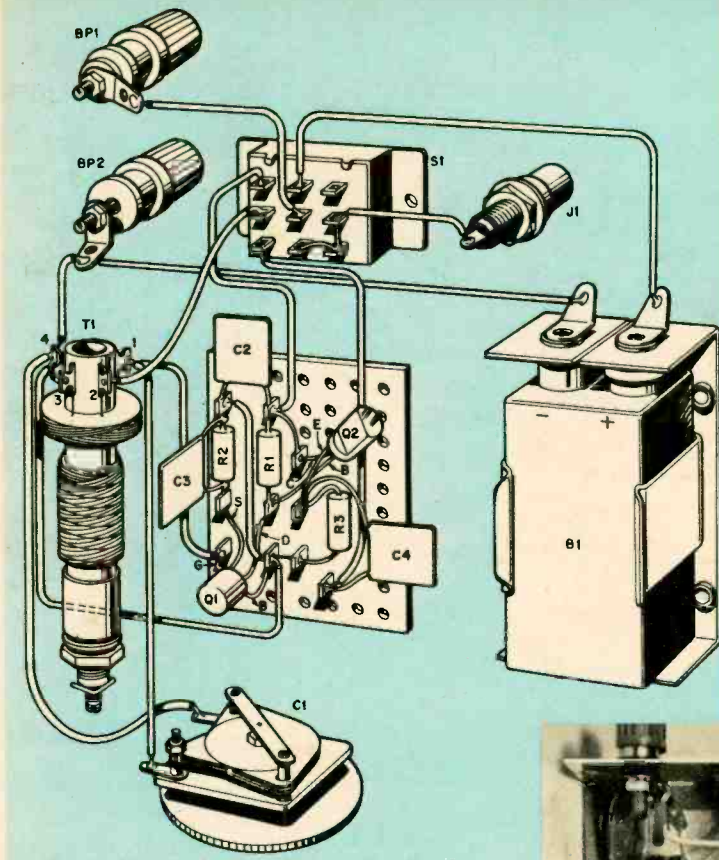
normally cannot find on the dial at all.

When used with such a receiver, the preamp's output at jack J1 should be connected to the receiver's antenna and ground terminals with low-capacitance coax such as RG174/U (or a cable with even lower capacitance). This provides between 20 and 40db gain, depending on the receiver's input circuit.

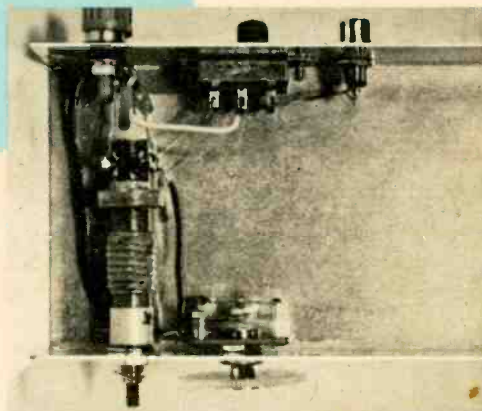
When used with a tube or transistor radio having a built-in loopstick antenna, the output at J1 should be connected to a loopstick antenna which you place near the antenna in the radio. The signal radiation from the preamp's loop to the radio provides 20 to 28db gain, depending on the radio.

Before starting construction it is vitally important to know how to handle a FET. An FET, while being installed, is easy prey to almost everything—unfortunately there is no second chance; goof and the FET is finished. As shown in the photographs of the FET, the transistor is supplied with all its leads tucked into a hollow metal rivet which shorts all the leads together. Until the FET is in the circuit the leads must be kept shorted because a high static voltage, caused by dropping the FET on a wool carpet, or the induced AC voltage at the tip of a soldering iron, is all it takes to blow the gate.

Obtain a length of fine wire by removing a single strand from a 6-in. piece of zip cord. Lightly wrap a few turns of the strand around the FET's leads between the rivet and



In pictorial at left, C1 and T1 are shown out of position so the connections to them can be seen. Their true positions are shown in the photo below, which was taken before the board was installed. In the pictorial, the three leads going to C4, R1 and Q1 (B) actually connect to the ends of the clips on the rear of the board. Wire going from left lead of C2 to Q1's lug marked B should be on back of board and centered between the lugs to which Q1's source and drain leads are connected. Mount board in U-section of Minibox (photo below) perpendicular to bottom with angle brackets and between front and back.



the case; then slide off the rivet and fan out the FET's leads. Leave the ends free so the strand can be unwrapped after the FET is soldered in the circuit.

When soldering, use a heat sink on each lead and solder quickly. If you suspect the FET is damaged, seat yourself firmly so you won't stumble, grasp the case of the FET firmly so it won't be dropped, and measure the resistance from the gate (G) to the drain (D) and source (S). Using either probe polarity, the resistance between the gate and drain or source should be almost infinite. If it is between 600 and 2,000 ohms, or equal to the drain-to-source resistance, the FET is defective. (You probably won't notice a change in the normal operating current if the FET is defective.)

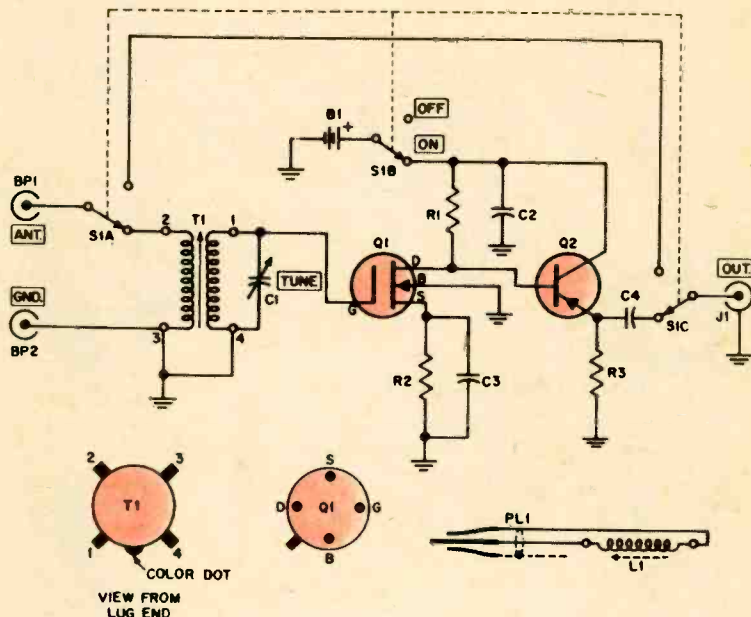
Construction. Our preamp is built in the U-section of a 5 1/4 x 3 x 2 1/8-in. Minibox. The parts layout is not critical as long as it approximates the pictorial. First step is to mount all the cabinet components except the battery holder. Transformer T1 mounts in a 1/4-in. dia. hole positioned 7/8 in. from the cabinet's left edge and 1 1/4 in. down from the top edge. Position tuning capacitor C1 1 1/8-

in. down from the top so it is centered on the front panel *after* the cover is installed. Keep C1 as close as possible to T1, making certain T1 does not interfere with C1's terminals.

Position antenna post BP1 and ground post BP2 5/8 in. from the right edge of the cabinet. Locate output jack J1 3 in. from the right edge, and switch S1 between the binding posts and T1.

Complete the cabinet wiring and then set the cabinet aside. It may be difficult to solder to C1's terminals, so instead of frying the capacitor, use a very small drop of soldering paste, and make certain all the paste is wiped away after the connections are soldered. Make certain T1's color dot is properly oriented before soldering any leads to its

Incoming signal is tuned by T1's secondary and C1 and is fed to gate of FET Q1. Signal is direct coupled to Q2, an emitter follower. When S1 is set to the off position, signal from antenna goes directly to output jack J1. Schematic at lower right is of loopstick and connecting cable which must be used if preamp is to be operated with radio which doesn't have pair of antenna and ground terminals.



Preamp for the Broadcast Band

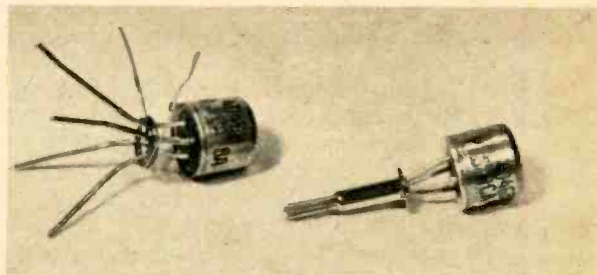
lugs. The dot should face the bottom of the cabinet. When wiring T1, do not use the terminal connections supplied with it. Instead, follow the wiring and terminal numbering shown in the pictorial.

The Perf-Board Assembly. Transistor Q1 and Q2's circuit is assembled on a 1½ x 2-in. piece of perforated board; push-in terminals are used for tie points. A single small L-bracket used as a mounting foot will secure the assembly to the cabinet. Make certain that when the board is mounted it does not extend above the top of the cabinet, or it will be impossible to get the cover on.

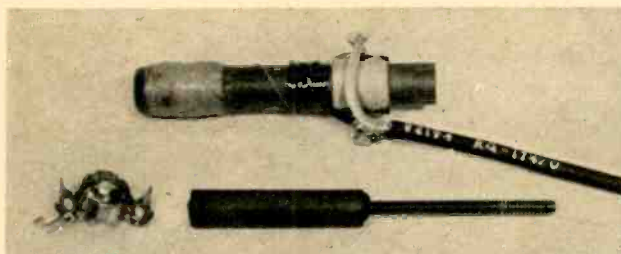
Transistors Q1 and Q2 should be the last components installed on the board; all other components and wiring should be completely soldered before Q1 and Q2, which should be tack soldered; do not wrap Q1 and Q2's leads around the terminals and apply a lot of heat and solder. To avoid soldering-heat damage to Q1, fan out the leads so they form a square, and install the push-in terminals in a matching-size square, with one board hole between the terminals. Attach the board's connecting leads to the push-in terminals on the back of the board; allow about 2 in. on the leads;

PARTS LIST

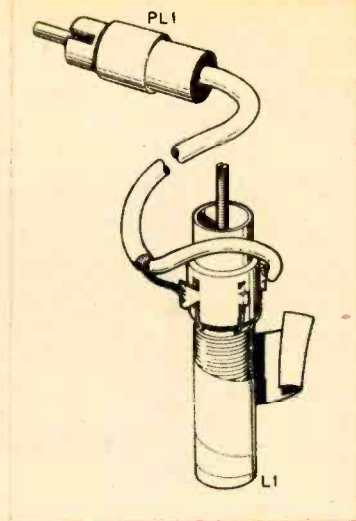
- B1—9 V battery (Burgess 2 U 6 or equiv.)
 - BP1, BP2—Five-way binding post
 - C1—10-365 μf miniature variable capacitor (Allied 43 B 7091 or equiv.)
 - C2, C3, C4—.05 μf , miniature ceramic capacitor (10 V or higher)
 - J1—Phono jack
 - L1—Loopstick antenna (see text)
 - PL1—Phono plug
 - Q1—40468 transistor (RCA)
 - Q2—2N3394 transistor (GE)
 - R1—2,200 ohm, ½ watt, 10% resistor
 - R2—470 ohm, ½ watt, 10% resistor
 - R3—4,700 ohm, ½ watt, 10% resistor
 - S1—3PDT slide switch (Lafayette 99 T 6166)
 - T1—Broadcast-band RF coil (J. W. Miller A-5495-A, Lafayette 34 T 8710 or equiv.)
 - Misc.—perforated board, flea clips, RG174/U coax, 5¼ x 3 x 2½-in. Minibox
- A complete kit of parts is available for \$11 postpaid from Custom Components, Box 352, Aldon Manor Br., Elmont, N.Y. 11003.



FET at right is supplied with leads shorted with rivet. Before installing, wrap fine wire around leads (left). Remove rivet, install, remove wire.



A loopstick antenna at the end of RG174/U coax couples the preamp's output to radios equipped with a built-in loop antenna. The cap, at left, can be discarded. The slug should only be used if it makes an improvement in performance, in which case cement it in the coil. You simply position the coil near the radio's loopstick antenna. Make sure when you connect the coax to the coil that you do not solder one of coax's leads to the tap lug.



they will be cut short during final assembly.

Position the board in the bottom of the cabinet so that one edge is approximately $\frac{1}{4}$ in. from T1's winding and the transistors are at least $\frac{3}{8}$ in. from C1. Mount the board in the cabinet vertically, using a starwasher between the mounting foot and the cabinet. Connect the board's leads to S1 and T1.

Checkout. Temporarily connect a 10-ma DC milliammeter between B1's positive terminal and S1; turn S1 *on*. The meter should indicate approximately 2 to 3 ma. If it indicates less than 2 ma or more than 5 ma, check for a wiring error. The indication will depend on Q1 and Q2. Transistor Q1 will normally draw about 1.7 ma, but it can go as high as 3 ma. Transistor Q2 will draw about 0.8 ma but it can go as high as 1.3.

Note that if Q1 has been damaged its current drain will be about normal, but the preamp won't work. If the indication is normal, remove the meter from the circuit.

Using the Preamp. If your radio has antenna and ground terminals connect the preamp to them using a 12 to 15-in. length of RG174/U coax. If your radio has a built-in AM loop, prepare a 12 to 15-in. length of coax and connect L1 to the free end. L1 can be a tunable loopstick antenna; remove L1's collar and slug.


If the preamp is connected to antenna terminals, set S1 to *off*, connect a long-wire antenna to BP1 and a ground to BP2. Tune in a weak station on the receiver at the top of the BC band and set C1 so its plates are opened fully. Then set S1 to *on* and adjust T1's slug for maximum received signal. Once T1 is aligned, signals are peaked by simply adjusting C1. The preamp won't work if the

signals are strong because the receiver's AVC action will compensate the receiver for the extra gain provided by the preamp.

If your radio has a built-in loop antenna, position L1 near the radio's loop and align T1 as previously described. After T1 is aligned, tune in a weak, high-end station on the loop-antenna radio, position L1 in a fixed position, slide L1's slug in and out. If moving the slug has no effect on the received signal, discard the slug. If it has an effect, position the slug for maximum received signal and cement it in position.

Feedback. Because of the preamp's high gain it is possible that radiation from L1 to the preamp's input might cause some instability, as evidenced by different stations being tuned in when C1 is adjusted for peak reception. If this occurs, try adjusting L1's slug. If this fails to cure the instability we suggest the external antenna be connected to the preamp with a few feet of coax. In most instances it will be possible to cure the instability by simply moving the preamp or L1 a few inches.

On some radios with antenna terminals and poor shielding, some instability might occur by radiation from the radio's antenna coil. This can be eliminated by slightly detuning the radio's antenna tuning control or by slightly detuning C1. Since the preamp has loads of gain, the slight loss caused by detuning will not be noticed.

The preamp is totally immune from overload and may be left in the circuit even when receiving strong stations. However, the receiver's AVC might be overloaded. This can be cured easily by slightly detuning the preamp with tuning capacitor C1. 



A Fine Finish for a Speaker Cabinet

By JOHN CAPOTOSTO WHILE the selection of speakers at most audio stores is quite large, the choice of cabinet finishes often is extremely limited. Oiled walnut is by far the most common. Occasionally you'll find mahogany and on special order you can get teak, rosewood, cherry or birch.

If none of these suits you, the solution is to get an unfinished cabinet and finish it yourself. Unfortunately, many people would settle for a finish they're not happy with rather than attempt to hand-finish a cabinet. They feel that without elaborate equipment, special materials, tools and the magic touch of an old-world cabinet maker they will botch the job. Nonsense! All that's needed for a professional job are a brush or two, sandpaper, steel wool, stain and some other finishing materials. The pros use sprayers, but only to do the job faster. With patience you can achieve the same results by hand.


Stains can be purchased in most wood finishes and if you are not satisfied with the selection you can make your own by adding oil colors and a little turpentine. Oil colors are sold at paint stores in a large variety.

First thing to do is remove those parts, such as grille cloth and hardware, that are not to be finished. If the grille cloth cannot be removed, cover it.

No matter how well the cabinet was sanded when it left the factory, you will have to sand it again. If the surface is fairly smooth, start off with 6/0 paper mounted on a padded block of wood. Sand until the wood feels like a piece of glass. Remove the dust, then lightly dampen a cloth with water and wet the surfaces to raise the grain. Allow the surfaces to dry, then sand again.

If the wood has an open grain such as has walnut, oak or mahogany, you will have to fill the pores with a paste wood filler of neutral tone, or one that matches the stain you use. Apply the filler with a brush then let it *set*. When it sets (starts to dull) wipe off the filler with burlap or excelsior, rubbing *across* the grain. For woods such as pine, maple or birch, eliminate the filler procedure.

Apply a prepared stain, or your own mix, to a scrap of the same wood you are to finish. If a scrap is not available, test the color on the bottom or rear of the cabinet where it won't be seen. When you get the proper shade, apply the stain to the wood with brush or cloth; let it penetrate, then wipe with a cloth.

Allow the stain to dry at least four hours then brush on a coat of sanding sealer, a clear material which dries quickly without streaks or brush marks. When dry, rub the surface with a worn-out piece of 6/0 paper. A white residue will appear on the work and paper. This is normal. After sanding, wipe the surface clean and then apply several coats of brushing lacquer. Allow each coat to dry before adding successive coats. After the last application of lacquer has dried, rub with fine steel wool. Dust, apply paste wax and buff gently. 

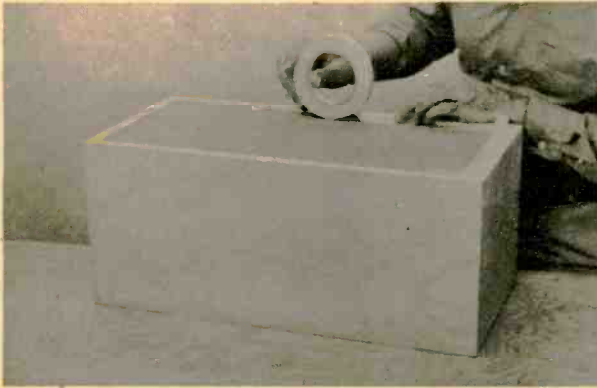


Fig. 1—Before sanding or applying stain, cover everything which is not to be finished. We protected edges of grille cloth with masking tape.



Fig. 2—It's easy to match colors when you use oils. All you have to do is dissolve the color in turpentine and then compare it with the sample.

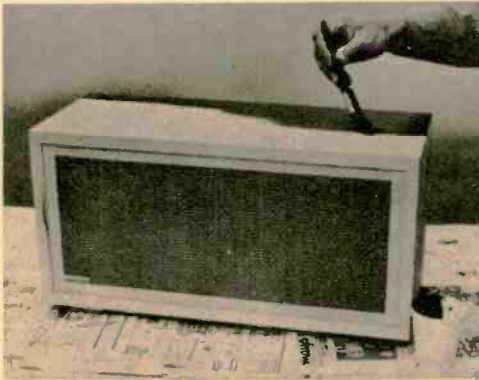


Fig. 3—After you have sanded the wood surfaces thoroughly with 6/0 sandpaper, apply a coat of stain as shown, then let the stain penetrate.



Fig. 4—Allow the stain applied in the previous step to penetrate thoroughly. After it has, wipe the surfaces of the cabinet with a soft cloth.



Fig. 5—After the cabinet has been stained and wiped with a soft cloth, apply a coat of clear sealer to the surfaces with a small paint brush.



Fig. 6—Finally, rub the sealed surfaces of the cabinet with fine sandpaper. Wipe away dust then coat the surfaces with clear brushing lacquer.

Good Reading

By Tim Cartwright

ABOUT YOUR HEARING. By G. A. Briggs. Herman Publishing Service, Boston, Mass. 132 pages. \$4.95

G. A. Briggs, formerly head of Wharfedale (loudspeakers) in England, has turned out more than a dozen books on music and sound reproduction. Now he has turned to aural matters. The result is no real treatise (in the vein, say, of Van Berjik's *Waves and the Ear*) but a quick survey of topics likely to interest the layman, with the emphasis on the nature of hearing losses and hearing aids. With a few exceptions, the relationships you might expect the author to draw between hearing and his hi-fi preoccupations really aren't covered. But there's a lot of interest, including chapters on the much-neglected subject of hearing tests, noise (with up-to-date coverage of the rock phenomenon) and hearing aids. Those familiar with Briggs'

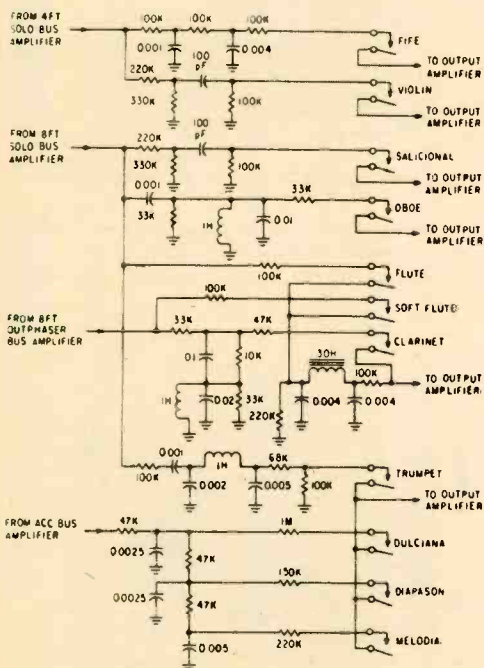


Fig. 7-6. Kinsman voicing circuits. Courtesy Kinsman.

Schematic from *Understanding Electronic Organs* is typical of illustrations throughout the book in the graphic clarity and detail of its presentation.

books will know the kind of humor to expect—and if it isn't exactly up to Bill Cosby's, at least the style is.

UNDERSTANDING ELECTRONIC ORGANS. By Thomas Jaski. Hayden Book Co. (Rider Series), New York. 207 pages. \$4.95

Although the author died a short time ago, his book seems to be a most comprehensive—and coherent—treatment of electronic organs. Beginning with an excellent short introduction on sound and music, it spends its first quarter or so on the best explanation I've seen of the *musical* aims of the electronic-organ builder. Unlike many books on the subject, this one isn't centered on one company's products and the author is free to talk about any interesting feature in any model. Well written and well illustrated, it's the one I'd recommend on the subject.

THE VHF AMATEUR. By Robert M. Brown, K2ZSQ/W9HBF. Editors & Engineers, New Augusta, Ind. 161 pages. \$4.50

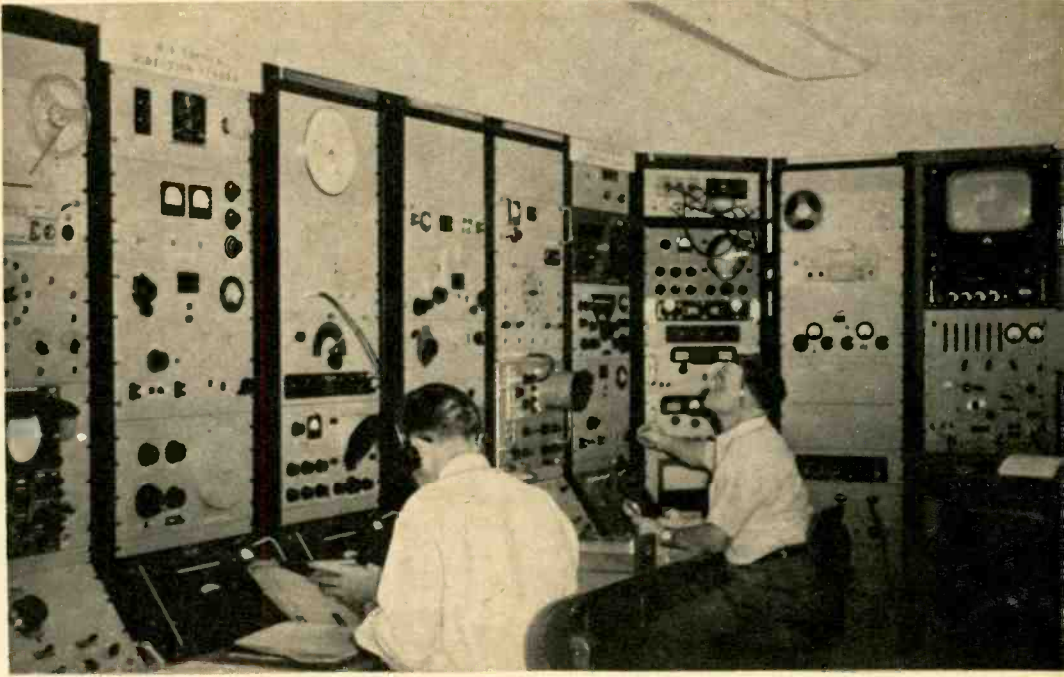
The VHF Amateur was a magazine published for the VHF addict. The book is a collection of materials, mainly construction projects, from the magazine's five years of publication and it provides much that you aren't likely to find elsewhere on the subject.

MANAGING TODAY'S RADIO STATION. By Jay Hoffer. Tab Books, Blue Ridge Summit, Pa. 288 pages. \$12.95

For some reason, Tab Books seems to make a specialty of books on local radio-station operation. Of the dozen or so that have come across my desk, this one is by far the most interesting. It offers a real wealth of information on management, programming and sales, and the sub-topics seem endless. You can find out how to hire and fire, how to play station politics, how to handle moonlighters, drinkers or just about anybody else. Coverage of programming and sales is pointed and practical as well as extensive.

RCA HOBBY CIRCUITS MANUAL. RCA, Harrison, N.J. 224 pages. \$1.75

If there really is an average reader of EI he should be on his way to the parts store for a copy of this manual. It's chock-a-block with detailed, accurate, easy-to-follow projects for hams, car nuts, photographers, restless homeowners and lovers of electronic games and novelties.



Typical FCC monitoring station is in Laurel, Md. Man on left is running frequency check on incoming signal. At top of panel over right man and at extreme left are tape recorders used to capture evidence of on-the-air misdeeds. Indicator for DF antenna is at upper left. Teletype (far right) links all stations.

Be A Paid Eavesdropper For The FCC

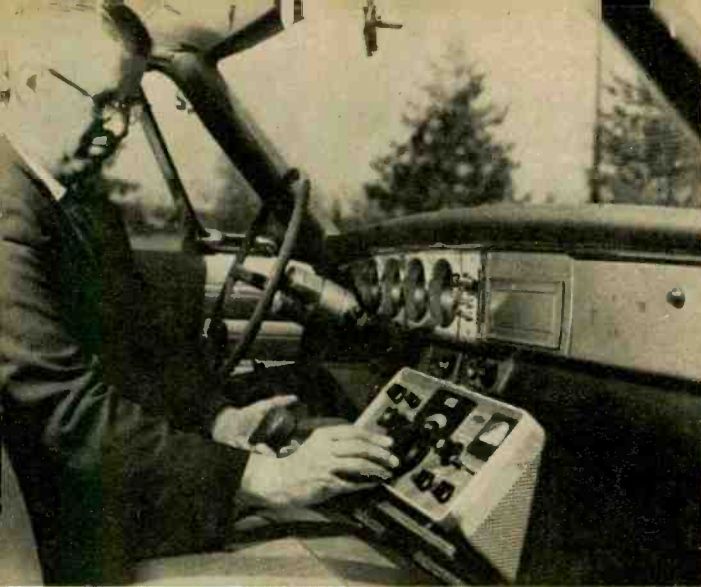
By DAVID WALKER FCC monitoring stations have plenty to do. In a year they'll eavesdrop on about 5,000 CBers, wince at what they hear and issue violation notices. They'll encounter about one illegal broadcast station *each week*. They'll root out and silence threats to public safety—in the Far West nearly 300 garage door openers were discovered to be crippling radio-navigation frequencies. They'll find sloppy electronic equipment—monitors in the Southeast found burglar alarms that interfered with aircraft up to 15 mi. away.

And they'll stumble on a few surprises—a deluge of TV interference complaints led West Coast monitors to, of all things, a slot-car racetrack. Then there's the problem of radio bugging. Complaints of hidden, miniature transmitters are expected to rise as people become increasingly aware of the electronic invasion of privacy.

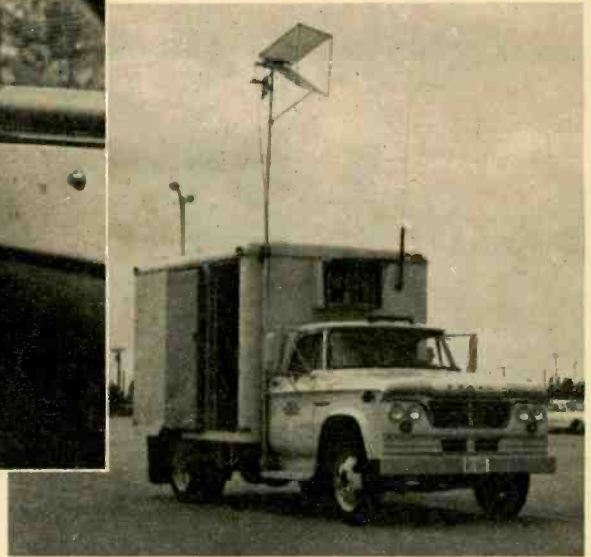
No wonder the Commission has hung out the Help Wanted sign. In one year monitors take about 900 emergency bearings on ships and planes in distress, identify a whopping 70,000 suspicious or questionable signals on the air, report on about 25,000 cases of interference or discover some 1,000 unlicensed radio operations. In addition, the FCC helps out other government activities (like tracking high-altitude balloons or finding lost weather buoys). Right now, the Commission needs about 20 men to keep its field engineering staff of about 400 up to full strength.

Like his counterpart in a police prowl car, an FCC monitor spends part of his time cruising. Only it's done on an array of receivers and measuring instruments at a fixed station. If something sounds amiss, he'll run a series of checks on the signal.

Let's say he's monitoring a regular AM radio station. He can measure the signal's



Mobile unit tracks down signals at short range. Mike (left hand) communicates with other units.



TV/FM enforcement uses three of these units which now can check stereo FM and color TV.

Be A Paid Eavesdropper For The FCC

frequency, modulation percentage, bandwidth and any spurious signals. Unless these factors stay within legal limits the monitor will issue a violation notice to the offender. The same applies to the myriad of other services licensed by the FCC—ham, CB, marine, taxi, police and others. Some violations are simply detected by ear—like obscenity uttered over the air (about 60 cases a year).

These signals must be within receiving range of the monitoring station. And many will be, since monitoring points are strewn across the country, including Hawaii, Alaska and Puerto Rico. When signals are capable of long-distance skip, monitoring is done at ranges up to some 10,000 mi. A Navy transmission in San Francisco, for example, was found to be interfering with air-ground communications in Hawaii. A defective transmitter in Bogota, Colombia, hampered U. S. communications on ham and public-service bands. In solving these cases, the monitor relies on his most useful tool: DF (radio-direction-finding). It's used in a variety of ways.

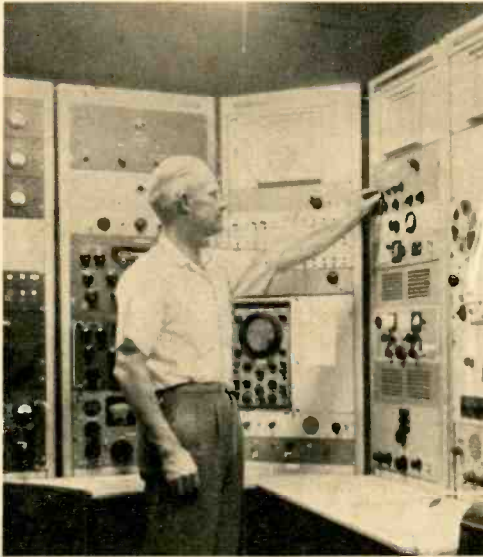
Each day, for instance, six monitoring stations swing their receiving antennas toward the Gulf of Mexico. Located at a central point in the Gulf is an atomic-powered buoy emitting weather data by radio. Big advantage of the buoy is that it needs virtually no refuelling for its power source. But the

atomic reactor could prove dangerous if the buoy broke its mooring. So FCC monitoring stations take a daily fix to check that all is well. If the buoy ever goes adrift it quickly will be pinpointed and recovered.

Often the monitor must take to a mobile unit—or even his legs—to carry him to his goal in locating a source of trouble.

Let's say that the Commission is receiving complaints that a new broadcast station is interfering with regular signals, has no call letters and uses language unsuitable for the airwaves. If the monitor can't hear the signal at the fixed station, he'll drive to the area where the complaints originate. There he tunes the signal on a mobile receiver and takes bearing on a rotating loop antenna. Probably he'll pin down the signal to a group of homes. At this point the loop no longer gives an accurate indication so he'll switch to a portable meter that indicates signal strength. Now it's a matter of tracing the signal door-to-door to check for highest readings. A knock on the suspicious door usually leads to the culprit.

It often turns out to be a precocious youth who began with innocent gadgets like a wireless mike or phono oscillator. But in trying to get too much of a good thing, young Marconi has added an amplifier and broadcasts a city-wide signal. It's such a popular pastime the Commission must snuff out each



Ivan Lorenz, an FCC engineer in California in early '50s, now is Chief of Monitoring Division.

station quickly or other kids in town will get the idea.

The FCC man usually treats these cases with a measure of sympathy. A few words (often to the parents) is enough to silence most budding broadcasters. The youth might be encouraged to direct his electronic enthusiasm toward ham radio.

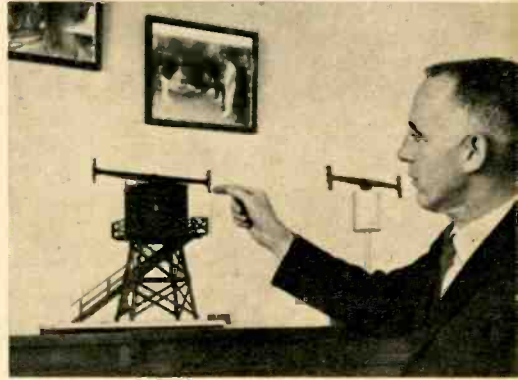
In tracking down more serious violations the investigator might need muscle to gain entry. Here he can be escorted by a U.S. marshal or turn the case over to a U.S. District Attorney. In instances where interference poses an immediate threat to life or property, the investigator can touch off a legal process to close down a complete factory. Most often it's a plant whose radio-frequency heating system is leaking interference. These stray signals can cause serious hazard to aircraft and other public-safety services.

What does it take to get a job policing the airwaves? A monitoring position is filled by what the FCC terms a *technician*. One important requirement: you must be able to copy at least 16 wpm in Morse code. If you don't know code it's still possible to get the job but you won't sit in a monitor's chair immediately. It's expected that you'll get up to 16 wpm by the end of your first year's employment.

If you're a ham, the code shouldn't prove a major stumbling block. But, surprisingly,



Curtis Plummer, Chief of Field Engineering Bureau, shows off model mobile unit from roaring '20s.



Plummer points to World War II Adcock DF station, modern remote-control version (center).

the ham license itself doesn't qualify you for the job—nor does any commercial FCC license. Other experience that's unacceptable includes repairing your own radio or TV at home or production-line work in the electronic field.

There is no written test to qualify you for the job. Your application will be judged on the basis of experience, education or a combination of both. Consider, for example, basic requirements for the lowest-level technician. In the parlance of Uncle Sam, it's grade GS-5. It calls for *general* experience of two years. The U.S. Civil Service, the agency that evaluates applications, defines general experience as "progressively responsible technical or craft experience in electronics, electricity, engineering or in a similar field. Such experience must have provided technical knowledge and background that can be applied in the development, testing and maintaining of electronic equipment and systems."

Then there's an additional requirement of one year of *specialized* experience. Here

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they look for signs that you've been progressing in your knowledge of electronic theory and practical use of equipment. You're expected to know how to read a schematic diagram and have some knowledge of formulas. If you've worked at bench repair and troubleshooting of radio and TV in a *commercial* shop, this can count as specialized experience.

Education can be substituted for experience requirements. A bachelor's degree in electrical or electronic engineering from an accredited college may take the place of all required GS-5 experience. So may 27 months at an accredited technical institute. If your educational background is incomplete it's possible to apply what you do have against a portion of the experience requirements.

If you qualify for the job at the lowest level, or GS-5, starting salary is \$5,331 (just over \$100 per week). But if your experience is significantly more, say five years, you might enter at grade GS-7 and begin at \$6,451. Salary increases occur both as a matter of time and grade. Within a particular grade there are regular increases at the end of each year for the first three years, then at 2-year and 3-year intervals until, after 10 years, you reach the highest salary in the grade (\$6,915 for GS-5).

Advancement from one grade to another usually adds to these increases. If the job is performed with reasonable competence you can expect to advance about one grade per year in the early years. Thus a GS-5 may progress in three years to GS-8 and earn over \$7,000. It's possible to earn over \$14,000 with no college degree. These salary

levels, incidentally, occasionally are re-scaled upward to account for inflation and cost-of-living. Back in July, 1966, all grades went up about \$200 annually on an overall average.

Fringe benefits while working for the Federal Government are elaborate. They are major enticements offered to technicians wooed by higher starting salaries in private industry. In addition to health and life-insurance plans, paid vacation runs from two to five weeks yearly, depending on service time. Retirement benefits, too, are liberal. For example, a man who's worked 30 years and earned an average of \$10,000 for five of them can expect a retirement income of more than \$5,000 per year at age 55.

If working for the FCC's monitoring division looks inviting, here's how to get the ball rolling. First thing you need is Form 57—Application for Federal Employment. It may be found at your local Post Office, or by writing United States Civil Service Commission, Washington, D. C. 20415. At the same time, write to the FCC and request information about career opportunities as a technician. The man to contact is Delbert H. Flint, Director of Personnel, Federal Communications Commission, Washington, D.C. 20554. He'll send you informative literature and further instructions. Once your application is approved by the Civil Service Commission, the FCC considers you *on the register* (eligible for employment).

Where you work will affect the conditions. At present, the FCC has little trouble staffing monitoring stations located in the South (Atlanta and Florida are currently the most popular points). Its Laurel, Md. station proves a little more difficult to man, possibly due to higher cost-of-living in the area. A job in Alaska wins additional pay because of an exceptional demand there for technicians. The Commission usually expects a technician to pay his own relocation expenses but they'll move your household gratis if your assignment is in California.

Once a technician is on the job he faces one more requirement. Anyone who occupies an FCC monitoring position is subject to security clearance. Reason is that monitors cruise the airwaves in search of more than just interfering or stray RF signals. They are called on to assist the FBI and other government agencies operating in strictly confidential areas. Like, would you believe a counterspy?

LOCATION OF FCC MONITORING STATIONS

Anchorage, Ak.	Allegan, Mich.
Douglas, Ariz.	Grand Island, Nebr.
Livermore, Calif.	Canandaigua, N.Y.
Santa Ana, Calif.	Chillicothe, Ohio
Fort Lauderdale, Fla.	Sabana Seca, P.R.
Powder Springs, Ga.	Ambrose, Tex.
Waipahu, Hi.	Kingsville, Tex.
Winter Harbor, Me.	Marietta, Wash.
Laurel, Md.	Spokane, Wash.

Freeze-Up Guard

By **VINCÉ DANIELS** IT'S a bitter cold day in the dead of winter. You and your family leave a warm house in the morning to visit relatives for the weekend. Upon returning Sunday afternoon you discover the place is freezing cold and the pipes have burst. The catastrophe is overwhelming. Not only do you have to spend the night and perhaps the next day at a motel, you are faced with an expensive and messy job of having the walls torn out to thaw pipes which will have to be replaced.

With our Freeze-Up Guard on duty such a tragedy can be averted. The Guard, a thermostatically-operated device, will give a visible indication to a neighbor when the temperature in your house drops below say, 50°. When this happens, your neighbor, whom you've asked to keep an eye on a lamp in one of your windows, will come over to check the house. If the heating system has failed, he will call the oil company to make repair before the temperature drops to freezing.

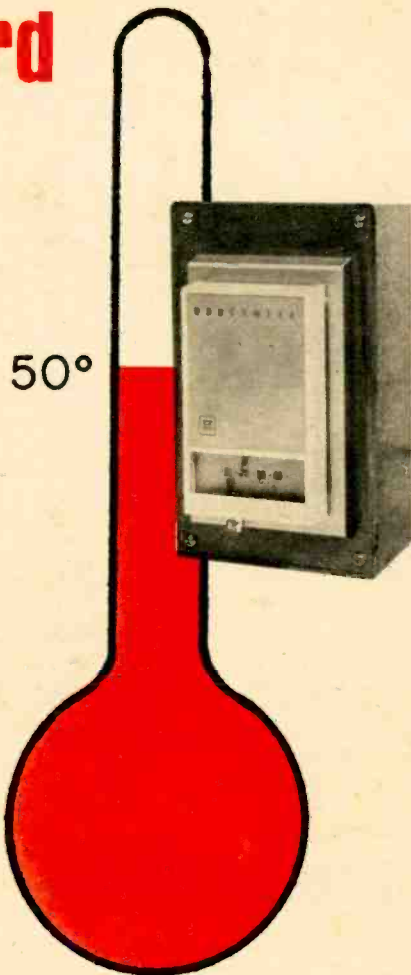
Our circuit has been designed so the window lamp normally stays on. Its going off could mean any one (or more) of three things: failure of the heating system, power failure or a burned out bulb in the lamp. The system, therefore, is fail-safe.

An alternative way to alert your neighbor is to use a wireless control system (Lafayette 99 T 9118). This system will enable the Guard to turn off a lamp in your neighbor's house, making it unnecessary for him to keep looking at your window.

Construction

You can build the Guard in a 6 $\frac{3}{8}$ x 3 3/16 x 1 $\frac{7}{8}$ -in. Bakelite utility case as we did, or in almost any box. First, temporarily mount the thermostat on the front panel. Note the location of the terminals on the back of the thermostat and punch a 1-in. dia. hole on the box's panel behind the terminals. Do not attach the thermostat to the panel at this time. The thermostat can be any low-cost type and can have either 117 VAC or *low-voltage contacts* because RY1's control current is very low.

Set the panel aside and mount SO1 and RY1 in the box. Relay RY1 is threaded for 8-32 screws so there's no need to remove



its cover. Drill a $\frac{3}{8}$ -in. hole for the line cord and connect all the wires except the two yellow leads which connect to the thermostat. Relay RY1's heavy blue lead is not used and can be cut short—tape the end to avoid a short.

When all other wiring is completed, fish the two yellow leads from RY1 through the hole in the panel and connect them to the thermostat's terminals. Mount the thermostat on the cover, making sure it's vertical, then mount the cover on the box.

Checkout

Plug a lamp in SO1 and plug PL1 into an AC outlet. Disregard whether the lamp lights or not at this time. Note the thermostat's room-temperature indication and adjust the temperature control lever so the minimum-temperature indicator is set to a *higher*

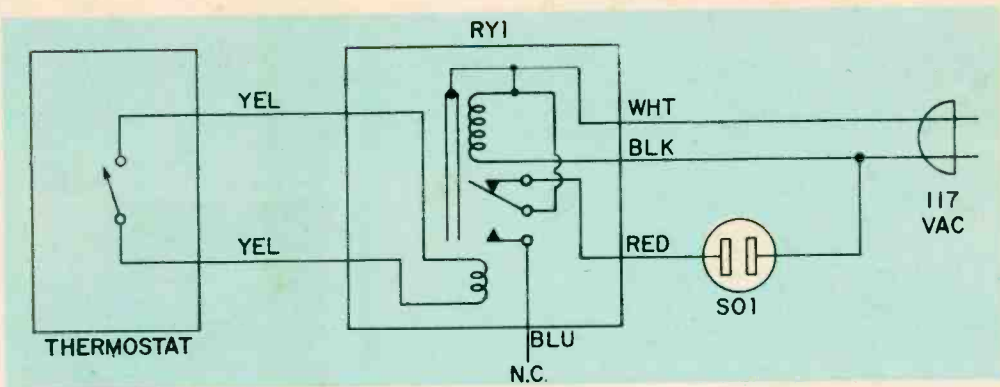
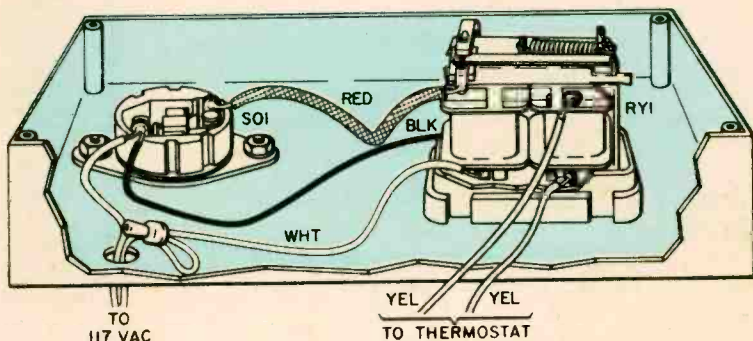


Fig. 1—Upper winding (primary of transformer) is energized by AC line voltage and induces voltage in lower winding (secondary). When thermostat closes, current increases in secondary. This opens contacts causing light to go off. Use blue lead instead of red and light will come on when the house temperature falls.



Freeze-Up Guard

temperature than that of the room; the light should go off. Next, move the lever so the indicator is below the room temperature; the light should come on. If the thermostat is equipped with an adjustable heat anticipator set it to the minimum value.

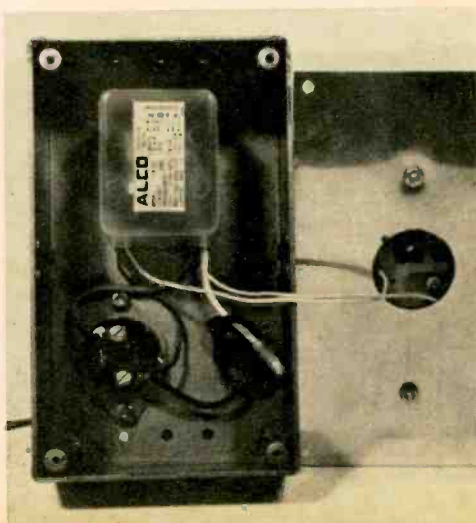
The thermostat must be mounted vertically; do not lay the Guard flat on a table. If you use the wireless remote control turn the transmitter *on*. Plug in the receiver in your neighbor's home; its pilot light should come on. Note that the wireless remote control system will work only if the transmitter and receiver are on the same side of the power-line distribution transformer.

Place a floor lamp in a window facing your neighbor and make certain the Guard is far from the lamp so the heat of the lamp doesn't affect the thermostat. Keep the Guard away from radiators and windows.

PARTS LIST

- RY1—SPDT isolation relay (Alco FR-102, Allied 41 C 4293)
- SO1—117 VAC socket
- Thermostat—Minneapolis Honeywell T822D10081 or equiv.
- Misc.—6 $\frac{3}{8}$ x 3 $\frac{3}{16}$ x 1 $\frac{1}{8}$ -in. Bakelite utility case (Lafayette 99 T 6272 or equiv.), wireless remote-control system (Lafayette 99 T 9118)

Fig. 2—Mount AC outlet and relay in Bakelite case; thermostat goes on the aluminum cover. Drill holes in case to dissipate relay's heat.





CB on a Motorbike

By **JOSEPH RITCHIE** THE domain of hellraisers on high-power motorcycles has undergone a change of characters and now we have more of a fun gang on lightweight motorbikes, which have soared in popularity. Reasons for this are that they cost a lot less than a motorcycle, they get excellent gas mileage and they're great fun to operate. Interestingly, many motorbikes are owned by CBers.

Now just because a CBER grinds the asphalt with two wheels instead of four, there's no reason he still can't enjoy the benefits of mobile CB operation. Using mini-size equipment, a 5-watt rig can be mounted on the smallest of motorbikes.

Safety First. It's difficult enough to keep a moving cycle under tight control. Making contacts while you are in motion is playing Russian roulette. And you won't be able to hear anything, anyway, with the engine roaring away and your ears buried well under your helmet—so don't try. When you want to go on the air, stop the cycle . . . or you may never get a second chance to try mobile-in-motion.

Smaller Than Small. An ideal transceiver for a motorbike is the Amphenol Model 750. Measuring just $4\frac{3}{4}$ x $5\frac{1}{2}$ x 2-in. it can be mounted on the handlebar without interfering with the clutch and brake cables. First step is to attach the gimbal bracket onto the handlebar with a hose clamp—the type that uses a screw thread to tighten the clamp (see Fig. 1). Even though the clamp is supplied with a thumb nut, use pliers for the final tightening as the clamp must withstand unusually high vibration.

Next, mount the transceiver in the bracket. To be sure it won't shake loose, install lockwashers between the bracket and the transceiver at each gimbal screw.

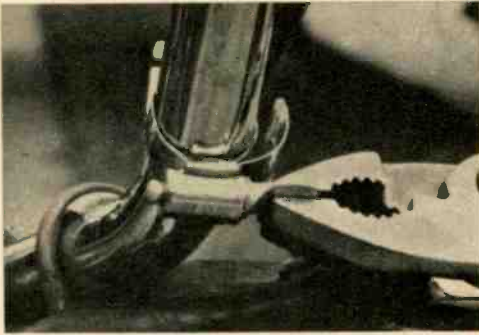


Fig. 1—Attach the transceiver's gimbal bracket to the handlebar with screw-lock hose clamps. Then use pliers to firmly tighten the thumbscrews.



Fig. 2—Install the transceiver in the gimbal using star washers between the bracket and transceiver to prevent mounting screws from loosening.

CB on a Motorbike

Taillight Antenna. A full-length (102 in.) whip is a poor choice for an antenna because there is absolutely no metal around it to act as a ground plane, and this will cause the SWR to go sky high. A better choice is a short whip-loaded antenna. While it is also designed to have a metal ground plane, it will provide an acceptable transmission-line match because it has an impedance-matching base-loading coil. We installed a Lafayette 42 T 0145 antenna because of its swivel base section and because it is easy to install.

Easiest place to mount the antenna is on the cycle's taillight bracket. Since there's a lot of vibration back there, make certain lockwashers are used under both the screw-heads and nuts. If the bracket isn't already drilled for an accessory, drill two $\frac{1}{4}$ -in. holes spaced at least 1 in. apart on top of the bracket. Then remove the antenna's wing nut section and install the swivel mount. Make certain the mounting screws are very tight and position the base-loading coil so it is vertical or tilting back very slightly. Install the whip section in the loading coil and attach a length of transmission line to the antenna.

Power is supplied by a Lafayette Dyna-Pack (99 T 3101)—a water-resistant case and a holder for 10 D cells (supplied). Do not operate the rig on motorbike power because of voltage and noise problems. Mount the pack as far as possible from the engine—a good spot is behind the seat next to the taillight bracket. Attach the pack to the bracket with plastic tape as shown in Fig. 4.

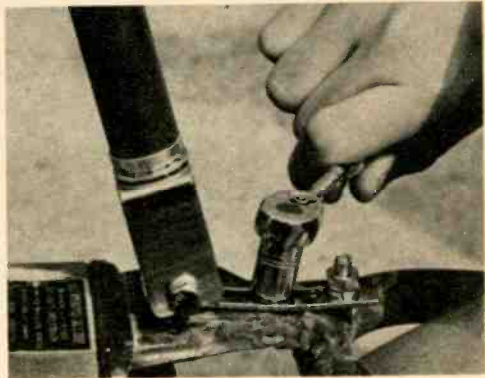


Fig. 3—Install swivel section of antenna on cycle's taillight bracket using two mounting screws and lockwashers. Whip is installed after swivel.

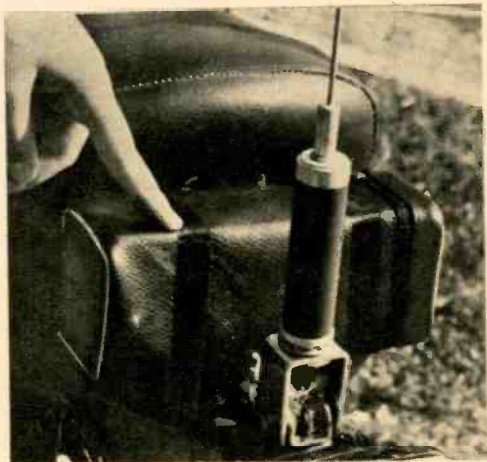


Fig. 4—Securely tape battery case to seat or taillight bracket. Load batteries in holder, close case and route power leads toward the seat.

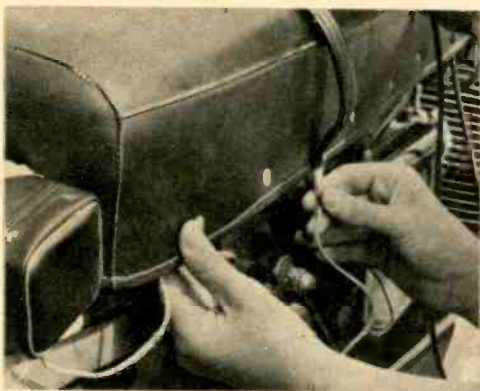


Fig. 5—Snake battery and antenna wires through cycle's wiring channel, which is under seat and gas tank. Tape the wires to brackets under seat.



Fig. 6—Bring wires through opening in center of fork, make loop and connect to transceiver. Put connectors on battery wires so rig can be removed.



Fig. 7—Transceiver isn't waterproof; therefore, keep it covered with a plastic bag when it is raining or if you park bike outdoors at night.

Battery life depends on how frequently the rig is used. Alkaline batteries will give three to four times more operating life than flashlight batteries. A better choice is rechargeable Nicad batteries. Do not charge Nicads off the bike's generator because the charging rate might be too great. Use a charger designed for Nicads; the battery holder easily slides out of the pack for indoor charging.

Final Wiring. Now comes the job of getting the wires from the antenna and power to the transceiver. Best way is to follow the cycle's own wiring. If you look under the seat you'll see the taillight wires running through clamps or brackets to a wiring channel under the gas tank. The wiring should exit at the fork, dead center so the wheel can be turned without pulling the wires. Run the battery and antenna wires alongside the taillight wires, securing them with tape or a twist of wire at every support bracket or clamp.

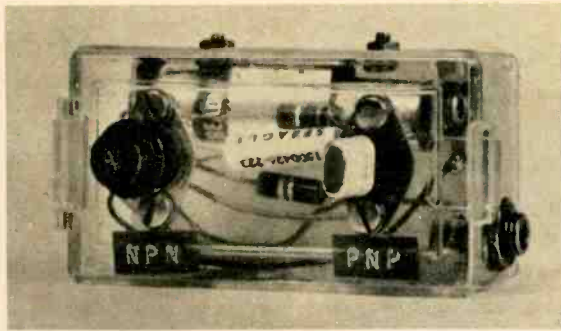
Leave a small loop in the coax where it exits from the fork and attach a PL-259 connector to mate with the transceiver's output connector. Similarly, leave a loop in the battery pack wires.

Checkout. Since the trunk-mounting antenna was designed to be used with a lot of metal under it, it can cause a relatively high SWR when mounted on the back of the motorbike. It is possible to improve the SWR by changing the depth of the whip in the base-loading coil. Connect an SWR meter in series with the transmission line and loosen the whip's retaining screw. Then very slowly change the depth of the whip in the coil until you get the lowest possible SWR. Even if the SWR is 3:1 it's still better than no CB at all.

Waterproofing. Neither the antenna nor the battery pack has to be waterproofed. The transceiver, however, though reasonably watertight on the front and sides has several holes on the back through which water can enter. Either seal the holes with silicon rubber adhesive or keep a plastic sandwich bag over the transceiver when not in use. You must disconnect the microphone. The mike, also the speaker, is a small speaker with a paper cone and is very easily damaged by moisture. Since the mike cable has a plug it is easy to remove.

Noise Suppression. Unlike automobiles, whose ignition system is noise suppressed, you might find your bike generates intolerable noise. Reason you pick it up is that your

[Continued on page 116]



\$1.59 Transistor Checker

QUICK way to test a transistor is to see whether it works in a circuit. And about the simplest circuit you can use is the one in our \$1.59 checker. Consisting of seven parts, it will tell you in seconds whether a PNP or an NPN transistor is good, bad or borderline.

Simply plug the transistor into the proper socket and listen for a tone from an earphone stolen from your transistor radio. A bad or weak transistor won't produce a sound. A so-so transistor will produce a low-frequency tone or chirp. A constant tone indicates a good transistor.

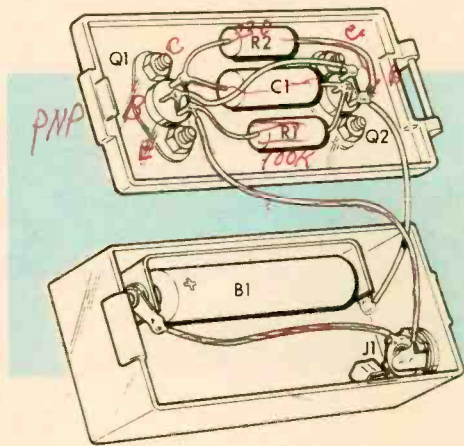
Build the checker in a small plastic box such as the type in which the General Cement Co.'s (G-C) hardware is packed (2½ x 1¼ x 1 in.). If you're checking a PNP transistor, make sure a good NPN transistor is in the other socket, and vice versa. You can use the checker to match a pair of transistors; each transistor should produce the same tone.

When selecting transistors for the checker, pick two with low leakage. The prices indicated in our Parts List are from Lafayette's 1969 catalog. If you have well-stocked junk box, you can bring the checker in for less.

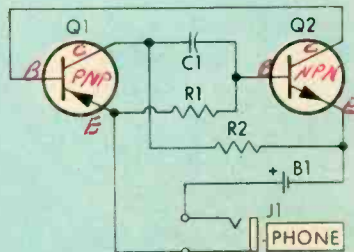
—Martin H. Patrick

PARTS LIST

- B1—1.5 V cell (size AAA, Eveready 912 or equiv.) 13¢
- C1—.02 µf, 100 V mylar capacitor 18¢
- J1—Miniature phone jack 18¢
- Q1—PNP transistor (Lafayette 19 T 1502 or equiv.) 25¢
- Q2—NPN transistor (Lafayette 19 T 2702 or equiv.) 25¢
- R1—100,000 ohm, ½ watt, 10% resistor 12¢
- R2—330 ohm, ½ watt, 10% resistor 12¢
- Misc.—Two transistor sockets (36¢) 8 ohm earphone.



Checker is built in 2½ x 1¼ x 1-in. plastic box. We used a holder, but you can solder wires to B1. Use care when drilling the holes for the sockets.



When you plug 8-ohm phone in J1, circuit is energized and oscillation starts. PNP transistor is at the left. The NPN transistor is at right.

Consumer Report

TAPE CASSETTES



By ROBERT ANGUS

IN THE past year, the inexpensive battery-operated cassette tape recorder has become so popular it has virtually replaced battery-operated open-reel recorders. At the same time, models integrated with compact hi-fi systems by Fisher, Scott, Lafayette, Harman-Kardon and others and cassette decks from quality tape-recorder manufacturers like Teac and Ampex have made the cassette respectable. With this sudden burst of popularity, EI decided to see just what kind of cassettes are on the market. How do they compare with conventional recording tapes? Can cheap cassettes really damage equipment? And are some brands better than others? What we found surprised us—and may help you both save money and get better performance from your cassette recorder.

If you've been shopping for blank cassettes, you know that they're available from most of the major suppliers of recording tape in lengths of 30, 60, 90 and 120 minutes. In addition to name brands like Ampex, 3M/Scotch, Audio, Soundcraft and BASF, there are no-name or house brands available at certain stores for much less than the standard brands. For example, you can pay \$2.59 for an Irish C-60 cassette, or \$1.09 for Radio Shack's Realistic brand. What's the difference?

In the trade, recording tape sold under a name other than the manufacturer's own and usually at a bargain price is called white-box tape. It may be anything from reject videotape to a cheap formulation on an inferior grade of acetate. The point is that the customer (and often the dealer from whom he buys it) doesn't know who made it or what its properties are. Nor can he be sure that the next time he buys the same white box the same tape will be inside.

In that sense, white-box cassettes don't exist. True, you can buy bargain tapes from Lafayette, Allied, Radio Shack, Olson—in fact any large store—and companies like Pickwick, Recoton and others who aren't ordinarily in the tape business have promotionally priced cassettes. But at present the number of companies capable of producing polyester-backed tape slit to the extra-narrow requirements of the cassette and packaging it inside a precision-molded plastic shell is relatively small. In fact, only three companies—Audio Magentics, Certron and Japan's TDK—dominate the private-label or white-box business in the United States. At the moment, none of the major cassette manufacturers except BASF produce an un-

branded product in addition to name brands (as many do with ordinary recording tape). The three independents all have their own tape-coating and slitting facilities and put a pretty uniform grade of tape in all their cassettes.

One thing we discovered during the relatively short period in which this article was prepared was that virtually all cassette manufacturers are making substantial changes and improvements in their product. Result: sharp differences between one shipment of cassettes and the next. For example, 3M changed its oxide formulation during our tests and several manufacturers stopped using screws to put their cassettes together, switching to the faster sonic welding process. So it's entirely possible that the cassette you buy three or four months from now may not be the same ones we discuss here.

The cassette was developed by Philips Electric in Holland and introduced into the U.S. in 1964. Theoretically, all cassettes and recorders must be manufactured under the Philips patents to specifications set by Philips. In practice,

Consumer Report: TAPE CASSETTES

although most of the major manufacturers do consider themselves bound by the Philips standards, some smaller companies do not.

The Tape

To find out how each tape sounds, we recorded standard test tones from a test record (CBS Laboratories STR-101) and music (Scheherezade, Capitol SP-8678) directly onto each cassette—first with an Aiwa TP 707, then with a Philips-made Ampex Micro-50 stereo deck and a component hi-fi system. 3M had told us that the tape used in its 270 series cassettes is essentially the same as its Dynarange 201 formulation. With that as a reference point, we checked six standard brands and three private-label types. We found that, between the two playback systems, there was very little difference in frequency response or music reproduction. There were some differences in tape hiss and tonal characteristics (some tapes sounded more shrill or more bassy than others).

Lowest in hiss were all Norelco (actually BASF tape) and Reeves Soundcraft Cassettes. Highest hiss came from C-60s labeled Aiwa and Pickwick (the latter actually manufactured by TDK) and by SMG C-90 and C-120 (actually made by Certron). Our SMG C-60, marketed by Sam Goody stores in New York and Philadelphia, actually exhibited very low hiss and proved, upon examination, to have been made by BASF. In the middle ground were, in increasing order of hiss, Scotch 271 and 272, Irish and Ampex C-60s, and Audio C-60.

Generally speaking, all cassettes tested and reproduced the 100-8,000 cps range, although the Certron C-90 and C-120 produced a somewhat thinner high end and generally more bassy sound than did the others. The BASF and Norelco C-120s, too, seemed to have subdued higher frequencies, though overall sound was quite acceptable. The Aiwa C-60 also lacked highs, though the bass and midrange seemed lifelike and satisfying. As for the other cassettes tested—Reeves, Audio, Ampex, Irish, Scotch, BASF and Norelco C-60 and C-90—while each has a characteristic sound, it is very difficult to rank one superior to another using the ear alone.

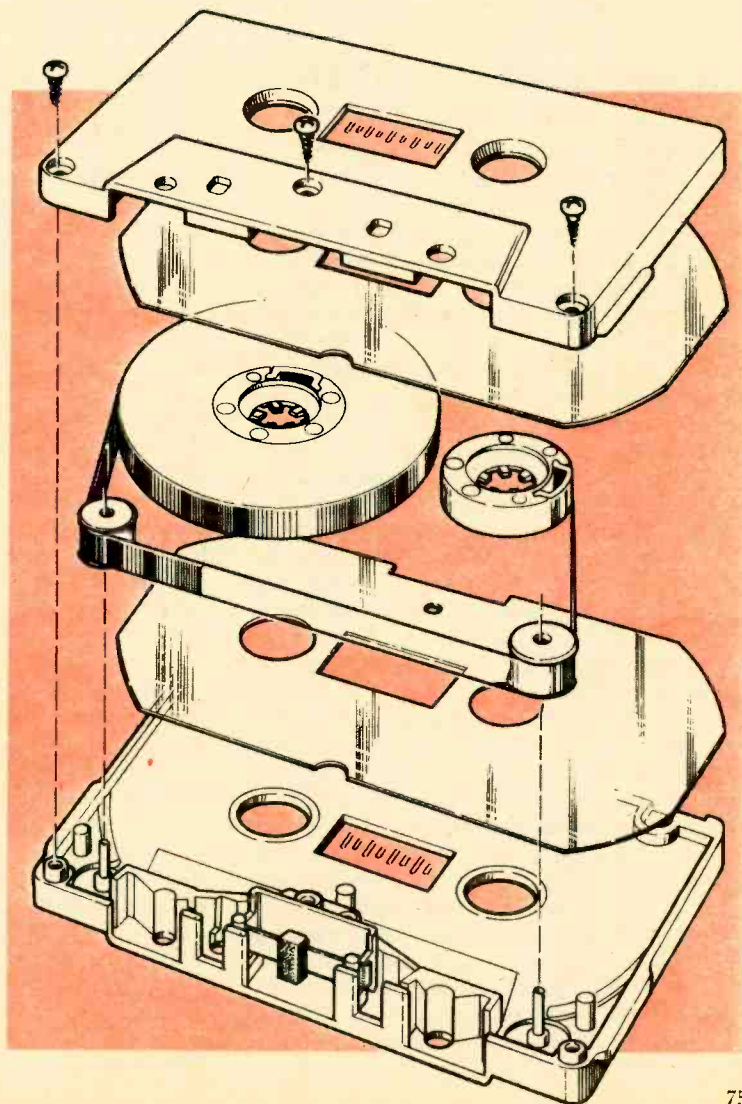
The smoother the tape, the less it's likely to wear your recorder heads, the less oxide shedding to gum up your machine and the less friction it's likely to generate (making for somewhat longer battery life and reducing one cause of flutter and wow). We checked this quality of tape in three ways: visual inspection of the tape itself, a sort of smear test to see just how much oxide comes loose and a measure of the tension required to pull the tape past the record heads. Visual inspection indicated that with four exceptions, all tapes had been polished to remove excess oxide. The SMG-Certrons had not and the Aiwa

and Norelco C-60s appeared semi-polished.

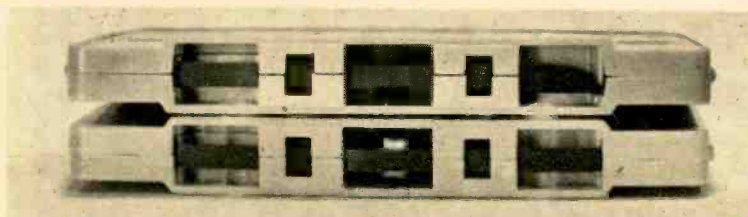
The next step was to attach a slip of tracing paper to the playback head and run the tape past to see how much oxide came off on the paper. Surprisingly, the two unpolished tapes (SMG C-90 and C-120) showed up among the best. In first place, with virtually no observable oxide shedding, was Reeves RC-90, closely followed by BASF C-60, Ampex 361, BASF C-120, SMG C-60 (the BASF tape) and the other SMG cassette. In the middle group, showing some trace of shedding were (in order) Scotch 273, BASF C-90, Norelco C-60, Audiopak C-60, Reeves RC-60, Norelco C-90 and C-120, and BASF C-120. Aiwa's C-60 brought up the bottom of the list, with definite oxide smears.

Tape tension involves several factors in addition to tape formulation—among them, construction of the cassette, precision moulding and the type of materials used. We found that tension varied from 1 to 2.6 oz., with a median of about 1.5 oz. Lowest were Norelco C-120 with 1 oz. and Audiopak with 1.2 oz. In the middle range were Pickwick, Reeves C-60, Scotch 271, Norelco C-60 and C-90, and BASF C-60. Slightly higher were SMG C-60, BASF C-120, Nivico and

Exploded view of cassette demonstrates its surprising complexity and suggests many variations possible within basic Philips specifications. This one is held together with screws; most now on the market are sealed by sonic welding. Outside case (top and bottom) includes pressure pad on spring and metal shield (center front at bottom), spaces for capstan and erase head (flanking pressure pad), windows for viewing remaining tape on feed hub (left). Flexible plastic shims between case and tape act as guides, remove excess static charge. Note U-shape plugs that hold transparent leader on hubs. Splice between tape and leader can be seen between the nylon idler rollers.



Precision of cassette manufacture is displayed in evenness of tape wind on fast forward. Sample at far right, from Reeves cassette, did best here.



Clearly visible differences in molding help account for twisted tape in upper sample. Note, also, differences in contour of the capstan/erase-head well.

Consumer Report: TAPE CASSETTES

SMG C-90. Requiring 2 oz. or more were BASF C-90, Ampex and Aiwa.

A problem with some of the first cassettes we tested was that the tape would come off the hub. As testing continued we found that every manufacturer had switched from a simple glue connection or anchoring the tape upon itself to a hub with a plug. The plug wedges the tape end (or, more precisely, the leader end) firmly into a well in the hub's circumference. In only one of these new cassettes we checked did the plug system fail.

Most manufacturers use a polyester leader, spliced to the tape itself. With one exception, all spliced it on the shiny (inside) portion of the tape. The exception, SMG-Certron, spliced on the coated side. Generally, all splices appeared firm and stable—but we'd like to single out BASF and SMG's C-60 for special mention. Their splices *really* are meant to hold!

Those manufacturers that produce C-120 cassettes (notably Scotch, Norelco and BASF) warned us that they didn't really expect their long-play product to do very well. In fact, our initial tests with C-120s were so disappointing that we planned to warn readers against them. Tape slipped off the hub pack and caught in the shell; tapes stretched and twisted. The problem is that C-120 cassettes must use a tape base so thin and light it has virtually no strength or body. It's for this reason that some manufacturers—Ampex, Reeves, Irish and Audio, for example—don't

even bother to make C-120s. However, we found that the final samples submitted for testing seem to have eliminated the twisting and slipping problem under normal use. Our advice: The manufacturers are improving C-120s greatly but, for the time being, we'd advise you to use shorter cassettes for best results.

The Shell

The general switch from screw construction to sonic welding cuts manufacturing costs. But generally the screw design is more rugged. With one notable exception, a 3-ft. drop to a concrete floor was enough to spring all sonic-welded models. The exception was the Reeves which appears to be virtually indestructible. (To get a look at its contents we had to saw it open.) Also, we subjected all cassettes to heat lamps hotter than anything likely to be encountered in normal conditions. None showed any damage as a result.

Except for the SMG-Certrons, Audiopak and Reeves, all manufacturers use the same type of nylon roller. In a number of cases these rollers were nicked, flattened or damaged. Among those that were not: Scotch 271, BASF C-60. Instead of rollers to guide the tape, Audiopak uses a serrated post. It's possible that these serrations may accelerate tape wear over a long period of time. Reeves' roller is a precision unit—the kind you'd expect in a clock.

Cassette shells vary from the neatly-molded and assembled to those with gaps, cracks, extra-large holes and the like. The one thing

[Continued on page 110]

The Listener

By C. M. Stanbury II

Costa Rican Question

FOR MANY years one of the best-known Central American broadcasters has been La Voz de La Victor operating at San José with 7,000 watts on 625 kc and 4,000 watts on 9615 kc in the 31-meter band. But during the past year normal broadcasting apparently has been suspended while the station tests new super-power transmitters.

At present it has a million-watter on 625 kc—the most powerful broadcast outlet in the western hemisphere—and 50 kw on 9615. That would make it also the most powerful commercial SW station in Latin America—but presently without commercials. During this test period, La Voz de La Victor has aired nothing but popular music and IDs.

So it seems the backer of the station can afford to wait a while before those profits start rolling in. Question: just what is planned for all that muscle and financed by whom?

Whatever the answer, it should prove interesting. Readers will have no trouble keeping tabs on the action for themselves. During those evenings when it's on the air La Voz de La Victor's million-watt MWER can be heard even on the simplest of gear virtually anywhere in North America except where there are locals on 620 or 630 kc. The 9615 outlet is almost as easily heard.

The 24-Hour Bit . . . In our November '68 Listener we told you about a full-fledged broadcast station that was put on the air in

24 hours. About the time that story was coming off the presses the Soviets were demonstrating (publicly in Czechoslovakia) equally sophisticated portable gear—or at least close to it.

On August 23, Reuters News Service reported that Free Czech Radio outlets were being blanketed by new jamming transmitters the invaders had brought in. That term—blanketed—may or may not be an exaggeration but on that same date Austrian monitors reported that FCR stations were becoming harder to hear because of the jammers. Also that same day, FCR itself reported shortly after midnight (GMT) that the Soviets were hurrying to set up a station at the headquarters of the Deputy Minister of the Interior. This one apparently took over from an interim operation on 1430 kc, based in East Germany.

While some Russian portables, like the one on 1430, did some broadcasting, most were employed in out-and-out jamming. In other words, it appears that the West has highly sophisticated portable broadcast voices while Russia has developed equally sophisticated portable jammers. Something of a Mexican standoff!

For VHFers . . . In our September column we did a piece about distant reception of aircraft on VHF that has evoked quite a bit of
[Continued on page 116]



This QSL folder, familiar to SWLs, was issued before La Voz de La Victor upped power to present levels.

March, 1969

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Notes from EI's DX Club

AMATEURS looking for an airborne QSO (a pretty rare bird) should keep their ears open for WAØVQO/am Ross Harp Jr. as he cruises over the western states. Ross is also a top-flight DX monitor. (See The Listener, elsewhere in this issue.)

For propaganda watchers, R. Peking has a new morning transmission beamed to North America. Randy Curtis (Nebraska) reports reception on 15095 kc at 0700-0800 EST. Apparently it's not aired weekends.

Larry LeBoeuf, VE3GHL (Ontario) is back with another good one—HKØBIS, San Andres Island. Larry worked him on 14125 kc around 1100 EST.

The Republic of Guinea, a long-time non-verifier, now is QSLing reports on its SW station at Conakry via form letter. One of the first to receive such a confirmation was Chris Lobdell (Massachusetts) who heard the station on 7125 kc at 1700-1800 EST.

Mike Macken (Massachusetts) has logged R. Ecuatorial, Bata, Rio Muni on 4926 kc at 1800 EST sign-off. This one counts as Spanish Guinea.

R. Sutatenza at Bogota, Colombia currently is installing a new 250-kw MW transmitter. Their present BCB frequency is 1560 kc but this might be changed as a result of that drastic power boost.

From Chris Lobdell again, we learn that R. La Cruz del Sur in Bolivia (which tried out several 60-meter frequencies) has been forced, temporarily at least, to return to their original 4985-kc channel due to interference problems.

Another Cruz del Sur—this one at Santiago, Chile—has been logged by Gerry Dexter (Wisconsin) on 11846 kc around 1845 EST.

A mysterious jammer seems to be working over HCJB's 1730-1800 EST Russian transmission to South America on 17890 kc. Jamming ends right at 1800 and while R. Lib-

erty uses 17895 for Russian about the same time, the jamming definitely is not slopover from 17895.

Those who haven't been able to bag Poland yet should watch for R. Warsaw's late-night (their time) concert session on 5990 kc until 2000 EST sign-off. This tip from Bob LaRose (New York).

The Voice of America has set up a third Philippine relay base at Pinang—apparently their three new 50-kw short-wave portables.

R. Cyprus has entered the short-wave wars with test transmissions to England. Permanent schedule is unknown as yet but keep an ear on 15245, 15260, 15270, 17760 and 17875 kc.

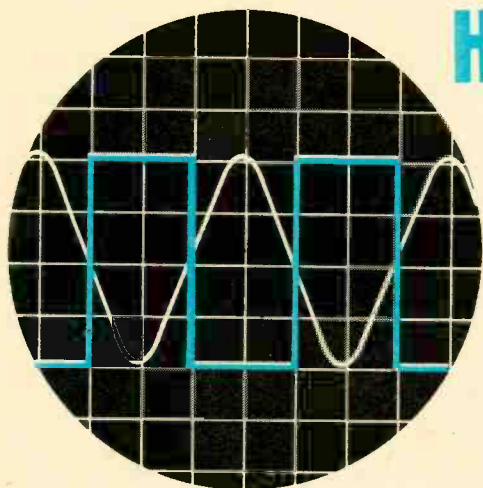
R. Nacional de Brasilia's new international service probably will be heard best during the winter at 1900-2000 EST on 11720 and 15445 kc. Programs are in Portuguese but with English IDs.

Rarely heard R. Cordac, a religious station operating from Burundi, has been logged in the Midwest on 4897 kc around 2320 EST.

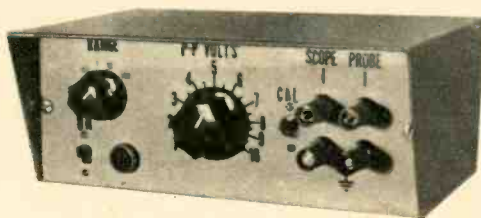
Propagation: As the days continue to lengthen, the higher frequencies will remain useful for DX over longer periods of time. During daylight hours, DX openings on 15, 17 and 21 mc will occur, continuing until several hours after sunset, local time.

Because of decreasing sunspot activity, the 10-meter amateur band will not open regularly to Europe. Over north-south circuits, however, 10-meter openings will continue to occur from about 8 a.m. to 5 p.m., local time. African openings also are expected to occur in the 10-meter band during those hours. Likewise, interference to Citizens Band operations from distant stations will decrease. But, between 10 a.m. and 4 p.m., reception of distant stations will be possible on most days.

Due to approaching summer conditions, noise levels in the broadcast band will begin to increase, making medium-wave DX more difficult. ●



How to Turn an Oscilloscope into a Voltmeter



By CHARLES GREEN, W6FFQ

IT SOUNDS ridiculous, but try to imagine a VOM or a VTVM with a blank scale. Of course, with the selector switch set to a particular range you would at least know from the needle movement that there's voltage in a circuit and its general magnitude. But how meaningful a measurement is that? When you troubleshoot with your scope seeing the waveform alone is something like seeing the meter's needle move over a blank scale.

To turn a faceless meter into a useful voltmeter you have to add a printed scale. And by assigning specific voltages to those horizontal lines in front of a scope's CRT, you turn the scope into a voltmeter. It's a simple job to do this with our calibrator.

Having connected the calibrator to your scope, you'll be able to tell that a waveform which just fits between three horizontal lines is, say, 300 V (peak-to-peak). Or a pattern between two lines could be a 0.5 V peak-to-peak signal. You'll be able to tell in an instant.

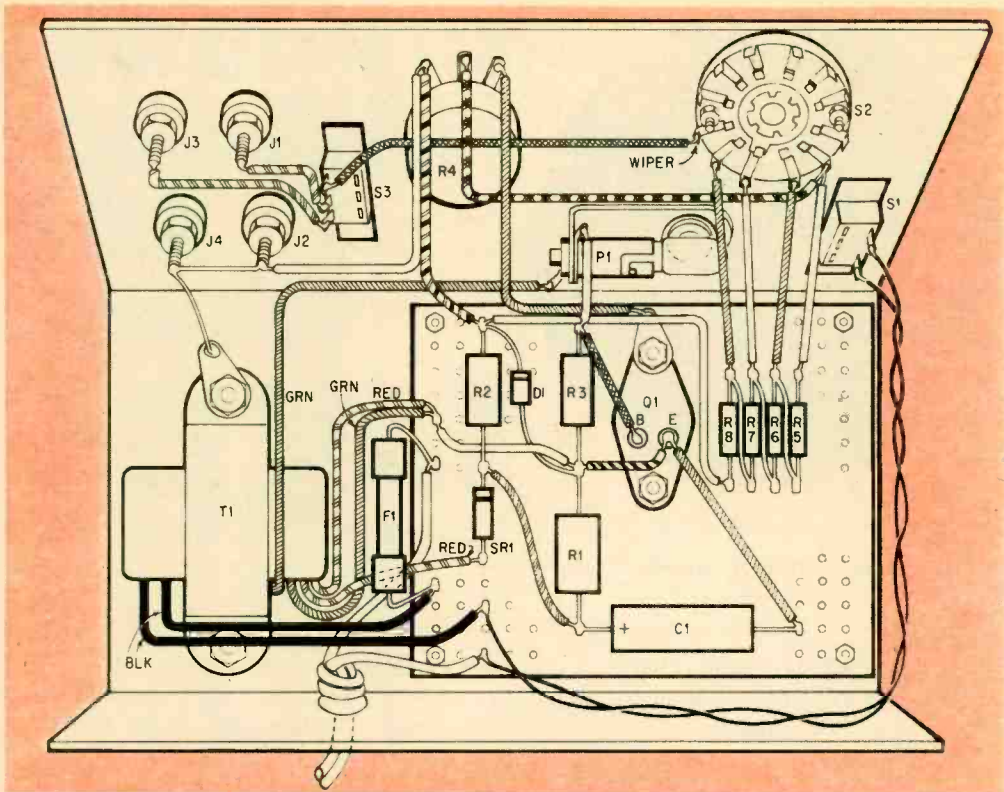
The calibrator is connected to the scope's vertical input terminals. A flip of a switch enables you to compare on the scope a known voltage from the calibrator with the unknown-signal's amplitude. In this way, signals from .05 to 100 V (peak-to-peak) can be measured.

The circuit uses an AC power supply, a zener diode and a high-voltage transistor to produce square waves of known amplitude. A potentiometer together with a four-step attenuator makes the unit easy to operate. Calibration requires only a VTVM or a 20,000 ohms-per-volt VOM.

Construction

The calibrator is built in a 3 x 8 x 5-in. aluminum Minibox. Most of the components are mounted on the box's front panel and on a perforated board. Best place to start is to lay out the front-panel parts where shown in the photo on the first page of this article.

Parts placement is critical to minimize hum pickup and wiring capacitance. For best results, follow our layout. Use lockwashers behind the panel to prevent



Oscilloscope

movement of R4, S2 and P1's socket. Make sure that P1's socket is insulated from the panel because this circuit is above ground.

Cut a 3 x 4-in. piece of perforated board and cut a 1/2-in.-dia. hole in it for Q1's case; mount Q1 upside down on the board as shown. Install a solder lug on Q1's mounting screw that is closest to the board's edge. Mount the board in the cabinet with a 3/8-in. metal spacer at each corner.

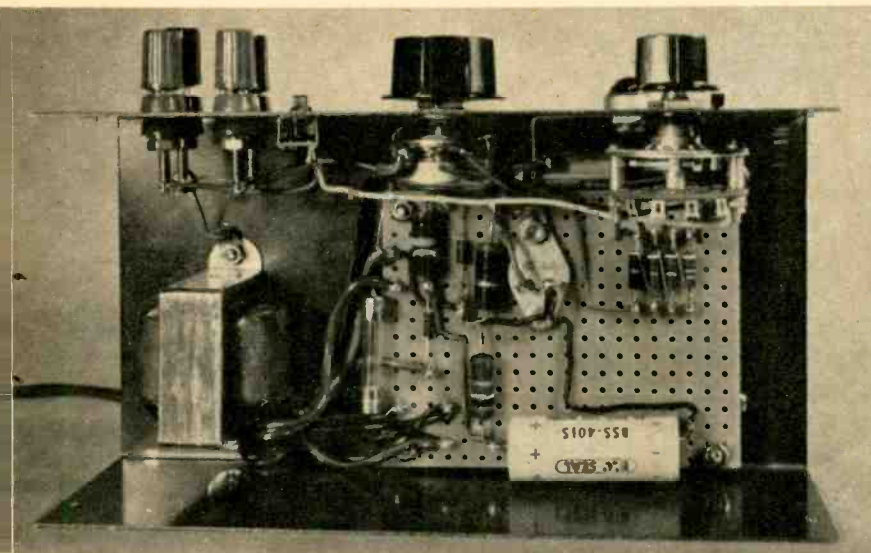
Mount power transformer T1 on the bottom of the box and make sure that it is away from J1, J2, J3 and J4 to minimize AC pickup. Mount a solder lug under T1's mounting screw that is closest to the front of the box and scrape the paint away for a good ground connection. Mount parts on the board with push-in terminals.

Calibration

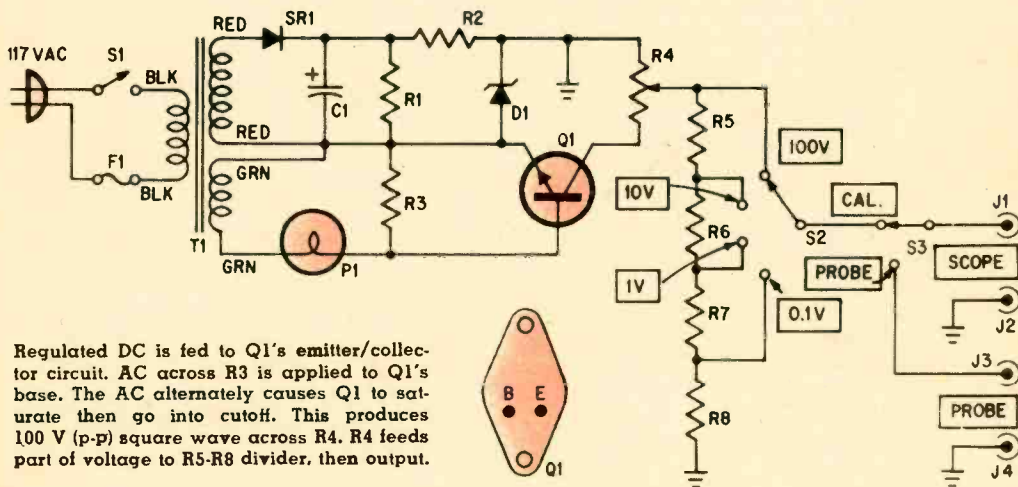
Before calibration, disconnect Q1's base lead. (Even though Q1's emitter-collector breakdown voltage is 300 V, the emitter-

PARTS LIST

- C1—40 μ f, 150 V electrolytic capacitor
- D1—Zener diode: 105 V, 1 watt, 5% (Sarkes-Tarzian VR105A, Allied 49 F 31 VR105A-ST. 87¢ plus postage. Not listed in catalog)
- F1—1/2-A pigtail fuse
- J1, J3—Red five-way insulated binding post
- J2, J4—Black five-way insulated binding post
- P1—No. 47 pilot lamp and holder
- Q1—40424 transistor (RCA, Allied 49 F 1 40424-RCA. 98¢ plus postage. Not listed in catalog)
- R1—100,000 ohm, 2 watt, 10% resistor
- R2—15,000 ohm, 2 watt, 10% resistor
- R3—10 ohm, 2 watt, 5% resistor
- R4—50,000 ohm, 2 watt, linear-taper potentiometer (Ohmite CU5031, Allied 46 C 1511)
- R5—91,000 ohm, 1/2 watt, 5% resistor
- R6—9,100 ohm, 1/2 watt, 5% resistor
- R7—910 ohm, 1/2 watt, 5% resistor
- R8—91 ohm, 1/2 watt, 5% resistor
- S1—SPST toggle or slide switch
- S2—Single-pole, 4-position non-shorting rotary switch (Centralab PA-1011 1-pole, 11-position switch used)
- S3—SPDT slide switch
- SR1—1N2071 silicon rectifier (Sylvania, 750 ma, 600 PIV) or equiv.
- T1—Power transformer; secondaries: 125 V @ 15 ma, 6.3 V @ 0.6 A (Allied 54 C 1410 or equiv.)
- Misc.—3 x 8 x 6-in. cowl-type Minibox (Bud SC-2132), perforated board, flea clips, 3/8-in. metal spacers, AC line cord.



Perforated board in our model is 3 x 4 in. and is raised above bottom of cabinet by $\frac{3}{8}$ -in. spacers to keep flea clips and Q1's case from touching cabinet. Note ground connection to cabinet at the lug on T1's top mounting foot. Keep T1 away from the binding post or AC will appear in output signal.



Regulated DC is fed to Q1's emitter/collector circuit. AC across R3 is applied to Q1's base. The AC alternately causes Q1 to saturate then go into cutoff. This produces 100 V (p-p) square wave across R4. R4 feeds part of voltage to R5-R8 divider, then output.

base breakdown voltage is only 2 V.) Also, make sure that C1 is fully discharged before making any connections to the circuit.

Temporarily connect a jumper from Q1's collector to C1's negative lead. Set S2 to 100 V and set S3 to *cal.* Connect the negative lead of a VTVM (or VOM) to J1 and the positive lead to J2. Set the VTVM's controls to a range that will indicate from 5 to 100 VDC.

Plug in the line cord and set S1 to *on.* Adjust R4 until the VTVM indicates exactly 100 V. Mark the panel above R4's pointer at this point. Turn R4 and mark the panel at other 5-V points as indicated by the

VTVM or by your VOM.

Unplug the unit and disconnect the VTVM. Discharge C1 then remove the jumper. Connect Q1's base lead. Connect the scope's vertical input to J1 and J2 using coax cable to minimize hum and noise pickup. Connect the scope's probe to J3 and J4.

Operation

When you wish to measure a voltage, set S1 to *on* and set S3 to *cal.* Range switch S2 and control R4 should then be adjusted until the calibrator's square-wave display on the CRT is exactly the same height as the dis-

[Continued on page 111]

The Sound That Goes Round And Round

By JOHN MILDER

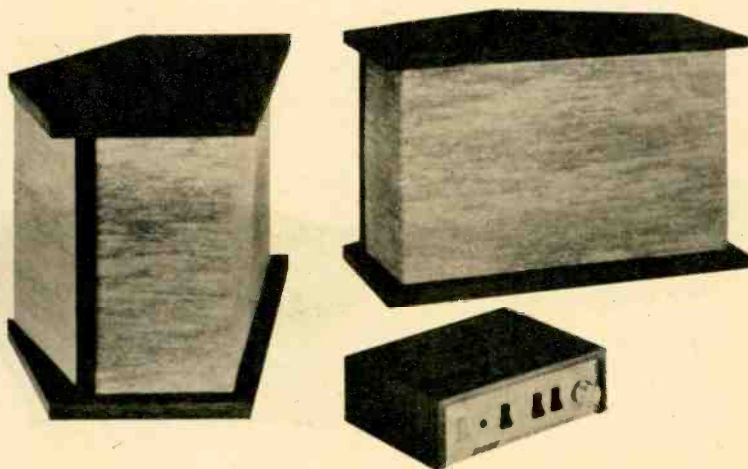
FEW products in recent years have caused the stir among lovers of good sound that has greeted the unveiling of the Bose 901 omnidirectional speaker system, which now seems to be spearheading a sound-in-the-round mania that began about four years ago with a column model. This isn't the first outbreak of round-sound fever but the temperature seems to be running higher this time—and the cash registers faster.

The Bose offering has been described (properly) as being either a radical new design or an ingenious combination of old ideas, depending on how you look at it. Its admirers (and there appear to be many) claim for it the ability to spread an illusion of the original program source across the wall of your room in a way that many speakers have sought to do but few have even approached.

The 901 uses nine 4-in. speakers in a fairly small enclosure. Only one of them is mounted in the flat front panel, firing directly into the room. The other eight point the other way from the angled back panel, bouncing their output from the surrounding walls. This, say its admirers, is why the Bose makes sound seem to come from the entire wall without the point-source effect of conventional speakers and without hole-in-the-middle stereo.

Since the walls become an even more integral part of the sound distribution system than they are with a conventional speaker, the acoustic properties might be expected to impose unusual limitations on good sound. Also, getting really deep bass from 4-in. speakers takes a lot of doing. To solve both problems, Bose throws in an elaborate, multi-position stereo equalizer to drive a pair of speaker systems. Total cost: \$476.

Bose 901 system includes a pair of speakers and stereo equalizer. Flat sides of speakers (here facing equalizer) are the front. Back (extreme left) holds eight of the nine speakers and must face wall a little over 1 ft. away.





Harman-Kardon HK50 system is upward-firing. Reflector projects sound through port running around top of cabinet.

The first important use of the indirect-radiation concept dates back to the 1930s when English acoustician P.G.H. Voigt produced several designs that pointed speakers up and away from the listener. Voigt was concerned primarily with a way to match high-frequency production to the requirements of a long horn path for bass and his designs eventually translated into several Lowther models that enjoyed commercial success on a reasonable scale in England. These systems used a single small-cone (usually 6 in.) driver with a heavy magnet. The front wave of the speaker bounced off a wide, curving surface inside the enclosure and exited both to the front and sides of a wedge-shape cabinet that went into a corner. The back wave went downward into a long folded horn that opened at the floor. Only one of this unorthodox family of speakers made it to this country, the Lowther TP-1. But other Lowther drivers were popular here in the Brociner corner-horn systems.

The objective—or at least the stated one—of these systems was to provide wide dispersion of high frequencies, using the walls of the room (from the vantage point of the corner cabinet) not just as an extension of a horn for bass response but also for coupling of mid- and high-frequency sound to the room. The Lowther models were joined by some even more unusual systems from Stewart Hegeman, who had been involved in the design of the Brociner systems. Hegeman probably was responsible for bringing the term omnidirectional—previously applied as a working term only to microphones—to the language of speaker design (and advertising).

Hegeman used some wondrously strange tweeters, looking like a cross between a tulip and an ice cream cone. They pointed upward and were mounted (sometimes alone and more often in multiples) in a separate sub-enclosure that perched on top of the main cabinet and was open at the top and sides. Hegeman produced several models of Pro loudspeakers under his own name for a limited market, then went on to adopt the basic design to a speaker system for Eico, the HFS-1, a slim rectangular column of a system open (except for grille cloth) at the top and the top few inches of each side. He also went back to a Lowther driver for use in a similar system for Harman-Kardon, the Citation X, which never quite made it to market.

At about the time of the Eico speaker, along came one of the earliest speakers designed specifically for stereo, JBL's Ranger Paragon. It housed two complete three-way speaker systems in a single 7-ft. cabinet. The speakers were mounted at the ends, pointing at a long curved panel running from one set of speakers to the other.

The idea of indirect radiation was continued in the Lafayette Criterion XL-360 (along Hegeman lines) and the cylindrical Leonhardt LH-500 but made its first surviving reappearance some four years ago in the Empire Grenadier. That appearance was a strange one to many audio buffs—a walnut Grecian column with a brass breast-plate where the mid-range speaker and tweeter were guarded. But the most unusual thing about the Empire was that the indirect radiator was the woofer which faced downward in the column and emitted sound through a slot that ran around the base of the column.

The announced purpose of this arrangement was [Continued on page 118]



Empire Grenadier series has bass port around bottom, mid and high drivers mounted in side.

The Ham Shack

By Wayne Green
W2NSD/1



ONE OF the perennial complaints of the more perspicacious is that hams don't talk about anything interesting. After hamming for about 30 years I must admit that it has not completely escaped me that a great percentage of the contacts on the air are dreadful wastes of time. I think I have a workable solution to the problem.

The urge to communicate drives a couple hundred thousand otherwise rational people around the world to get on the amateur bands and fight both interference and atmospheric conditions for the miniscule reward of a partly-heard description of the equipment that someone else has bought plus the promise of a QSL card. This small return seems enough to keep many amateurs going for years, through tens of thousands of contacts.

When a fellow starts out in ham radio he has a terrible time thinking what to say when he gets on the air. About the only thing that comes to his semi-paralyzed mind is to recite a list of his equipment. With experience, the operator is able to relax a little and add brief comments about the weather. A large number of amateurs never make it much past this point.

In the past, I've used a number of different approaches to getting amateurs to talk with me on the air. I've tried bringing up many different interests in my opening transmission of a contact, hoping the other fellow would respond. Some did but I still found myself listening to that same old refrain a lot of the time. With a little planning, you can have a set of stories worked out and at hand to interject into your contacts in the hope of striking a spark with the other chap. A good ground rule for all contacts is to avoid, at almost all cost, any discussion of your equipment—or the weather.

Now, to get to my proposal. Most of us have several areas of interest in which we can conduct meaningful conversations. The big problem in amateur radio is to find fel-

lows with like interests. My suggestion is quite simple: let's get fellows with similar interests on a channel where they can meet and talk. The Country Hunters would have a channel where they could congregate for shop talk. The UFO enthusiasts would have a channel. Even the YLs could have a spot.

The listing below should take care of a good proportion of interests. The more esoteric could be accommodated on a time-sharing plan so that more frequencies wouldn't be needed. If the scheme works out reasonably well on 20 meters it might be duplicated down on 80 meters.

Won't the taking of 50 kc from 20 meters work a hardship on that already crowded band? Au contraire. At present almost every contact on 20 meters is a two-way QSO. But in the round-table, mutual-interest gatherings of the UFO net on 14300 I have found that large numbers of net stations will stand by and listen enthusiastically as long as the proceedings are brisk and the conversation interesting.

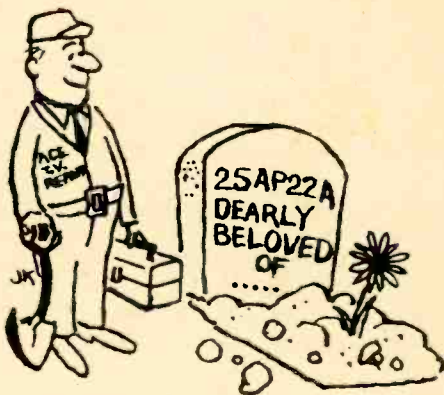
WAYNE GREEN'S GUIDE TO SPECIAL INTERESTS ON 20 METERS

(See text for suggested use)

FREQ. (kc)	SPECIAL INTEREST
14250	DXing
14252	Religion
14254	Girls
14256	Travel
14258	Hunting/fishing/diving
14260	Stamps/coins
14262	Photography
14264	Astronomy
14266	Animals
14268	Boats
14270	Spectator sports
14272	Cars
14274	Golf/skiing/skating
14276	Occult
14278	Doctors/lawyers
14280	Flying
14282	Books
14284	Clubs (Masons/Rotary/etc.)
14286	Boy Scouts
14288	Languages
14290	Stock Market
14292	VHF/moonbounce/scatter
14294	CD/RACES/etc.
14296	Ham TV/RTTY/FAX/FM
14298	Arts: music/painting
14300	UFO net

Death of a Color CRT

By ART MARGOLIS



A COLOR picture tube does not die the way a black-and-white one does and its fatal symptoms are bound to confound a diagnostician familiar only with b&w. The commonest way a monochrome CRT passes away is through low emission—a gradual dimming of screen brightness. A color CRT almost never quits this way. It usually gasps its last with light to spare. Let me tell you about four color picture-tube failures I've encountered on service calls.

Case No. 1

One of my customers with a taste for the ponies greeted me with the statement, "Before you leave you're going to charge me \$169."

It seemed unlikely but I just shrugged and turned on his set. A color show was on and the picture was beautiful. The flesh tones needed a touchup so I adjusted the hue and level controls. I switched to a monochrome show. It had a green tint to it. I went in the back of the set and lowered the green screen control slightly. A good b&w picture showed, minus the green tint.

My customer nodded knowingly. "That's exactly what I do every hour or so. I've become an expert at adjusting those controls."

In order to get a perfect b&w picture on a color TV the three colors—red, green and blue—must be mixed on the tricolor phosphor screen in exactly the right amounts; 59 per cent green, 30 per cent red and 11 per cent blue produces the appearance of white light. When the colors lose their precise mixture all you have to do is touch up the red, green and blue screen controls until your eye tells you the picture is b&w. The procedure varies slightly from set to set.

As I watched, the monochrome started to develop a pinkish tint. I turned the red screen down slightly. Again the b&w picture was restored. Then gradually the green tint started coming back.

It looked bad. The bombardment of a color TV screen by electrons must be of a constant intensity. In a b&w tube a slight change in emission is hardly discernible on the screen. But a slight change in emission of the three guns of a color tube changes the gray-scale tracking, causing a tinted picture. The change also can be caused by a slight shifting or even buckling of the metal shadow mask as it warms under the stream of electrons from the three guns. If that happens the electrons no longer find their way precisely to the color phosphor dots. Result: a drift in color. Either way,

Color CRT

there's no cure but CRT replacement.

It took me about two hours to install the new picture tube. When I had his TV back on again the customer asked, "Well, how much?" I added up my figures—and they came close to his \$169. He leapt to his feet. "I knew it! Just my luck!"

I looked blank. "That's what I won on the daily double last night," he said. "I knew I won it for a reason."

Case No. 2

Another customer had a common complaint—no picture. When I turned on his TV, I heard the high voltage bristle on, followed by the audio. But there was no light on the screen. I took the many screws out of the back of the color set and plugged in my cheater cord.

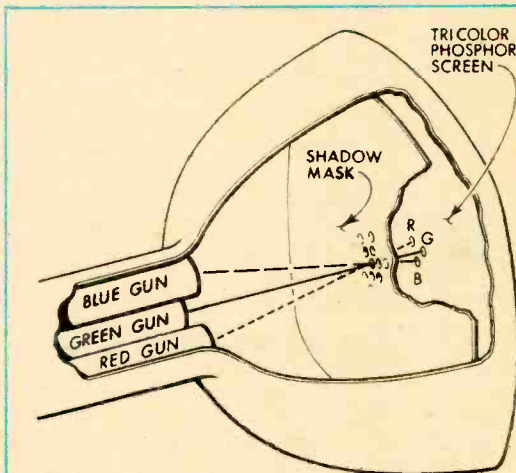
I glanced at the picture-tube heaters. They were coming on. I placed the back of my hand near the shell of the picture tube. The hairs on my hand were attracted by the high static charge in the picture tube, so the high voltage was okay.

The brightness on a CRT disappears if there is no high voltage, if the CRT guns open or short or if the voltages fed into the guns are incorrect in such a fashion as to cut off the electron beams. From a quick-check point of view, then, the high voltage and color picture tube were exonerated. That left the CRT input voltages. I removed the cap from the CRT neck and began checking with my voltmeter.

The focus voltage was in the thousands as it should be. The screens were in the normal 500-V range. The control grids were correct at about 200-V and the cathodes near 300. That eliminated the input voltages. My quick-check analysis had been wrong.

I replaced the cap on the CRT neck and fired up the TV. Then I drew the curtain on the picture window. I could see the CRT heaters were lit and the high voltage bristled once again. But, in the dimness, a new symptom revealed itself.

The neck of the tube developed a light purple glow as the high voltage came on. The glow grew in intensity till the heaters were no longer visible. It obviously was a case of a shorted electron gun. I hadn't left the cap on the tube long enough before to pick up the visual symptom—the glow of



Slightest shift in position of shadow-mask holes causes beams to move off phosphor dots for which they are intended, degrading picture.

gases fluorescing under the influence of the excessive current flow due to a short in the gun. RIP one more color CRT.

Case No. 3

The man who owns the paint store lives in an apartment above his shop. He was busy when I arrived so I went up into the living room and turned on his TV.

It came on but there was a deep purple cast to the screen. I went into the rear of the TV and tried adjusting the red, green and blue screen controls. I turned all three down so the picture went black. One by one, I tried the controls—first the red and a red picture appeared, then the blue and a blue picture showed, then the green and nothing happened.

The paint man walked in. "There's no green in your picture—only red and blue," I told him.

He smiled and instructed me like a child, "You mean no yellow."

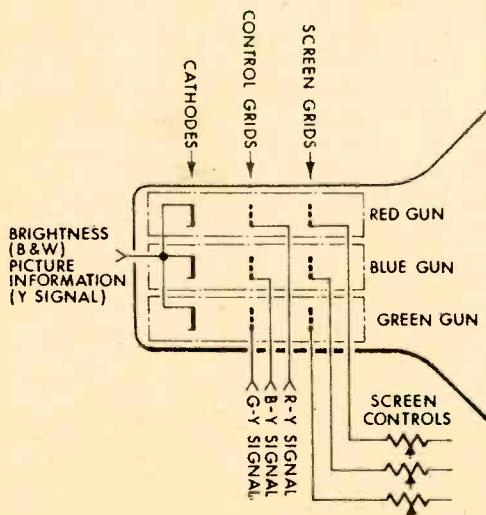
I shook my head, "Nope, I said green." Struggling to maintain his patience, he continued, "Look, buddy, I mix paints all day long. Don't tell me my colors."

Without giving him a direct answer, I plugged in my cheater cord and watched the TV come back on. I looked at the electron guns in the tube. Sometimes one of the guns will go out and you can spot the trouble visually. But these three were still lit. I plugged my CRT tester onto the cap of the

picture tube. It indicated good emission on the red and blue guns but none on the green. This usually is caused by an open circuit in the cathode—something that can happen at any time. But, in older tubes, low emission can come from stripping off or poisoning of the cathode's barium-oxide coating.

Hoping for the latter, I tried rejuvenation. A CRT's equivalent of Geratol is about 8 V administered to the gun's heater circuit. The resulting overheating starts the barium oxide boiling and reshuffles its outside layer, dissipating the poisoning. Stubborn cases call for a booster shot—a momentary charge of about 1,000 V on the control grid. This has the effect of sucking a rush of electrons from the cathode, stripping away the outer layer of the barium oxide. But it's strong medicine—if the dose is too big it removes all the barium oxide and you've lost a patient.

In this case, nothing worked. I stood up and announced, "The green gun in your picture tube has quit—and I mean green. When you mix paints you use the colors that work best in giving you the shade you want. Color TV mixes colored light and must use the standard primary colors for the mixing of light—red, blue and green—if it is to achieve the maximum range of apparent colors on the screen. Anyway, you need a new picture tube. If you're going to get good color."



Same brightness signal is fed to cathodes of all guns so heater-to-cathode short in one affects all, killing b&w image but not color.

He just looked glum for a moment and then answered, "I guess you do mean green—like money."

Case No. 4

Another case was a rush job first thing one morning. I had sold the customer a 21-in. color TV a few years ago for his basement. Saturday afternoons his lush basement den would be crowded with cronies energetically betting on the sports events on TV. Now he said he needed a working set by 10 a.m.

The only thing I had handy was a new 25-in. color job. As I lugged it down into his basement I saw that things had changed. There were about ten expensively dressed gentlemen sitting around and a battery of phones was lined up on a conference table covered with green felt in the center of the room.

I turned on the 21-in. TV mounted in the wall. At first it came on fine and showed one of the UHF stations. Then, suddenly, the picture smeared as if someone had taken a rag and rubbed it across a freshly printed page. I cranked the color intensity control up. The colors came up beautiful. It was just the b&w picture that had smeared. I tapped the neck of the picture tube and the black and white picture cleared in flashes, then smeared again.

There are four components to a color picture signal. In addition to the red, green and blue signals there also is the b&w picture, produced by tying together all three cathodes and feeding the b&w picture simultaneously to all three guns. The three control grids receive the three color signals. The colors were coming through fine but the b&w picture was snafued so one of the guns had developed a heater-to-cathode short. Since all three cathodes were tied together the short affected all of the b&w signal input. Only a new color picture tube would cure the trouble.

My customer grunted at the announcement. "How much?" he asked, pointing at the 25-in. replacement set. I told him it would run about \$500. The customer looked around. "Okay boys, the ante is 50 bucks apiece."

The money was quickly on the long table. As I counted it, the TV chimed 10 o'clock. I couldn't help glancing at the screen to see what kind of action would be on at that hour. But they still had on the UHF channel—broadcasting continuous stock-market tapes!

Big A Ham Antenna

By EDWARD M. NOLL, W3FQJ

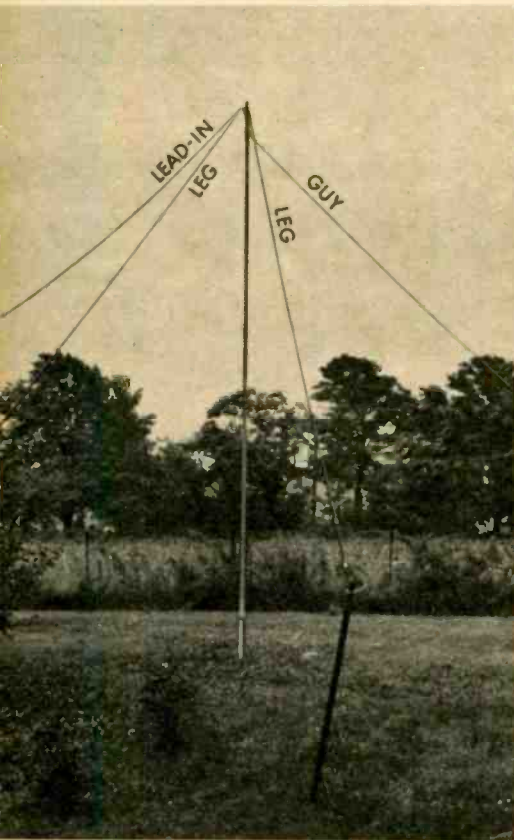


Fig. 1—15/40-meter antenna installation in author's backyard. Telescoping mast is 30 ft. high. Leg in foreground is attached to an 8-ft.-high post.

MOST easily set up and cheapest sky-hook for the 15-, 40- and 80-meter ham bands is a half-wave dipole. Only thing is, if your backyard is small you may not be able to erect one for, say, the 80-meter band because the length would be about 120 ft.

Buying the vacant lot next door might be a solution—but an expensive one. Another way is to erect a half-wave dipole that goes up instead of out. In a general way, here's how. Get a 30-ft. telescoping mast. Attach (with a special insulator) to the top of it the center of the dipole, then erect the mast so it is vertical. Let the legs of the dipole droop so there's a 45° angle between them and the mast and you're in business. Such an antenna is called an inverted V, which is what that strange character in our title is—an upside-down V. An inverted V is a half-wave dipole whose ends are lower than its center. Only one high support is required.

On-the-air checks of such an antenna revealed that signal levels were just slightly below those obtained from a straight dipole. However, the inverted antenna has a more omnidirectional pattern and for DXing it has a low angle of radiation. With the feed point reasonably high, you can expect good performance.

The inverted-V antenna is suitable for multi-band operation. The ends of the antenna are readily accessible and length changes can be made quickly and conveniently.

The 40- and 80-meter antennas we describe are a half-wavelength long. Each leg is a quarter wavelength. The 15-meter antenna has a total length of $3/2$ ($1\frac{1}{2}$) wavelength. Each leg is $3/4$ wavelength long.

Why this odd multiple of a quarter wavelength for the 15-meter antenna? Take a look at the schematic of the 15- and 40-meter antenna shown in Fig. 3. All it takes to change the $1/4$ wavelength (length of one leg) 40-meter antenna into a $3/4$ -wavelength (length of one leg) 15-meter antenna is about 2 ft. of wire.

The increase in length can be made quickly at the ground by using an additional 2-ft. section of wire at each leg. These sections can be connected with alligator clips as shown in Fig. 7. Disconnect the section for 40-meter operation and connect it for 15-meter operation. The dimensions shown on the diagram are somewhat shorter than the calculated dimensions because of the nearness of the ends of the legs to ground.

The transmission line connecting the antenna to the transmitter should be a multiple of a half wavelength long. A 45-ft. length of 72-ohm coax (or a whole multiple) is recommended for operation on the 15- and 40-meter bands.

A 30-ft. telescoping mast was used for the installation shown in Fig. 1. The legs of the antenna are tied to metal posts with plastic washline. A single length of plastic washline was used also for the guy wire for the mast. The two antenna legs also provide guying.

Additional leg length is all that is necessary for three-band operation. Required are more antenna wire, another pair of insulators and more alligator clips. Such an antenna is shown in Fig. 4. When all clips are connected the antenna works on 80 meters. About 120 ft. is required between the tie-down points. The length of the transmission line is 92 ft. or a multiple thereof.

If the transmitter loads easily on 80 meters you can use a shorter 46-ft. length of coax. Such a length can be used when the top of the antenna is on a pole at the top of the house and there is a short distance to your trans-

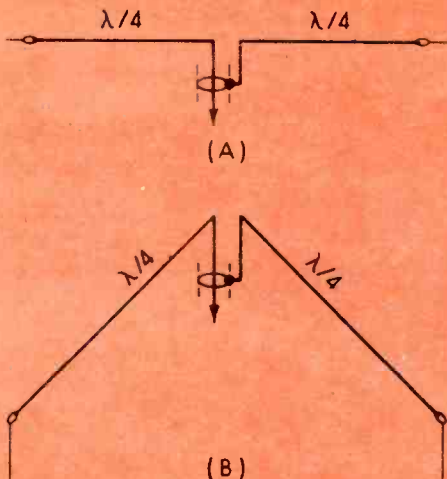


Fig. 2—Conventional half-wave dipole is shown in A. Half-wave inverted dipole is shown in B.

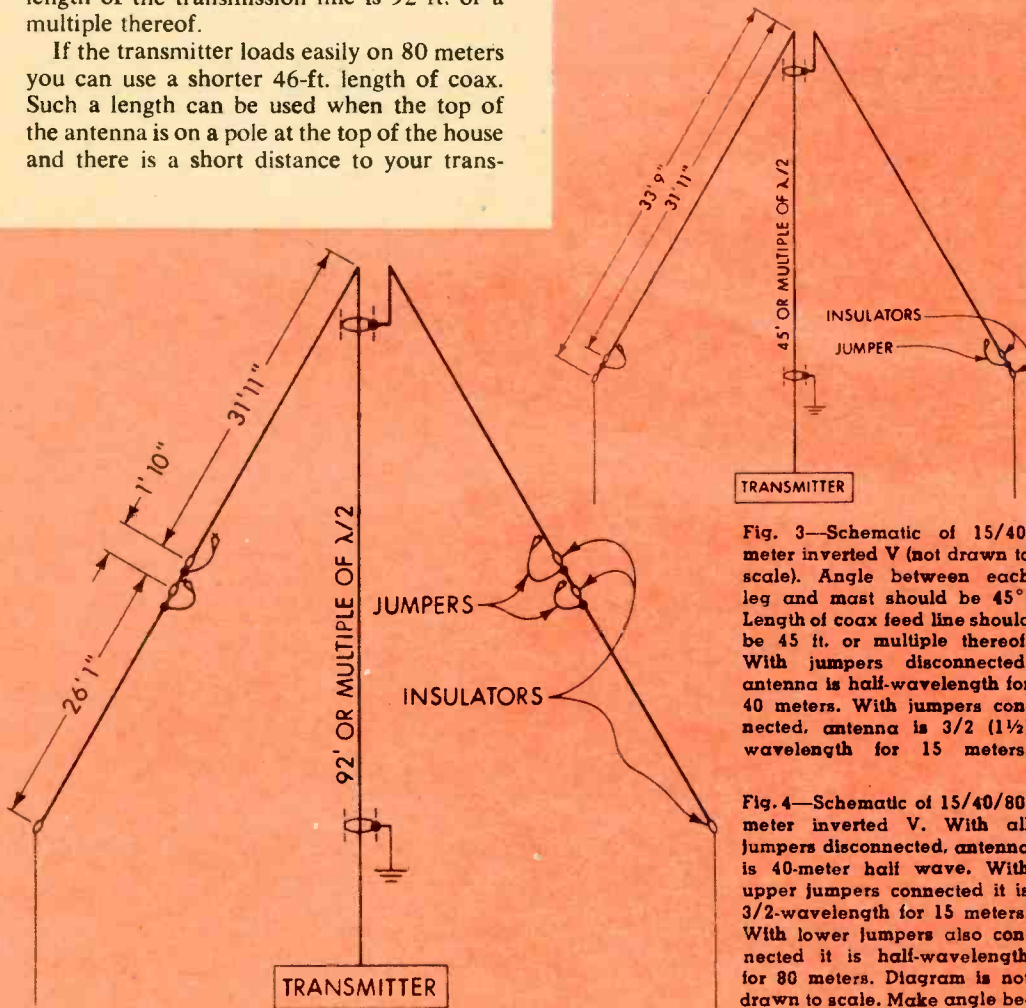


Fig. 3—Schematic of 15/40-meter inverted V (not drawn to scale). Angle between each leg and mast should be 45°. Length of coax feed line should be 45 ft. or multiple thereof. With jumpers disconnected, antenna is half-wavelength for 40 meters. With jumpers connected, antenna is 3/2 (1½) wavelength for 15 meters.

Fig. 4—Schematic of 15/40/80-meter inverted V. With all jumpers disconnected, antenna is 40-meter half wave. With upper jumpers connected it is 3/2-wavelength for 15 meters. With lower jumpers also connected it is half-wavelength for 80 meters. Diagram is not drawn to scale. Make angle between each leg and mast 45°.

Big A Ham Antenna

mitter—in a top-floor room. Equations used to calculate each leg's length are;

$$\frac{1}{4}\text{-wavelength (ft.)} = 234/f(\text{mc})$$

$$\frac{3}{4}\text{-wavelength (ft.)} = 738/f(\text{mc})$$

Erecting it. Enough theory—let's put up a 15/40-meter antenna.

First, dig a hole in the ground as in Fig. 6. Support a 2½-in. I.D. piece of pipe in the center and fill the hole with concrete.

Go get the mast (but do not extend the sections yet) and attach the Budwig connector to the top of the uppermost section as shown in Fig. 5. Attach the legs, following the dimensions shown in Fig. 3, and the coax feedline. For the third guy wire attach another piece of wire at the back of the antenna. Put the collapsed mast in the hole and temporarily attach three guy wires to the top of the lowest section. Secure the guy wires to stakes in the ground. Fully extend the sections one at a time, starting with the smallest.

Pull the two antenna legs out so they make a 45° angle with the mast. Then attach them to 8- to 10-ft.-high posts as shown in Fig. 1. The posts must be firmly implanted as the legs also serve as guy wires. Set up the rear guy wire and remove the lowest guy wires.

Because the angle of the legs and their distance from the ground will affect the antenna's resonant frequency, make legs longer then trim them for minimum SWR.

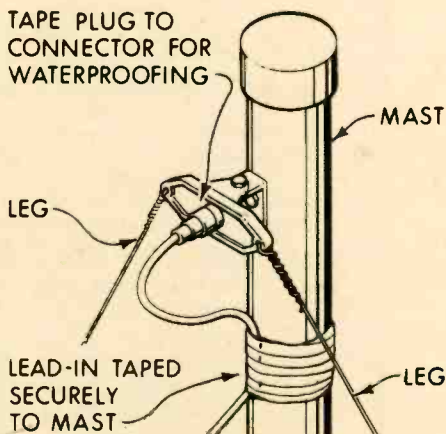
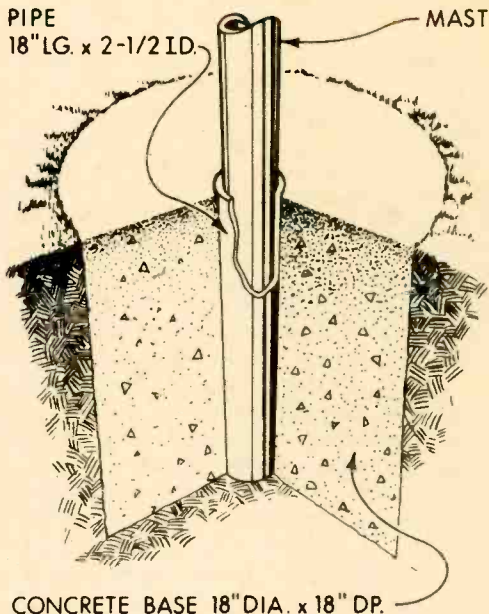


Fig. 5—Method of coupling legs and transmission line and attaching connector to top of mast. Connector is attached to mast with an angle bracket.



CONCRETE BASE 18" DIA. x 18" DP.

Fig. 6—To facilitate lowering mast for band changes, pour concrete foundation and put pipe in center. Mast can be lifted out and lowered.



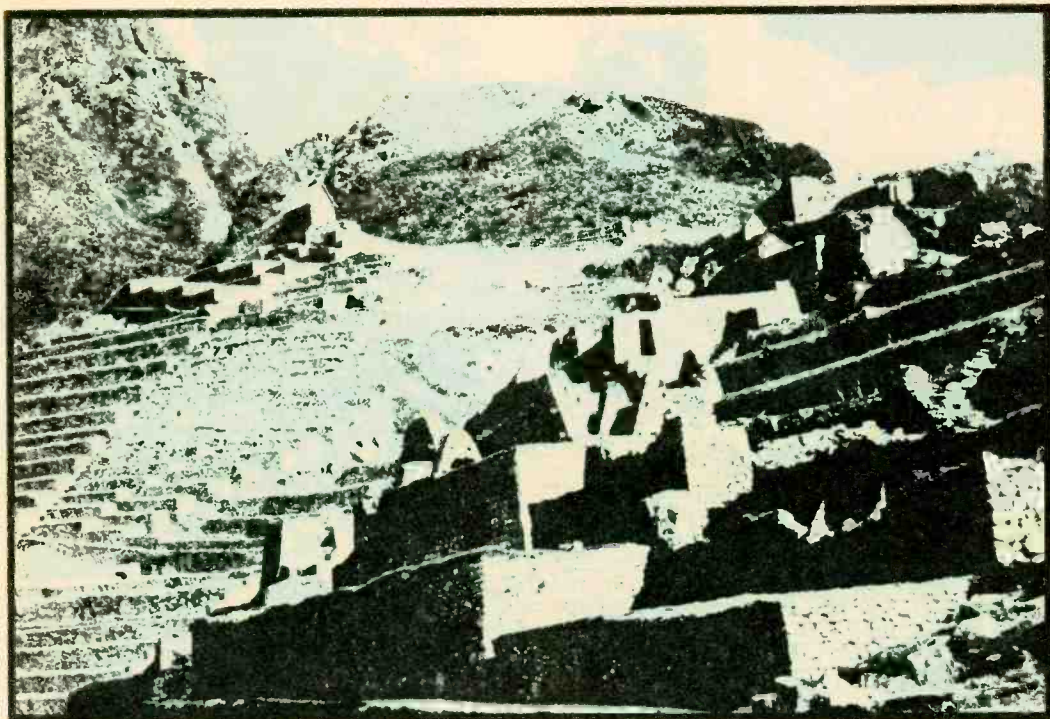
Fig. 7—To switch bands, sections of legs must be added or removed. Quick and easy way is with porcelain strain insulators and alligator clips.

MATERIALS

Alligator clips
72-ohm coaxial cable
Connector (Budwig HQ-1. Budwig Mfg. Co., Box 97, Ramona, Calif. 92065. \$2.95 post-paid)
Porcelain strain insulators
Telescoping masts:

	Allied	Lafayette
30 ft.	11 C 2101ZW	18 T 5611WX
50 ft.	11 C 2103ZW	18 T 5609WX

Misc.—Concrete, tape, antenna wire, guy wire



Machu Picchu, the most famous of all Inca ruins in Peru, was high point of the recent Randi Expedition.

DXpedition in Search of the Incas

By PAT JORDAN, WB2QLF
as told to Robert Long

THE FIRST time I heard about the Randi Expedition to the Land of the Incas, to call it by its official name, was about a year before the expedition really got under way. I was 15 and I hadn't had my ham license long. But, since Randi lives not far from my home in New Jersey I called him. I had heard he would need a radio operator. Could I apply? All he would say was that plans still were up in the air. It was to be almost a year before I knew I was accepted.

The idea seemed pretty wild—particularly the idea that, along the way, the Randi Expedition might somehow find Vitcos, the lost city of the Incan empire. The story goes that when the Spanish came to Peru some of the Inca aristocracy managed to retreat with great quantities of gold to their most inaccessible mountain stronghold at Vitcos. But no one ever has found Vitcos or the gold. If its ruins really exist the expedition might stumble on them the way Hiram Bingham stumbled on Machu Picchu a century ago.

The months went by but I didn't forget about the expedition. Randi (James Randi—better known as the Amazing Randi) is an



Pat Jordan sits in front of the Randi Expedition tent with his transceiver, a Drake TR-4. He used a dipole antenna most of the time and eventually found that best contacts came in evening hours.

Solid color line on map shows route, beginning at Guayaquil with side trips to Salinas, Cuenca, Cajamarca, Pucallpa; then through Cuzco and Machu Picchu to Bolivia and back via Arequipa (see text).



DXpedition in Search of the Incas

unusual man. He's in show business and often is thought of as a magician or late-night radio-TV personality. But his interests include all sorts of things. Many of them were important to the trip.

Photography, for instance. We made stills and movies wherever we went. When some of our camera equipment was stolen in Peru, it was a severe handicap since several specific subjects had to be put on film.

Another of Randi's interests is archaeology. Almost everywhere we went in Peru and Ecuador there were ruins and caves and monuments to be explored—not just the famous Inca ones like Machu Picchu but some that are much earlier, as well. And then there are the lines engraved in the desert outside Nazca. They're a great mystery, particularly because their pattern is so huge and the ground so flat that they can be appreciated only from the air. How they were laid out or why nobody seems to know.

Then there's archery. Randi has demonstrated his ability with a bow and arrow on TV and he got a particular kick out of beating the Indians at their own game.

I also should mention that Randi takes a great deal of interest in the Foster Parents Plan. One of our stops—at Chimbote, Peru—was made in order to film an FPP center.

Of course, I didn't know much about all these interests before we started. It just looked like a once-in-a-lifetime opportunity for something sort of spectacular—even though I didn't really think Randi would pick me at first. One of the ham magazines had printed an item on Randi's search for an amateur operator. So I wrote him a letter, reminded him of our conversation and waited some more. After some interviews he finally introduced me to the other members of the expedition—Jaime Carvajal of Quito, Ecuador, and Russel Shoub of Montreal. Russel would accompany us only during the early stages of the trip but Jaime—the only one of us at home speaking Spanish—was indispensable. I'll tell you more about that when I come to our one big emergency.

The whole trip took about 3½ months. We flew to Guayaquil, Ecuador (near the top of the map on this page), early in March 1967. After some delay waiting for our Ford Bronco and other heavy equipment to arrive by ship—time we spent mostly in Salinas—we headed by way of Cuenca to the Peruvian

border and down the coast. Our first detour took us up to Cajamarca in the Andes where there were caves that Randi wanted to photograph. Returning to the coast, we continued south through Trujillo to Chimbote and on to Lima. Then we turned into the mountains again, through the mining region around La Oroya and Cerro de Pasco, and on down the far side to Pucallpa in the jungle. Although it's not very far from the western coast, Pucallpa actually is on a tributary of the Amazon River which drops only a few hundred feet in crossing almost the entire continent to the east coast of Brazil.

Since there are few roads in the Andes we had to return to the coast before turning south once more. After spending some time in the desert between Ica and Nazca we crossed the western Andes again to Cuzco. There is no road from Cuzco to Machu Picchu—where we spent one night camping in the ruins—so we had to take the train. Returning to Cuzco we continued through the Andes to Lake Titicaca.

I had lost my passport in Cuzco so I couldn't go all the way with Randi and Jaime into Bolivia. You feel awfully helpless in a foreign country when something like this happens—particularly when you haven't picked up much of the language. But there was nothing I could do about the passport until we got back to the U.S. Embassy at Lima. And my wait on the Peruvian side of the border was only a matter of hours.

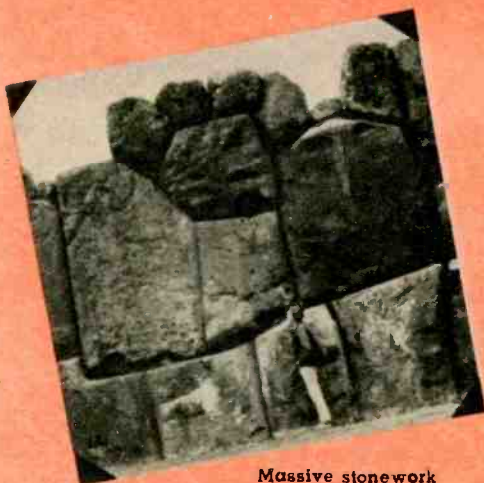
On the return trip we went through Arequipa to the coast and then straight up the highway to Guayaquil and our flight home—in time for my 17th birthday. When I say highway, of course, I don't mean anything with four lanes and cloverleaf intersections. If it was paved it was a highway.

By now it should be obvious to any amateur reading this that the trip really was not a DXpedition in the usual ham sense. We didn't go to Peru just to make DX contacts. In fact, many nights it was all I could do to throw up an antenna and get out with our regular messages, I was so tired. Still, I was on the air about three nights of each week. First I'd handle any traffic for the expedition, like arranging to have our film flown out for processing or getting time checks. Then, if conditions were good and I wasn't too tired I might go on and see who else was on the band.

We had a Drake TR-4 transceiver with an RV-4 remote VFO and two Hy-Gain an-



Pat digs the Bronco out of the sand by the ruins of the Huaca del Sol near Trujillo.



Massive stonework of Sacsahuaman, outside Cuzco, has such perfect joints that even a sheet of paper cannot be inserted.



Huaca Dragon, Chanchan (near Trujillo) has been restored from ruins. Yes, that's Pat standing on top.

DXpedition in Search of the Incas

tennas—a 14AVQ vertical and an 18 TD dipole. I thought at first that the vertical would be better but when we were in Chimbote I set them both up and compared signal reports. The dipole proved better. We had some pretty makeshift masts—trees, high-tension towers or whatever was handy. Sometimes, in the Andes, there was nothing we could do but stand on a rock holding the antenna. You can get awfully cold and tired in no time above 10,000 ft.

If I had wanted to I could have sat down every night to see whom I could work. I can't remember once when I got on the air that I wasn't able to get out to someone. Usually I worked 20-meter phone on sideband, contacting my father, WB2IYO, for most stateside business. Peru is almost due south of New York so operating conditions usually were best early in the evening. But I worked lots of places besides South America and the States. I've got QSLs from Moscow, Sweden, Austria—even from Australia and Antarctica. In Cuzco one night I was set up with my beam pointed north for New York when I got a fellow from Guam. He said he had his beam running north and south, too, trying to reach someone in Antarctica. So we figured the contact must have been via the South Pole!

One thing that caused confusion in working from Ecuador was the temporary call I had been assigned. Usually the temporary area call is added to the end of the regular call. In Peru, for instance, they tacked Peru's call (OA4) on the end of my U.S. call (WB2QLF), making my Peruvian call WB2QLF/OA4. But Ecuador gave me an entire Ecuadorian call and tacked my U.S. call on the end, making me HC2RE/WB2QLF in Ecuador. American hams, hearing this call, would tell each other that they were working some joker from Ecuador with a portable in New Jersey. Here I was 3,000 mi. away and they thought I was next door!

I can't say enough nice things about the amateurs we met in South America. Their hospitality was wonderful and we met them all along our route. One man in Lima had a beautiful station with a dipole on the flagpole.

Early in the trip, before the Bronco arrived, we had rented an old Chevy that was a piece of junk with everything falling apart. Right away we had a flat tire, which we replaced with the spare. But 2 mi. farther we



Here's what the expedition camp looked like set up in a valley in the Andes.



Pat and Randi pose at the transmitter. Randi holds the bow he used to outshoot Indians.



Time out for a swim in an Andean stream—Pat on the far right, Jaime standing nearer center.

had another flat.

Jaime and Russel decided to hitch a ride to a gas station and who should pick them up but the mayor of Salinas. He invited us over to his hacienda and gave us permission to camp there. I set up the station in his garage with the 14AVQ stuck in the ground out near the driveway. The line voltage turned out to be something like 87 V instead of 117. When I turned on the TR-4 it pulled so hard on that 87 V that all the lights in town dimmed as I spoke.

One day I was called down to the hacienda, where the mayor's daughter was in tears. She had backed her car over the antenna and it was broken in two. I gathered up the pieces and we inserted a wooden plug to get it back together. It didn't look too good but, if anything, I think it worked better after that.

Considering the punishment it took, all the ham gear operated beautifully. During the day I would roll the transceiver in my sleeping bag to keep out the dust and pad it against bouncing on the mountain roads. Then, at night, I'd unwrap it and blow out the dust. When I'd throw the switch the green light would come on and the little voices start coming out of the box just like nothing had happened.

In Cuzco, though, I lost a tube in all the bouncing. In Peru they get tubes from Europe so the only way we could replace the one from the Drake was by knowing the European equivalent. It doesn't sound like tracking down a tube type should be a big deal. But doing anything in South America is a big deal. Even in a city the size of Lima it takes a whole day just to mail a postcard. The siesta, for example, isn't just something you hear about in the movies. They really shut down everything from noon to about 1:30. You just can't get anything done, no matter how important it is.

The only real crisis came on the trip from Nazca to Cuzco. Randi had been getting chills and we went to a doctor in Nazca who said it might be malaria. Randi didn't want to take any more time than necessary and we had some penicillin tablets with us, so he took a couple of them. He was feeling pretty poor still when we got to Puquio but there didn't seem to be anyone around the hospital who could help. So we took off again.

Before we could reach Abancay, Randi was feeling much worse—getting the shakes and blacking out and getting delirious. I was pretty nervous. You couldn't go more than

15 mph over those roads and even then you got bounced around. So we pulled up at the next town—about five shacks on either side of the road. Jaime set up a cot in one of the shacks while I got on the air and called an emergency. But it took almost six hours for a doctor to come in from Abancay.

Fortunately, the night before, I had contacted a station in Quito, Ecuador. I gave the operator Randi's symptoms and asked him to call a doctor for us. He did and came back with a whole list of procedures—what to do if this happened or that happened to Randi's condition. This was where Jaime was particularly indispensable. The whole conversation was in Spanish. It was, in fact, the one time I couldn't get by on the air with English.

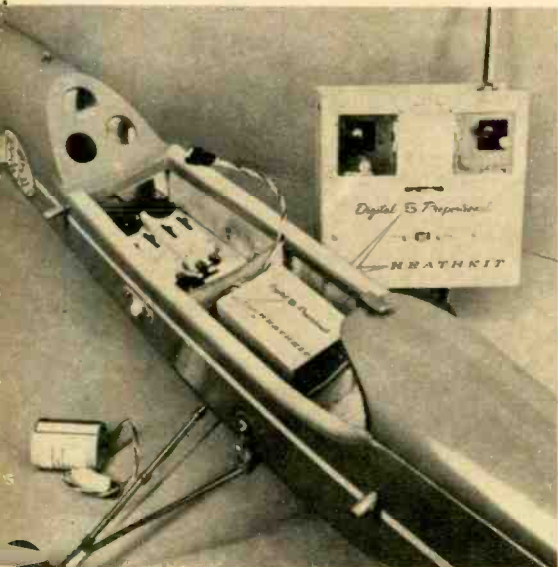
Anyway, the procedures seem to have been a big help because by the time the doctor arrived Randi was so much better the doctor couldn't be sure what the trouble had been. While we were there I got in touch with the U.S. Embassy and the Peruvian Air Force. They flew in a helicopter and took Randi back to the hospital at Puquio for tests before we went on.

Aside from this emergency the trip wouldn't have been nearly as successful without the ham gear, but this made me especially glad that Randi foresaw the need for it. It certainly proved its worth beyond doubt.

Maybe I make it sound as though the expedition was pretty grim—and in some ways I guess it was. Most of the roads, except for the Pan American Highway, were terrible. From Lima up into the mountains was a miserable trip. Just driving would get you exhausted and make you feel light-headed at that altitude. I felt nauseous, my muscles ached, it was hard to breathe and it was cold. And in the desert there was sand so fine it was like dust. It got into your eyes, your hair, your food, your equipment—everything.

But there were more pleasant things, too. Most of all, there were the people we met, the scenery and the ruins, of course. And I picked up some pets along the way. I'd wanted to buy a baby leopard in Pucallpa but I was afraid he would get out of hand as he grew larger. I did get a baby monkey (which died four days later), some parrots and a boa constrictor. Last summer the boa got out and disappeared but it came back about a month later. I guess I probably have some neighbors now who wish both of us would go back to Peru.

El Kit Report



First R/C Kits

NEWEST members of the growing family of Heathkit builders are radio-control model fans. They joined the club about a year ago when Heath announced the Digital 5 proportional R/C system. Now, after only one year of production, Heath claims to be one of the biggest manufacturers of R/C equipment in the country. Heath estimates it now ranks No. 2 or possibly even No. 1 in unit sales.

The reason for the success of the system is that it's based on a design (Kraft Systems, Inc.) that has been tested and accepted in its field. (Heath soon will sell more expensive two-frequency systems that will operate on 27 and 72 mc.) The basic electronics has been retained, but the system has been redesigned mechanically to simplify construction and tuneup by model builders.

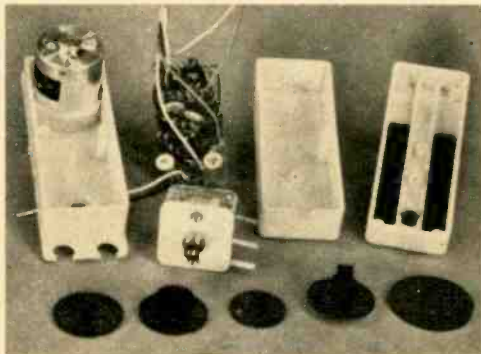
As the name implies, the \$219.95 Digital 5 proportional R/C system (transmitter, receiver, two battery packs and four servos) can handle five servos; however, the kit is supplied with only four. An extra servo kit costs \$21.50.

The photo at the left shows a system installed in the fuselage of a large model plane. The transmitter is at the upper right and at the lower left is the rechargeable N/C battery pack. Three servos are at the back of the cockpit. In front is the receiver.

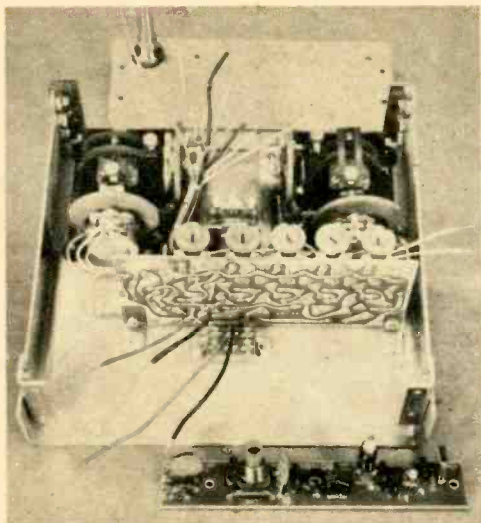
The system can handle five controls simultaneously and proportionally. The latter term means that as you move a control on the transmitter, a servo in the model moves to an off-neutral position. The servo holds the position until the stick is moved again. Four model controls are handled by the transmitter's two control sticks. The fifth function in the model is controlled by a small knob above the on-off switch.

One feature of the system is that all servo movements—even the shortest—provide full power. Present-day multi-control stunt planes have around a 5½-ft. wingspan, weigh 6 or 7 lbs. and travel from 50 to 80 mph in level flight. Full servo power is really needed for violent stunting!

About the Kit. The transmitter includes a built-in Nicad battery pack (9.6 V at 500 mah) and equipment in the model is powered by a 4.8-V pack of the same type cells. There is a charger in the transmitter to charge both battery packs connected in series. One detachable cable runs from the transmitter to a 117-VAC outlet, another goes to the battery pack in the model (which does not have to be removed for charging). A full charge takes around 15 hours. The transmitter will operate about five hours with a full battery charge but receiver time naturally depends on how much the servos are moved (servos idle at only 2 ma, draw 350 ma when the motor is stalled, move with no



SERVO. Drive motor is cylindrical object at upper left. Next to it is circuit board under which is variable feedback capacitor. Gears are below.



TRANSMITTER. Pretuned RF strip (bottom) goes at top. Encoder board is in center. Objects at upper right and left are stick-control mechanisms.

load at about 80 ma).

At the top of the transmitter case is the RF strip, which comes fully aligned and tested. Under the transmitter at each side are the dual control assemblies which you must assemble. At bottom are the battery pack and charger components.

You build the transmitter first. Next comes the more crowded and compact receiver. Last are the servos, with a cramped circuit board and tight mechanical assembly.

The receiver has been enlarged considerably from the Kraft version and is on two circuit boards for easier construction. There are still a large number of small parts to assemble—the receiver takes more time than any other part of the system.

The servo case is in three parts. The center section holds the drive motor and the feedback capacitor. All feedback or closed-loop servos have a feedback element which senses the position of the servo output shaft and cuts servo motor power when the servo has reached the same relative position as the transmitter control. The servo bottom cover holds the amplifier board snugly in place while the top covers the gears and carries the two racks which provide alternate push-pull output.

In the past, digital proportional systems required top-grade test equipment for tune-up, including an expensive oscilloscope. Heath has worked things out so that you

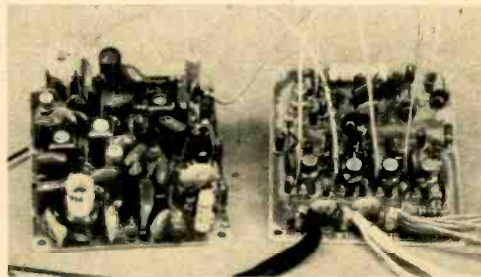
need no test equipment to tune this outfit. The transmitter output meter is clipped into different parts of the transmitter and receiver for tune-up. Specific instructions are given for each step, along with a list of all parts that might be at fault if the meter indication at any one step is incorrect.

The transmitter weighs 2¾ lbs. and feels comfortable in your hand (such transmitters are normally held in both hands with the two thumbs atop the main control sticks). The rounded corners do not cut into your hands as do edges on some transmitters. A handy feature of this transmitter, seen on few others, is the fully-collapsible antenna, which collapses into the case when not in use—it projects only 1¼ in. above the case top in this condition. The complete plane installation weighs about 21 oz.

We have heard construction-time claims running from 18 hours to well over 30. Our time was about 30 hours, which included some three hours study of the manual and much careful checking as assembly progressed.

We found the operation of the system to be every bit as satisfactory and reliable as that of ready-built commercial outfits which we compared it to. Servo power response time and centering is ample for any model. Though we did not check it, Heath claims satisfactory operation over a temperature range from 0° to 160° F. Transmitter power output is approximately 400 mw into the antenna—about average for R/C units.

Heath sells all parts separately; you can buy any part you want. The \$9.60 transmitter RF strip is a good buy; it has a 600-mw input, comes tuned to any of the five R/C frequencies and includes a crystal. To change frequency, you need another one of these strips and a matching receiver crystal.



RECEIVER BOARDS. Receiver board is at left, decoder board is at right. They are mounted on top of each other with spacers. Wires go to servos.



DXing the Outposts

By **ALEX BOWER** YOU SAY you like the lure of faraway places? Well, then, EI's latest DX awards—the Outposts Award for Hams and the Outposts Award for SWLs—should be just your meat. Our criterion in establishing which DX countries would qualify for the awards was simply that they should be separate units for DX purposes but not politically independent. And the total list (published on page 60 of our Jan. '69 issue) sure was a large flock of rare birds! So rare, in fact, that we ask DXers for only six QSLs to qualify for the award.

Even so, it won't be easy to log those six. Many, in fact are unloggable except through ham contacts, DXpeditions, over-flying aircraft and the like, Navassa Island in the Caribbean and Crozet Island in the Indian Ocean are famous cases. But there are about 30 others on the list, mostly in the Pacific and Indian Oceans. They include everything from remote dots of land like Malpelo, Cocos, Juan do Nova and Bouvet Islands to places like Wrangell Island, Cay Sal and Franz Josef Land. So, leaving hams to their own devices, this article will give SWLs some tips on shortcuts to the Outposts Award.

There is, for example, the BBC relay on Ascension Island. Several members of its

staff are interested in DX, take pains to check reception reports, verify correct ones and—equally important—reject bad reports. SWLs should have no trouble hearing Ascension outpost. It uses many frequencies but probably will be found most easily on 15105 kc, at the bottom of the 19-meter band, between 1145 and 1900 EST. Unless your report involves something unusual you will receive a regular BBC card but with the location typed in, making it valid for Ascension. Incidentally, reports still may be addressed to BBC South-Atlantic Relay, c/o Ascension AAFB, Patrick AFB, Fla. 32925—and a U.S. 10¢ stamp may be used as return postage instead of IRCs.

The Greek Dodecanese Islands (just off the Turkish coast) and the U.S.-held Ryukyu Islands (South of Japan) are the homes of, respectively, VOA Rhodes and VOA Okinawa. That makes them subject to the Voice's new no-ID policy (the VOA no longer announces relay locations on the air). The result that the majority of SWLs who use simple receivers with minimal calibration have no way of knowing which relay is being heard. And the Voice, when QSLing reception reports, usually won't be able to tell, either.

To nail down the Dodecanese try 7285 kc

EI's OUTPOST DX GUIDE

OUTPOST	STATION & LOCATION	FREQ. (kc)	BEST DX TIMES (EST), NOTES
Alaska	KFAR, Fairbanks	660	After 0200
Angola	Emissora Official, Luanda	4820 or 9660	1700-2000, 0500-0700 0500-0800
Ascension	BBC Relay	15105	1145-1900
Bahamas	ANS, Nassau	1540	Early evenings
Bermuda	ZBMI, Pembroke	1235	Night
Dodecanese Is.	VOA, Rhodes	7285 or 11710	Just before 1500 sign-off Until 1030
Fiji Is.	FBC, Suva	3230	0400 and later
French Guiana	ORTF, Cayenne	3385	Early evenings
French Polynesia	R. Tahiti (ORTF), Papaete	11825	After 2200
Hawaii	KORL, Honolulu	650	After 0200
Martinique	ORTF, Fort de France	3315	Early evenings
Mozambique	R. Clube de Mocambique, Lourenco Marques	15295	Midday
Netherlands Antilles	R. Netherland Relay, Bonaire	9590	2000 (send reports to R. Netherland, Hilversum, Netherlands)
New Caledonia	ORTF, Noumea	Z170	After 0200
Papua	Australian B.C. (VLT9), Port Moresby	4890	After 0300
Ryukyu Is.	VOA, Okinawa	1178 or 11965	0600 sign-on Until 0500
Surinam	R Surinam, Paramaribo	725 or 15456	Early evenings Early evenings

just before 1500 EST when, if you can hear it, it will be the VOA transmission nearest the upper edge of 41 meters. Or you can try 11710 kc until 1030 when it will be that VOA station nearest the low end of 25 meters. At 1030 the Voice relay at Wooferton, England takes over 11710 (Wooferton is the one VOA relay still announcing its location on the air because the station is operated by the BBC).

To log the Ryukyu Islands watch for VOA Okinawa on 11965 kc until 0500 EST. At that time it will be the VOA transmission nearest the top of 25 meters. After 0500, 11965 is used by one of the Voice's Philippine relays. If you live west of the Mississippi, keep one ear open for VOA Okinawa on 1178 kc (medium wave) starting at their 0300 PST sign-on.

R. Netherland's evening (EST) relay from Bonaire, Netherlands Antilles, on 9590 kc poses a problem similar to the VOA relays since RN also neglects to announce the relay location on the air. But once the DXer has been alerted to the pitfall his problem is solved because this will be the only station

carrying RN's North American service at that particular hour.

So there you have four of the most interesting stations for EI's Outposts Award. You can pick the remainder from the other 11 stations in our Outpost DX Guide, taking those which best suit your particular location, equipment and available listening time. Of these stations, the only one that might deserve special mention would be R. Surinam, whose SW operations appear to be erratic although it is heard widely on its MW frequency.

A few more stations could be added to the list if we were to include BCB frequencies. They don't represent SW'ing, of course, but they do qualify for the Outpost Award. In fact, we've included two BCB stations as it is—in Hawaii and Alaska—since they represent outposts that many of our readers will want to try for.

We'd suggest you try to log a couple extra stations in case some of the broadcasters suddenly become slow verifiers. (At press time, all of the stations on our list were verifying good reports.) Anyway, good luck! 📻

How to get into One of the hottest money-making fields in electronics today— servicing two-way radios!



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

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

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

Your best bet today, especially if you

don't have a college education, is probably in the field of two-way radio.

Two-way radio is booming. Today there are more than *five million* two-way transmitters for police cars, fire department vehicles, taxis, trucks, boats, planes, etc. and Citizen's Band uses—

and the number is still growing at the rate of 80,000 new transmitters per month.

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

Why You'll Earn Top Pay

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

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

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

Be Your Own Boss

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

How To Get Started

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

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

you \$5,000. Or you may even be invited to move *up* into a high-prestige salaried job with one of the major manufacturers either in the plant or out in the field.

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

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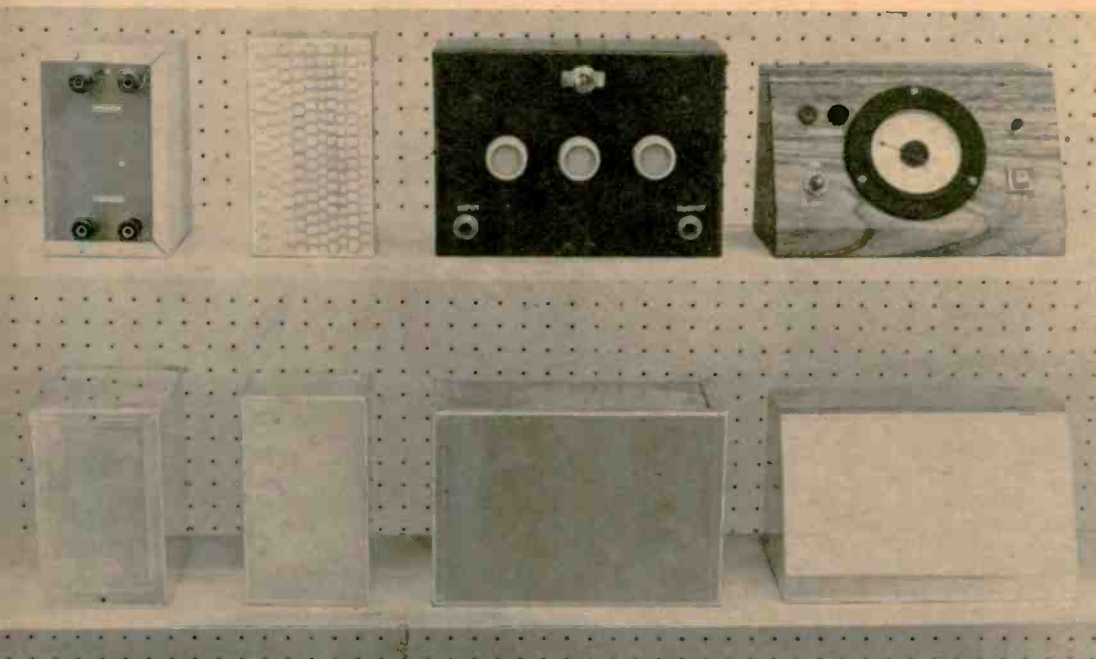
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EI-80



How to Make a Mini-Box Look Like a Maxi-Box

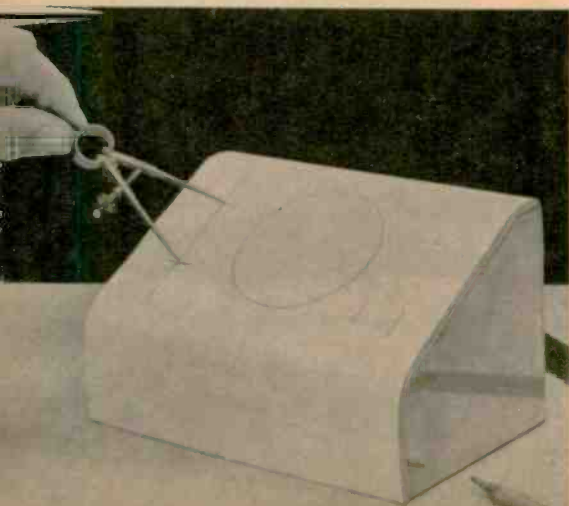
To locate cutouts and holes, panels have to be laid out. The usual method is to scribe lines. This is fine except the surface will quickly be filled with lines and scratches going every which way. To keep the surface free of construction lines, spread rubber cement on it then apply a sheet of white paper. By using paper you can use a pencil, the layout will show up better and the aluminum surface will be protected against scratches. Drill and cut with the paper in place. When finished, peel off the paper and rubber cement.

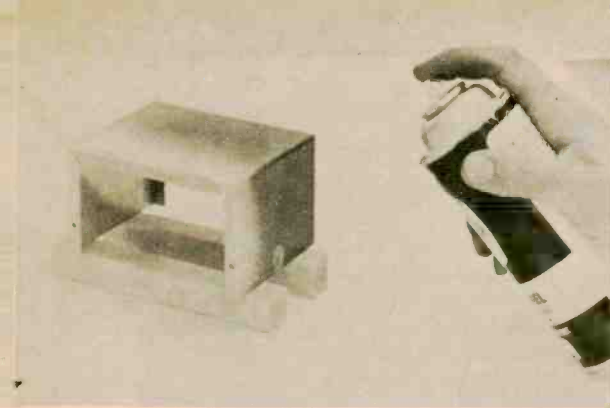
By JOHN CAPOTOSTO IT'S a pity that so many well designed projects end up with a slapped-together home-made look. You know what we mean. The earmarks are crooked screw heads, jagged edges, scratches, runs of paint and sloppy lettering.

Take a look at the photograph above. On the bottom shelf is an assortment of raw aluminum cabinets. Directly above are the same cabinets that have been transformed into projects and given a professional finish. They don't look like homebrew jobs.

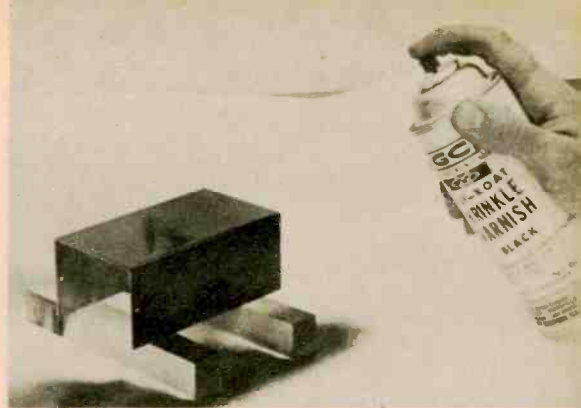
Your projects, too, can be made to look like a million with very little effort. The trick is choosing the right materials and using them properly. The materials you'll need are steel wool, a file, rubber cement, a knife, dry transfer letters, wood-grained Con-Tact paper, hammertone paint, wrinkle paint, a dowel, cleansing powder and an electric drill.

Decided it is worth the time to do the job right? Then read on to see how simple it is to make your project look like a piece of manufactured equipment. ♣





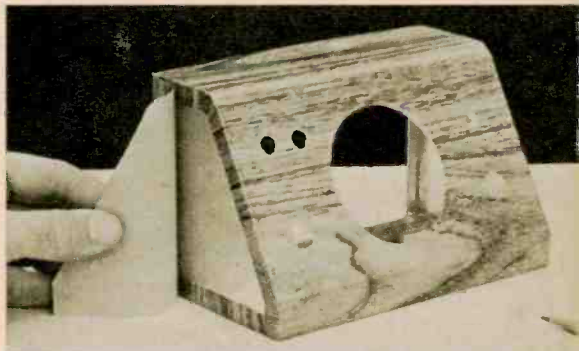
Before painting, deburr cabinet and round all sharp corners. Then rub with 000 steel wool so the finish will adhere. Wash the cabinet to remove grease and dust. Hammeritone and wrinkle finishes are standbys, but don't overlook metallic colors, which are available at model shops. Follow these steps: 1) Spray in a clean area and don't raise dust after you start. 2) Cover the area with newspaper and prop cabinet up so its edges don't stick to the paper. 3) Shake the paint can and hold it about 10 in. from work. Above, colored lacquer is applied over hammeritone.



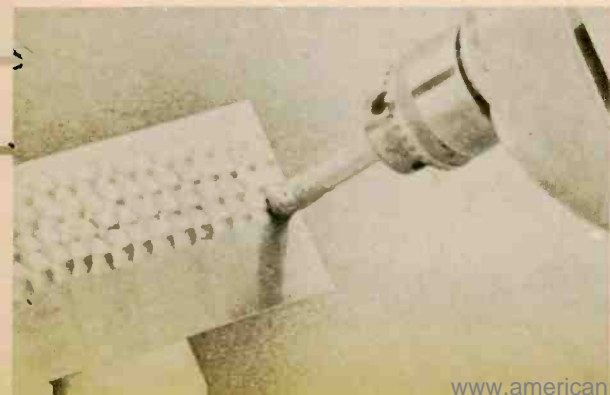
To give the cabinet a wrinkle finish, as above, you must apply two coats. Application of the second coat a few minutes after the first causes a reaction called reticulation which produces the wrinkle effect. Unfortunately the only wrinkle finishes available are black and gray. To get another color, first apply the wrinkle finish. After it has dried, spray on any color you want. The added color must be compatible as some have a tendency to dissolve the base coat; try them on scrap metal first. Hammeritone paints are applied by spray or brush in usual manner.



Hammertone finishes are available for either brush or spray application. Both work well, but the brushing type is less likely to run. No special techniques are required. The secret is in the material itself which dries with a hammertone effect. Unfortunately you won't find wrinkle or hammertone finishes in many parts distributors' catalogs; try paint or art-supply stores. Generally you'll find that wrinkle is available in black and gray and hammertones are available in blue, brown and silver. We found that by using a transparent metallic finish over the hammertone, we could obtain any color we desired.



Another attractive finish that is often overlooked can be produced with pressure-sensitive wood-grained vinyl material which is suitable for boxes and panels. The material is available at department and houseware stores under such names as Con-Tact and Sanitas. The material is durable, washable and easy to apply and you have a choice of practically any wood finish. To avoid raw edges, the material should overlap slightly. Miter the corners 45° as shown and when covering panels, the material should wrap around completely. If the material gathers at the edges because of the shape, the flaps can be slitted or notched.



The engine finish is attractive and easy to achieve. It is often found on lady's compacts and cigarette cases. To produce it you need either a hand drill or drill press, a 1/4-in. dowel (or pencil eraser, as shown) and cleansing powder. The work should be free of scratches and other blemishes and must be unfinished metal. Insert the dowel in the drill, apply a paste of cleansing powder to the dowel's end, then press down on the work while the drill is turning. (Try it on scrap metal to get the feel.) You get the design by overlapping concentric circles. Rinse the work with water then spray it with a coat of clear lacquer.

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Tape Cassettes

Continued from page 76

even the poorest-molded don't do, however, is exceed Philips specified overall dimensions. We examined each shell carefully to see if both halves meet evenly, if there was any excess plastic (flash) to affect performance, etc. We found BASF, Norelco and SMG-60 at the head of the class in molding, with the other SMG's, Pickwick and Ampex lower down. In between were Reeves, Audio, Scotch and Aiwa. Differences, however, were small in terms of practical effect.

Inside most cassettes are two plastic sheets designed to help pack the tape evenly and drain off any static electricity. In some cases, these add materially to friction and tape tension. And we found a few units in which the plastic sheets were missing altogether. Norelco, on the other hand, uses extras in its C-120 to solve the problem of flopping tape. The SMG C-90's was rough-textured with evidence of severe oxide flake-off, while companies like Reeves and Pickwick use extra-slick sheets.

Then there's the matter of pressure pads. We found that even the smallest provided satisfactory contact with the recorder head. Most manufacturers glue a piece of felt to a springy metal strip that provided minimum tension. Audiopak uses an oversized piece of foam rubber with no spring. Our tests showed no advantage or disadvantage to this system. One Reeves cassette we sampled came from the dealer with the metal strip bent and the pad out of place. It was the only case we found, however, and was not repeated in other Reeves samples.

Philips' specifications give a maximum label area of 3.587 x 1.774 in. Out of this overall area, however, come the two hubs and the viewing window, leaving little space on which to title the cassette. Nevertheless, some manufacturers do substantially better than others in providing space—BASF and SMG C-60 allow you three full lines, while SMG C-90 and C-120 provide no indexing space at all. Most other manufacturers provide two lines (quite short in the case of Scotch, Norelco and Ampex).

Contents space on the box varies wildly, too. SMG-Certron provides no indexing space at all. In addition to BASF and Norelco, high marks for indexing space go to Aiwa.

So?

Which cassette offers the ideal combination of high fidelity recording characteristics, low oxide shedding and friction, precision molding and assembly, high visibility, good packaging and labelling? Our tests show no single cassette winning in every category. But now that you have the information about each, you can make your own decision about which factors are most important to you.

During the course of our tests, however, we did discover some basic truths to guide you:

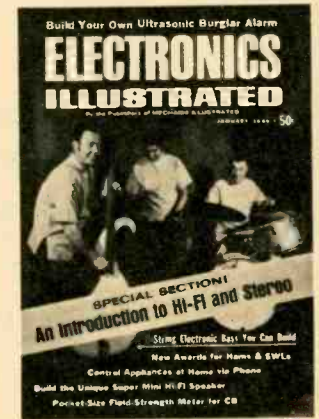
- On most cassette recorders, particularly those priced below \$100, all cassettes will produce virtually equally acceptable fidelity.
- Contrary to what brand-name manufacturers say, inexpensive cassettes are no more likely to jam in your recorder than are the established brands.
- When it comes to durability (of both cassette and recorder) there are significant differences.
- Most manufacturers are making regular and significant improvements in their cassettes. It seems likely that all cassettes will be better in a year or two than the best of today.
- It's easier to identify private-label cassettes than it is white-box tape. The law requires the manufacturer to stamp the country of origin on the cassette shell.
- Most manufacturers still aren't happy with their C-120 cassettes. Fidelity is not perfect and the tape does stretch. But they're satisfactory if handled carefully.

Scope Into Voltmeter

Continued from page 85

played signal. You can determine the voltage of the displayed signal by flipping S2 back and forth while adjusting R4. If the CRT has a graticule, the signal amplitude can be noted on the graticule divisions and R4 adjusted until the square wave has exactly the same peak-to-peak amplitude. The signal's peak-to-peak voltage can then be read from R4's scale.

The scope centering controls may have to be adjusted to position the calibrator's square wave for the most convenient display. The scope can also be calibrated before you measure a signal by setting a desired peak-to-peak voltage output with R4 and adjusting the scope's vertical-gain control for a display of the desired number of vertical graticule divisions.



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Swap Shop

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

AMATEUR RADIO

KNIGHT R-100 receiver. Will swap for Sony 105 tape recorder. Bill Teat, Jr., 2619 Derbyshire Rd., Maitland, Fla. 32751.

GONSET G-66 mobile receiver. Will swap for ham transmitter or tape recorder. Bill Hardy, 204 Sunset Dr., Lower Burrell, Pa. 15068.

HEATH DX-60B transmitter. Will swap for best offer. Stewart Weis, 4250 Davis, Skokie, Ill. 60076.

HEATH HO-10 Monitorscope. Will trade for best offer. R. Marks Jacobs, 4941 Tracy, Kansas City, Mo. 64110.

AUTOMATIC CQ-sender for use with inexpensive tape recorder. Swap for best offer or good antenna. Carey Coggins, 7235 Hunters Branch Dr. NE, Atlanta, Ga. 30328.

HOMEBREW 15-watt transmitter. Will swap for VFO. Ricky Miller, WN9UAY, Route 3, Sumner, Iowa 50674.

LETTINE 240 transmitter, other gear. Will swap for R/C system for model airplane. Tom Leap, 11 Fargreen Rd., Camp Hill, Pa. 17011.

MOSLEY V-4-6 vertical antenna for 10-40 meters, other gear. Want a ham antenna, tower and rotator. Robert Smith, WA0TAM, 444 Newport, Denver, Colo. 80220.

KNIGHT T-60 transmitter. Want bigger transmitter or 6-meter equipment. Lawrence D. Olmstead, Route 1, Moorhead, Minn. 56560.

HEATH GD-125 Q-multiplier. Will swap for good set of headphones or best offer. Fred Lynch, 816 W. Center, Girard, Ill. 62640.

SWR/FIELD-STRENGTH meter, other gear. Want 5UP1 CRT, junked scope for parts or best offer. Robert Wurth, 495 Myrtle, Florissant, Md. 63031.

HEATH VF-1 VFO, other gear. Will swap for Knight T-60, Heath MT-1, DX-60 or tube tester. Michael Jones, Route 1, Box 532, Fortson, Ga. 31808.

SURPLUS ARC-5/BC-459, 7-9.1 mc., ready for ham use. Will swap for power supply with 12.6 VDC at 5 A, 250 VDC at 100 ma and 400-500 VDC. Mike Penrod, 2005 Judson, Manhattan, Kan. 66502.

AM STATION—HR-10B, etc. Want SSB rig. Bill Molnar, WA3JKQ, 214 Cumberland Ave., Masantown, Pa. 15461.

HAMMARLUND HQ-110 AC receiver. Will trade for photo enlarger. D. H. Appert, 1610 L St., Davis, Calif. 95616.

HALLICRAFTERS SX-130 receiver. Will swap for best offer. Tom Dornback, 19W167 21st Pl., Lombard, Ill. 60148.

HOMEBREW 400-W linear amp, other gear, parts. Will trade for SSB transceiver or best offer. Dan Woolman, 1719 W. Tomah Ave., Porterville, Calif. 93257.

JOHNSON Viking Ranger. Would swap for Heath SB-200 or equivalent. H. L. Anderson, 639 No. Wahsatch, Colorado Springs, Colo. 80903.

HEATH HD-16 code oscillator. Want Knight or Heath SWR bridge. Steve Korn, WN2FKE, 12 Sander-son Ave., West Caldwell, N.J. 07006.

KNIGHT T-60 transmitter, mike. Want Knight KG-220 or Lafayette PF-30. Ed Sheehy, 519 Wellington Rd., Norristown, Pa. 19403.

JOHNSON Viking II receiver, other gear. Want Eico 753 or similar. George Csanahanin, WN2DYE, 95 Woodland Ave., Fords, N.J. 08863.

HEATH HO-10 Monitorscope. Want Heath, Eico equipment, sweep generator, etc. Richard M. Jacobs, WA9AIY, 4941 Tracy Ave., Kansas City, Mo. 64110.

CONVERTED SURPLUS T-19 80-meter transmitter, BC-453 and BC-348 receivers with power supply. Will swap for best offer. Robert Davis, 1100 W. 7th St., El Dorado, Ark. 71730.

[Continued on page 114]

Hi-Fi Today

* Hear, Hear!

By John Milder

A FEW columns back, I praised two new headsets from AKG, an Austrian company previously known almost exclusively for its dynamic microphones, including the familiar little ball-on-a-stick that you see used by practically all singers on television. If anything, my respect for the AKG headsets has grown—especially for their combination of comfort (including light weight) and good performance.

In that previous column—which actually appeared just a year ago, in the March '68 issue—I confessed my dislike for earphones in general. All too often their sound quality is just too mediocre or the mechanics of wearing them just too cumbersome. Some press too hard against the skull, some have leads that seem forever tangled, some have overstuffed ear cushions.

But now I've come across a new headset (from another microphone manufacturer) that really is something else to my mind. The manufacturer is Sennheiser, a German company specializing in professional condenser microphones. And the new headset is labeled the HD-414 and carries a suggested price of \$29.95.

The sound from these headphones is really superb—a bit better in my opinion than any headset I've ever heard before. But the unusual and obvious thing about the Sennheisers—and it probably has a good deal to do with their sound—is that they replace the usual molded cups that fit around the ears with a simple, ever so slightly concave puff of foam material (polyurethane, I guess) that presses right against the ear.

What this arrangement does is eliminate the usual cavity between the ear and the headset transducer. In a report on headsets a couple of years ago, Consumers Union suggested that all headsets could benefit from slipping a bit of absorbent cotton into earpiece openings to eliminate the cavity effect of mid and high frequencies bouncing around between ear and headset. That technique does help, to my mind, but Sennheiser's technique seems to do a lot more. How much of the excellent performance is due to the technique and how much to the transducer I don't know but the results are impressive.

The one negative side effect of the Sennheiser technique is that external sounds aren't excluded well. These are not the headphones to wear to ignore your wife or her choice of Johnny Carson or the Late Show. During soft musical passages on the phones, you'll *hear*. But how important that is under most circumstances I don't know. One interesting plus of the Sennheiser technique is that you can hear your own voice when you talk and you don't wind up shouting at the wife and kids in the style of foxy grandpa.

The light pressure from the Sennheiser foam pads seems to produce as good coupling to the ear for low bass response as conventional headsets. Here, though, I have to note that with any headset in my experience you have to press the earpieces by hand against your ears to get full impact on material below, say, about 200 cps.

By now, I guess I've made clear just how much this headset has impressed me. Not to be slighted, though, is the fact that the HD-414 achieves its performance at the modest retail tag of \$29.95. One reason for that is elegant use of inexpensive plastic for the headband and earpieces, without a trace of chintziness in appearance or feel.

I don't know how widely available this new headset will be but it's certainly worth tracking down and auditioning for yourself. ♪



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HEATH Twoer, HT-40 and HG-10. Make swap offer. Bill Ward, Route 6 Box 539F, Greensboro, N.C. 27405.
HAMMARLUND Super Pro with manual. Will swap for any other piece of ham gear of equal value. Stephen L. Brock, Box 326, Chester, Calif. 96020.
SURPLUS STATION: TCS and RBC-3 receivers with power supplies, converted transmitter for 40, 75, 80 meters. Will trade for Heathkit SB-301 or equivalent. Ronnie Midgett, 205 Marlon Ct., Jacksonville, N.C. 28540.

HEATH GD-125 Q-multiplier, Knight CPO. Will trade for Heath AA-131, Elco HF-65 or Dyna PAM-1 preamps. Dave Varn, 4702 7th St. SW, Canton, Ohio 44710.

JOHNSON Viking Valiant, 80-10 meters. Will swap for medium-price general-coverage receiver. Ed Cortez, 1100 Corley Ave., Barnwell, S.C. 29812.

GRAYMARK AM transmitter, other gear. Want Star Roamer or best offer. Wayne Del Medico, 3220 Oneida St., Sauquoit, N.Y. 13456.

HEATH HW-32 20-meter transceiver. Will swap for best offer. Lt. M. Feldman, 12 Rabel Apt., Biloxi, Miss. 39531.

NAVY SURPLUS CV-71/URR RTTY converter. Will trade for service equipment or best offer. R. M. Shideler, 7307 Keystone La., Apt. 201, Forestville, Md. 20028.

SURPLUS RT-7/APN-1 transceiver. Will swap for AN/CRC-7 or AN/URC-4. Mike Bruski, 1039 W. 7th Ave., Oshkosh, Wis. 54901.

HEATH DX-20 transmitter 80-10 meters. Will trade for stereo or mono tape recorder or best offer. Bob Lombardi, 4880 NW 177th St., Miami, Fla. 33054.

SHORT-WAVE LISTENING

DRAKE SW-4A receiver with speaker. Make swap offer. Mike Mochizuki, 2365A Palolo Ave., Honolulu, HI. 96816.

SONAR FR-101 monitor receiver, 25-50 mc, antenna, cable. Will swap for best offer. C. L. Crosier, 229 Chestnut St., Salem, N.J. 08079.

HEATH GR-64 and Q-multiplier. Want Knight T-60 or similar. David Tensley, 1628 E. 36th Ct., Tulsa, Okla. 74105.

AUTOMATIC RADIO SW-7100 tuner for car radio. Swap for best offer. H. E. Larrieu, 204 E. Wm. David Pky., Metairie, La. 70005.

KNIGHT R-55A. Want fine camera. Jim Reynolds, Kent Dr., Catlin, Ill. 61817.

HEATH GR-64 receiver with Q-multiplier. Want ham gear or best offer. Edward Hopkins, Box 349, Stuart, Va. 24171.

HALLICRAFTERS S-120 and Q-multiplier. Will swap for tunable police radio (30-50 mc) or best offer. Gerald R. Giguere, RR 1, Chebanse, Ill. 60922.

KNIGHT R-55A receiver. Will swap for CB base or mobile ham transceiver. Pete Woloshuk, 3018 Rhodes Ave., Melrose Park, Ill. 60164.

HEATH GR-64 short-wave receiver. Want unbuilt stereo receiver or tuner kit. Greg Bays, 1322 Wilbury Rd., San Mario, Calif. 91108.

KNIGHT Star Roamer. Want solid-state stereo amplifier. Steven Korn, WN2FKE, 12 Sanderson Ave., West Caldwell, N.J. 07006.

NATIONAL NC-190 receiver. Will swap for best offer. Melvyn C. Rouse, Rt. 1 Box 575, LaGrange, N.C. 28551.

HEATH GR-64 short-wave receiver, other gear. Will swap for CB transceiver of equal value or best offer. Marc Povitsky, 9534 Bensley, Chicago, Ill. 60617.

KNIGHT Span Master, phones, antenna. Swap for CB transceiver or walkie-talkie, at least 1-watt. R. vanWeemen, c/o U.S.F.C., Orleans, Calif. 95556.

HALLICRAFTERS S-120. Will swap for Ameco R-5 Knight R-55A or similar. Richard S. Converse, 117 Center St., Hamburg, N.Y. 14075.

KNIGHT Star Roamer. Want 2-station intercom, AC power. Bill Foster, 65 Edgerton St., Darlen, Conn. 06820.

HALLICRAFTERS S-47 receiver with bass reflex speaker. Make swap offer. Jerry Sheehan, RFD 2, Box 82, Plymouth, N.H. 03264.

HEATH GR-91 short-wave receiver. Will swap for VHF amateur gear. William Goble, 330 Wood St., Clarion, Pa. 16214.

LAFAYETTE HA-63 receiver. Will swap for Heath Twoer, other 2-meter gear or Heath DX-60A/B. John Schmidt, WN2EMV, 56 Orton Rd., W. Caldwell, N.J. 07006.

KNIGHT Star Roamer, new. Make swap offer. Rudy Bozarth, RD 1, Box 459A, Orwell, Ohio 44056.

SURPLUS R-208 receiver, less transformer. Swap for best offer or Knight Star Roamer. Vernon Mulligan, Box 64, Springfield, W. Va. 26763.

HALLICRAFTERS S-20R. Want test equipment or other. Leo Cravines, 1660 Lantona Way, Turlock, Calif. 95380.

HEATH GR-64 receiver with Q-multiplier. Make swap offer. T. Kirby, 49 Manwaring Rd., Norwich, Conn. 06360.

KNIGHT Space Spanner. Will swap for CB transceiver or best offer. Jeff Koron, Box 241, Russell, Kans. 67665.

HALLICRAFTER S-38C receiver, new tubes, and speaker. Trade for good tape recorder or best offer. R. Estand, 1209 Brookhaven Dr., El Paso, Tex. 79925.

LAFAYETTE Explor-Air receiver. Will swap for best offer. Bruce Blechman, 2288 Mött Ave., Far Rockaway, N.Y. 11691.

HALLICRAFTERS S-38D receiver. Will swap for CB transceiver or walkie-talkie, at least 1 watt. Phil J. Verville II, 208 Montezuma St., Hancock, Mich. 49930.

KNIGHT R-100A receiver with S-meter and matching speaker. Want Lafayette HA-350, good condition. Tom H. Wood, 24 Roxbury Rd., Port Washington, N.Y. 11050.

MODIFIED all-wave receiver. Will swap for 5-watt CB transceiver. Clayton Dickerson, Box 118, Neponset, Ill. 61345.

RECEIVER—A-120. Will swap for tape recorder or stereo amplifier. Dan Walsh, 8361 Trinetta Dr., Garden Grove, Calif. 92641.

KNIGHT Star Roamer. Will trade for good CB transceiver, CB antenna or best offer. Ken Ascher, 15351 Pembroke, Detroit, Mich. 48235.

SURPLUS gear, including ARC-5 receiver. Want CB or other gear. Bobby Anderson, 208 E. Washita, Wetherford, Okla. 73096.

HALLICRAFTERS receiver, service equipment. Want CB transceiver. E. Seifert, 1342 Eggert Pl., Far Rockaway, N.Y. 11691.

KNIGHT Ocean Hopper. Will swap for crystal calibrator and good SWL headset or best offer. David Bruce, 8101 SW 90th Terr., Miami, Fla. 33156.

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ATWATER KENT receiver and speaker. Will swap for best offer. Dan Contway, Rt. 1 Box 12, Sparks, Okla. 74869.

RCA 9-TW-309 combination TV AM/FM record player (1949). Want ham gear, especially receivers. Stan Kleski, 3845 Bolton Ave., Columbus, Ohio 43227.

ATWATER KENT model 40 power pack with #80 tube. Want R/C, CB transceiver or best offer. David J. Mittler, 717 Spruce Trail, Bowling Green, Ky. 42101.

PHILCO 38-7 radio (BCB to 19 mc). Want guitar amp, stereo tape deck of hi-fi equipment. David Wilk, 3174 Wabash Ave., Pittsburgh, Pa. 15234.

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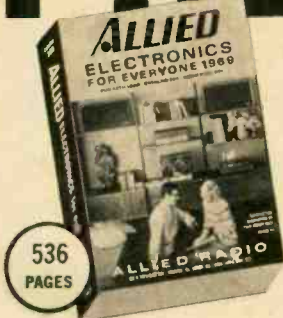
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CIRCLE NUMBER 23 ON PAGE 13

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(Act of October 23, 1962)

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1. Date of Filing: Oct. 1, 1968.
2. Title of Publication: Electronics Illustrated.
3. Frequency of Issue: Bi-Monthly.
4. Location of Known Office of Publication: Fawcett Place, Greenwich, Connecticut 06830.
5. Location of the Headquarters or General Business Offices of the Publishers: Greenwich, Connecticut 06830.
6. Names and Addresses of Publisher, Editor, and Managing Editor: Publisher, Fawcett Publications, Inc., Greenwich, Conn.; Editor, Robert G. Beason, Stamford, Conn.; Managing Editor, Robert D. Freed, Stony Brook, N. Y.
7. Owner: Fawcett Publications, Inc., Greenwich, Conn.; W. H. Fawcett, Jr., Norwalk, Conn.; Marion Bagg, Kansas City, Mo.; Roger Fawcett, New York, N. Y.; V. D. Fawcett, Greenwich, Conn.; M. B. Fawcett, Norwalk, Conn.; Gordon W. Fawcett, Greenwich, Conn.; Gloria Leary, Santa Monica, Cal.; V. F. Kerr, Bakersfield, Cal.; Allan Adams & Jack Adams—Trustees, Greenwich, Conn.; John H. Fawcett, Wilton, Conn.; Thomas K. Fawcett, New York, N. Y.; Roscoe Kent Fawcett, Reno, Nevada; M. F. Fawcett, Greenwich, Conn.; H. A. Fawcett, New York, N. Y.

8. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages or Other Securities: None.

9. For Completion by Nonprofit Organizations Authorized to Mail at Special Rates: Not applicable.

10. Extent and Nature of Circulation:
 Average No. Copies Each Issue During Preceding 12 Months:
 A. Total No. Copies Printed (net press run), 365,771. B. Paid Circulation: 1. Sales through dealers and carriers, street vendors and counter sales, 78,997; 2. Mail subscriptions, 222,232. C. Total paid circulation, 301,229. D. Free distribution (including samples) by mail, carrier or other means, 2,720. E. Total distribution (sum of C and D), 303,949. F. Office use, left-over, unaccounted, spoiled after printing, 61,822. G. Total (sum of E & F)—should equal net press run shown in A), 365,771.

Actual Number of Copies of Single Issue Published Nearest to Filing Date: A. Total No. copies printed (net press run), 377,779. B. Paid Circulation: 1. Sales through dealers and carriers, street vendors and counter sales, 72,709; 2. Mail subscriptions, 236,231. C. Total paid circulation, 308,940. D. Free distribution (including samples) by mail, carrier or other means, 2,659. E. Total distribution (sum of C and D), 311,599. F. Office use, left-over, unaccounted, spoiled after printing, 66,129. G. Total (sum of E & F)—should equal net press run shown in A), 377,719.

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

signed GORDON W. FAWCETT

The Listener

Continued from page 77

response. For one thing, we stated that the ground station being worked provides a clue to the aircraft's location. That's true—but only up to a point.

The difficulty—as pointed out by readers R.M. Mulvaney (a USN flier) and Ross Harp, Jr. (a commercial pilot)—is that the major U.S. aeradios have networks of remote relays enabling them to work aircraft far beyond the range of direct communications. For example, a San Francisco DXer might hear an aircraft working Salt Lake City while the plane was directly over the listener's antenna. So, to be on the safe side, you'd better stick to position reports and ETAs (estimated times of arrival) when determining the location of those airborne loggings.

Mr. Harp also tells us about a phenomenon that is effective 75 per cent of the time during winter months over northern Canada, Alaska and, presumably, other Arctic land masses. The extent of this phenomenon seems to be largely unpublicized. The propagation mode we're referring to is scatter caused by a combination of aurora borealis and meteor showers, producing reception of airborne VHF signals (on the 118-136 mc band) anywhere between 1,500 and 2,500 mi. away.

CB on a Motorbike

Continued from page 71

battery and antenna leads are probably passing right next to the bike's ignition coil, which is generally mounted under the gas tank. You can reduce the noise level using some of the following noise reduction techniques, but check with your dealer first to find out if they will affect the bike's performance.

First, make certain the ignition coil case is securely grounded. If the ignition coil is not supplied with a metal case try to get one installed by the dealer—or get a new coil with a metal case. Use a length of shielded ignition coil cable (available in the Lafayette 42 T 0905 noise-suppressor kit) and make certain the shield is firmly bonded to the cycle's frame. If the cycle has a battery and generator, bypass the battery leads to ground with the coaxial type capacitors in the noise suppressor kit.

Ham Accessories

Continued from page 28

mighty valuable talk power).

The compressor is suggested primarily for use with AM transmitters, or SSB transmitters which do not employ ALC (automatic level control). The reason for this is that ALC is speech compression accomplished in the RF stages; all modern SSB transmitters employ ALC. Putting speech compression on top of RF compression can lead to garbled modulation or excessive plate dissipation in the final.

(5) **Scanalyzer.** The \$119.95 Heathkit Model SB-620 Scanalyzer is one of those instruments you feel you can do without until you use it—then you wonder how you ever got along without it. First off, it is a panoramic adaptor; that is, when connected to the receiver it displays on a CRT all signals—CW, AM or SSB. It simplifies finding holes in the QRM, indicates relative strength of the signals and indicates signals coming in around your operating frequency.

Unlike a conventional panoramic adaptor, the Scanalyzer also has a 10-kc sweep rate which can resolve pips representing two stations separated by only 1 kc.

The CRT bezel is calibrated directly in kc and gain. You can read directly from the CRT the operating frequency of an observed signal and its relative amplitude in relation to a received (center screen) signal. A logarithmic amplifier is provided which boosts the low-level pips so you can more easily study the characteristics of a weak signal. By using a reduce sweep width, you can easily study the characteristics of a received signal. For example 60-cps hum, single-tone modulating frequencies (AM) and harmonic-distortion products can be observed.

Provision is made for applying a sample of your transmitter's output and that of a test RF generator to the Scanalyzer. This permits critical observation of your transmitter's output and will indicate over-modulation of AM transmitters with two-tone tests.

The Scanalyzer is an in-line accessory and can be permanently connected to both the receiver and transmitter for continuous operation as both a panoramic adaptor—receiver analyzer—and transmitter analyzer.

(6) **Electronic Keyer.** If you eavesdrop on the CW band segments long enough you'll soon notice an odd thing. A low-power Nov-

ice plodding along at 8 wpm often makes more contacts than an operator running a full gallon into a deluxe antenna. The answer is not that the gallon is buried on the bottom of a mountain range. Instead, the Novice is sending perfect, easy-to-copy characters, while machine-gun Charlie with the weights off his bug and the gallon is sending a string of heaven-knows-what. In short, the perfect fist gets the most contacts regardless of speed or signal strength because he is a real pleasure to work—a no-sweat contact.

If you don't have the skill or patience to develop a perfect fist, let Eico's model 717 keyer do the job. (Kit: \$49.95; assembled: \$69.95). The keyer provides perfect dot-dash-space ratios at speeds of 3 to 75 wpm. All characters are self completing; once you tap the sideswiper key to the dot or dash side the keyer generates a perfect character, even if your fingers accidentally slip off the paddle the instant you start the character. The keyer also provides sidetone monitoring, with a built-in speaker and via a headphone monitoring jack. Sidetone volume and tone controls are provided.

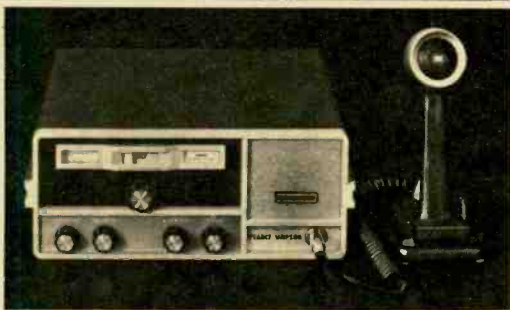
The keyer uses relay rather than solid-state keying. Since relay contacts are non-polarized, the keyer can be used in any type of keying circuit: low or high voltage, grid block or cathode keying, or positive or negative voltage keying circuits.

The keyer's function switch provides a keying-line short, allowing for continuous transmitter operation, tune-up or phone operation without a keying shorting bar.

Summing Up. *SWR bridge/RF power meter:* indicates an antenna system's SWR and transmitter's output up to 15 watts. *Matchbox:* matches a transmitter's output into any antenna. *Dummy load/wattmeter:* measures a transmitter's output power into a 52-ohm load. *Compressor:* boosts low-level modulating signals and attenuates high-level signals. *Scanalyzer:* displays a 150- to 500-kc segment of a band or your transmitter's output. *Keyer:* produces perfect dot-dash-space ratios no matter how heavy your fist.

It's going to be a rare operator who can utilize the six new accessories for, after all, a ham with a low SWR has no need for an antenna tuner, while the CW operator has no need for a speech compressor. And the phone man has no need for an electronic keyer. But the point is, at least one of these new accessories can mean a sharp increase in the fun you get from the ham game. —

The remarkable difference about Pearce-Simpson's Guardian 23 and Guardian 23-B: they work.



What's the most important thing about a CB base-station and mobile-unit combination?

When some guy says something, the guy at the other end should be able to hear it.

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So the great thing about the Pearce Guardian 23 and Guardian 23-B (in fact all Pearce-Simpson's radios) is that the transmitters transmit and the receivers receive.

Don't laugh. Not every CB manufacturer can make that statement.

If you want to get technical, here's the explanation. Pearce-Simpson's exclusive HetroSync circuitry sharpens transmitted signals. High level saturation limiting provides automatic speech clipping. And the Superhet receiver hears signals that ordinary sets distort or fade.

Guardian 23 comes with palm microphone, mounting cradle, AC and DC power cords. Guardian 23-B comes complete with built-in, all transistor, solid state pre-amplifier that lets you stay a comfortable distance from your mike and still broadcast loud and clear. And Pearce-Simpson's new SuperMod desk mike is available as an option.

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CIRCLE NUMBER 18 ON PAGE 13

The Sound That Goes Round

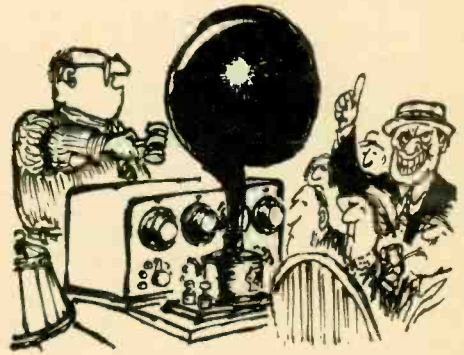
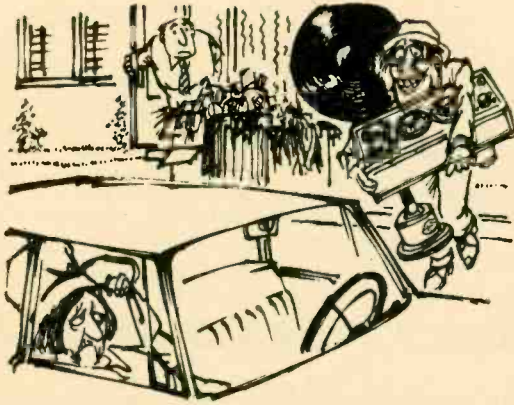
Continued from page 87

to make bass omnidirectional. That raised a good many eyebrows since bass frequencies generally are taken to be omnidirectional and most speaker designers give cabinet placement instructions to curb this problem—advising you to move a speaker toward a wall (or corner) where the bass will be focused at you instead of dissipated in all directions. But Empire insists that the column speakers spread bass more uniformly, discouraging standing waves and other malevolent bass phenomena.

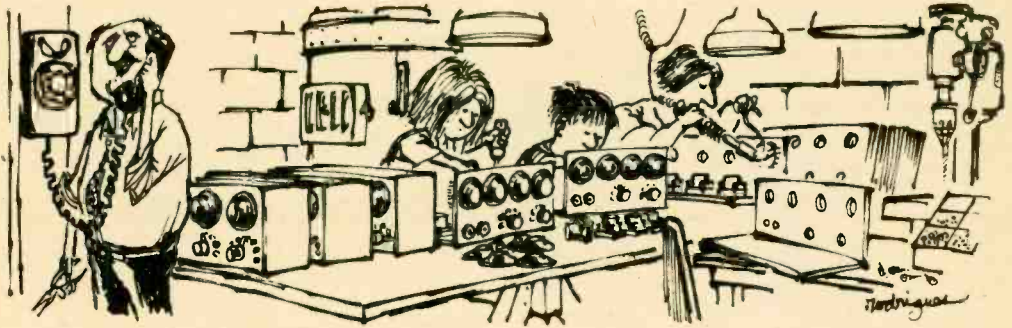
The first Bose system was the shape of a quarter sphere, designed to nestle in a corner on the floor. It used multiple small radiators, pointed outward, and evoked as its operating theory[™] the old Lowther-Hegeman objective of coupling the speaker to the environment by using the walls as an extension of the speaker. Perhaps because of its over-\$1,000 price tag for the stereo pair the system didn't attract many buyers. But the 901 has unquestionably stirred more talk than any speaker in quite a while.

In the meantime, Harman-Kardon has put out the HK50, designed by Richard Shahinian (who also worked on the Lafayette XL-360). The HK50 is an open-topside affair that—like the Bose 901—claims to achieve the proportion of direct to reflected sound you would experience in a concert hall. In principle, it is a two-way acoustic-suspension system pointed upward into a specially designed reflector whose contour, in effect, loads the output of the asymmetrically placed woofer and tweeter individually—much as a conventional system might have a horn-loaded woofer and a direct-radiator tweeter. The reflector then disperses the sound out the top of the enclosure in all directions.

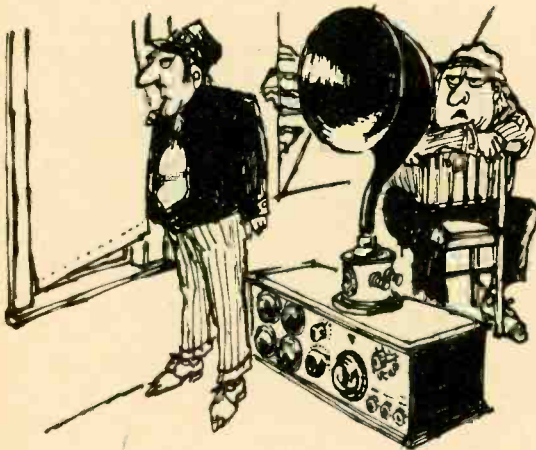
It's hard to say how far the new crop of speakers will go. Some listeners may feel that the new indirect radiators achieve an effect rather than a quantifiable gain (or loss) in fidelity. But there's a whole new generation of listeners who were weaned on electronic rock and see nothing wrong in an effect for its own sake. And the most vocal of the direct-radiator boosters so far have belonged to the Great Beyond of the over-30 generation. Anyway, that's where it's at, baby!



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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 70 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 troubleshooting—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 troubleshooting. 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, the 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 instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to 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. 600AE, Hewlett, N. Y. 11557

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SERVICING LESSONS

You will learn troubleshooting 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. Statistka, 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 27, Maxima, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute. I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

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

PRINTED CIRCUITRY

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

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

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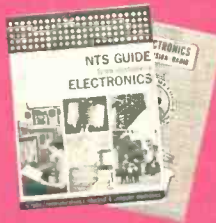
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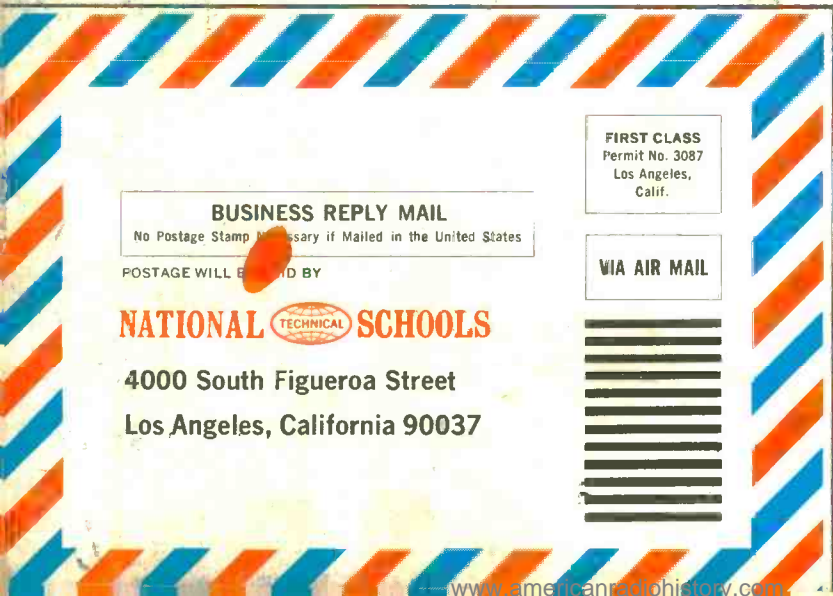
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